US Army Corps of Engineers®
Portland District

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

FINAL ENVIRONMENTAL IMPACT STATEMENT

APPENDIX A: ALTERNATIVES DEVELOPMENT

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ACRONYMS

AFF	Adult Fish Facility
DDR	Design Documentation Report
DEIS	Draft Environmental Impact Statement
DPE	Dam passage efficiency
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FSC	Floating Surface Collector
FSS	Floating Screen Structure
EIS	Environmental Impact Statement
ESA	Endangered Species Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
pHOS	Proportion of hatchery origin spawners
PSM	Pre-spawn mortality
RM&E	Research, monitoring and evaluation
SWS	Selective Withdrawal Structure
USACE	U.S. Army Corps of Engineers
UWR	Upper Willamette River
WVS	Willamette Valley System

APPENDIX A HAS BEEN REVISED FROM THE DEIS
INSERTION OF LARGE AMOUNTS OF TEXT IS IDENTIFIED; MINOR EDITS ARE NOT DENOTED

Summary of changes from the DEIS:

- **The distinction between a No-action Alternative and action alternatives has been provided in FEIS Appendix A, Chapter 1, Introduction.**
- **Modifications have been made to avoid interpretations of the Proposed Action as an alternative. Descriptions of the Proposed Action and Purpose and Need for the Proposed Action have been revised in FEIS Appendix A, Section 1.1.**
- **Descriptions of the measures in FEIS Appendix A, Chapter 2, Measures Considered in Alternatives Development, have been reformatted for consistency.**
- **Information has been added to clarify all measures; most tables have been updated.**
- **DEIS Table 2-2, Tributary Low Flow Targets for Drier Conditions, has been deleted and data combined into FEIS Table 2-1.**
- **DEIS Table 2-13, Elevations and Outlet Statistics, has been deleted; data were repeated from Measure 40 table data.**
- **The DEIS table identifying the distribution of floating fish screens has been deleted under Measure 392 because this information is provided in FEIS Chapter 2, Alternatives.**
- **Measure 52, Provide Pacific Lamprey Passage and Infrastructure, has been revised to clarify parameters of this measure. The title of this measure has been changed to “Provide Pacific Lamprey Passage Infrastructure.”**
- **Measure 105 has been renamed from “Construct Water Temperature Control Towers” to “Construct Selective Withdrawal Structures.”**
- **DEIS Section 2.8, Near-term Operations Measures, has been updated. The term “Near-term Operations” has been changed to “Interim Operations” throughout the EIS. Fall Creek Dam Interim Operations were deleted in Table 2-25.**
- **DEIS Chapter 5, Preferred Alternative Identification and Implementation, has been deleted from the FEIS and incorporated into this appendix as Attachment 4. FEIS Chapter 2, Alternatives, has been revised to update information on the DEIS Preferred Alternative – Alternative 5. Analyses of Alternative 5 are provided in FEIS Chapter 3, Affected Environment and Environmental Consequences. Final alternative selection is provided in the Record of Decision.**
- **Measures Used to Develop a Preliminary Range of Reasonable Alternatives have been added to FEIS Attachment 1, Initial Measures Screening. This includes information on the WRDA22 Report to Congress.**

CHAPTER 1 - INTRODUCTION

This appendix provides a detailed description of development of the range of reasonable alternatives analyzed in this Environmental Impact Statement (EIS). This appendix describes the history of project alternative formulation, why alternatives or measures were screened out or retained for further analysis, and the screening criteria used to make these decisions. Detailed descriptions of all measures retained for detailed analysis are also provided. The programmatic scope of the Proposed Action is described in EIS Section 1.1, Background.

The U.S. Army Corps of Engineers (USACE) has engaged with 11 Cooperating Agencies during the development and refinement of alternatives (Appendix L, Cooperating Agencies). Cooperating Agencies include tribes and Federal and state agencies that have jurisdiction by law or special expertise with respect to any environmental impact involved in a proposed alternative. As the alternatives may affect tribal trust lands and resources, the Confederated Tribes of the Grand Ronde Community of Oregon, the Confederated Tribes of Warms Springs, and the Confederated Tribes of Siletz Indians are participating as Cooperating Agencies.

The Grand Ronde Tribe actively participated as a Cooperating Agency in development of this EIS by attending cooperator meetings, special topics meetings, and WVS field trips and by providing written and verbal comments. USACE and the Grand Ronde Tribe executed a Memorandum of Understanding on February 28, 2020. Also, in a letter dated June 2, 2020, the Grand Ronde Tribe provided comments to USACE acting in their role as a Cooperating Agency. The comments were specific to the alternatives and corresponding measures.

Staff from the Siletz Tribe and Confederated Tribes of the Warm Springs Reservation have also participated in Cooperating Agency meetings. Both Tribes expressed interest in acting as Cooperating Agencies and engaged with USACE in multiple meetings, phone calls, and emails to discuss the potential but did not sign a Memorandum of Understanding with USACE. Federal agencies include National Marine Fisheries Service, Fish and Wildlife Service, Bonneville Power Administration, Bureau of Reclamation, and Environmental Protection Agency. State agencies include Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality, Oregon Department of Water Resources, and Oregon Department of Agriculture. During the alternatives development process, USACE reached out in various ways, such as workshops, to receive input from cooperators. The cooperators also provided input on the scope, objectives, and measures that informed the alternatives development process.

Additionally, USACE received input from the public during a scoping process. As part of the public scoping process, USACE scheduled and facilitated five public scoping meetings in June 2019 to engage with and inform the public on the development of the EIS and to solicit input and public comments. Meetings were held throughout the Willamette Valley to provide an opportunity for interested stakeholders from different communities to attend. There were 384 unique comments received during Scoping of which 183 pertained to Alternatives (such as new suggested alternatives, changes in operations, or factors to consider when developing alternatives).

With input from cooperators and the public, USACE will determine the best plan for the operations and maintenance of the WVS while continuing to consider impacts to the human and natural environment from the proposal. USACE has evaluated eight alternatives, including the No-action Alternative (NAA), and their environmental effects in the EIS and identified a Preferred Alternative based on this analysis.

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

Action alternatives are distinguished from the NAA because they represent WVS management that would differ from the scope of existing operations and maintenance. Action alternatives include actions, or measures, that would modify the scope of operations and maintenance in comparison to no action – or not selecting and implementing an alternative that differs from existing WVS management.

END NEW TEXT

A full description of the alternatives and their effects is included in the EIS were made available for public review and comment.

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

1.1 PROPOSED ACTION AND THE PURPOSE AND NEED FOR THE PROPOSED ACTION

The Portland USACE District has prepared this EIS to assess the continued operations and maintenance of the WVS, a combination of 13 multipurpose dams and reservoirs (impoundments), riverbank protection projects, fish passage facilities, adult fish collection facilities, and hatchery programs in the Willamette River Basin.

The Proposed Action is to continue operations and maintenance of the Willamette Valley System (WVS) for specific, authorized purposes. Responsibility for operating each dam and reservoir and the overall system was directed to USACE by Congress in authorizing legislation. Consequently, the Proposed Action is to continue with this authorizing legislation. The Proposed Action would be implemented over a 30-year timeframe.

The purpose and need for the continued operations and maintenance of the WVS is to operate the system in accordance with the eight Congressionally authorized purposes as detailed in Section 1.10, Congressionally Authorized Purposes, and in compliance with the ESA and all other applicable treaties, laws, and regulations. The purpose and need statement was revised slightly between the Draft Environmental Impact Statement (DEIS) and the Final Environmental Impact Statement (FEIS) to make explicit what was implicitly described in the DEIS. Specifically, that the actions being analyzed must comply with existing laws, treaties, and regulations.

1.1 Overview of Alternatives Development

USACE undertook a step-wise approach to development of the alternatives. These steps are:

1. Identify potential objectives for meeting the purpose and need using input from public scoping comments as well as from Cooperating Agencies.
2. Screen potential measures that were identified from public comments, internal brainstorming sessions, and input from Cooperating Agencies to ensure they met the purpose and need as well as one or more objectives and are technically feasible.
3. Build alternatives using combinations of the remaining measures around unifying themes or strategies.

The environmental consequences of each alternative in the final array resulting from this process are assessed in the EIS for their impacts to resources such as water quality, fish and wildlife, socioeconomics, recreation, etc. The environmental consequences analyses used various models and qualitative analyses based on the best professional judgement of subject matter expertise. The alternatives were then evaluated and compared utilizing the four formulation and evaluation criteria and the four accounts specified in USACE Planning Policy for Conducting Civil Works Planning Studies (Engineer Regulation 1105-2-103). The evaluation criteria are defined in the Principles and Guidelines as follows:

- **Effectiveness** is the extent to which the alternative plans contribute to achieving the planning objectives.
- **Efficiency** is the extent to which an alternative plan is a cost-effective means of solving the problem and achieving the objectives.
- **Acceptability** is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies.
- **Completeness** is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other federal and non-Federal entities.

The four accounts established by the Principles and Guidelines to facilitate evaluation and display the effects of alternative plans. These include:

- The **National Economic Development (NED)** account that displays changes in the economic value of the national output of goods and services.
- The **Environmental Quality (EQ)** account that displays non-monetary effects on significant natural and cultural resources.

- The **Regional Economic Development (RED)** account that registers changes in the distribution of regional economic activity that result from each alternative plan.
- The **Other Social Effects (OSE)** account that registers plan effects from perspectives that are relevant to the planning process but are not reflected in the other three accounts.

Following the alternatives evaluation and comparison phase, USACE identified the Preferred Alternative for inclusion in the DEIS (Attachment 1). Figure 1-1 summarizes this alternatives development and identification process. A discussion of each step in the formal alternatives development process is provided below, including: objectives development, measures development, alternatives strategies development, and development of the final array of alternatives to be evaluated and compared in the EIS.

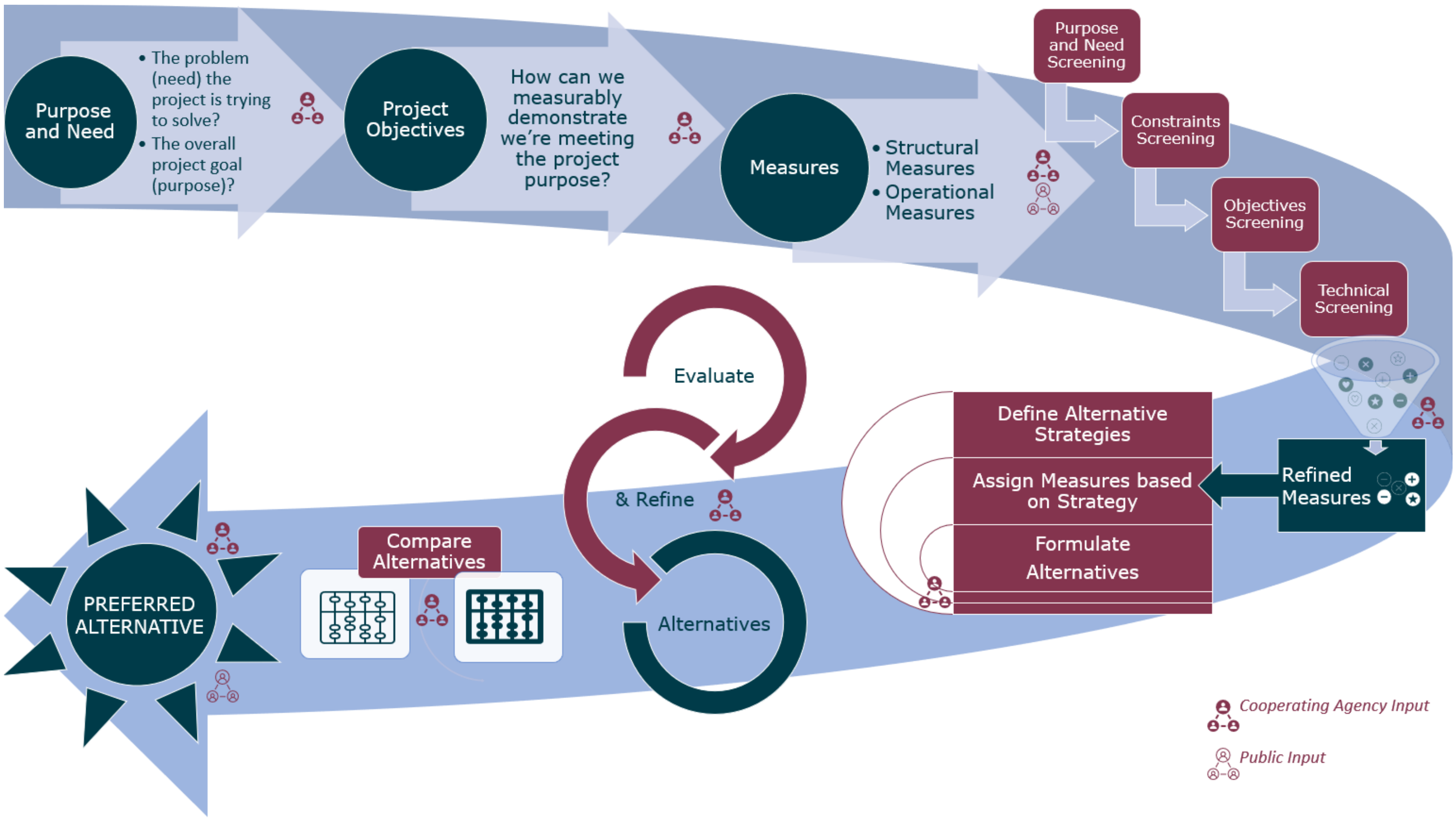

Figure 1-1. Willamette Valley System EIS Planning Process.

1.1.1 Objectives Development

Objectives describe the results you want by solving the identified problems and taking advantage of opportunities. USACE held several internal and cooperating agency workshops in April 2020 to develop objectives that would help focus efforts on finding solutions to WVS operational challenges faced by the agencies. These meetings, along with a review of public scoping comments, led to the identification and development of 18 proposed objectives for alternatives formulation.

Objectives that did not meet the purpose and need for the project were determined to be outside the scope of the EIS and were removed from further consideration. The objectives that met the purpose and need were retained and refined to focus on resources required by federal law to be protected, such as threatened and endangered species, or on regionally important resources identified during the scoping phase. The resulting seven primary objectives include:

1. Allow greater flexibility in water management (related to refill, drawdown timing, and other water management measures).
2. Increase opportunities for the creation of nature-based structures during maintenance of USACE-managed revetments (structures that help prevent bank erosion).
3. Allow greater flexibility in hydropower production.
4. Increase anadromous ESA-listed fish passage survival at WVS dams.
5. Improve water management during the conservation season to benefit anadromous ESA-listed fish and other authorized project purposes.
6. Reduce pollutant levels to restore impaired water quality associated with the WVS dams to benefit anadromous ESA-listed species.
7. Reduce spawning and rearing habitat competition caused by hatchery fish.

The identification of these objectives, along with the EIS purpose and need, guided the development of a reasonable range of alternatives.

1.1.2 Measures Development

Once project objectives were identified, USACE interdisciplinary team focused on measures that would meet more than one identified objective. These measures include a range of operational and structural modifications that could be made to improve juvenile and adult fish passage operations and to increase flexibility for water management. Measures are typically specific to a discrete action in a precise location. Structural measures are those involving a physical change to the project such as installation of a feature in the spillway or construction of a temperature control tower. Operational measures are those involving a change in how water is stored or released at the projects or how juvenile fish are transported around the projects. Examples of operational measures include a change in timing of drawdown or refill of a water storage reservoir and a change in how much water is released through the spillway. An alternative is usually constructed from a number of measures that are combined to meet the objectives.

Measure development consisted of input from subject matter experts within USACE, public comments during the scoping process, and through workshops with Cooperating Agencies. As the development of measures and the initial array of action alternatives was being conducted, additional measures were identified either through USACE technical team or through coordination with the Cooperating Agencies.

An initial list of approximately 700 measures were compiled from those submitted during the public scoping process, cooperating agency workshops, input from federal agencies, and through workshops with USACE subject matter experts. Measures were identified by name, project purpose, measure type, and by what agency or entity proposed the measure. Under project purpose, the identifiers were the authorized project purposes of the Willamette Valley System as well as measures focused on cultural resources and operations and maintenance. The authorized project purposes for the Willamette Valley System include hydropower, fish and wildlife, recreation, water quality, flood risk management, and water supply. Table 1-1Table 1-1. shows the number of initial measures identified for the different project purposes.

Table 1-1. Project Purpose Identifier and the Number of Proposed Measures Within Each Category.

Identifier	Number of Proposed Measures
Cultural	**2**
Fish and Wildlife	**260**
Flood Risk Management	**68**
Hydropower	**81**
Operations and Maintenance	**7**
Water Quality	**154**
Water Supply	**107**
Recreation	**25**
Total	**705**

USACE technical team worked through multiple rounds of screening of the initial array of measures. While each round has specific criteria for screening, the overall measures screening process is an iterative process. Measures were continually screened against all screening criteria. After the screening was completed, the remaining measures were combined to create the array of action alternatives.

1.1.3 Measures Screening

Following compilation of all submitted measures, USACE technical team conducted several rounds of screening to reduce the number of measures to allow for the development of a reasonable range of alternatives.

Many measures were submitted under different names from different sources but were essentially the same. For this reason, USACE started by identifying and removing duplicate measures. Following the removal of duplicate measures, USACE identified and screened out measures based on the following initial criteria:

- It is outside the scope of the WVS EIS. For example, "Eliminate/control sea lions at Willamette Falls."
- It is a part of the NAA. For example, "Maintain current WVS water supply operations."
- It is an objective, not a measure. For example, "Prioritize Demand."
- It is a measure being addressed by other projects or entities. For example, "Historic Properties Management Plans at reservoirs" is being covered by Master Planning effort.
- It is a potential Mitigation Measure that could be considered for implementation of the proposed action. For example, "Fund restoration of Willamette Greenways and public access areas along the mainstem to protect intact riparian, floodplains, and off channel habitats."

Additional screening was conducted in the following phased approach:

Step 1. Screening based on if a measure meets the project's purpose and need.

Step 2. Screening based on if a measure violates a study constraint.

Step 3. Screening based on achieving objectives.

Step 4. Screening based on geographic location.

Step 5. Screening based on technical, environmental, and risks.

Details and examples for how these steps were implemented are provided below. A table listing all measures considered, if they were retained or eliminated, and the screening step applied for measures eliminated from further consideration are provided in Attachment 2, Attachment 3, and Attachment 4.

Purpose and Need Screening

The Purpose and Need statement for the WVS EIS the continued operations and maintenance of the WVS in accordance with authorized project purposes, while meeting ESA obligations to avoid jeopardizing the continued existence of listed species. Therefore, a measure was screened if:

- The measure does not meet the purpose and need because it eliminates or abandons one or more of the Congressionally authorized project purposes (i.e., water supply, recreation, hydropower, etc.) Elimination of a purpose was very broadly defined as being able to operate for that purpose at least one day in the period of record, as modeled.

  Example Suggested Measure: 'Remove turbines to provide safer outlet for fish passage.'

  Decision: Removed from consideration because the removal of the turbines would eliminate hydropower, which is an authorized project purpose.

- The measure is for a new structure for purposes other than addressing ESA obligations. The primary purpose of this EIS is for operations and maintenance of the WVS while meeting ESA obligations; new structures for purposes other than meeting ESA obligations were considered out of scope.

  Example Suggested Measure: 'Build solar panel fields.'

  Decision: Removed from consideration because this measure includes construction of new facilities that do not help operate and maintain the system while meeting ESA obligations.

Constraint-based Measures Screening

USACE then used a decision tree to screen measures based on whether they met the project constraint, which was developed based on the purpose and need for the project-continued operation and maintenance of the WVS in accordance with authorized project purposes while meeting ESA obligations. In this process, measures were eliminated from consideration for the following reasons:

- The measure already has sufficient NEPA coverage to be implemented or NEPA coverage was initiated and will be completed prior to this DEIS.

  Example Suggested Measure: 'to promote and improve off-water recreation within the WVS'.

  Decision: these activities already have sufficient NEPA coverage.

- Measures that would result in changes to flood risk management from current levels were screened out. A hard constraint for measures screening was change to flood risk management levels. USACE conducted preliminary hydrologic modeling for any measures that proposed operational changes with uncertain flood risk effects. Results of the preliminary modeling were used to further screen any operational measures with potential flood risk effects.

Example Suggested Measure: 'remove dams'

Decision: Removed from consideration as USACE would not be able to maintain current levels of flood risk management*.*

- Documentation exists that demonstrates that the measure would compromise dam safety that could not be mitigated. USACE did a preliminary evaluation of measures for dam safety considerations, where dam safety subject matter experts eliminated measures from consideration where safety concerns could not be mitigated.

Example Suggested Measure: 'Fill reservoirs higher.'

Decision: Removed from consideration because filling reservoirs higher than elevations identified within the water control manual would compromise the structural integrity of the dam.

1.1.3.3 Objectives-based Measures Screening

USACE then reviewed each measure to ensure it met one or more objectives. Measures that did not meet the objectives were removed from further consideration. For example, as there were no objectives specific to recreation and navigation, any measures limited to recreation or navigation were screened out.

1.1.3.4 Geographic Location-based Measures Screening

USACE reviewed the remaining measures and documented where each could be implemented at the 13 dam and reservoir locations or along the revetments. Measures were chosen as part of one or more of the alternatives for a specific location (e.g., dam site) based on the ability of the measure to achieve the stated objectives of the alternative or alternatives. Furthermore, any proposed operational measure must be tied directly to an existing facility, and these were located based on whether the configuration of the dam allows for the specified operational measure in addition to if the measure met the objectives of the alternative. Structural measures were similarly tied to specific facilities. For example, a fish passage structure would not be proposed at Dorena Dam as there are no listed species that require passage at that facility. There are a few measures that were not location-specific as they are basin-wide. A measure's dependency on another measure was also considered during the geographical location process; in other words, USACE considered whether certain measures required another measure to be located adjacently to properly operate, such as juvenile fish collectors and selective withdrawal structures.

Though most of the measures that made it to this stage in the screening process moved forward, a limited number of measures were screened out. For example, a head of reservoir fish collector was eliminated from further consideration as it was determined by USACE fish biologists to not be a preferred measure of juvenile fish passage at any of the project locations.

1.1.3.5 Technical Screening

USACE interdisciplinary team then developed technical screening criteria to help identify and eliminate measures with low potential to contribute to future management of the WVS. This potential was assessed using technical criteria including technical feasibility, level of environmental effect, and risk associated with implementation of the measure. USACE reviewed each measure based on these criteria and removed from further consideration any measure that would result in at least one unacceptable condition.

Table 1-2 provides a description of the technical screening criteria and the unacceptable condition by which a measure would be screened out.

Table 1-2. Technical Screening Criteria Descriptions.

Criteria	Description	Unacceptable Condition
Technical feasibility	Practicality of a proposed measure, including whether it can be implemented using available technology, techniques, skills, and resources	Available information (i.e., scientific support/consensus across several agencies) is not sufficient to support implementation of the measure or proof of concept. Available information clearly demonstrates major risk of failure with implementation of the measure. The expected benefit or change would be minimal within the study timeframe and spatial scale (not distinguishable from measures in NAA).
Level of environmental effect	Effects caused by a measure to the human or natural environment	Available information clearly demonstrates that the measure would have, or would be expected to have, unacceptable effects.
Risk associated with implementation	Potential for failure during planning, design, or after construction or initiation of measure	Available information clearly demonstrates major risk of failure or a lack of feasibility.

1.1.4 Formulation of Alternatives

An alternative is a set of one or more measures that work together to address the EIS objectives. Each alternative consists of different measures, or a combination of the same measures in significantly different ways. The WVS EIS evaluated and compared several action alternatives as well as a NAA. All alternatives, including the NAA, are described in Chapter 2, Alternatives.

The action alternative development process focused on creating strategies to meet more than one primary objective within individual alternatives. The alternatives were formulated to explore the tradeoffs from blending measures while continuing to emphasize specific resources. USACE interdisciplinary teams collaborated to determine where measures would be most effective ("measures siting"). These same participants then used best professional judgment to determine whether there were any operational or structural measures that could not be performed together (conflicting measures). If measures were determined to be conflicting, the team decided which measure to retain and/or modify to meet the alternative's strategy and objectives. The objectives are described in Section 1.1.1, Objectives Development.

Following the measures screening process, alternatives were formulated using the remaining measures based on different formulation strategies. Each alternative strategy places a different emphasis on the project objectives described in Section 1.1.1, Objectives Development. Table 1-3 summarizes the alternative strategies and associated project objectives.

Table 1-3. Project Alternative Strategies and Associated Objectives.

Alternative	Strategy	Objectives[1]
No Action	Current operations and maintenance Practices	1, 5
1	Improve Fish Passage Through Storage-Focused Measures: Increase the probability of refilling WVS reservoirs and supplemental water delivery for authorized purposes	1, 2, 3, 4, 5, 6, 7
2A and 2B	Integrated Water Management Flexibility and ESA-Listed Fish Alternative	1, 2, 4, 5, 6, 7
3A and 3B	Operations Focused: Improve passage of ESA-listed fish through existing structures by modifying water control operations	2, 4, 5, 6, 7
4	Structures Focused: Improve passage of ESA-listed fish by constructing fish passage and temperature control structures	1, 2, 3, 4, 5, 6, 7
5	Refined Integrated Water Management Flexibility and ESA-Listed Fish Alternative	1, 2, 4, 5, 6, 7

[1]Notes:

1. Allow greater flexibility in water management (related to refill, drawdown timing, and other water management measures).
2. Increase opportunities for the creation of nature-based structures during maintenance of USACE-owned revetments (structures that help prevent bank erosion).
3. Allow greater flexibility in hydropower production.
4. Increase anadromous ESA-listed fish passage survival at WVS dams.
5. Improve water management during the conservation season to benefit anadromous ESA-listed fish and other authorized project purposes.

6. Reduce pollutant levels to restore impaired water quality associated with the WVS dams to benefit anadromous ESA-listed species.
7. Reduce spawning and rearing habitat competition caused by hatchery fish.

To begin, USACE started creating alternatives based on the strategies focused on meeting the objectives through either maximizing storage, changing operations only, or by primarily building structures. These resulted in Alternatives 1, 3A, 3B, and 4, respectively. Alternatives 3A and 3B were both built of primarily operational measure with some modification of existing infrastructure and the construction of AFFs for benefits to be realized from the proposed operational measures. Alternative 3A and 3B are very similar but propose a slightly different combination of operations. By making this distinction between Alternatives 3A and 3B, the EIS allows for the unique impacts associated with each of these operations and the tradeoffs between them to be assessed and compared.

Preliminary analysis, particularly for hydropower, water supply, recreation, water quality and ESA-species impacts as well as preliminary costs, was completed for these initial four action alternatives. The results of this preliminary analysis were utilized to inform formulation of alternatives which integrate structural and operational measures to improve performance at meeting one or more objectives. Prior to this effort it was difficult to know which operational measures in 3A or 3B would provide suitable downstream passage results when compared to the structure focused alternative. Structural measures require significant design and engineering efforts, additional environmental compliance (such as site-specific NEPA documents), and often long construction timeframes. This can substantially delay a structural measure's implementation and substantially increase the cost of an alternative. Thus, the formulation of integrated alternatives was an effort to identify downstream fish passage measures with the highest likelihood of meeting ESA-species needs while balancing cost and managing risk and uncertainty associated with implementation timing.

USACE used the following six steps to assess the initial alternatives using preliminary data and formulate new alternatives:

1. Define metrics and thresholds based on preliminary data to assess how each measure meets the objectives.

2. De-prioritize measures by subbasin that do not meet the pre-defined thresholds, by assessing metrics outputs for each measure.

3. Qualitatively rank remaining measures according to metric results.

4. Determine measures which have at least a moderate ranking in each subbasin for each metric.

5. Assess impacts to other key missions for measures identified in step 6 not considered in the metrics defined in step 2.

6. Formulate Alternative 2 considering results of steps 5 through 6.

Table 1-4 describes each of the metrics developed to compare the initial array of alternatives. The results for the initial array of alternatives were compared and evaluated by a cross-functional team of subject matter experts who used the to rank the alternatives. Based on these rankings and best professional judgement, Alternatives 2A and 2B were formulated combining structural and operational measures to balance water management flexibility and meet ESA-listed fish obligations. Two integrated alternatives were formulated so that the operational and structural downstream fish passage measure specifically at Cougar Dam could be more quantitatively assessed. The use of structural versus operational downstream passage measures has unique environmental and operational implications.

Table 1-4. Integrated Alternative Formulation Metrics.

Category/ Resource	Formulation Metric	Description	Unit of Measure
ESA-Listed Fish	Chinook Dam-Passage Survival	The probability of survival from the upstream boundary of the forebay to the downstream boundary of the tailrace for each of the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette. It includes the forebay, all routes of passage, and the tailrace of a given dam. Percent survival of at least 60% is indicative of a self-sustaining population.	Average % Survival for the Period of Record
ESA-Listed Fish	Steelhead Dam-Passage Survival	The probability of survival from the upstream boundary of the forebay to the downstream boundary of the tailrace for each of the North Santiam and South Santiam. It includes the forebay, all routes of passage, and the tailrace of a given dam. Percent survival of at least 60% is indicative of a self-sustaining population.	Qualitative assessment based on best professional judgement

Category/ Resource	Formulation Metric	Description	Unit of Measure
ESA-Listed Fish	Bull Trout Survival and Connectivity/Influence of Reservoir Change (for Alt 2 formulation)	Qualitative criterion based on best professional judgement of fish biologists	Positive - Measure/Alt would be beneficial to species Neutral - Measure/Alt would not change or have negligible effect on species Negative - Measure/Alt would adversely affect the species
ESA-Listed Fish	Performance Uncertainty	Qualitative assessment of the confidence in the modeling results associated with each measure.	High/Medium/Low
Water Quality	Extreme water temperatures	Mortality Impact: Water temperature impact exceeds 25°C (Juveniles) and 24°C (Adult migration) at monitoring locations below dams	Percent of days in each year that modeled water temperature is above 25°C (juveniles) and 24°C (adult migration)
Water Quality	Stressful water temperature for fish	Increased stress, decreased growth, disease to juvenile fish; migration impaired to adult migration at monitoring locations below dams	Percent of days in each year that modeled water temperature is 21-24°C (juveniles) or 20-23°C (adult migration)
Water Quality	Optimal water temperature	Optimal water temperature conditions for fish at monitoring locations below dams	Percent of days in each year that modeled water temperature is 10-20°C (juveniles) or 12-19°C (adult migration)
Water Quality	Safe water temperature	Safe water temperature below 10°C (Juveniles) and 12°C (Adult migration) at monitoring locations below dams	Percent of days in each year that modeled water temperature is below 10°C (juveniles) and 12°C (adult migration)

Category/ Resource	Formulation Metric	Description	Unit of Measure
Water Quality	Egg emergence (Incubation) at monitoring locations below dams	Estimated egg emergence day based on modeled cumulative water temperature below dam [Sep 20 + 1750 ATU]	Month-Day in which cumulative water temperature below dam [beginning Sep 20] exceeds 1750 ATU
Hydropower	Change in Hydropower Generation	Change from No Action in megawatts of production	Average Annual MW produced individual at each hydropower dam
Irrigation/M&I	Water in Conservation Pool Storage	Reservoir storage is adequate to meet existing irrigation contracts and M&I water supply demand from April through October.	Number of days in period of record that reservoir elevation exceeds minimum conservation pool individually at each dam from April 1 to October 31
Water Supply (M&I)	City of Salem water supply requirement	Storage is sufficient to provide for the City of Salem's water supply system to operate.	Number of days in the period of record that the Mehama gage exceeds 750 cfs.
Recreation	Reservoir Boat Ramp access	Reservoir elevation allows access during the summer conservation season (May 1 - Sept 1)	Number of days in each year of period of record that boat ramps are accessible: High = all boat ramps accessible (elevation depends on each individual reservoir) Medium = at least one boat ramp is accessible elevation depends on each individual reservoir) Low = no boat ramps accessible elevation depends on each individual reservoir)

By making this distinction between 2A and 2B, the EIS allows for the unique impacts associated with a structure vs an operation to be identified for downstream passage at Cougar and tradeoffs between to be assessed and compared.

Following the formulation of Alternative 2A and 2B, USACE assessed the environmental consequences associated with each of the seven alternatives, including the NAA. The findings are discussed in detail in Chapters 3 and 4 of the EIS and further described in the associated Appendices. Following the effects analysis, the alternatives were evaluated and compared for identification of the Preferred Alternative. While comparing the Alternatives, the USACE considered the benefits, environmental consequences, and tradeoffs of alternatives within and outside of current authorities as reflected in Chapter 3, Environmental Consequences and Chapter 4, Cumulative Effects. USACE developed multiple criteria to evaluate how effectively each alternative met the EIS objectives with consideration of cost and the economic, environmental, and social effects and then performed a tradeoff analysis using these criteria to compare the alternatives.

USACE included an evaluation of the environmental and social effects of the alternatives based on the effects analyses completed for wildlife, wetlands, vegetation, cultural resources, socioeconomics, and environmental justice and considered these effects in the trade off analysis process. However, there was not enough differentiation in the level of impact between the alternatives for the effects to these resources to inform the decisions. Therefore, criteria for these resource areas were not included in the decision-making process.

The cost to design, construct, and operate and maintain each an alternative as well as impacts to recreation, hydropower production, water supply, ESA-listed fish did provide clear tradeoffs for comparing alternatives. In addition to metrics for cost and economic effects resulting from impacts to recreation, one or more metrics were developed to measure how effectively an alternative met each of the primary objectives outlined in Section 2.1 except for Objectives 2 and 7. Objectives 2, to increase opportunities for the creation of nature-based structures during maintenance of USACE-managed revetments, and Objective 7, to reduce spawning and rearing habitat competition caused by hatchery fish, are effectively met by including the revetment and hatchery measures, respectively, an alternative. As all action alternatives include these measures there is no measurable difference in how well they meet these objectives. The metrics for the remaining objectives, the economic metrics for impacts to recreation, and the metrics for costs are described below.

Where possible, USACE developed quantitative or semi-quantitative metrics to measure the criteria, otherwise a qualitative assessment based on the environmental consequences analysis (provided in Chapter 3, Environmental Consequences) was uses to evaluate how well an alternative met the criteria.

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

Economic effects on water supply were not analyzed because water supply effects between structural and hybrid alternatives (Alternatives 1, 2A, 2B, 4, and 5) were minimal while effects between the operations-only alternatives (Alternatives 3A and 3B) were very distinct. An economics would not provide additional information that was not already assessed by the quantitate NED and RED benefits analyses.

END NEW TEXT

Table 1-5 defines each metric and lists the sections in Chapter 3 where the supporting information can be found in the EIS for each metric. Although absolute values provide important context, it is more relevant for decision-makers to consider the estimated differences between each of the action alternatives and the No Action Alternative (NAA). The methodology and analysis for each metric is provided in the associated resource's environmental consequences analysis in Chapter 3 and the associated Appendices and the associated sections of the EIS are listed in Table 1-5.

Based on the outcomes of the trade-off analysis (discussed in detail in Chapter 5), Alternative 2B was tentatively identified as the Preferred Alternative. However, after engaging with BPA, NMFS, and USFWS, USACE determined that the integrated temperature and habitat flow regime (Measure 30a as described in Section 2.1.1) proposed in Alternative 2B should be refined to improve outcomes for ESA species. Alternative 5 was formulated to be identical to Alternative 2B but for the flow measure. Different from all other alternatives, Alternative 5 includes the Refined Integrated Temperature and Habitat Flow Regime (Measure 30b as described in section 2.1.2). Alternative 5 is the Preferred Alternative

Table 1-5. Evaluation and Comparison Metrics.

USACE Criteria	Metric	Definition	Supporting Information
Objective 1. Allow greater flexibility in water management	Conservation storage Impact to Downstream Flows	The peak volume of water stored systemwide. Flows at downstream control points. • High Impact = downstream flows are much lower in the summer. • Medium Impact = downstream flows are lower in the summer. • Low Impact = downstream flows are about the same or higher in the summer.	Section 3.2, Hydrologic Processes and Section 3.13, Water Supply in the EIS and corresponding Appendix B and Appendix J
Objective 2. Increase opportunities for the creation of nature-based structures during maintenance of USACE-owned revetments	Includes maintaining revetments using nature-based engineering or altering revetments for aquatic ecosystem restoration (9)	By including this measure, the alternative would increase the amount of nature-based materials during maintenance of USACE-owned revetments	Chapter 2, Alternatives, in the EIS, Measures Common to All Alternatives
Objective 3. Allow greater flexibility in hydropower production	Net Present Value (NPV)	Measures the impact to the economic viability of hydropower at WVS hydropower dams. Compares the expected revenue produced at each hydropower facility versus expected costs. Presented as a total for the WVS. Based on changes in generation under the alternatives and any potential effects from that on the regional energy environment, as well as the joint-use construction cost of the alternatives.	Section 3.12 in the EIS and Appendix G, Power and Transmission
Objective 4. Increase anadromous ESA-listed fish passage survival at WVS dams	Bull trout habitat gains Downstream survival relative rank: 7=best, 1=worst	Number of bull trout populations with habitat gains (out of 3) from fish passage improvements	Section 3.8 in the EIS and Appendix E, Fish and Aquatic Habitat

USACE Criteria	Metric	Definition	Supporting Information
Objective 5. Improve water management during the conservation season to benefit anadromous ESA-listed fish and other authorized project purposes. Objective 6. Reduce pollutant levels to restore impaired water quality associated with the WVS dams to benefit anadromous ESA-listed species.	Chinook Populations reaching replacement Chinook Populations persistence Legacy Chinook Population risk	Relative rankings of model results of Chinook and steelhead survival below dams as affected by flow and water temperatures. The number of spring Chinook populations (out of 4) modeled to achieve spawner replacement on average over a 30-year timeframe The number of Chinook populations (out of 4) modeled to exceed a minimum adult abundance threshold. Indicates if the McKenzie spring Chinook population is at a low risk of extinction.	
Cost	Estimated Total Annual Cost	Annual costs over the 50-year period of analysis in 2021 dollars including annualized first costs for design and construction as well as the annual cost for Operations, Maintenance, Repair, Replacement and Rehabilitation.	Appendix M, Costs
Economic Effects	NED Benefits - Average Annual Benefits (total for all reservoirs) in millions of dollars	The change from the NAA in the dollar value of reservoir recreational visitations using recreation season (April 15 through Sept 15) availability of reservoir boat ramps and the changes in visitation across various recreation activities that are estimated to occur when boat ramps are available versus when they are not available. The higher the value, the greater the economic benefits as compared to the NAA.	Appendix K, Recreation Analyses and Appendix I, Water Supply Analyses

USACE Criteria	Metric	Definition	Supporting Information
Regional economic impact from recreation effects	RED Benefits Impact	A qualitative assessment of the impact to RED considering the full-time jobs created/lost by whether an alternative makes conditions more/less conducive to water-based recreation and the regional output equal to the sum of employee compensation, proprietor income, other property type income, and indirect business taxes. The higher the impact the greater numbers projected for jobs lost and reduction in regional output. An assessment of a high impact means greater numbers of jobs lost and greater than $100,000 annual reduction in multiple basins.	Appendix K, Recreation Analyses and Appendix I, Water Supply Analyses

CHAPTER 2 - MEASURES CONSIDERED IN ALTERNATIVES DEVELOPMENT

The following measures are placed into the following categories: flows, water quality - temperature, water quality - Total Dissolved Gas (TDG), downstream passage, upstream passage, measures common to all alternatives, existing operations continuing forward, and Interim Operations. These include structural and operational measures. Structural measures are those that would require the construction of new structures or physical modifications to existing structures and/or components. Operational measures are those that use existing infrastructure to meet the proposed objective(s).

Each measure is identified by both a short title and a tracking number. The tracking number was assigned when the measure was first identified to allow the measure to be tracked throughout the screening process.

2.1 FLOW MEASURES

2.1.1 Measure 30a. Integrated Temperature and Habitat Flow Regime

Description:

This section describes operational measures to manage streamflow on tributaries and on the mainstem Willamette River via water releases from USACE-managed dams. Physical habitat and water quality are important attributes to consider for meeting the habitat needs of aquatic biota in both flowing and impounded sections of a river system.

Temperatures conditions can annually exceed biological thresholds for native aquatic species in the Willamette River Basin regardless of streamflow conditions. Physical habitats provided by streamflow are only of value to an aquatic organism when they are within thermal biologic thresholds. Therefore, a primary objective of the fish flow management regime is to help avoid exceeding these thresholds and to improve the available habitat.

The proposed adaptive “fish flows” are based on three components:

1. Alternative minimum flows that incorporate magnitude, seasonal variation, and annual hydrologic conditions,

2. Opportunistic/adaptable water releases for real-time water temperature management, and

3. Fall maximum outflows from Detroit/Big Cliff, Green Peter/Foster, Cougar, and Lookout Point/Dexter Dams.

Tributary and Mainstem Minimum Flows

The adult UWR spring chinook salmon species and life stage were chosen as the priority in the development of the fish flows. Pre-spawn mortality substantially constrains productivity of UWR spring Chinook salmon (e.g., Keefer et al. 2010; Zabel et al. 2015).

Two separate minimum flow regimes for the major tributaries (North Santiam, South Santiam, McKenzie, and Middle Fork Willamette) were developed for the conservation storage and use seasons, based on hydrologic conditions in any given year in Table 2-1.

The early season minimum flows in Table 2-1 correspond to flows providing greater than or equal to 90 percent Wetted Usable Area (WUA) for UWR spring Chinook salmon and UWR steelhead spawners (R2 2013; RDG 2014) below WVS dams. The 2008 Biological Opinion and RPA recognized the 2008 RPA flow targets are not always achievable in dry years. The minimum flow level for drier years were defined based on flows corresponding to 80 percent WUA for spawners below WVS dams (R2 2013; RDG 2014). An 80 percent WUA is consistent with NMFS application of an 80 percent criteria as protective of salmonid habitat needs (NMFS and USFWS 2013).

The minimum flow regimes for both wetter and drier conditions included in increase above the lowest minimum value according to optimal hydrograph shapes determined by Peterson et al. (2022). Their work indicates that water temperature is likely driving the shape of the optimal flow regimes they identified, and the best candidate minimum flow. The appropriate minimum flow regime each year will be determined according to the storage achieved (less than or greater than 90 percent of the rule curve[1]) every 2 weeks between February 1 and June 1. After June 1, the flow regime applied on June 1 will be followed for the remained of the conservation season. The flow targets from the NMFS 2008 Biological Opinion were carried forward for other dams and subbasins not listed in Table 2-1.

The mainstem Willamette River minimum flow targets at Salem (5000 cfs) and Albany (4500 cfs) would be in place in all water year types and in all months except April 1 to June 30. Minimum flows during April and May at Salem will be 10,000 cfs, and 8,000 cfs in June for purposes of water temperature management in the mainstem. The reservoirs used to provide the mainstem flow would be decided on a real-time basis depending on realized hydrologic conditions throughout the Willamette River Basin.

Temperature Pulses

In addition to application of base flow targets, flow from the WVS reservoirs would also be used adaptively during April-June in each year to reduce and stabilize water temperature during important migration timeframes for UWR spring Chinook salmon and UWR steelhead,

[1] A rule curve is seasonal reservoir elevation targets or restrictions, represented graphically as curves, that guide reservoir operations.

mitigating warmer air temperatures to the extent possible. Flow in addition to meeting the base flow targets in

Table 2-1 would be released to achieve specified temperature targets. The specific flow targets within this measure are based on the observed relationship between flow, air temperature, and water temperature during 2001-2018 (Stratton, et.al., in press). The following guidelines, as measured at Keizer (USGS 14192015; water temperature), Salem (USGS 14191000; streamflow), and Salem Airport (air temperature) are proposed during April-June:

Table 2-1. Tributary Flow Targets for Wetter (reservoir >90% of rule curve) and Drier (reservoir <90% of rule curve) Conditions.

Dam	Detroit / Big Cliff		Green Peter / Foster		Cougar*		Lookout Point / Dexter	
Start Date	>90%	<90%	>90%	<90%	>90%	<90%	>90%	<90%
1-Feb	1000	800	1000	700	300	250	1200	1000
15-Feb	1000	800	1000	700	300	250	1200	1000
1-Mar	1000	800	1000	700	300	250	1200	1000
15-Mar	1000	800	1000	700	300	250	1200	1000
1-Apr	1200	800	1200	700	360	250	1440	1000
16-Apr	1500	800	1500	700	450	250	1800	1000
1-May	1550	880	1550	770	465	275	1860	1100
16-May	1600	960	1600	840	480	300	1920	1200
1-Jun	1550	1040	1550	910	465	325	1860	1300
16-Jun	1500	1120	1500	980	450	350	1800	1400
1-Jul	1400	1200	1400	1050	420	375	1680	1500
16-Jul	1250	1280	1250	1120	375	400	1500	1600
1-Aug	1250	1040	1250	910	375	325	1500	1300
16-Aug	1250	960	1250	840	375	300	1500	1200
1-Sep	1250	960	1250	840	375	300	1500	1200
16-Sep	1200	960	1200	840	360	300	1440	1200
1-Oct	1200	960	1200	840	360	300	1440	1200
15-Oct	1200	960	1200	840	360	300	1440	1200
1-Nov	1200	960	1200	840	360	300	1440	1200
15-Nov	1200	960	1200	840	360	300	1440	1200

*NOTE: Where minimum flows required for dam operations are greater than flows listed in Table 2-1, those project-specific minimums will be applied in place of those minimums listed in Table 2-1. These include an operating outflow minimum limit of 1050 cfs from Detroit/Big Cliff dams, and 1350 cfs for Lookout Point/Dexter dams.

<u>April - May</u>

A 64°F (17.8°C) max threshold 7-day average of daily max (7dADM) water temperature would be targeted for migrating juvenile steelhead. This threshold could be met when flows are at least 10,000 cfs, and air temperatures are at most 78 °F 7dADM. At warmer air temperatures, more flow is required to meet the water temperature threshold. Flow would be augmented up to 18,000 cfs, at air temperatures of 90 °F 7dADM.

<u>June 1-15</u>

A 68°F (20°C) max threshold 7-day average of daily max (7dADM) water temperature would be targeted for adult chinook. This threshold could be met when flows are at least 8,000 cfs and air temperatures at most 80°F 7dADM. Flow would be augmented up to 14,000 cfs, at air temperatures up to about 89 °F 7dADM.

<u>June 16-30</u>

A 69°F (20.6°C) max threshold 7-day average of daily max (7dADM) water temperature would be targeted for adult chinook. This threshold could be met when flows are at least 8,000 cfs and air temperatures are at most 82°F 7dADM. Flow would be augmented up to 14,000 cfs in advance of forecasted air temperatures up to about 92°F 7dADM.

These proposed fish flow targets for temperature management are intended to reduce thermal stress on ESA-listed fish and reduce mortality during extreme heat.

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

The temperature pulses would be junior in priority to the minimum flow targets discussed above. The decision to pulse would be based on if there is enough stored to meet tributary and mainstem targets throughout the season. If USACE, in coordination with WATER determines, based on event driven modeling, that there is enough stored water to provide the pulse, then USACE will release stored water to reduce excessive stream temperatures. Considerations on whether to complete the pulse include, but are not limited to water supply forecast, realized system storage, ramping rates, and biological priorities.

END NEW TEXT

<u>Maximum Flows</u>

From September 1 to October 15, maximum outflows from DET/BCL, GPR/FOS, CGR, and LOP/DEX will be applied to protect against redd dewatering after the spawning season

(Table 2-3). Since high flows encourage spawning in areas of the river which could become dewatered after reservoirs have been drafted for flood risk management, reducing egg and fry survival, maximum flows were developed based on spawning WUA estimates developed by R2 (2013) and RDG (2016). The 75% WUA spawning flow at the upper portion of the WUA flow relationship was chosen. This flow level is higher than the 100% WUA flow estimates by R2 (2013) and RDG (2016). The 75% WUA spawning flow level was chosen to help balance the need to encourage spawning in areas that will remain wetted after reservoir drafting and the need to increase flows to draft reservoirs for flood management.

Deviations from the above approach will be considered as part of the WATER process, in coordination with the WATER Flow Management and Water Quality Team. Deviations could be expected where operational changes are necessary for project maintenance activities or emergency outages, and due to hydrologic variability requiring changes in flow management. Deviations should be developed based on the best available scientific information, with assumptions about risks, benefits, and uncertainties clearly stated and documented.

Table 2-2. Threshold Flows at which flow augmentation could provide cooler temperatures in each timeframe and an associated water temperature threshold of which not to exceed. Flows provided in kcfs; temperature estimate in degrees F based on Stratton, et. al. (in press).

–	Apr – May	Jun 1-15	Jun 15-30
Air Temperature Threshold (F)	Flow (kcfs) Needed to Keep Below 64°F Water Temperature	Flow (kcfs) Needed to Keep Below 68°F Water Temperature	Flow (kcfs) Needed to Keep Below 69°F Water Temperature
74	8.7	6.4	5.9
75	9	6.6	6
76	9.3	6.9	6.2
77	9.6	7.2	6.5
78	9.9	7.5	6.7
79	10.3	7.8	6.9
80	10.7	8.1	7.2
81	11.2	8.5	7.5
82	11.7	8.9	7.9
83	12.2	9.4	8.2
84	12.7	9.9	8.6
85	13.4	10.4	9
86	14	11	9.5
87	14.7	11.8	10.1
88	15.4	12.7	10.6
89	16.4	13.7	11.3
90	17.4	14.9	12
91	18.6	16.1	12.9
92	19.8	17.7	14
93		19.6	14.8

Table 2-3. Maximum outflows to be achieved during the Chinook salmon spawning season, September 1 to October 15, annually. Flows based on average WUA values across study reaches for flows achieving 75% of the spawning habitat below these dams as reported by R2 Resources (2013) and RDG (2016), as averaged across study reaches.

Chinook Salmon Spawning	NS (Big Cliff)[a]	SS (Foster) [a]	S Fk. MK (Cougar) [b]	MF (Dexter) [c]
Recommended Max Spawning Q (75% WUA Q; cfs)	2175(a)	2825(a)	880(b)	3500(c)
For reference: 100% WUA Q (cfs)	1300	1500	500	1900
For reference: 2008 Biological Opinion max spawning season flows (cfs)	3000	3000	580	3500

a. Average of reaches 1 and 2 from R2 2013.
b. Average of mainstem S. Fork transects 1,2,3,7 from RDG 2016.
c. Average of Mainstem transects 1,2,3,10 from RDG 2016.

Purpose: Provide biologically based flows and reduce thermal stress on ESA-listed fish and reduce mortality during extreme heat.

Intended Benefit: Increase fish survival

Operational or Structural Measure: Operational. Reduced minimum flows during early spring; higher flows during late spring and summer compared to NAA.

Location: Basin-wide

2.1.2 Measure 30b. Refined Integrated Temperature and Habitat Flow Regime

Description:

Measure 30b is a modification of Measure 30a, with changes to the mainstem and tributary minimum flow regimes. Salem flows are divided into two to three categories, based on the current water year's percentage of the Northwest River Forecast Center's rolling 30-year average April-September water supply forecast at Salem, as listed in

Table 2-4. Flows are subject to change throughout the season based on realized hydrology and annual water management decisions. The categories go from three to two starting in mid-June as the majority of the basin's water supply has been realized by mid-June and flows become more stable. Minimum flow thresholds based on being above or below 90% of rule curve at Detroit/Big Cliff, Lookout Point/Dexter, and Foster Dams are modified as noted in Table 2-5. See Measure 30a for full description for the background development of the flows. Additional water releases from the projects may also occur to achieve temperature targets in the mainstem as measured at Salem, as noted in Measure 30a. The reservoirs used to provide the mainstem flow would be decided on a real-time basis depending on realized hydrologic conditions throughout the basin.

Purpose: Provide biologically based flows and reduce thermal stress on ESA-listed fish and reduce mortality during extreme heat.

Intended Benefit: Increase fish survival

Operational or Structural Measure: Operational. Reduced minimum flows during early spring; higher flows during late spring and summer compared to NAA.

Location: Basin-wide

Table 2-4. Mainstem Minimum Flow Thresholds.

Time Period	Water Supply Forecast Percent of 30 Year Average	Salem Minimum Flow, cfs (7 Day Moving Average)	Salem Minimum Flow, cfs (Instantaneous)	Albany Minimum Flow, cfs
April	<80%	12,000	12,000	–
–	80-100%	15,000	13,000	–
–	>100%	17,800	14,300	–
May	<80%	10,000	8,000	–
–	80-100%	13,000	12,000	–
–	>100%	15,000	12,000	–
June 1 - 15	<80%	8,000	8,000	4,500
–	80-100%	10,000	10,000	4500
–	>100%	13,000	10,500	4500
June 16 - 30	<80%	5,500	5,500	4,500
–	>=80%	7,000	7,000	4500
July	<80%	5,000	5,000	4,500
–	>=80%	6,000	5,500	4500
August	<80%	5,000	5,000	4,500
–	>=80%	6,500	6,000	4500
September	<80%	5,000	5,000	4,500
–	>=80%	7,000	6,500	4500
October	<80%	7,500	6,000	4,500
–	>=80%	10,000	8,000	4500

Table 2-5. Tributary Minimum Flow Thresholds.

Dam	Detroit / Big Cliff		Green Peter / Foster		Blue River	Cougar*		Fern Ridge	Hills Creek	Lookout Point / Dexter		Fall Creek	Cottage Grove	Dorena
Start Date	>90%	<90%	>90%	<90%	all levels	>90%	<90%	all levels	all levels	>90%	<90%	all levels	all levels	all levels
1-Feb	1050	1050	1140	700	50	300	250	50	400	1200	1000	50	75	190
15-Feb	1050	1050	1140	700	50	300	250	50	400	1200	1000	50	75	190
1-Mar	1050	1050	1140	700	50	300	250	50	400	1200	1000	50	75	190
15-Mar	1050	1050	1140	700	50	300	250	50	400	1200	1000	50	75	190
1-Apr	1200	1050	1200	700	50	360	250	50	400	1440	1000	80	75	190
16-Apr	1500	1050	1500	700	50	450	250	50	400	1800	1000	80	75	190
1-May	1550	1050	1550	770	50	465	275	50	400	1860	1100	80	75	190
16-May	1600	1050	1600	840	50	480	300	50	400	1920	1200	80	75	190
1-Jun	1550	1050	1550	910	50	465	325	50	400	1860	1300	80	75	190
16-Jun	1500	1120	1500	980	50	450	350	50	400	1800	1400	80	75	190
1-Jul	1400	1200	1400	1140	50	420	375	30	400	1680	1500	80	50	100
16-Jul	1250	1280	1250	1140	50	375	400	30	400	1500	1600	80	50	100
1-Aug	1250	1050	1140	1140	50	375	325	30	400	1500	1300	80	50	100
16-Aug	1250	1050	1140	1140	50	375	300	30	400	1500	1200	80	50	100
1-Sep	1250	1050	1140	1140	50	375	300	30	400	1500	1200	200	50	100
16-Sep	1200	1050	1140	1140	50	360	300	30	400	1440	1200	200	50	100
1-Oct	1200	1050	1140	1140	50	360	300	30	400	1440	1200	200	50	100
15-Oct	1200	1050	1140	1140	50	360	300	30	400	1440	1200	50	50	100
1-Nov	1200	1050	1140	1140	50	360	300	30	400	1440	1200	50	50	100
15-Nov	1200	1050	1140	1140	50	360	300	30	400	1440	1200	50	50	100

* For the Preferred Alternative, Cougar Reservoir minimum would only be the <90% value due to the deep drawdown.

2.1.3 Measure 304. Augment Instream Flows By Using the Power Pool

Description:

Water stored in the designated power pools would be used to support biological flow targets when natural streamflows are not adequate to provide the biologically justified flows. The measure would only be implemented to meet ESA obligations and not provide water to meet consumptive needs. Due to the annual variability in hydrologic conditions throughout the basin, a set priority for use of the power pools is not possible and will be determined on an as-needed basis based on flow conditions in the tributaries. Coordination would occur through the WATER team. This measure would allow the stored water to be used when needed without additional analysis on a case by case or year by year basis. Pass inflow once elevation reaches minimum power pool elevation.

Minimum pool elevations under this measure will not conflict with a co-incident fish passage measure that requires a regulating outlet. For example, Measure 40 describes drafting the Hills Creek pool down to 25 feet above the RO (top of RO: 1421’ + 25’ = 1446’) which is above minimum power pool specified above. In this case, the lowest elevation will be consistent with the elevation needed for the downstream fish passage measure.

Purpose: The water stored within the power pool would be used to augment natural streamflow to assist in meeting minimum tributary flows during the summer and late fall (June 1 – November 30).

Intended Benefit: The benefit of this operation is increased likelihood of meeting tributary minimum flows during the late summer through fall.

Operational or Structural Measure: Operational. Allows regular use of the power pool for purpose of supporting fish flows.

Location: Detroit, Green Peter, Lookout Point, Hills Creek, and Cougar Dams. The re-regulating reservoirs, Dexter and Big Cliff, do not have power pool storage; therefore, the measure is not applied to these two reservoirs. Foster Dam has a small power pool, but this measure is not recommended for that reservoir due to the downstream passage and water quality work.

Table 2.1.3a. Measure 304 Category Response.

Category	Response
Description of work	Use water stored in the power pool to meet minimum fish flow requirements.
Duration	Intended timeframe is summer through late fall, when natural flows decrease and there is increased out of stream use of natural flow.
Estimated Start Date	June 1
Estimated End Date	November 30 (modeling rule is set to end Dec 31 to ensure outflows don't drop to 0 cfs)
Recurrence Interval	Annually
Max pool elevation Min pool elevation Max draft rate	Normal rule curve Minimum power pool Max draft rate below minimum conservation pool is 3 feet/day for dam safety purposes
Outlet	The turbines will be used to draft water while in the power pool, though fish passage outlet takes priority during passage operation timing.
Estimated start of outlet restriction	Minimum turbine cavitation limits.
Duration of outlet restriction	No outlet restriction except normal use patterns for minimum turbine cavitation limits.
Max flow (cfs)	Maximum flow as described in the 2008 Biological Opinion or Measure 30.

Table 2-6. Minimum Power Pool Elevations and Storage Volumes.

Dam and Reservoir	Lowest Proposed Draft Limit (Minimum Power Pool Elevation) (feet)	Minimum Conservation Pool Elevation (feet)	Power Pool Storage Volume (acre-feet)	Power Pool Storage (percent of total storage)
Detroit	1,425	1,450	36,375	21.2
Green Peter	887	922	62,600	36.5
Lookout Point	819	825	11,377	6.6
Hills Creek	1,414	1,448	48,800	28.5
Cougar	1,516	1,532	8,700	5.1

2.1.4 Measure 718. Augment Instream Flows by Using the Inactive Pool

Description:

The reservoirs are generally not drafted below minimum conservation pool unless hydrologic conditions result in reservoir inflows less than what is needed to provide downstream minimum flows. Water stored in the designated inactive pools would be used to support biological flow targets when natural streamflows are not adequate to provide the biologically justified flows. This measure would allow the water stored in the inactive pool to be used on a case by case or year by year basis without additional analysis.

Purpose: The water stored below minimum conservation pool would be used to augment natural streamflow to assist in meeting minimum flows at downstream control points during the summer and late fall (June 1 – November 30).

Intended Benefit: The benefit of this operation is increased likelihood of meeting tributary minimum flows during the late summer through fall.

Operational or Structural Measure: Operational. The lowest outlet in the reservoir would be used to draft the reservoir to the desired elevation without a need for structural modifications.

Location: Blue River, Fall Creek

Table 2.1.4a. Measure 718 Category Response.

Category	Response
Description of work	Use water in the inactive pool to meet minimum instream flow requirements.
Duration	Intended timeframe is summer through late fall, when natural flows decrease.
Estimated Start Date	June 1
Estimated End Date	November 30
Recurrence Interval	Annually
Max pool elevation Min pool elevation Max draft rate	Normal rule curve See Additional Information below for project specific elevations. Max draft rate below minimum conservation pool is 3 feet/day for dam safety purposes.
Outlet	The ROs will be used to draft water below minimum conservation pool, except at Fern Ridge where it is the sluice gates.
Estimated start of outlet restriction	N/A

Category	Response
Duration of outlet restriction	N/A
Max flow (cfs)	Maximum flow as described in the 2008 Biological Opinion or revised targets.
Additional Information	**Lowest Proposed Draft Limit**
Blue River	1150 ft (top of RO is 1140 ft) (Min Con is 1180 ft)
Cottage Grove	735.5 ft (top of RO is 725.5 ft) (Min Con is 750 ft)
Dorena	755 ft (top of RO is 745 ft) (Min Con is 770.5 ft) Dorena Hydro min op level is 770.5 ft
Fall Creek	790 ft (top of RO is 680 ft) (RO invert is 670 ft) (Min Con is 728 ft) Note, the reservoir currently drafts to run of river for fish passage operation in late fall, below 680 ft, which takes precedence over this measure.

2.1.5 Measure 723. Reduce Minimum Flows to Congressionally Authorized Minimum Flow Requirements

Description:

Minimum flows from the dam for downstream fisheries purpose are derived from HD531. Detroit/Big Cliff and Lookout Point/Dexter have minimum operating limits, due to physical constraints, which are higher than the HD531 minimum flows. These higher minimum operating flows would take priority over the lower HD 531 flows. Mainstem flow targets are the authorized minimum flow objectives from HD531.

Purpose: Use the HD531 authorized minimum flows for the projects and the HD 531 minimum flow objectives for Albany and Salem to maximize filling of the reservoirs during the refill season.

Intended Benefit: Benefit reservoir refill by allowing the reservoirs to capture more spring runoff rather than passing high spring inflows.

Operational or Structural Measure: Operational

Location: Basin-wide

Table 2.1.5a. Measure 723 Category Response.

Category	Response
Description of work	Spring and summer tributary flow targets are the HD 531 flows. Summer mainstem targets based on HD 531 objectives.
Duration (hours/days)	N/A
Est. Start Date (day/month)	June 1 (mainstem); annual tributaries
Est. End Date (day/month)	November 30 (mainstem); N/A tributaries
Recurrence Interval (X years)	Annually
Max pool elevation (ft, proj datum)	Up to maximum conservation pool
Outlet (RO/spillway/etc.)	Alternative does not change outlet use
Est. start of outlet restriction (day/month)	N/A
Duration of outlet restriction (days)	N/A
Max flow (cfs)	N/A
Additional Information	See flow targets in tables below.

Table 2.1.5b. Mainstem Flows.

Control Point	Date	Augmentation for Fish Habitat and Water Quality (cfs) (per HD 531)
Salem	Jun 1 – Nov 30	6,500
Albany	Jun 1 – Nov 30	5,000

Table 2.1.5c. Tributary Flows.

Dam	Minimum Flow(cfs)	Remarks HD 531 has two distinct time periods that do not span the full year.
Detroit/Big Cliff	1000/750	1 Feb – 30 Jun = 1000 cfs 1 Jul – 30 Nov = 750 cfs
Blue River	30	1 Feb – 30 Jun = 30 cfs 1 Jul – 30 Nov = 30 cfs
Cottage Grove	75/50	1 Feb – 30 Jun = 75 cfs 1 Jul – 30 Nov = 50 cfs
Cougar	300/200	1 Feb – 30 Jun = 300 cfs 1 Jul – 30 Nov = 200 cfs
Dorena	190/100	1 Feb – 30 Jun = 190 cfs 1 Jul – 30 Nov = 100 cfs

Dam	Minimum Flow(cfs)	Remarks HD 531 has two distinct time periods that do not span the full year.
Fall Creek	30	1 Feb – 30 Jun = 30 cfs 1 Jul – 30 Nov = 30 cfs
Fern Ridge	50/30	1 Dec – 30 Jun = 50 cfs 1 Jul – 30 Nov = 30 cfs
Green Peter	50	1 Feb – 30 Nov = 50 cfs HD531 was adopted prior to Foster Dam being proposed; hence the minimum flow released at Green Peter is the 50 cfs but also that needed to ensure Foster minimum flows.
Foster	800 – 400	1 Feb – 30 Apr = 800 cfs 1 May – 31 May = 750 1 Jun – 30 Jun = 600 1 Jul – 30 Nov = 400 cfs Foster was not included in HD 531; therefore, minimum flow from Foster is the combined minimum for Green Peter and Cascadia* Dams.
Hills Creek	100	1 Feb – 30 Jun = 100 cfs 1 Jul – 30 Nov = 100 cfs
Lookout Point/Dexter	1200/1000	1 Feb – 30 Jun = 1200 cfs 1 Jul – 30 Nov = 1000 cfs

* House Document 531 authorized Cascadia Dam on the Upper South Santiam River. This dam was never built; however, the House Document 531 flows were never adjusted. This dam is not included in the EIS analyses.

2.2 WATER QUALITY MEASURES - TEMPERATURE

2.2.1 Measure 105. Construct Selective Withdrawal Structure

Description:

This measure assumes a Selective Withdrawal Structure (SWS) design similar to the Detroit SWS Design Documentation Report (DDR) and Floating Screen Structure (FSS) specifications (USACE, 2019a). This measure complements Measures 392 and 722 for the Adult Fish Facility.

This measure would use selective withdrawal structures to achieve Clean Water Act (CWA), total maximum daily load (TMDL), and ESA water temperature requirements below each identified dam when possible. SWSs include outlet works that allow for selective withdrawal of water at various temperatures that could be blended to improve downstream water temperature. Structural fixes could allow releases from various elevations in the reservoir, send this water through the powerhouse, and continue to generate power while meeting downstream water quality targets. Water temperature simulations assume outlet details and temperature targets align with those used in previous studies (Buccola, et.al, 2012, Buccola, et.al, 2016; Buccola, et.al, 2017, USACE, 2019a; USACE 2019b). These structures could also be attached to or combined with new fish passage facilities (notably Measure 392: construct downstream passage) to more effectively meet the requirements of fish passage RPAs (NMFS 2008).

Purpose: Provide more normative temperatures downstream of the project.

Intended Benefit: Increase fish survival

Operational or Structural Measure: Structural

Location: Detroit, Lookout Point, Green Peter, Hills Creek

2.2.2 Measure 166. Use Regulating Outlets for Temperature Management

Description:

Due to the strong stratification that most of the valley lakes experience during the spring, summer, and fall (before lake turnover), there is an opportunity at some projects to release relatively cool water from the regulating outlets (below the power intakes). This cooler water (compared to releases through the turbines) can provide a benefit for chinook egg incubation downstream. Projects that include various usable outlet inverts include Detroit, Green Peter, and Lookout Point Dams. Actual mix between outlets depends on desired temperature targets.

Purpose: Provide more normative temperatures downstream of the project during fall/winter.

Intended Benefit: Increase fish survival

Operational or Structural Measure: Operational

Location: Detroit, Green Peter, Lookout Point

Table 2.2.2a. Detailed Information for Measure 166 at Detroit, Green Peter, and Lookout Point Dams.

Category	Detroit	Green Peter	Lookout Point
Description of work	Allocate up to 60% of total outflow to ROs during fall when pool is less than 200 ft above each set of ROs (upper/lower).	Use ROs during fall to meet cooler temperature target.	Use ROs during fall to meet cooler temperature target.
Duration (hours/days)	45 days	45 days	45 days

Category	Detroit	Green Peter	Lookout Point
Est. Start Date	1 October	1 October	1 October
Est. End Date	15 November	15 November	15 November
Recurrence Interval (X years)	Annually	Annually	Annually
Max pool elevation (ft, proj datum)	200 ft max head restriction	-	900
Outlet Invert Elevation (RO/spillway/etc.)	1335 (2) & 1260 (2)	745	724
Min flow (cfs)	60% of total outflow to ROs during this timeframe except when combined with measure 40, where a 50/50 split between upper and lower RO will attempt to optimize fish passage (upper RO) and temperature management (lower RO).	60% of total outflow to ROs during this timeframe except when combined with measure 40, where fish passage is prioritized.	60% of total outflow to ROs during this timeframe except when combined with measure 40, where fish passage is prioritized.
Max flow (cfs)	4960 cfs	4420 cfs	13,000 cfs (all ROs full open at max con pool)
Additional Information	Current head restriction on ROs is 200 feet maximum. This measure would assume that this limitation would still exist.	Current head restrictions on ROs are assumed for this measure.	There are no current head restrictions on ROs in the WCM.
Note	This temperature operation is included in NAA. Limited to a maximum of 200 ft head pressure on RO gates.	Limited benefit at Green Peter due to RO’s (745 ft elevation) close proximity to the turbines (795 ft elevation).	Limited benefit due to RO’s (724 ft elevation) close proximity to the turbines (780 ft elevation).

2.2.3 Measure 479. Foster Dam Fish Ladder Temperature Improvement

Description:

This measure would provide more normative temperatures at the existing Foster Dam adult fish facility. Upstream fish migration at Foster Dam has been observed to be delayed and consensus among regional fisheries managers is that the temperature of the water in the fish ladder is too cold to attract fish in the spring and early summer (May and June).

Under this measure, a structural modification to Foster Dam would be implemented to reduce delay of upstream-migrating spring Chinook salmon and winter steelhead by increasing the water temperature in the fish ladder. During the later spring and summer months, the Foster forebay is stratified in terms of temperature. The existing water supply for the fish ladder is located at the powerhouse intakes, below the thermocline, and as a result the temperature of the flow issuing from the pre-sort pool at the top of the fish ladder and from the ladder entrances is too cold compared to the historic or ambient river temperatures.

The major feature of this measure is construction of a new Forebay Warm Water Supply (FWWS) pipe that would draw warm water from above the thermocline in the Foster forebay. The existing water supply pipe would remain in use and a network of pipes and valves would allow the two water sources to be mixed to achieve desired temperatures at the side fish ladder entrance, AWS sump, pre-sort pool and truck fill location. The temperature targets were developed as a function of the upstream South Santiam River, with maximum target temperatures constrained by needs for fish health. A juvenile fish exclusion screen would be provided upstream of the FWWS intake to keep juvenile fish from entering the FWWS pipe. Figure 2-1 provides a piping schematic and identifies the four temperature target locations.

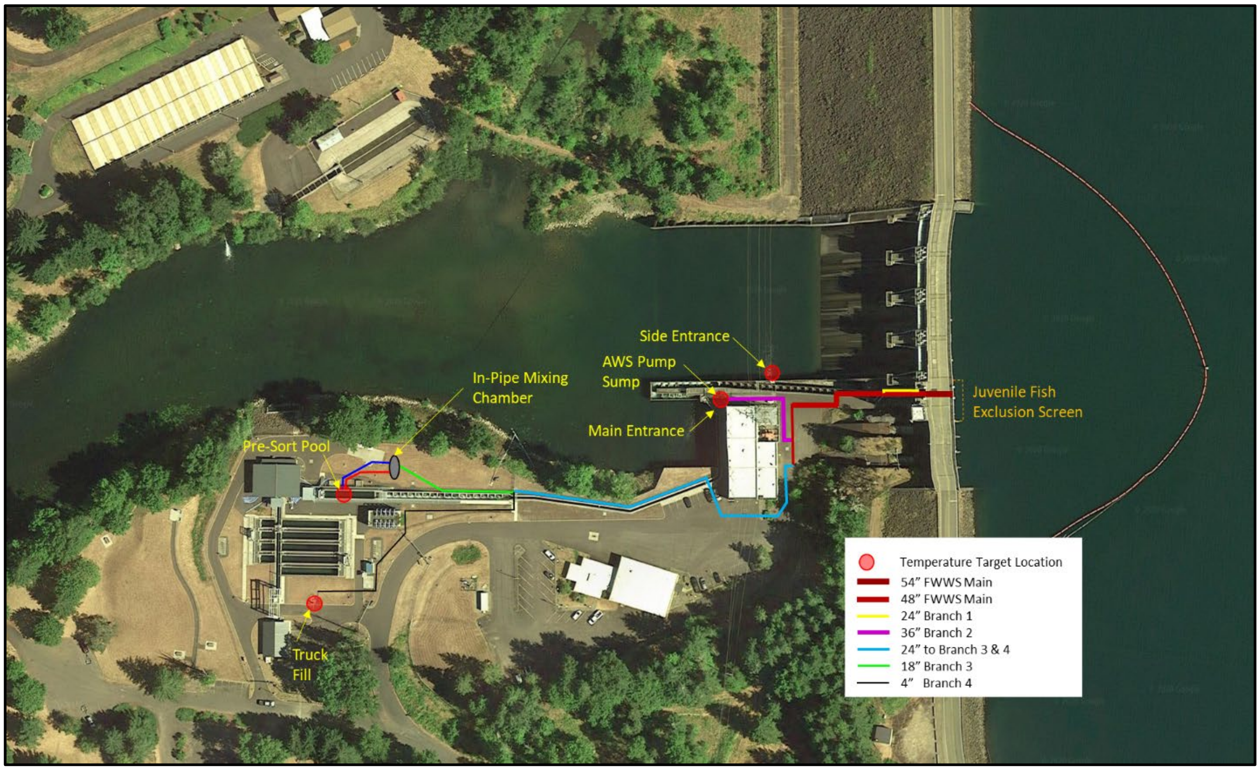

Figure 2-1. FWWS Piping Schematic with Temperature Target Locations.

The construction approach, feasibility, and design of the structures for the Foster Temperature Improvement measure has been developed to a 60% Plans and Specifications phase and a record of the design is described in the Design Documentation Report (DDR). For the purposes of modeling and effects analysis, the design documented in the DDR would be used. Table 2-7 shows some of the assumptions used for this measure.

Purpose: Provide more normative temperatures in the fish ladder and attract upstream migrant fish in a timelier manner during the spring

Intended Benefit: Decrease the time it takes for fish to pass the project, as well as reduce the straying of hatchery fish and the percentage of hatchery origin spawners in the wild.

Operational or Structural Measure: Structural

Location: Foster Dam

Table 2-7. Assumptions Used for the Structural Temperature Improvement at Foster Dam.

Category	Description
Description of work	Implement structural modifications to improve ladder water temperature at Foster Dam
Estimated Annual Start Date (day/month)	The FWWS will operate from about 01 May through 30 September, when the reservoir is at (or approaching) its maximum conservation pool[2].
Duration (hours/days)	The FWWS would operate 24/7.
Pool elevation (feet)	El. 638.2 to El. 644.6 (NAVD 88)
Recurrence Interval (years)	Annually
Maximum FWWS Flow (cfs)	144 cfs

2.2.4 Measure 721. Use Spillway to Release Warm Surface Water in Summer

Description:

Use the spillway when available in the spring and summer to improve downstream water temperatures from spring through autumn. By extending the use of the spillway, a larger volume of warm surface water from the reservoir can be released and cold deep water can be reserved for later in the fall/early winter when necessary for fish incubation. In the fall, the deeper regulating outlets (ROs) can release a limited amount of cooler water at Detroit, Green Peter, Lookout Point Dams.

- DET: Use spillway (Spillway Crest (1541 ft) as soon as available in spring to provide attraction temperatures for upstream migrant adult Chinook salmon. 60% of total outflow during specified period except, where applied and combined with measure 714. In this case, the downstream temperature target will determine the ratio of discharge between the spillway and turbines.
- GPR: Use spillway (Spillway Crest (969 ft) as soon as available in May to provide attraction temperatures for upstream migrant adult Chinook salmon. Use ROs in the fall to reduce temperatures for egg incubation downstream of FOS. 60% of total outflow during specified period except, where applied and combined with measure 714. In this case, the downstream temperature target will determine the ratio of discharge between the spillway and turbines.
- FOS: Night-time spillway (Spillway Crest (597 ft) operation during the spring followed by fish weir operation May-July. At the time the alternatives were analyzed, this measure had been implemented under the NAA at Foster.

[2] FWWS operation requires a forebay elevation at or above El. 638.2 feet (NAVD 88). The forebay reaches El. 638.2 on 01 May assuming standard refill in accordance with the Water Control Diagram. Changes in refill timing would affect the start date for FWWS operation.

- BLU: Use spillway (Spillway Crest (1321 ft) as soon as available in spring to provide attraction temperatures for upstream migrant adult Chinook salmon. Structural modifications would be required to safely implement this measure at Blue River Dam because the spillway was not designed for frequent use; it was designed to occasionally pass fill due to flooding events. Site-specific design and environmental compliance documentation (as described in Chapter 7) would be prepared for necessary modifications at Blue River Dam.
- LOP: Use spillway (Spillway Crest (888 ft) as soon as available in spring to provide attraction temperatures for upstream migrant adult Chinook salmon. 60% of total outflow during specified period except, where applied and combined with measure 714. In this case, the downstream temperature target will determine the discharge ratio of discharge between the spillway and turbines.
- HCR: Use spillway (Spillway Crest (1495 ft) as soon as available in spring to provide attraction temperatures for upstream migrant adult Chinook salmon. The downstream temperature target will determine the discharge ratio of discharge between the spillway and turbines. Structural modifications would be required to safely implement this measure at Hills Creek Dam because the spillway was not designed for frequent use; it was designed to occasionally pass fill due to flooding events. Site-specific design and environmental compliance documentation (as described in Chapter 7) would be prepared for necessary modifications at Hills Creek Dam.

Purpose: Restore normative temperatures to extent possible using existing outlets.

Intended Benefit: Increase fish survival.

Operational or Structural Measure: Operational

Location: Detroit, Green Peter, Foster, Blue River, Lookout Point, Hills Creek

2.3 WATER QUALITY MEASURES – TOTAL DISSOLVED GAS (TDG)

2.3.1 Measure 174. Structural Improvements to Reduce Total Dissolved Gas

Description:

Structural modifications to reduce TDG could include spillway deflectors, similar to those installed at Columbia River USACE-managed dams, may provide a permanent fix to TDG problems at Willamette Valley System dams. These deflectors redirect the flow from the spillway from a plunging flow that transports air bubbles deep into the stilling basin to a horizontal jet that maintains entrained air much closer to the water surface. Structural modifications could also focus on redesign of current outlets, spillways or stilling basins. Methods to reduce TDG could include, but are not limited to:

- Boulder augmentation or debris jams that create more natural riffles downstream and degas supersaturated water. Little is known regarding the design and construction of riffles and debris jams and how effective these man-made structures may be for TDG abatement below WVS dams.
- Distribute spillway flows uniformly across the entire spillway to reduce downstream TDG.
- Construct pipe extensions on the downstream side of regulating outlets to submerge releases in the stilling basin and reduce jet impact on the tailwater surface.

Purpose: Minimize TDG below projects

Intended Benefit: Increase fish survival

Operational or Structural Measure: Structural

Location: Detroit, Big Cliff, Green Peter, Foster, Hills Creek, Lookout Point, and Dexter dams.

2.4 DOWNSTREAM FISH PASSAGE MEASURES

2.4.1 Measure 40. Deeper Fall Reservoir Drawdown for Downstream Fish Passage

Description: This measure involves drawing down reservoirs in the fall to within 25 feet over the regulating outlets (RO) (and 25 feet over the Cougar diversion tunnel (DT)) for downstream passage.

Purpose: Decrease reservoir elevation in fall to improve downstream fish passage rate and survival at WVS dams, annually.

Intended Benefit: Decreasing reservoir elevations to near regulating outlets will increase the number of juvenile **s**pring Chinook salmon and juvenile winter steelhead passing and their survival rate. Juvenile salmonids are known to pass if a surface route is available, particularly in spring and fall. Fish passage survival has been demonstrated to increase as reservoir elevation is decreased over the outlet.

Operational or Structural Measure: Operational. Modifications of existing facilities for use of an outlet for safe fish passage may be required. Specific modifications would be determined during the design phase if the action is implemented as part of the final EIS/ROD. The operation to the DT at Cougar would require the construction of a tower at the DT and connecting bridge to facilitate access for required outlet maintenance.

Location: Detroit, Green Peter, Cougar, Blue River, Lookout Point, Hills Creek

Table 2.4.1a. Details for Fall Reservoir Drawdown Operation for Fish Passage.

Category	Response
Description of work	Use ROs (DT at Cougar under 3B) to pass fish in fall. Limit turbine operations to reduce fish passing via penstocks.
Duration (hours/days)	24 hours a day for 3 weeks
Estimated Start Date	1. Drafting of each reservoir will begin July 1, annually at a rate to achieve the Oct 1 rule curve elevation on Sept 1. (See #1 on Figure 2-2). 2. During the spawning season (Sept 1 to Oct 15), the total discharge from the dam will be maintained at or below the maximum flows for spawning (Table 2-8)(See #2 on Figure 2-2). 3. After the spawning season ends Oct 15, the draft rate will then be revised as needed to achieve the Nov 15 target elevation (Table 2-9) (See #3 on Figure 2-2). 4. Figure 2-2Pool target elevations (Table 2-9) will be achieved beginning at the earliest Nov 15, and the latest Dec 15. (See #4 on Figure 2-2).
Estimated End Date	Maintain target elevation as feasible for 3 weeks, but no later than Dec 15. Then refill to minimum conservation pool as feasible.
Recurrence Interval	Annually
Max pool elevation (ft, proj datum)	Target elevations for each dam are included in Table 2-8 below. Twenty-five feet over the top of the RO was chosen to avoid cavitation.

Category	Response
Outlet (RO/spillway/etc.)	Limit turbine operations to between the hours of 1000 to 1800 whenever the reservoir elevation is at or below 50 ft over the top of the penstock and also between Oct 1 and December 15.
Estimated start of outlet restriction	When reservoir elevation is within 50 ft of penstock
Duration of outlet restriction (days)	21 days starting as early as November 15, or until December 15, whichever comes first
Max flow (cfs)	When combined with M479 at Detroit, assume 50/50 split between upper and lower RO to optimize fish passage (upper RO) and temperature management (lower RO). Where conflicts may occur, fish passage optional objectives of Measure 40 should be prioritized over operations for water temperatures.

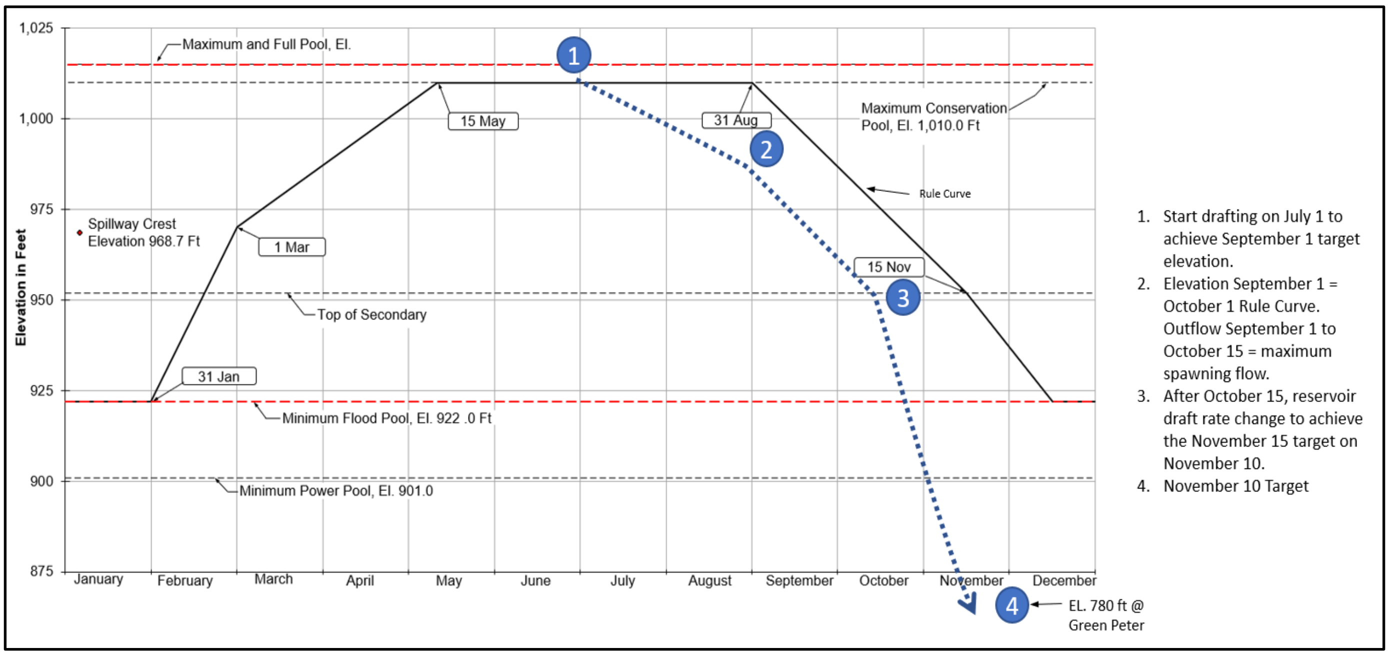

Figure 2-2. Reservoir drafting approach to achieve target elevation by Nov 15. This example shows the Green Peter rule curve.

Table 2-8. Maximum outflows to be achieved during the Chinook salmon spawning season, September 1 to October 15, annually. Flows based on average weighted usable area (WUA) values across study reaches for flows achieving 75% of the spawning habitat below these dams as reported by R2 Resources (2013) and RDG (2016), as averaged across study reaches.

Chinook Salmon Spawning	NS (Big Cliff)[a]	SS (Foster)[a]	S Fk. MK (Cougar)[b]	MF (Dexter)[c]
Recommended Max Spawning Q (75% WUA Q; cfs)	2175	2825	880	3500
For reference: 100% WUA Q (cfs)	1300	1500	500	1900
For reference: 2008 Biological Opinion max spawning season flows (cfs)	3000	3000	580	3500

a. Recommended max Q = Average of reaches 1 and 2 from R2 2013.
b. Recommended max Q = Average of mainstem S. Fork transects 1,2,3,7 from RDG 2016.
c. Recommended max Q = Average of Mainstem transects 1,2,3,10 from RDG 2016.

Table 2-9. Drawdown reservoir target elevations. Target elevations = invert elevation + height of outlet + 25 ft over the top of the ROs and Cougar Dam diversion tunnel.

Dam	Target Elevation (feet) (25 feet above top of the outlet)[1]
Detroit *	1,370
Green Peter	780
Lookout Point	761
Hills Creek	1,446
Blue River	1,165
Cougar RO	1,516
Cougar DT	1,330

* Detroit target elevation was calculated based on an invert elevation of 1340', which is the RO centerline elevation, not the invert. This error was caught after modeling was complete. USACE determined this difference in elevation would not affect model results.

Table 2-10. Elevations and Outlet Statistics.

Elevations in NGVD 29	HCR	LOP	CGR	BLU	GPR	DET
Minimum Conservation Pool Elevation	1448	825	1532	1180	922	1450
Minimum Power Pool	1414	819	1480	–	887	1425
Number of Regulating Outlets	2	4	2	2	2	4
Size of RO	6’6”x12’6”	6'9"x12'	6'6"x12'6"	4'9"x8'	5'6"x10'	5'8"x10'
RO invert (bottom) elevation (ft)	1,409	724	1,479	1,132	745	2@ 1,335 2@ 1,260
Top of penstock	1396	790	1430	N/A	817	1419
50 ft above top of penstock	1446	840	1480	N/A	867	1469
100 ft above top of penstock	1496	890	1530	N/A	917	1519

Table 2-11. Flows achieving 100% WUA habitat area for the Chinook salmon spawning life stage (R2 2013 and RDG 2016).

Reach	NS	SS	S FK MK	MF
1	1286	1140	614	2918
2	900	2400	283	1600
3	1700	920	519	1025
4	1250	–	–	–
Mean	1284	1487	472	1848

2.4.2 Measure 714. Pass Water Over Spillway in Spring for Downstream Fish Passage

Description: This measure involves passing water over the spillway in spring and early summer for downstream fish passage.

Purpose: Increase the number and the survival of juvenile salmon and steelhead passing downstream of WVS dams.

Intended Benefit: Spring Chinook salmon, winter steelhead. Increase the number and the survival of juvenile salmon and steelhead passing downstream of WVS dams in the spring.

Operational or Structural Measure: Operational. Some locations may require structural improvements to implement the operation.

Location: Detroit, Big Cliff, Green Peter, Cougar, Blue River, Lookout Point, Dexter, Hills Creek

Table 2.4.2a. Measure 714 Category and Response.

Category	Response
Description of work	Use spillway to pass fish in spring
Duration (hours/days)	24 hours a day for 60 days
Estimated Start Date (day/month)	May 1 (or as soon as pool elevation allows)
Estimated End Date (day/month)	July 1 (or as hydrology supports)
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	<= 25 ft above spillway crest
Outlet (RO/spillway/etc.)	Spillway. No turbine operations at Foster Dam during 0600 to 1000, and 1800 to 2200 from April 15 to July 1. Operations of turbines at other dams should be secondary to spillway operations.
Estimated start of outlet restriction (day/month)	NA
Duration of outlet restriction (days)	NA
Max flow (cfs)	For all projects where applied and when combined with measure 721, the downstream temperature target will determine the discharge ratio of discharge between the spillway and turbines.
Additional Information	This should be paired with an outplanting measure above Green Peter. There are currently no spring Chinook salmon or winter steelhead above project. Increases chance of not refilling

2.4.3 Measure 720. Deep Spring Reservoir Drawdown for Downstream Fish Passage

Description:

This measure involves drawing down reservoirs in the spring to within 25 feet over the top of the RO (and Cougar DT) for downstream juvenile fish passage. The reservoirs would be held at this elevation for six weeks (three weeks at GPR). Drawdown reservoir target elevation is 25 feet over the top of the RO (target elevation = RO invert elevation + RO height + 25 feet). For alternatives using the CGR diversion tunnel, target elevation will be 25 feet over the top of the diversion tunnel.

Purpose: Increase the number and the survival of juvenile salmon and steelhead passing downstream of WVS dams.

Intended Benefit: Increase the number and the survival of juvenile salmon passing downstream of WVS dams in the spring.

Operation or Structural Measure: Operational. Note, measure assumes modifications of existing facilities for use of an outlet for safe fish passage. Specific modifications would be determined during the design phase if the action is implemented as part of the final EIS/ROD. The operation to the DT at Cougar would require the construction of a tower at the DT and connecting bridge to facilitate access for required outlet maintenance.

Location: Detroit, Green Peter, Cougar, Blue River, Lookout Point, Hills Creek

Table 2.4.3a. Measure 720 Category and Response.

Category	Response
Description of work	Use low elevation outlets to pass fish in spring by delaying refill of reservoirs. Beginning February 1 draft reservoir as needed to the target elevation by May 1 and holding elevation until June 15, except Green Peter. For Green Peter Dam, draft to the target elevation by May 1 and hold until May 21 (due to probability of refill if held at target elevation until June 15 based on initial Res-Sim modeling results). This measure would be prioritized over other operational measures for fish.
Duration (hours/days)	3-6 weeks, 24 hours a day
Estimated Start Date	1) Hold reservoir elevation at minimum conservation pool elevation from Feb 1 until Mar 1. 2) Draft reservoir between Mar 1 to May 1 to get to target elevations noted in table below as 25’ above outlets. 3) Hold at target elevations until the end date of June 15 (except at Green Peter until May 21).
Estimated End Date	Green Peter May 21, all other locations June 15

Category	Response
Recurrence Interval	Annually
Max pool elevation (ft, proj datum)	Target elevation: 25 ft over the top of the upper ROs and 25 ft over the Cougar diversion tunnel
Outlet (RO/spillway/etc.)	Limit turbine operations to between the hours of 1000 to 1800 between March 1 and June 15 (May 21 for Green Peter) and whenever the reservoir elevation is at or below 50 ft over the top of the penstock.
Estimated start of outlet restriction (day/month)	March 1 to June 15 (or May 21 for Green Peter).
Duration of outlet restriction (days)	Approx. 14 weeks; Green Peter approx. 10 weeks
Max flow (cfs)	NA
Additional Information	None

Table 2-12. Drawdown Reservoir Target Elevations.

Dam	Target Elevation (feet) (25 feet above top of the outlet)[1]	Duration Held at this Elevation (weeks)
Detroit	1,370	6
Green Peter	780	3
Lookout Point	761	6
Hills Creek	1,446	6
Cougar RO	1,516	6
Cougar DT	1,330	6

2.4.4 Measure 392. Construct Structural Downstream Fish Passage

Description: Provide downstream fish passage using a Floating Screen Structure (FSS) (gravity fed flow which may include pumps for supplementing flow) or a Floating Surface Collector (FSC) (pumped flow only). Feasibility, design, cost, and specific biological benefit of the structure will be determined during a future construction design phase. Assumes attributes of existing FSS designs (as described in the DDRs for DET FSS and CGR FSS). Where a FSS is included, design assumes a temperature tower to accommodate reservoir fluctuation and gravity fed outflow (as described in the DDR for DET) and for mooring of the FSS. Pumps are assumed at GPR FSS for this measure to supplement inflows for fish attraction. Where an FSC is included as the structural solution, a pumped flow of 1000 cfs is assumed. Flows for FSS are described below.

Purpose: Provide downstream fish passage at various reservoir elevations.

Intended Benefit: Improved fish passage during normal operating reservoir levels.

Operational or Structural: Structural

Location: Detroit, Green Peter, Cougar, Lookout Point, Hills Creek

Table 2.4.4a. Measure 392 Category and Response/Assumptions.

Category	Response/Assumptions
Description of work	Implement structural downstream fish passage at dams identified in each EIS alternative
Duration (hours/days)	For FSS, prioritize turbine ops at nighttime hours (dusk to dawn). Should minimize power peaking (i.e., variable flows) to the extent possible during this time and adaptive management will be used to inform how to operate for power peaking and collection efficiency.
Estimated Start Date (day/month)	NA
Estimated End Date (day/month)	NA
Recurrence Interval (X years)	NA
Max pool elevation (ft, proj datum)	The FSS routes water to the turbines. The FSS operates within the normal turbine elevation range at each project. The FSS can operate down to 5 feet below min con before it would need to be deballasted (inoperable)
Estimated start (day/month) of targeted elevation	NA
Duration at target elevation (days)	NA
Restricted Outlet (RO/spillway/etc.)	NA
Estimated. start (day/month)	NA
Duration (days) of outlet restriction	NA
Min, Max flow (cfs)	See Table 2-15
Additional Information	Structural design would need to accommodate predicted pool fluctuations under the proposed alternative. Measure 105 for a temperature tower at all locations where an FSS is indicated is assumed.

Minimum and maximum flows through the FSS for DET and CGR were based on design flow ranges as documented in their respective Design Documentation Reports (DDRs). The FSS inflow operating range for Hills Creek Dam was assumed from the Cougar Dam FSS design, given the similarity in dam configuration and turbine capacity. Total FSS inflow capacity for GPR and LOP were determined by scaling based on the DET design flow. This was accomplished by dividing the DET total design flow by the DET turbine capacity, and then multiplying the result with the total turbine capacity flows at GPR and LOP. Due to the frequency at which flows can be less than 1000 cfs from GPR Dam, it was assumed that pumped flow would be used to supplement the FSS inflows up to 1000 cfs for the minimum FSS operating range at GPR.

Table 2-13. Detroit FSS Scaler for Design Flow/Turbine Capacity.

Dam	Max total turbine capacity at min con (cfs)	FSS V-screen design flow (cfs)	Scaler (design flow / turbine capacity)
DET	4960	4600 (double barrel)	0.927

Table 2-14. FSS Inflow Operating Range.

Dam	Max total turbine capacity at min con	Det FSS Scaler	Estimated total V-screen design flow based on scaler	Total V-screen design flow assumed for EIS	Notes
LOP	8100	.927	7509	6000	Adjusted down design flow, based on Kock et al. 2019 model of FSC fish guidance efficiency indicating efficiency would be high assuming a double V-screen design of 6000 cfs.
GPR	4420	.927	4097	4000	

Table 2-15. Minimum and Maximum Flows (cfs) through each FSS by Project.

Dam	Minimum FSS flow (cfs)	Maximum FSS flow (cfs)	Notes
Detroit FSS[1]	1050 (equivalent to cavitation limit for BC)	5600	Per Detroit DDR
Cougar FSS[2]	300	1000	Per Cougar DDR
Green Peter FSS	50 cfs supplemented to 1000 cfs with recirculating pumped flow from forebay	4000	Based on Det FSS scaler * GPR turbine capacity (See table above)
Lookout Point FSS	1350 (equivalent to cavitation limit for DEX)	6000	Based on Det FSS scaler * LOP turbine capacity, adjusted based on Kock et al. FSC model (see table above)
Hills Creek FSS	300	1000	Assumed from CGR DDR

1. Detroit FSS: There are two entrances in the FSS, capable of handling flow ranges from 1,000 cfs to 5,600 cfs. The design flow rate for fish collection operations is 4,500 cfs, with each channel operating at a flow of 2,250 cfs. Future provisions for pumped attraction flow will accommodate 1,000 cfs to drive flow through the FSS and continue attracting and collecting fish from the forebay. (Final DDR.)
2. Cougar FSS: There are two entrances on the Dual Entrance Angled FSS, with the starboard collection channel sized to pass 400 cubic feet per second (cfs) and the port collection channel sized to pass 600 cfs. Including two entrances instead of only one allows for better control of hydraulic conditions over the full range of design flows (300 to 1,000 cfs). (per 90% DDR.)

Table 2-16. FSS Single Barrel Operating Ranges.

Dam	Single barrel operating range (cfs)	Notes
DET FSS	1000 to 2250	Per Detroit DDR
GPR FSS	1000 to 1950	Scaled Max. FSS flow based on single/total FSS flow for DET = 2250/4600 = 0.49
LOP FSS	1000 to 2950	Scaled Max. FSS flow based on single/total FSS flow for DET = 2250/4600 = 0.49
CGR FSS	300 to 400	Per Cougar DDR
HCR FSS	300 to 400	Assumed from CGR DDR

For Alt 1, the FSS would be assumed to be operated consistent with the water storage theme. Therefore, it was assumed the FSS would be operated at the design flow for a single V-screen at night (12 hours) during the primary periods fish are available to pass downstream, otherwise at a min flow as designed for DET FSS of 1000 cfs. Juvenile Chinook salmon and steelhead are primarily available to pass from WVS reservoir forebays between May 1 and June 30, and September 15 to December 15, based on Alden, and studies summarized by USGS 2017. USACE used the most common Res-Sim outflows between April 1-July 1, and September 1-December 1 to approximate the flows at which the collector would be most likely to operate.

Due to the priority on storage in Alterative 1, the typical outflows during the fish passage season were most often around the minimum operating range of the collector. Therefore, USACE assumed the FSS would be operating with one barrel most of the time for most projects.

Modeling dam passage survival in the Fish Benefits Workbook requires estimates of dam passage efficiency (DPE). To estimate DPE, the regression model published by Kock et al. (2019) was applied, which requires estimates of the effective forebay area, FSS entrance size, and FSS flow.

From Koch 2019: "The effective forebay area (EFA) is defined as the area of the forebay that downstream migrants can access between the dam and the 500-m mark located upstream of each collector entrance (Figure 2)." Google Earth was used to estimate the EFA by drawing a 500m line from the area of the dam where a collector would likely sit, then roughly sketched in an area by drawing roughly straight line from the point 500m from the dam outlet. The estimate for effective area at Cougar may be high due to effects of the cul-de-sac. The effect of forebay size, however, was less influential than inflow through the collector.

Table 2-17. Effective Forebay Areas where each FSS is to be Operated.

Reservoir/Dam	Effective forebay area (Ha)
Detroit	24.2
Green Peter	20.9
Foster	47.9
Cougar	27.6
Blue River	28
Lookout Point	35.4
Hills Creek	55.4

Entrance size for a conceptual FSS at Hills Creek Dam was assumed from the Cougar Dam FSS design given the similarity in dam configuration and turbine capacity. The entrance size from the Cougar FSS, based on the 90% DDR, is 57 ft wide by 34 ft tall, or 1938 sq ft.

The FSS entrance sizes for GPR and LOP were determined by scaling the design based on the relationship of the DET FSS entrance area and DET FSS max flow from the DET DDR (0.317). This scaler was then applied to the estimated max FSS inflows for Lookout, Green Peter and Hills Creek dams to estimate an entrance size for FSS concepts at these dams.

Table 2-18. Detroit FSS Entrance Sizes Scaler.

Dam	Entrance area (total for 2 trash racks/barrels)	Max FSS inflow	Scaler
DET	1776 sq ft	5600	.317

Table 2-19. FSS Entrance Areas.

Dam	Maximum FSS flow (cfs)	Entrance area (sq ft)	Notes
DET FSS	5600	1776	From DET DDR
GPR FSS	4000	1268	Max FSS flow * 0.317
LOP FSS	6000	1902	Max FSS flow * 0.317
CGR FSS	1000	1938	From CGR DDR
HCR FSS	1000	1938	Based on CGR DDR

LOCATION: Foster

Current downstream passage conditions support a viable spring Chinook salmon or winter steelhead population above Foster Dam; however, improvements may be necessary for winter steelhead and spring Chinook salmon should current operations fail to maintain self-sustaining populations. To facilitate improved downstream passage, this measure would provide for a structural solution. Approach, feasibility, design, cost, and biological benefit of the structure will be determined during the construction design phase. The modified design would be consistent with a surface route structure. The design would utilize a flow rate of 500-800 cfs.

Table 2-20b. Details for Structural Passage at Foster.

Description of Work	Structural Passage at Foster
Duration (hours/days)	Fish structure operates 24/7, year-round at 600 cfs. No spillway operation for fish passage purposes or temperatures. (i.e., this replaces the NAA fish operations). ALT 1: No turbine operational constraints. ALT 4: Limit operating the turbine units to ½ day (i.e., same turbine limits as in the NAA).
Estimated Start Date (day/month)	Fish structure: Year-round Alt 4: Limit turbine operations: March 1 (spring start) May 1 (summer start)
Estimated End Date (day/month)	Alt 4: Limit turbine operations: April 30 (spring end) June 15 (summer end)
Recurrence Interval (X years)	Annually when the pool is within the operating elevation (winter at 615 MSL min and summer at 635 MSL max).
Max pool elevation (ft, proj datum)	615 MSL (min elevation) to 635 MSL (max elevation): Foster spillway
Estimated start (day/month) of targeted elevation	NA
Duration at target elevation (days)	NA
Restricted Outlet (RO/spillway/etc.)	Turbines restricted between 1900 and 0700 during fish passage seasons
Estimated start (day/month)	When within operating range
Duration (days) of outlet restriction	When within operating range
Max flow (cfs)	800 cfs

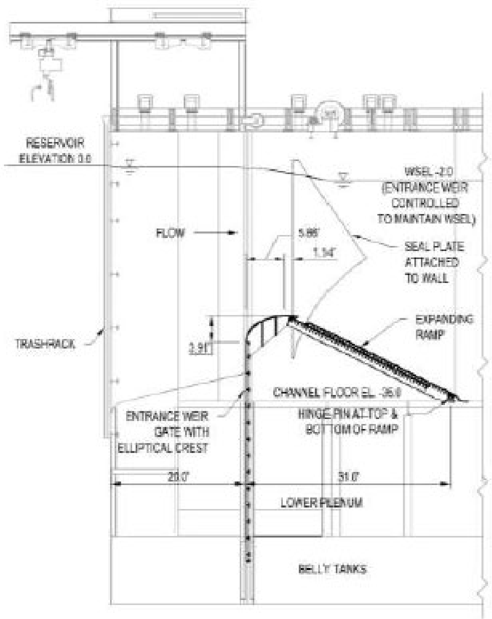

Figure 4-11. Section View of Entrance Weir with Elliptical Shaped Crest

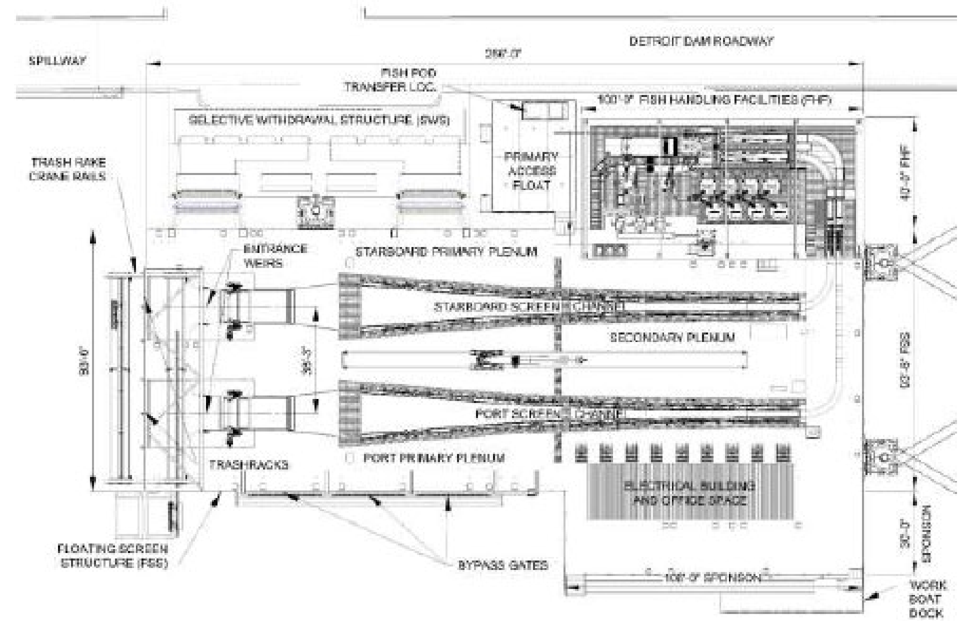

Figure 4-8. Plan View of the FSS and SWS

Figure 2-3. Section and Plan View of Detroit FSS (Figures from the Detroit FSS DDR).

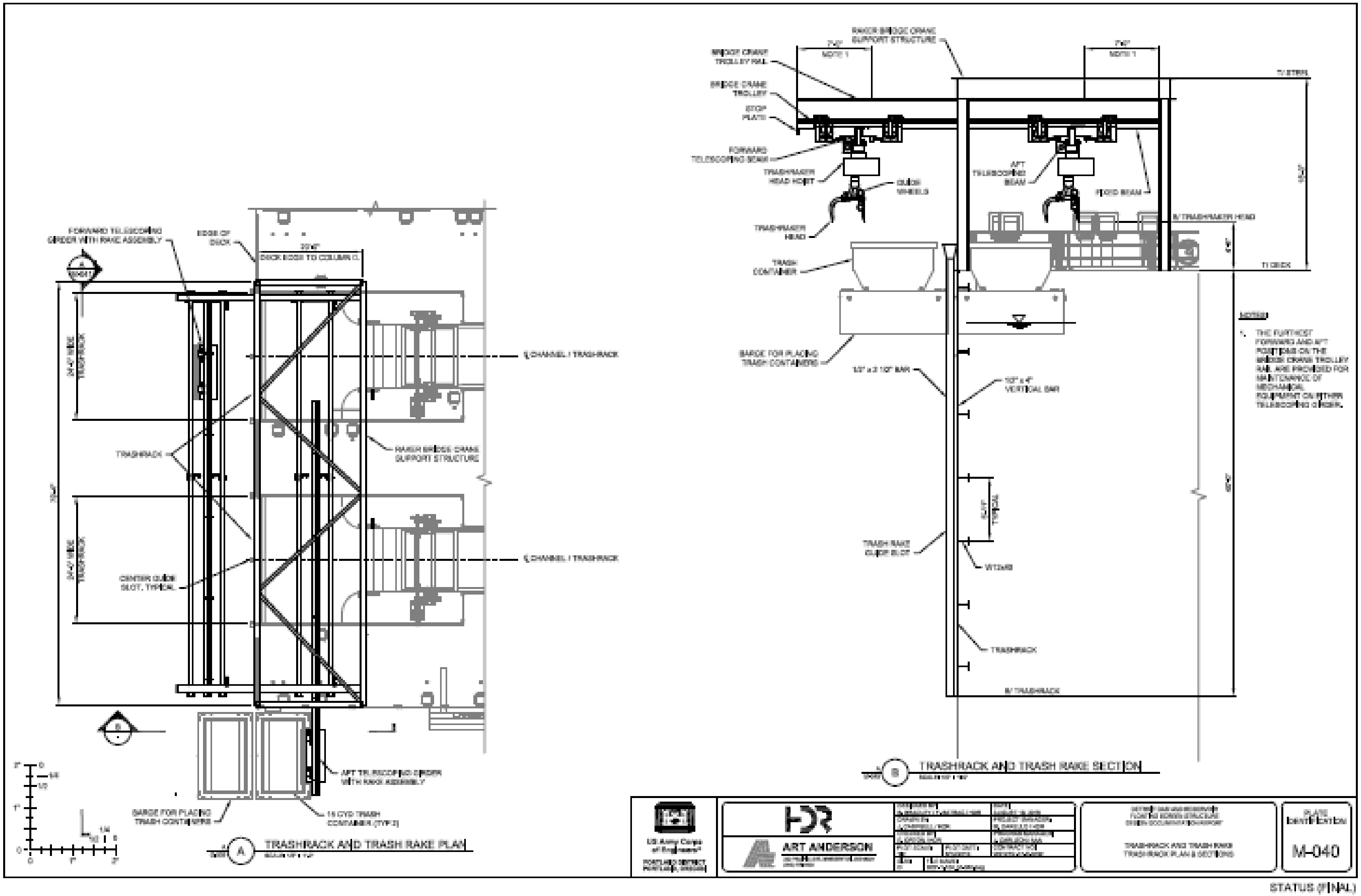

Figure 2-4. Plate M-040 from DET DDR Appendix A.

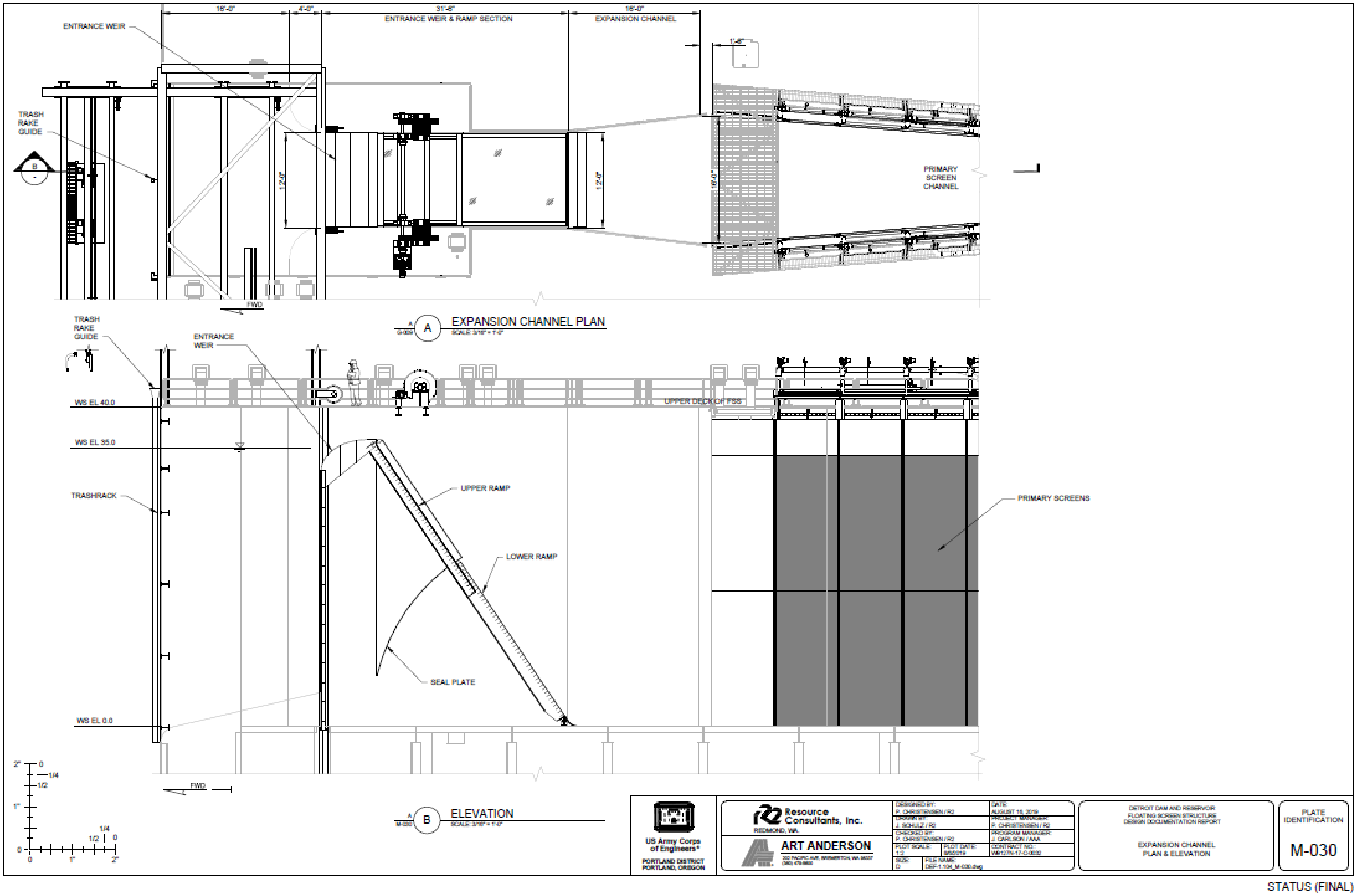

Figure 2-5. Plate M-030 from DET DDR Appendix A.

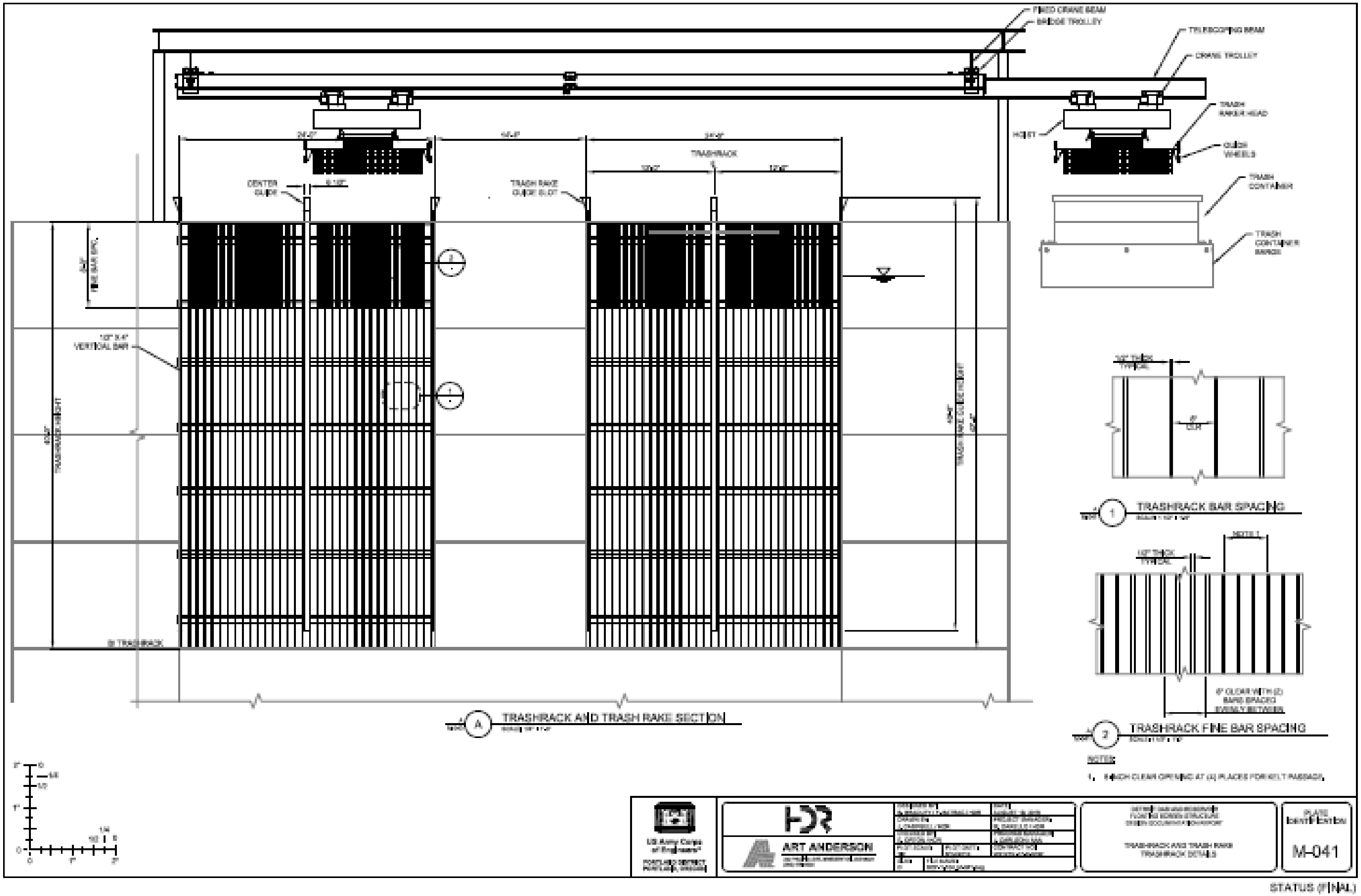

Figure 2-6. Plate M-041 from DET DDR Appendix A.

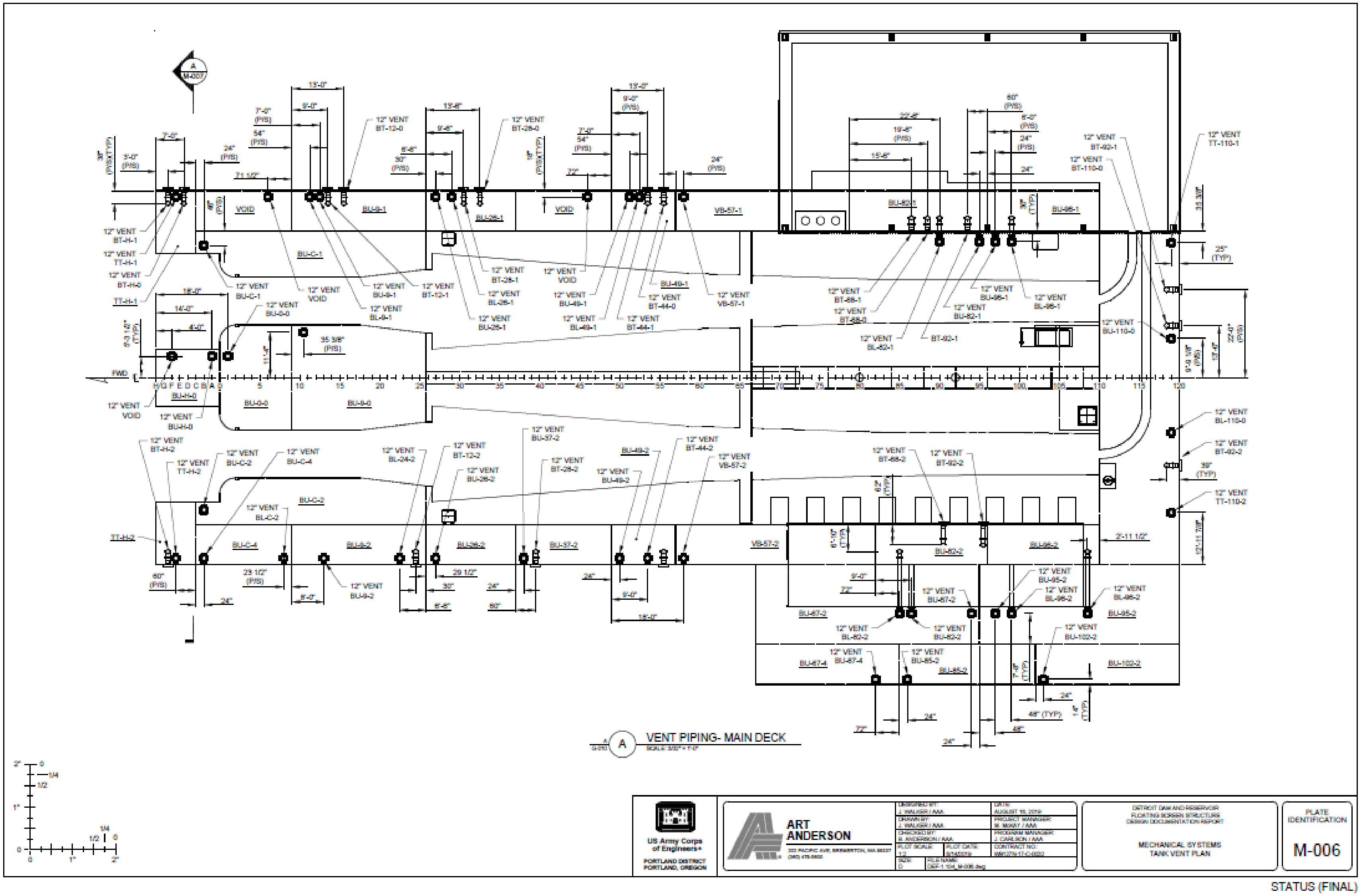

Figure 2-7. Plate M-006 from DET DDR Appendix A.

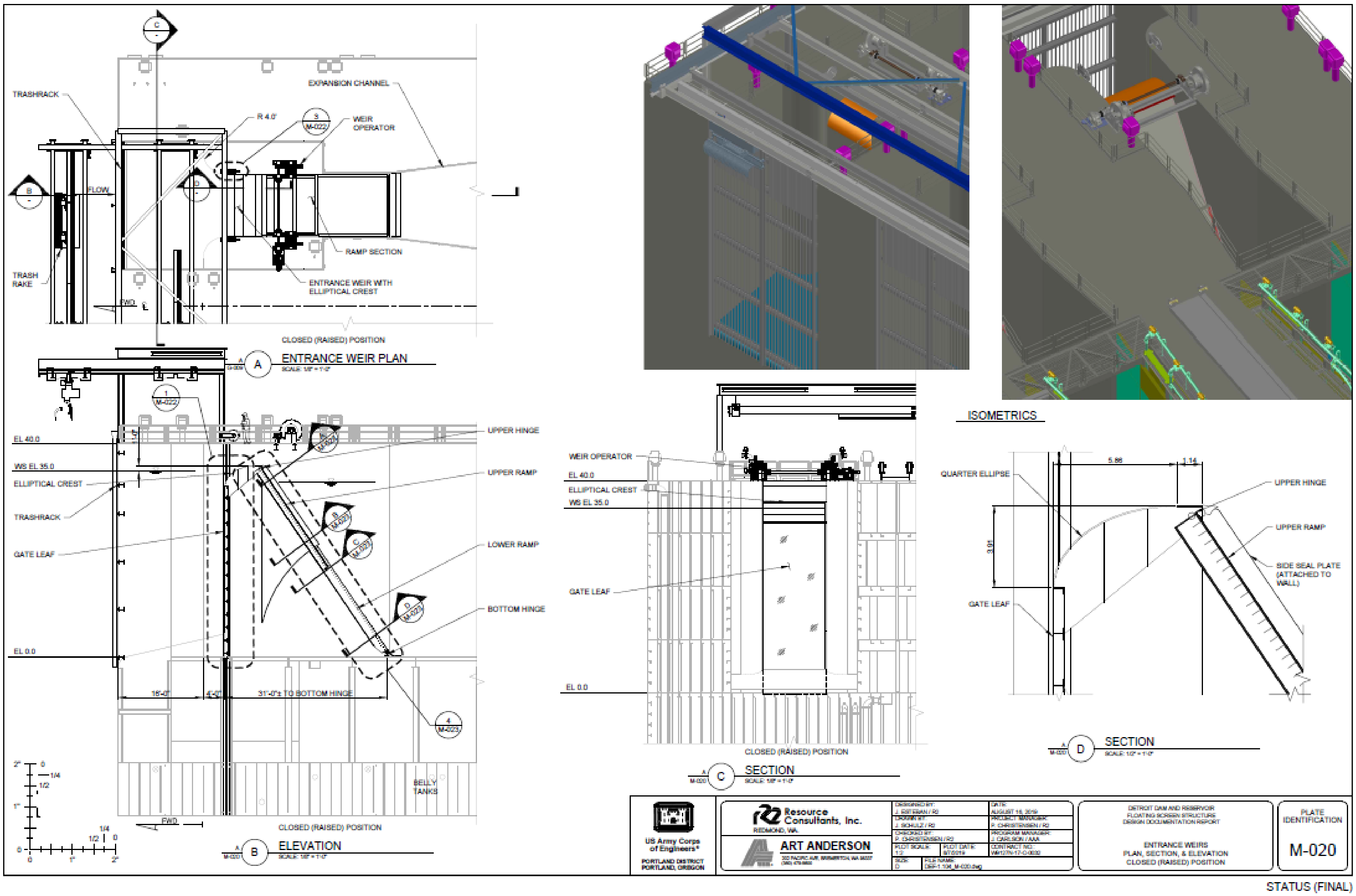

Figure 2-8. Plate M-020 from DET DDR Appendix A.

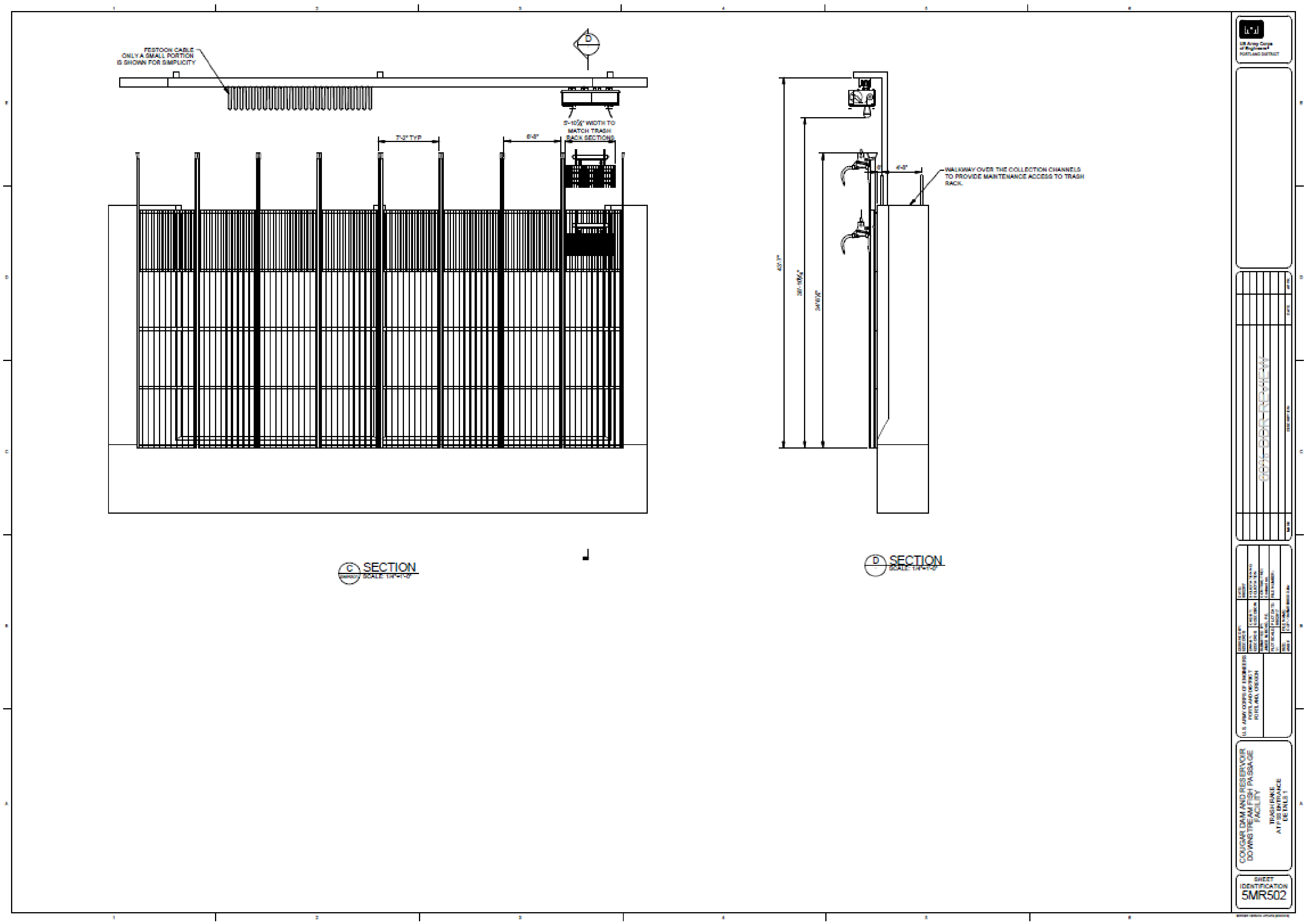

Figure 2-9. Sheet 5MR502 from CGR DDR 90% vol 5.

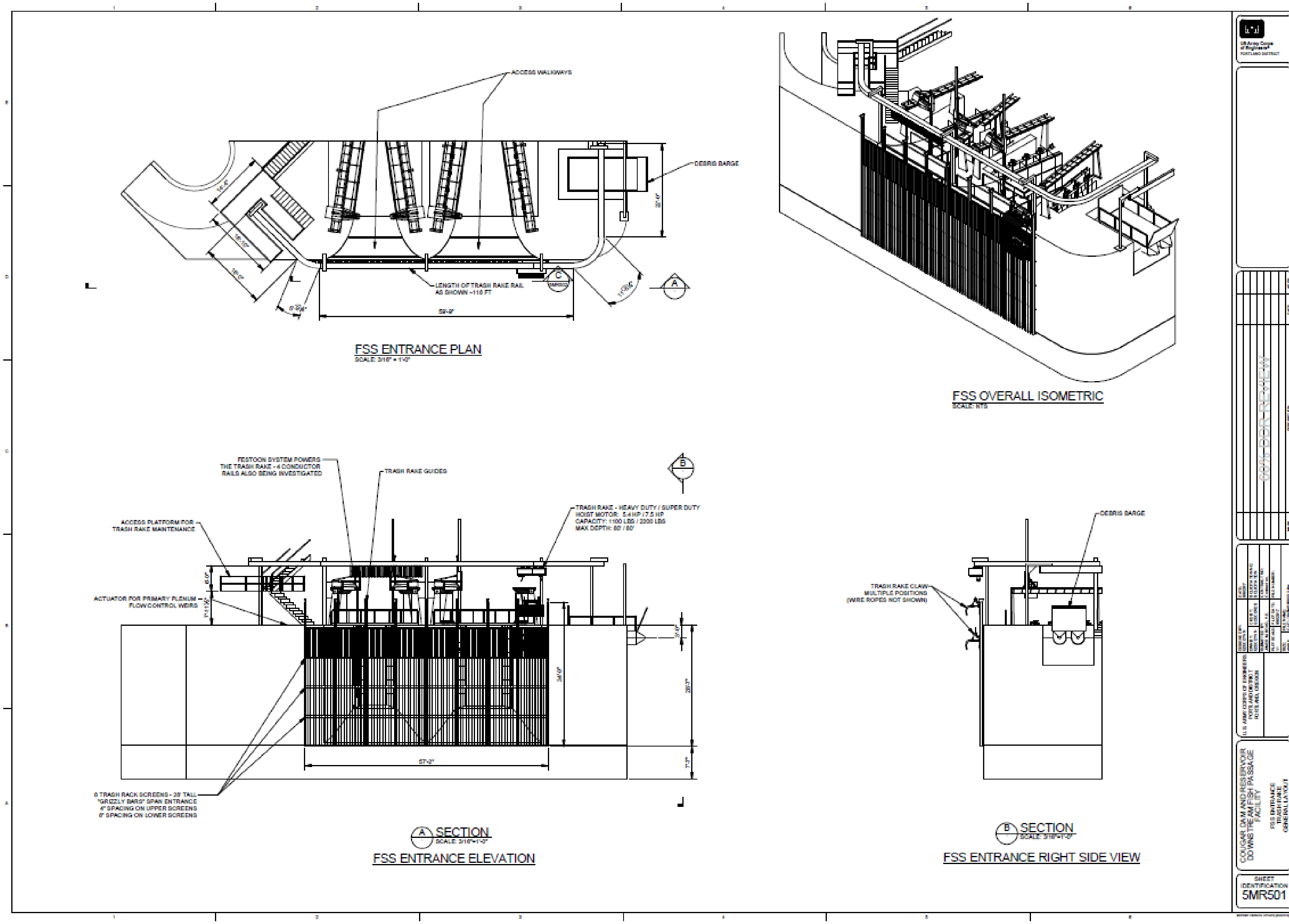

Figure 2-10. Sheet 5MR501 from CGR DDR 90% vol 5.

2.5 UPSTREAM FISH PASSAGE MEASURES

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

2.5.1 Measure 52. Provide Pacific Lamprey Passage Infrastructure

Description: Lamprey swim differently than salmon; passage facilities built for salmon present a difficult obstacle for this species. Square corners in the ladders are particularly difficult for lamprey. Lamprey will grab onto a vertical or horizontal surface then release, burst ahead, and grab on again in a near, up-ladder location. As they creep along in this way, they can lose their grip and be washed down the ladder.

Any new adult fish facilities under Measure 722, or facility modifications and upgrades for ESA-listed species, including at the drop structures under Measures 639, would include the following types of features and modifications to benefit lamprey:

- Rounded corners in turning pools
- Rounded side edges of the ladder opening
- Replacement of diffuser screens with lamprey-friendly screens
- Other nature-based features could be included in the design of ESA-listed adult fish facilities.

Site-specific design and environmental compliance documentation (as described in Chapter 7) for these features would be included in the design and environmental compliance documentation for the modifications or construction of ESA listed adult fish facilities.

Purpose: To assist Pacific lamprey with passage efficiencies.

Intended Benefit: To improve Pacific lamprey passage efficiencies.

Operational or Structural: Structural

Location: Green Peter, Blue River, Hills Creek Dams

END NEW TEXT

2.5.2 Measure 639. Restore Upstream and Downstream Passage at Drop Structures

Description: Fish passage modifications at the two Long Tom River drop structures may include, but are not limited to, notching, removal, or construction of an adjoining fish ladder or bypassing the drop structures via modified culverts and using the oxbow river features (formerly the native Long Rom River channel). Available habitat would be from the confluence of the Long Tom River and Willamette River to Fern Ridge Dam. The drop structures are the Monroe, Stroda, and Cox Butte drop structures. The approach, feasibility, design, and biological benefit of the structure would be determined during the construction design phase.

Purpose: Provide passage for fish, including juvenile Chinook salmon, to the mainstem Long Tom River and tributaries.

Intended Benefit: Restored access to available habitat between the drop structures and Fern Ridge Dam.

Operational or Structural: Structural

Location: Long Tom River, downstream of Fern Ridge Dam

2.5.3 Measure 722. Construct Adult Fish Facility

Description: Construct adult fish facilities below dams. Specifications for the facility will be determined during the engineering, design, and construction phases of implementation.

Purpose: Construct new AFFs to provide adult upstream passage above Willamette Valley System dams.

Intended Benefit: Provide access to spawning habitat upstream of USACE-managed dams.

Operational or Structural: Structural

Location: Green Peter, Blue River, Hills Creek Dams

Blue River: This measure would be paired with a downstream fish passage measure. There is currently no fish passage at Blue River Dam for ESA-listed UWR spring Chinook salmon. A passage program at Blue River may offer a unique opportunity to create additional biological benefit to the McKenzie River spring Chinook salmon population, in addition to improving passage at Cougar Dam in the McKenzie Sub-basin. The design for purposes of this measure is assumed to be similar in scope and design to those constructed at Cougar Dam and Fall Creek Dam.

Green Peter: Adult upstream passage for spring Chinook salmon and steelhead through the construction of a Green Peter AFF at the base of Green Peter Dam. Design of the Green Peter AFF will consider and incorporate flow and water temperature requirements to ensure adequate fish attraction into the facility for collection and avoidance of stress and disease in fish being collected. Lessons learned from the original AFF at Green Peter Dam will be adopted (USACE 1995). or purposes of this measure, it is assumed that the Green Peter facility would be similar in size and scope to AFFs currently operated at Cougar Dam and Fall Creek Dam. Additional design would be necessary to ensure adequate water supply (flow and temperature) into the facility, which may increase design complexities and overall cost of the Green Peter AFF above that of the two existing AFFs.

Hills Creek: Provide adult upstream passage spring Chinook salmon and bull trout. The measure will need to be paired with a temperature management measure at Hills Creek Dam so water temperatures in the tailrace and within the adult fish facility are adequate for fish attraction into the facility for collection and avoid stress and disease in fish being collected. For purposes of this measure, it assumed that the facility will be similar in scope and design to AFFs currently operated at Cougar Dam and Fall Creek Dam.

2.6 MEASURES COMMON TO ALL ALTERNATIVES

2.6.1 Measure 384. Gravel Augmentation Below Dams

Description:

Develop and implement a sediment nourishment program below targeted WVS Dams. Determine an appropriate sediment gradation and annual nourishment quantity to achieve desired habitat improvements for spawning adult and rearing juvenile Spring Chinook salmon and Winter Steelhead. Determine and develop an appropriate sediment injection site(s) below each targeted dam. Develop and implement a monitoring program and adaptive management plan to ensure that expected habitat gains are realized and negative effects are minimized.

Purpose: Supplement sediment blocked by targeted WVS dams where it is reducing or degrading habitat for spring Chinook salmon and winter steelhead below Willamette Project dams.

Intended Benefit: Improve the quality or quantity of habitat for Spring Chinook salmon and winter steelhead. Adding appropriate sediment to include clean gravel increases or improves river substrate conditions for spawning and rearing of these species below WVS dams.

Operational or Structural Measure: Neither

Location: North (below Big Cliff Dam) and South Santiam (below Foster Dam) and McKenzie River Basins (Cougar and Blue River Dams)

2.6.2 Measure 719. Adapt Hatchery Mitigation Program

Purpose and Background

The overall goal of the measure is to adjust production of WVS hatcheries for mitigation obligations and conservation needs after demonstrated improvements to fish access to habitat above dams**.** Each subbasin hatchery program will be considered separately according to the metrics and protocols described below.

Congress authorized USACE to mitigate for the construction of the WVS recognizing that the project dams would block access for migratory fish to habitat and inundate habitat and several existing hatcheries. USACE has historically done this by carrying out a program to produce and release hatchery salmon, steelhead trout, and game fish in the Willamette River Basin. Congress did not define detailed goals for mitigation, including the level of fish production to be achieved, leaving USACE discretion to determine how to implement the fish mitigation program in the Basin —whether that be through hatchery programs, passage improvements, or a combination thereof. Current levels of mitigation production are defined in hatchery genetic management plans (HGMPs) prepared by ODFW and USACE (see Table 2-21 and Table 2-22). Because USACE is providing access to blocked habitats with the implementation of WVS fish passage actions, it is proposing to reduce the hatchery production amounts needed for mitigation after demonstrated improvement to fish habitat access. The ESA, enacted after the original authorizing document, also requires that USACE consult with the Services to ensure production and release of hatchery spring Chinook salmon, summer steelhead, and rainbow trout does not jeopardize any ESA-listed species. Available science allows for further assessment of how changes to the WVS hatchery program can help avoid unacceptable risks to ESA listed species from federal hatchery programs by accounting for potential effects like; density-dependent impacts, genetic introgression, predation, and other hatchery effects.

The purpose of WVS EIS Measure 719 is to continue the hatchery mitigation and conservation program, taking into account that the original requirement for the mitigation is reduced with improved fish passage and water quality, and to address hatchery effects to endangered species consistent with the 2011 UWR Chinook salmon and steelhead recovery plans (ODFW and NMFS 2011). Existing HGMPs describe how hatchery Chinook are currently being used to support reintroduction of spring Chinook salmon above WVS dams, as well as a framework for reducing or ending hatchery supplementation above WVS dams as effective fish passage is achieved and unmarked adults increase. The HGMPs recognize that Federal hatchery mitigation obligations will be reduced based upon a crediting system once fish passage is improved, but do not include a crediting system or process for establishment of that system. The HGMPs require assessing natural origin adult returns as a part of the framework for determining the need for outplanting hatchery Chinook salmon above dams. It will be necessary to assess dam effects at multiple life stages, not only adults, considering that adult Chinook salmon and steelhead returns are affected by a range of factors (some related to the WVS dams, and others not, e.g., ocean conditions, harvest, freshwater habitat).

Brood take and juvenile production/release levels for all programs (spring Chinook salmon, summer steelhead, rainbow trout) will not be reduced in association with fish passage improvements until future negotiations between USACE, NMFS, and ODFW occur.

A proposed process for reductions in hatchery fish production is included below but would not be implemented until after future negotiations with NMFS and ODFW.

Spring Chinook Salmon Crediting

- Before passage improvements

Hatchery juvenile spring Chinook salmon releases and outplanting of adult spring Chinook salmon hatchery fish above dams will occur according to the HGMPs and NMFS associated 2019 Biological Opinion (Biological Opinion).

- After passage is improved

After passage improvement at a dam (years 0-5), hatchery-origin returns (HORs) would continue to supplement NORs outplanted in order to meet but not exceed the abundance thresholds as defined in the HGMPs (Table 2-20). For projects at which only natural origin fish are currently outplanted above a project (i.e., Foster Dam), this plan would remain consistent with strategies to maintain hatchery production below the dam.

(Table 2-20) provides the Adult Chinook salmon outplanting thresholds from the associated HGMPs and NMFS' 2019 Biological Opinion with the exception of the South Santiam. When the number of natural origin (unmarked) Chinook salmon spawner returns are below these levels, hatchery origin returns will be used to supplement to achieve the thresholds*. The South Santiam HGMP indicates 600 total, if needed, however up to 800 hatchery adult Chinook salmon will begin being outplanted above Green Peter Dam in 2022. Currently, no hatchery origin (marked) fish are outplanted above Foster so the outplant number for South Santiam in (Table 2-20) is for fish intended for reintroduction above Green Peter.

Table 2-20. Adult Chinook salmon outplanting thresholds.

Subbasin	Natural-origin fish threshold*	Natural-origin female fish threshold*	Natural-origin male fish threshold*
McKenzie	600	400	200
Middle Fork	2450	N/A	N/A
South Santiam	800	0	0
North Santiam	1500	750	750

* When unmarked (natural origin) adult Chinook salmon returns are below these levels, supplement with adult hatchery Chinook salmon to achieve the thresholds*. The thresholds are taken from the 2016 HGMPs, with the exception of South Santiam. The South Santiam HGMP indicates 600 total, however up to 800 hatchery adult Chinook salmon will begin being outplanted above Green Peter Dam in 2022.

PHASE 1 - Years 1-7 following improved fish passage conditions:

Following the implementation of downstream fish passage improvements, hatchery spring Chinook salmon production will remain at production levels as defined in the HGMPs. Annual dam passage survival (DPS, i.e., dam passage efficiency * dam passage survival) will be measured in two separate years which are representative of typical operating conditions (i.e., water years within 95% of normal hydrological conditions in the period of record) to evaluate fish passage efficiency and survival at the dam. The precision needed about annual DPS will be determined at the time of the assessment to evaluate passage. Observed performance will be compared to downstream passage survival rates estimated to support the replacement criteria[3].

PHASE 2 - After Year 7 following a fish passage improvement – production crediting based on adult return rates:

Recognizing several factors can affect adult Chinook salmon returns, cohort replacement rate (CRR) serves as a basis for evaluating overall population performance. CRR will be estimated as:

$$CRR = \frac{\text{Number of } \textbf{unmarked} \text{ 3,4 and 5 year old returns produced by outplants (males and females) in Year X}}{\text{Number of spawners (}\textbf{marked and unmarked}\text{) in Year X}}$$

CRR is calculated using the above equation; and uses the entirety of the spawning population in the reach above the dam regardless of the origin of the parents. In other words adults of hatchery origin used to supplement the number of spawners are considered part of the cohort parentage. Since outplanted adults will continue to be supplemented with hatchery fish until natural origin fish meet or exceed the HGMP thresholds (Table 2-20), the HGMP thresholds define the minimum abundance levels for assessing CRR above each dam.

After 7 years CRR will be calculated for three separate cohorts accounting for adult returns in years 3-5, 4-6 and 5-7. If the CRR for Chinook salmon is >1 based on a geometric mean of replacement rates for the three cohorts returning in years 3-5, 4-6 and 5-7, then the full credit for fish passage improvements will be applied to the spring Chinook salmon hatchery production for the subbasin in which returns are being assessed. In this case Chinook salmon production will be reduced over a period of five years to a *Reduced Level of Production* (see below). This gradual reduction strategy allows economic interests to adjust and provides the State of Oregon additional time to seek funding for additional hatchery production if desired.

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[3] Downstream passage survival rates needed to support replacement of sub-populations above dams will be estimated using life cycle models developed for the WVS EIS and ESA consultation.

2. “Consensus” is used instead of “effective” because using the effective number of spawners would result in a lower post-production (Ppost) value that may not result in the desired number of effective spawner returns.

The basin-specific NOR thresholds will be the same as the outplanting thresholds indicated in the Table 2-20.

If CRR < 1, and DSP criteria not met, then mitigation credit reductions will not occur at this time and instead be re-assessed again after year 14.

After re-assessment, if the geometric mean of CRR is >1.0 for cohorts returning in years 12, 13 and 14, then reductions to Chinook salmon release will be reduced over a period of five years to the *Reduced Level of Production*.

If the geometric mean of CRR is still <1.0 for cohorts returning in years 12, 13 and 14, and the DSP target is met, non-project effects will be evaluated. There have been several methods proposed in similar programs for measuring quantifying non-project effects for the purpose of demonstrating reduced impact to ESA-listed salmonids. For example, the Lewis River Hydroelectric Projects M&E Plan (2010) describes the number of ocean recruits (i.e., Total Adult Production; TAP), and adult escapement to traps accounting for harvest removals. Another possible metric may include examining the ratio of adults observed at Willamette Falls to those observed at traps when enroute mortality is accounted for (e.g. Keefer et al. 2017). Extensive modeling of hydrologic conditions relative to available habitat are ongoing as part of the SWIFT project (Peterson et al. 2021), passage modeling by the University of British Columbia, among other efforts may be applied to provide assess the effect of project management on juvenile outmigration and adult returns compared to off-project effects (e.g., ocean conditions, poor hydrologic conditions, harvest, etc.). UBC[4] has shown that marine survival alone can impact the effects of perfect passage in poor marine years. If these available methods indicate substantial non-project effects on replacement, credit for dam fish passage improvements will be determined through further review and discussion among the State of Oregon, USACE and NMFS following the same process as outlined below under ‘reduced hatchery production” and take into consideration the effectiveness of the dam passage conditions, other project effects, and other non-project effects. Based on this assessment, outcomes could include:

- No changes to mitigation production, with further actions to address project effects. CRR would then be reassessed after 7 years following implementation of additional action.
- Changes to mitigation production due to recognized impacts from the hatchery program constraining natural production, with alternative mitigation implemented.
- Mitigation credit due to recognition of improved passage conditions and non-project effects constraining CRR. In this scenario mitigation production for passage could be fully reduced, while maintaining some *Reduced Level of Spring Chinook Salmon Production* (see below) to mitigate for any remaining, non-passage, project effects identified.

[4] Porteus, T, UBC (University of British Columbia). April 13, 2022. Differences in Smolt to Adult Survival Rates Between Willamette River Sub-basins and Implications for the Recovery Potential of Spring Chinook Salmon. Presentation to the Willamette Fisheries Science Review.

Reduced Level of Spring Chinook Salmon Production

The purpose of the *Reduced Level of Production* is to maintain some mitigation production, to be developed with the State of Oregon and NMFS, recognizing 1) some project effects may remain that require mitigation after successful fish passage is implemented and assessed, 2) hatchery production may need to be maintained for conservation/safety net purposes recognizing uncertainty in reintroduction success, and 3) increases in natural origin returns when still below the CRR of 1 may warrant reductions in hatchery production and releases to help increase natural productivity. The Reduced Hatchery Production levels will be based on the passage assessment leading to habitat access as referenced in HD 531. Alternative mitigation may also need to be considered where there are effects on ESA-listed species from the production and release of hatchery mitigation fish. If CRR is improved by passage, yet remains below a CRR of 1, brood take needed to support conservation outplanting should be assessed as part of determining reduced levels of production. The deficit in replacement value (in number of consensus spawners) will be used to calculate a potential new production level (Ppost) intended for meeting conservation (outplanting) needs in years 9-14[2]:

$$P_{Post} = \frac{\#\ of\ outplants_y - \#\ of\ returns_{y5}}{SAR_{harv}}$$

Where SAR_{harv} is the estimated smolt to adult return rate assuming harvest and y is the brood year and y5 is all of the progeny that can reasonably be assigned to brood year y.

For purposes of calculating a new conservation production level, changes in the SAR from increased levels of natural origin brood should be considered.

Rainbow Trout Crediting

As for spring Chinook **salmon** and summer steelhead, trout hatchery mitigation needs after fish passage improvements at WVS dams will be developed with the State of Oregon. The initial authorization for game fish mitigation related to construction and operation of the WVS was based on concerns about the productivity of resident fish given impoundment and inundation by authorized projects. Trout mitigation changes as it relates to passage improvements at WVS may be important to consider given these assumptions about productivity of resident trout in reservoirs, addressing effects of ongoing hatchery trout stocking on ESA-listed fish reintroduction and natural production (including local fisheries for hatchery stocked trout), and/or to account for other mitigation credits that have or are continuing to occur (e.g. BPA is directly addressing the mitigation for inundation through the Wildlife Enhancement Memorandum of Agreement; BPA & ODFW 2010). Impacts to ESA-listed fish from rainbow trout is recognized and the current HGMPs describe approaches to limit overlap of rainbow trout and ESA-listed fish. USACE anticipates that further changes may need to be made once passage is implemented to limit impacts on reintroduced populations.

Summer Steelhead Crediting

In association with improved fish passage conditions at WVS dams, any changes to the mitigation hatchery production of summer steelhead as funded by USACE will also be developed with the State of Oregon. Non-native hatchery summer steelhead are produced to mitigate for the effects of the WVS on native ESA-listed winter steelhead. Plans for any reintroduction of winter steelhead above WVS dams (including within the Winter Steelhead Distinct Population Segment; DPS) have not been developed. Summer steelhead provide no conservation value to support winter steelhead reintroduction above WVS dams, and are known to have negative impacts on winter steelhead in the Willamette Basin (e.g. fitness effects associated with introgression). It also may not be feasible to assess winter steelhead CRR. Oncorhynchus Mykiss progeny can become either resident (rainbow trout) or anadromous (steelhead). Recent work indicates that non-anadromy may be an adaptive strategy in response to reservoir inundation with lack of adequate passage and that these strategies are plastic, i.e., anadromous females can breed with non-anadromous males with documented success of anadromous progeny as summarized in McAllister et al. (2022 in draft). Estimates of CRR for steelhead are uncertain given some offspring will remain in freshwater and mature as rainbow trout, and some adult steelhead returns will be progeny of rainbow trout.

Table 2-21. Willamette Hatchery Mitigation Program Production Goals for UWR Spring Chinook Salmon in each Subbasin According to the Hatchery Genetics Management Plans.

Subbasin	ESA Conservation Purpose (per HGMP)	USACE-funded Non-Conservation Release (per HGMP)	ODFW-funded Release per HGMP	Total Hatchery Release
North Santiam	630,000	74,000	0	704,000
South Santiam	350,000	289,000	382,000	1,021,000
McKenzie	604,750	0	0	604,750
Middle Fork Willamette	NA	2,039,000	0	2,039,000

Table 2-22. Willamette Hatchery Mitigation Program Production Goals for Summer Steelhead in each Subbasin According to the Hatchery Genetics Management Plan.

Subbasin	USACE Release (per HGMP)	ODFW-funded Release per HGMP	Total Hatchery Release
North Santiam	0	121,000	121,000
South Santiam	0	121,000	121,000
McKenzie	0	108,000	108,000
Middle Fork Willamette/Mainstem	157,000	0	157,000

2.6.3 Measure 9. Maintain revetments considering nature-based engineering or alter revetments for aquatic ecosystem restoration

Description:

As routine operations and maintenance of existing USACE-managed revetments on riverbanks is needed, include nature-based engineering methods; and evaluate and implement project(s) for Substantial Alterations where ecosystem restoration benefits are identified and there is a willing non-Federal cost-share sponsor.

Under all action alternatives, basin-wide maintenance would be carried out to support streambank stabilization revetments currently managed by USACE. Revetments constructed by USACE that are maintained by non-federal sponsors within the WVS are not a Federal Action and therefore not covered in this EIS. Nature-based (bioengineering) methods would be included to the extent practicable to decrease hard surfaces (e.g., rock) within the system to provide habitat for various fish and wildlife species in the river margins and riparian zone while maintaining the authorized project purposes.

This measure would be implemented as part of maintenance actions and would include:

- Consideration of nature-based engineering options as part of any USACE maintenance activity for USACE-managed revetments.
- Following standard engineering practices for maintenance such that the revetment will still meet intended authorized purposes.

In addition, USACE will seek opportunities working with a Non-Federal Sponsor(s) to study and work through the process for a substantial alteration project. Section 1135 Project Modifications for Improvement of the Environment (WRDA 1986) under the Continuing Authority Program is the only authority that allows USACE to alter a federal project for ecosystem restoration purposes. All requirements under this authority can be found in the Engineering Regulation 1105-2-100 Planning Guidance Notebook.

Under Continuing Authority Program studies, USACE must have a non-federal sponsor to cost share the project, acquire all necessary real estate, and Operate and Maintain the project in perpetuity. Working with the Services, as well as local agencies and stakeholders, USACE will seek non-federal sponsors for substantial alterations to provide ecological improvements to one or more Willamette Valley Basin Bank Protection Projects (WVBPP) that are determined to be in the Federal Interest using the Aquatic Ecosystem Restoration (AER) metrics (cost per habitat unit).

Existing information will be used to identify projects with the greatest ecosystem restoration potential. For example, several revetment studies have been completed since the 2008 Biological Opinion that will inform the identification and prioritization of potential Section 1135 projects with the greatest potential. The annotated bibliography of these existing studies is provided below. However, additional technical analysis will likely be necessary to further evaluate potential effects of any modifications proposed by a Section 1135 project. For instance, Section 1135 projects cannot increase flood risk, therefore analyses to determine if a proposed project could increase flood risk must be performed as a part of the Feasibility Study for a Section 1135 project. Post construction monitoring will also be conducted to ensure the project performs as intended, both biologically and for bank protection. This information would also be used to investigate the implementation of future substantial alterations to revetments.

Revetment Studies Annotated Bibliography

West Consultants Inc. 2020. Willamette River Bank Project FY19 Routine Inspections Consequence Assessment. Prepared for the US Army Corps of Engineers. Contract No. W9127N18D0002

A consequences assessment for all 193 WVRBPP structures. The purpose of this work is to develop a reconnaissance-level assessment of the consequences associated with the removal or failure of the WVRBP revetments. This study classified the majority of revetment reaches, and most individual revetments as High Consequence, described as “Critical infrastructure is located within the revetment reach query zone and is located within the buffer zone. Failure of these revetments to prevent channel migration, overflows, or channel avulsions could result in significant near-term (engineering time scale) impacts to critical infrastructure. “Only 8% of individual revetments and none of the revetment reaches are classified as Low Consequence, described as “Critical infrastructure is not located within the revetment reach query zone and non-critical infrastructure is not located within the buffer zone. Failure of these revetments to prevent channel migration, overflows, or channel avulsions is not expected to result in impacts to critical infrastructure and it is unlikely to put non-critical infrastructure at risk in the near term.”

River Design Group. 2018. Revetment Alternatives Concepts - Willamette River Bank Protection Program Prepared for the US Army Corps of Engineers. W9127N-12-D-0006 Task Order 0010.

Goal is to develop revetment concepts for 24 revetment locations. The alternative concepts are intended to provide CENWP with a starting point for prioritizing future revetment repair or replacement designs in response to revetment erosion and destruction. Previous WRBP Program revetment evaluation reports completed by CH2M HILL (2011) and Hulse et al. (2013) were reviewed to assess revetments that were previously identified for repair, removal, or replacement. In addition to revetments included in these two reports, CENWP identified other revetments during project scoping and following the 2017 revetment inspection. These structures are either in degraded condition, are located at high risk profile sites, and/or CENWP is responsible for structural maintenance. Lastly, revetments with a potential conservation benefit were highlighted. Conservation benefits may include altering revetments to restore river-floodplain processes such as mainstem-side channel connections for fish use, or to enhance riparian vegetation and terrestrial habitat conditions. Several revetments satisfy more than one of these categories. Conservation opportunity was used as the as primary reason for inclusion for seven of the 24 revetments assessed.

CENWP contracted with WEST Consultants, Inc. (WEST) as a subcontractor to Alden Research Laboratory, Inc. (Alden), to conduct a consequences assessment for all 193 CENWP and local Sponsored revetments. Alden provided contract and project management and WEST conducted the technical analysis. The purpose of this work is to develop a reconnaissance-level assessment of the consequences associated with the removal or failure of the WRBP revetments. In contrast to the 2013 study previously discussed, the scope of services for this work does not include any detailed engineering analysis of hydraulics, hydrology, scour, or erosion. The purpose of this study is to develop an inventory of critical infrastructure within the area of influence of the revetments (or grouping of revetments) and use that information to assign the revetment reach (or individual revetment) a consequence classification rating. This information is intended to help the CENWP with future decision-making regarding maintenance priorities.

> Hulse, D.W., Branscomb, A., Brehm, C., Enright, C., Gregory, S., and Write, S. 2013. Assessment of potential for improving ESA-listed fish habitat associated with operations and maintenance of the Corps Willamette Project: an approach to revetment prioritization for removal or modification to restore natural river function. Prepared for the US Army Corps of Engineers. Cooperative Agreement W912HZ-11-2-0045

Beginning in 2011, a team from the University of Oregon, Oregon State University and River Design Group developed and demonstrated a three-phase approach to prioritizing the system of USACE maintained Willamette Project revetments for future consideration for removal or modification to enhance natural river function. From this effort, four USACE-maintained revetments were recommended for further, more detailed consideration regarding removal or modification to restore natural river function. However, additional good sites likely exist. The resulting prioritization tool can be actively updated as additional information is obtained to refine the reported prioritization of revetment zones or conduct completely new prioritizations.

River Design Group, Inc., and HDR Engineering, Inc. 2013. Potential Consequences of Failure Analysis, Corps Maintained Revetment Projects. Prepared for US Army Corps of Engineers

A hydraulic, hydrologic, and geomorphic investigation of consequence for 60 CENWP maintained revetment projects on the Row River, McKenzie River, and Coast Fork, Middle Fork, and mainstem Willamette River. The remaining 28 CENWP maintained revetments were excluded from the study because they were either destroyed or located significantly off the main channel and are no longer serving their intended purpose. No prior consequence assessment had been conducted for the 105 locally sponsored projects. The 2013 study included a detailed hydrologic and hydraulic analysis to consider revetment failure consequences. HEC-RAS hydraulic models were developed and used to simulate several annual exceedance-probability discharges. These models were then modified to represent "without revetment" conditions. Model results were used to develop inundation maps for with- and without revetment conditions. Additionally, bank scour calculations were conducted to understand erosion potential at the sites.

CH2MHILL. 2011. Willamette River Basin, Oregon, Bank Protection and Channel Improvement Damage Assessment and Maintenance Repair. Prepared for the US Army Corps of Engineers.

A reconnaissance study that encompasses 18 damaged Willamette River Basin, Oregon, Bank Protection and Channel Improvement Project (WRBP Project) revetments maintained by USACE. The revetments examined by this study were identified as damaged during annual USACE maintenance inspections performed since 2001. The purpose of the reconnaissance study was to develop maintenance or repair proposals for each site. The study included field reconnaissance, documentation of reconnaissance-level review of damages, evaluation of repair options, prioritization of revetment repairs, cost estimates for recommended actions, and identification of environmental permitting requirements. The planning objectives are to stabilize riverbanks to protect life and public and private property, protect revetments from further damage, prevent revetment failures and potential ecological impacts of the failures, reduce riverbank erosion, and restore beneficial functions of revetments. Maintenance and repair proposals included natural and nature-based features such as using large wood material and vegetated riprap.

Purpose: Decrease hard surfaces (e.g., rock) within the system of revetments.

Intended Benefit: Provide habitat for various fish and wildlife species in the river margins and riparian zone while maintaining the authorized project purposes.

Operational or Structural: Structural

Location: Basin-wide

2.6.4 Measure 726. Maintenance of existing and new fish release sites above dams

Description: New sites will be developed, or existing ones maintained to provide access for outplanting of adult fish. Several outplanting sites were evaluated to facilitate maximum productivity of adults and compared to the most current WFOP. Sites were selected based on higher ranking. Where the evaluation report proposed upper and lower release sites, only the lower sites were chosen per NMFS comments on self-sorting, with the exception of Blue River. There are few habitat data available for outplanting above Blue River. Any fish outplanting implemented would necessitate a habitat evaluation above Blue River. Note: An outplanting site is assumed “active” if passage is implemented at the corresponding dam. The sites in Table 2.6.4a are currently used or have been proposed due to high quality habitat.

Purpose: Provide access to outplant adult fish for natural spawning.

Intended Benefit: Increased access to high quality spawning habitat.

Operational or Structural: Structural

Location: Detroit, Foster, Green Peter, Cougar, Blue River, Lookout Point, Fall Creek, Hills Creek. Table 2.6.4a includes details on the new and proposed outplanting sites.

Table 2.6.4a. Comprehensive List of New and Proposed Out Planting Sites.

Dam	Description	Ownership	Lat	Long	Existing or New?
Detroit	Atiyeh property	Private	44.808	-122.409	New
Detroit	Breitenbush USGS Gauge Site (#14179000)	USFS	44.7512	-122.132	New
Detroit	Parrish Lake Road (Upper)	USFS	44.5243	-121.997	Existing
Detroit	Cooper's Ridge (Lower)	USFS	44.6928	-122.05	Existing
Minto	North Santiam River upstream of Minto	USFS	44.7578	-122.36	Existing
Foster	Gordon Road (Upper)	Private	45.1718	-122.384	Existing
Foster	River Bend A (Lower)	Linn County	44.407625	-122.57	Existing
Foster	Caulkins Marina (reservoir release) *	Linn County	44.413	-122.625	New
Cougar	Hardrock campground (lower)	USFS	44.0363	-122.203	Existing
Cougar	Homestead campground (upper)	USFS	43.967	-122.159	New
Lookout Point	Site 1 (lower)	USFS	43.8929	-122.316	Existing
Lookout Point	Site 3 (upper)	USFS	122.2465	43.8848	New
Fall Creek	Gold Creek Confluence (upper)	USFS	43.981	-122.407	Existing
Fall Creek	Site C (lower)	USFS	43.968	-122.63	Existing
Hills Creek	Construction site (spur road)	USFS	43.505	-122.422	Existing
Hills Creek	Paddy's Valley	USFS	43.443	-122.193	Existing
Blue River	Lower release site 2-5 miles above head of reservoir	USFS	TBD	TBD	New
Green Peter	Lower release site 2-5 miles above head of reservoir in Quartzville Creek	USFS	TBD	TBD	New
Green Peter	Lower release site 2-5 miles above head of reservoir in Middle Santiam	USFS	TBD	TBD	New

*Caulkins Marina is only active in alternatives with passage at Green Peter

2.7 EXISTING OPERATIONS CONTINUED FORWARD

2.7.1 Fall Creek Drawdown for Fish Passage

Fall Creek reservoir is currently and will continue to be drawn down to its lowest outlet, elevation 690, for a few weeks in November lasting sometime into December. The actual operation varies based on when fish are present and are passing. The NAA analyzes this operation as a deep fall drawdown to elevation 690 from November 15th to December. This measure would occur under all action alternatives as well.

2.7.2 Continued Operation of Existing Adult Fish Facilities

Under all alternatives, USACE would continue to operate and maintain the existing adult fish collection facilities located at Dexter, Foster, Fall Creek, Minto (downstream of Big Cliff), and Cougar dams (Figure 1 22) in accordance with the WFOP, the operational plan noted in Section 1.10.2. The WFOP is developed annually by USACE in coordination with the BPA as well as regional federal, state, and Tribal fish agencies and other partners through the WFPOM coordination team. Generally, adult fish collection facilities are operated annually between April and October. However, the WFOP describes year-round operations and maintenance activities of the adult fish collection facilities as coordinated through WFPOM to protect and enhance anadromous and resident fish species listed as endangered or threatened under the ESA, as well as non-listed species of concern including lamprey. The WFOP guides USACE actions related to fish protection and passage at the 13 Willamette projects.

2.7.3 Operation, Maintenance, Repair, Replacement and Rehabilitation

Once construction of the water resources project, like the facilities that make up the WVS, is complete, the operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) phase begins. During this phase, ongoing activities are conducted to support the function of the project. The OMRR&R phase is made of a spectrum of activities including everything from regular maintenance activities, such as the repainting a rusty guardrail or replacement of lightbulbs, to major maintenance and rehabilitation activities such as the repair, replacement, or rehabilitation of entire facility components, e.g., the replacement of the slide gate seals or repair of hydraulics in a dam. OMRR&R activities occur at all facilities in the WVS including within and around the dams and powerhouses, the adult fish facilities, and the hatcheries. This section describes the distinction between regular and major operation, maintenance, repair, replacement, and rehabilitation and outlines how activities under each will be addressed in this EIS.

Scheduled/Routine Maintenance

Routine maintenance is defined as the maintenance, repair, or replacement of existing fixtures or parts in which no changes to original design or purpose to ensure WVS facilities run safely either through preventive maintenance or repairs. Routine maintenance includes activities that are predictable and repetitive, but not activities that would constitute major repairs or rehabilitation of a capital asset. This type of preventative and corrective maintenance is coordinated and planned to occur at regular intervals and is referred to as scheduled, or routine, maintenance. Routine maintenance is performed at regular intervals on all hatcheries, fish facilities, spillway components, generating units, and supporting systems to ensure project reliability and to comply with North American Electric Reliability Corporation/Western Electricity Coordinating Council regulatory requirements. Routine maintenance is coordinated through the regional forum, such as the WFPOM and WATER, to minimize effects to ESA-listed fish species. The routine maintenance program allows staff at USACE, BOR, and BPA to proactively plan and schedule capital improvement programs based on equipment condition and degradation to ensure system operations remain safe, reliable, and in compliance with applicable laws and regulations.

These activities are described in the Operations and Maintenance Manuals for each facility. The library of Operations and Maintenance Manuals are incorporated here by reference. An annotated bibliography of these manuals is provided below. These activities will continue and are included in all alternatives, including the NAA. It is assumed that these actions will not result in impacts to the environment as they are mostly sited within existing structural facilities. However, each action is routinely assessed for environmental compliance prior to implementation.

Annotated Bibliography of Operations and Maintenance Manuals, dated 06/15/2022

Operation and Maintenance Manual: Blue River Dam, Blue River Lake, South Fork McKenzie River, Oregon. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1972. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Blue River Dam for flood control and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Cottage Grove Reservoir Project, Coast Fork Willamette River. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1968. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Cottage Grove Dam for flood control and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Cougar Reservoir Project, South Fork of the McKenzie River, Oregon, General, Sections 1.00 - 1.22, Dam and Equipment, Sections 2.01 - 2.14, Powerhouse Switchyard and Equipment, Sections 3.01 - 3.29, Fishway Facilities and Equipment, Sections 4.01 - 4.04, Buildings and Grounds, Sections 5.01 - 5.04, Reservoir and Reservoir Areas, Sections 6.01 - 6.05. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1964. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Detroit Dam and Powerhouse and Big Cliff Dam and Powerhouse for flood control, power generation, and other conservation uses. This manual is designed for use by

operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Facility Operations and Maintenance Manual: Cougar Adult Fish Collection Facility. Portland, Oregon: Portland District, U.S. Army Corp of Engineers, 2017. This manual will work in conjunction with the Contractor's Operation and Maintenance Manual, which consists of twelve volumes that contain detailed product and maintenance information for every component of the system. The manuals are intended to provide the overall framework and guidance on how to identify, operate, maintain and troubleshoot components.

Operation and Maintenance Manual: Detroit Project, Detroit Dam and Powerhouse, Big Cliff Dam and Powerhouse, Part I - Description, Part II – General, Part III - Operation. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1954. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Detroit Dam and Powerhouse and Big Cliff Dam and Powerhouse for flood control, power generation, and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Dorena Reservoir, Row River, Oregon. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1968. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Dorena Dam for flood control and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Fall Creek Reservoir, Fall Creek, Oregon. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1968. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Fall Creek Dam for flood control and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

System Operation and Maintenance Manual: Fall Creek Dam and Reservoir, Adult Fish Facility Upgrade, Willamette River Basin, Middle and South Santiam River, Working Final. Portland, Oregon: Portland District, U.S. Army Corps of Engineers, 2018. This manual is intended to provide a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

Operation and Maintenance Manual: Fern Ridge Reservoir, Long Tom River, Oregon. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1968. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Fern Ridge Dam for flood control and other conservation uses. This manual is designed for use by operating and

maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

System Operation and Maintenance Manual: Foster Dam and Reservoir, Adult Fish Facility Upgrade, Middle and South Santiam River, Portland, Oregon: Portland District, U.S. Army Corps of Engineers, October, 2017. Oregon Department of Fish and Wildlife and the Willamette Valley Project will be responsible for the operation and maintenance of the Foster Dam and Reservoir Adult Fish Facility Upgrade. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation meets NOAA Fisheries criteria and provides effective fish passage. The System Operation and Maintenance manual provides the necessary guidance in the general system operation and describes the specific operation and maintenance of each component in the system.

Operation and Maintenance Manual: Green Peter Dam, South Santiam River, Foster Oregon, Dam and Powerhouse. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1970. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Green Peter Dam and Powerhouse and Foster Dam and Powerhouse for flood control, power generation, and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Hills Creek Reservoir Project, Middle Fork Willamette River Oregon, Volume I, Volume II, and Volume III. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1965. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Hills Creek Dam and Powerhouse for flood control, power generation, and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

Operation and Maintenance Manual: Lookout Point Dam and Powerhouse, Dexter Dam and Powerhouse, Part I - Description, Part II – General, Part III - Operation. Portland, Oregon: Portland District, Corps of Engineers, U.S. Army, 1953. The purpose of this manual is to present detailed information pertinent to the operation and maintenance of Lookout Point Dam and Powerhouse and Dexter Dam and Powerhouse for flood control, power generation, and other conservation uses. This manual is designed for use by operating and maintenance personnel and includes the physical description, operation and maintenance of the equipment and systems.

System Operation and Maintenance Manual: Minto Fish Collection Facility, Willamette River Basin, North Santiam River, Oregon. Portland, Oregon: Portland District, U.S. Army Corps of Engineers, September, 2017. Oregon Department of Fish and Wildlife and the Willamette Valley Project will be responsible for the operation and maintenance of the rebuilt Minto Fish Collection Facility. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation meets NOAA Fisheries criteria and provides effective fish passage. The System Operation and Maintenance manual provides the necessary guidance in the general system operation and describes the specific operation and maintenance of each component in the system.

In addition, USACE utilizes five fish hatcheries to meet mitigation goals for the construction and operation of the WVS. Hatcheries include Marion Forks, South Santiam, McKenzie, Leaburg, and Willamette Hatchery. Operations and maintenance actions include (but are not limited to) fish production, feed, chemical use, grounds maintenance, janitorial services, and more. The facilities and their operations are summarized below:

Marion Forks Hatchery: “Marion Forks Hatchery is located along Marion and Horn Creeks (Santiam River tributaries in the Willamette Basin) about 17 miles east of Detroit, Oregon, along Highway 22. The site is at an elevation of 2,580 feet above sea level, at latitude 44.6125 and longitude -122.9472. The site area is 15 acres, owned by the US Forest Service Willamette National Forest.” (ODFW 2021, 2022, 2022). All structures are managed by USACE.

“There are two water rights: 15,257 gpm from Marion Creek and 14,368 gpm from Horn Creek. Water is supplied from Marion Creek from April through September, and from Horn Creek from October through March. All rearing units use single-pass water.” (ODFW 2021, 2022, 2022).

Structures and Equipment: “The hatchery has 34 stacks of Heath stack incubators. Fish rearing facilities include 12 Canadian style troughs (21’ x 2.6’ x 1.75’), 4 Reiff rearing troughs (16’ x 3.25’ x 2.7’), 8 raceways (20’ x 80’ x 3’) and 48 circular ponds (24’ diameter x 2.5’depth).

Marion Forks has a flatbed truck with a 1,000-gal tank equipped with two aerator pumps. The hatchery also uses regional trucks, which have a 1,600-gal tank equipped with recirculation pump and oxygen pumps, to haul both adults and juveniles.

The hatchery also uses a 400 gallon slip tank in their pickup for hauling fingerling fish.

The hatchery has a 1983 Nielsen Fish Pump.” (ODFW 2021, 2022).

South Santiam Hatchery: “South Santiam Hatchery and the Foster Fish Collection Facility are located on the South Santiam River just downstream from Foster Dam, 5 miles east of downtown Sweet Home. The facility is at an elevation of 500 feet above sea level, at latitude 44.4158 and longitude -122.6725. The site area is 12.6 acres [and most structures] are managed by USACE.

The hatchery currently receives water from Foster Reservoir. A total of 8,400 gpm is available for the rearing units. An additional 5,500 gpm is used in the adult holding pond. All rearing ponds receive single-pass water.

The incubation room is approximately 18-ft by 24-ft and contains 30 16-tray vertical incubators and two six-foot fiberglass picking troughs. All incubators and both troughs are plumbed with reservoir and well water.

Early rearing at the South Santiam Hatchery takes place in three 3-ft x 3-ft x 14 ft and two 4-ft x 4-ft x 20 ft fiberglass rearing tanks. Continued rearing takes place in ten 17-ft x 75-ft x 4-ft Burrows raceways and four 21-ft x 75-ft x 4-ft Burrows raceways. A middle walkway provides access for feeding and other tasks. Water is supplied at both ends of each raceway via 4-inch valves. In addition, the former adult holding pond was retrofitted into a large rearing pond with enough capacity to rear 300,000 spring Chinook salmon.

South Santiam Hatchery has a 1200-gallon tanker truck for fish transportation." (ODFW 2021, 2022).

McKenzie Hatchery: "McKenzie River Hatchery is located along the McKenzie River approximately 22 miles east of Springfield, Oregon. The site is at an elevation of 700 feet above sea level, at latitude 44.1167 and longitude -122.6361. The site area is 16 acres." (ODFW 2021, 2022). All structures and land are owned by USACE.

"Water rights total 31,500 gpm from two sources: the McKenzie River and Cogswell Creek. All raceways are supplied with gravity fed single-pass water. Adult holding ponds are supplied with single-pass water or can be supplied with reuse water from the raceways in an emergency." (ODFW 2021, 2022).

Structures and Equipment: "Broodstock enter the McKenzie Hatchery fish ladder from the river and navigate 12 jump steps where they then advance 100 ft. to the next 5 jumps, allowing passage under Greenwood Drive. From this point they move upstream 50 yards and make a final jump over a finger weir into the collection channel. The collection channel is located at the downstream end of the holding ponds. From there the fish are crowded into the spawning building using a power crowder. A lift brings the fish up to two holding tanks where they can be anesthetized. The fish then can be handled for sorting, inoculation, transport, or placement into the holding ponds for broodstock.

McKenzie Hatchery has a liberation tank truck with a 1,500-gallon capacity. While broodstock is generally collected and spawned on-site, this unit can haul up to 130 adults.

Incubation facilities consist of 38 full stacks of vertical tray incubators (640 trays). Dual water supplies are available from either the McKenzie River (Leaburg Canal) or Cogswell Creek, and can be isolated from each other. The two water supplies are used independently for incubation. A water chiller cools a limited amount of water for otolith marking. Rearing facilities include eight Canadian troughs of 89 cubic ft. each, and 30 concrete raceways with a volume of 3,338 cubic feet each." (ODFW 2021, 2022).

In 2018, the water supply at McKenzie Hatchery was compromised due to structural integrity issues in Leaburg Canal that supplies the hatchery. To continue fish production, fish are being collected from two locations on the McKenzie River. The primary source of collection is a fish trap at Leaburg Hatchery. Fish are also being collected from a fish sorter located at the top of the left bank ladder, though in lower numbers. In the past fish were collected at the McKenzie Hatchery, however due to current water conditions, collection the last several seasons has been in the single digits and is ineffective. Broodstock are being held at Leaburg Hatchery and at Foster Fish Facility. The raceways at Leaburg are designed for juvenile fish and are not deep enough for adults. Covers are placed over the raceways to avoid sunburn. Foster has superior adult holding facilities and thus some of the fish are held there. Incubation of this year's juveniles occurred entirely at McKenzie Hatchery. Leaburg does not physically have the capacity to incubate the number of fish that are required. Early stages of rearing are taking place at McKenzie Hatchery. Once water conditions degrade, fish are moved to Leaburg where they are reared until release. This hybrid operation using both McKenzie and Leaburg Hatchery is ongoing and will continue until a solution is implemented.

Willamette Hatchery/Dexter Fish Facility: “Willamette Hatchery is located along Salmon Creek (Middle Fork of the Willamette River tributary in the Willamette Basin) about 2 miles east of Oakridge, Oregon, off Highway 58. The site is at an elevation of 1,217 feet above sea level, at latitude 43.7436 and longitude -122.4425. The site area is 108 acres, owned by the US Forest Service Willamette National Forest.” (ODFW 2021, 2022). Structures are owned by both the Oregon Department of Fish and Wildlife and USACE. “There are six water rights: 82.5 cfs from Salmon Creek and 500 gpm from underground well. All rearing units use single-pass water.” (ODFW 2021, 2022).

Structures and Equipment: “Broodstock are collected at the Dexter Ponds Facility, a satellite to Willamette Hatchery. The fish voluntarily swim up a fish ladder located at the base of Dexter Dam, then swim through a "V" notched weir into the adult trap. There is a single adult collection pond at the Dexter Pond Fish Facility. The concrete pond has a volume of 3,848 cubic ft and dimensions of 74 ft long by 13 ft wide by 4 ft high. The pond can accommodate a flow rate of up to 18,000 gpm.

The Willamette Hatchery and Dexter Ponds Fish Facility utilize four liberation trucks, with capacities varying from 250 to 3,000 gallons. These trucks are equipped with oxygen and aeration pumps.

Adults are collected at Dexter Dam and transported to the adult Chinook salmon holding facility at the Willamette Hatchery until spawning. The holding facility was constructed in a former earthen rearing pond from the original hatchery. It is inadequate for current adult holding needs at the Willamette Hatchery. Consequently, the adults are overcrowded in the pond, not easily captured, and overly stressed which contributes to high pre-spawn mortality of collected broodstock. The earthen pond is 25 ft wide by 275 ft long and has a depth of approximately 1.5 ft. The flow rate is approximately 1,500 gpm. The existing pond has a design capacity for 800 adults. However, due to current hatchery production levels and high pre-spawn mortality of broodstock, approximately 3,000 adults over-summer in the broodstock pond. Improving the broodstock pond would dramatically increase the survival of this ESA-listed broodstock needed for conservation/recovery efforts in the Middle Fork Willamette River, reduce annual transportation costs of adults to the hatchery from Dexter trap, and reduce annual operation costs at the hatchery (i.e., antibiotic treatments).” (ODFW 2021, 2022). Rehabilitation of the adult brood holding pond is a requirement in the 2019 Hatchery Biological Opinion issued by the National Marine Fisheries Service.

“Eggs are incubated in vertical heath style incubator trays. There are 67 stacks of incubators cumulatively allowing for the incubation of 9 million eggs. There are 1,005 units, each of which can accommodate 8,000 eggs. Two water sources (Salmon Creek and well water) are available to each stack of incubators at a flow rate of 5 gpm. All incubators are equipped with alarms.

Willamette Hatchery has 40-20x80x3-foot raceways, 10-20x100x6-foot raceways, 13 Canadian style starter troughs, and 2 show ponds. The Dexter Pond Fish Facility has 4-18x135x8-foot raceways and a 172x64x8-foot asphalt pond. The Dexter Ponds are also used for acclimation. Dexter Pond, located 33 miles downstream of the hatchery, is operated as a satellite facility. The site is at an elevation of 654 feet above sea level, at latitude 43.9248 and longitude -122.8072.” (ODFW 2021, 2022).

All facilities undergo the maintenance activities summarized below:

Hatchery Production Levels and Activities: Hatchery Production Levels and Activities can be found in respective Hatchery and Genetic Management Plans and annual/biannual reports.

Feed and Chemical Use: Feed and chemical use data can be found in annual/biannual hatchery reports.

Grounds Maintenance: The grounds maintenance is performed for USACE-owned property at the seven (7) Willamette Valley Facilities: Marion Forks Hatchery, Minto Fish Facility, South Santiam Hatchery, Foster Fish Facility, Willamette Hatchery, and Dexter Fish Facility.

Frequency of maintenance fluctuates throughout the year. Table 2-23 lists the acreage of grounds for mowing, grass height standards, and lists the acreage of grounds maintained at each facility.

The grounds maintenance services include, but are not limited to:

- Removal of weeds in flowerbeds, parking lots, or and along fence lines. Application of herbicides.
- Mowing of grass areas to the standard identified in Table 2-23. Trimming and maintaining trees and shrubs to prevent obstruction and present an aesthetic appearance.
- Preparing soil and plant annuals and/or perennials in flowerbeds
- Removing all debris, trash, grass clippings, and ice/snow from all parking areas, sidewalks, driveways, or other areas which prevent an unsafe passage of employees.

Table 2-23. Size and Area of Grounds Maintenance.

Facility	Mowing (Acres)	Moving (Standard)	Acres of Grounds Maintained
Marion Forks	2	3”	8
Minto	0	N/A	2.5
South Santiam	3	3”	4
Foster	0.75	3”	1
Willamette	7	3”	30
Dexter	2	3”	10

Janitorial: Periodic housekeeping of Government facilities (i.e., Marion Forks Hatchery, Minto Fish Facility, South Santiam Hatchery, Foster Fish Facility, Willamette Hatchery, and Dexter Fish Facility) is done in a manner and frequency that results in a clean and healthy environment. These services include office space, restrooms, break areas, windows, floors, and carpets with sufficient frequency to provide a safe and healthy environment for users of the facilities.

Janitorial services include, but are not limited to:

- Vacuum carpeted areas where applicable, including floor mats or rugs
- Sweep and mop linoleum, vinyl, laminate or concrete work surfaces
- Clean restrooms
- Includes mirrors, toilets, urinals and floors
- Restock toilet paper, paper towels, soap, etc. as needed
- Clean drinking fountains
- Clean tables, counter tops and other work surfaces
- Clean window and door glass
- Clean and dust light fixtures.

Table 2-24. Type and Frequency of Maintenance at Each Facility.

–	Floor Surfaces			Trash Cans		Recycle Bins		Office Toilets	
Facility	Floor Surface (Sq Ft)	Flooring Type	Freq.	Num	Freq.	Num	Freq	Num	Freq
Marion Forks	25,000	Laminate, concrete, vinyl, carpet, wood	1x/ week	8	1x/ week	2	monthly	4	1x/ week
Minto	9,350	Laminate, concrete	1x/ week	5	1x/ week	2	as needed	1	1x/ week
South Santiam	780	Linoleum	1x/ week	3	1x/ week	3	Bi-weekly	1	1x/ week
Foster	390	Tile	1x/ week	2	1x/ week	0	NA	1	1x/ week
Willamette	4,500	Concrete, carpet laminate	1x/ week	20+	1x/ week	7	2x/ month	3	2x/ week
Dexter	75	Laminate	1x/ week	3	1x/ week	0	NA	1	2x/ month

*Estimated - Both Leaburg and McKenzie are under lease under ODFW's management.

Universal Waste Management: Universal Waste is managed to the standards set forth below or by reference:

Manage the following categories of universal waste in accordance with federal, state, and local requirements: Batteries as described in 40 CFR 273., Lamps as described in 40 CFR 273.5, and Mercury-containing equipment as described in 40 CFR 273.4 Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed.

Electronics End-of-Life Management: Recycle or dispose of electronics waste, including, but not limited to, used electronic devices such computers, monitors, hard-copy devices, televisions, mobile devices, in accordance with 40 CFR 260-262, state, and local requirements.

Releases/Spills of Oil and Hazardous Substances: Response and Notifications. Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated in accordance with 40 CFR 300. Maintain spill cleanup equipment and materials at facility. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release.

Mercury Materials: Manage mercury containing materials as a hazardous waste for disposal.

Disposal of wastewater: Do not allow wastewater from activities to enter waterways or to be discharged prior to being treated to remove pollutants.

Surface Discharge: Surface water is managed to the standards set forth below or by reference: Surface discharge in accordance with the requirements of the Clean Water Act – NPDES – Summary of the Clean Water Act, US EPA.

Used Oil Management: Used is managed to the standards set forth below or by reference: Manage used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while onsite exhibits a characteristic of hazardous waste. Used oil containing 1,000 parts per million of solvents is considered a hazardous waste and disposed of at the Contractor's expense. Used oil mixed with a hazardous waste is also considered a hazardous waste. Dispose in accordance with paragraph regarding Hazardous Waste.

Oil Storage Including Fuel Tanks: Oil storage is managed to the standards set forth below or by reference: Provide secondary containment and overfill protection for oil storage tanks. Use drip pans during oil transfer operations. Cover tanks and drip pans during inclement weather. Provide procedures and equipment to prevent overfilling of tanks.

Rainwater Accumulation: Rainwater is managed to the standards set forth below or by reference: Monitor and remove any rainwater that accumulates in open containment dikes or berms. Inspect the accumulated rainwater prior to draining from a containment dike to the environment, to determine there is no oil sheen present.

Drinking Water: Drinking water is managed to the standards set forth below or by reference: Drinking water systems must meet federal, state, and local requirements. If applicable, must maintain all registrations, operator certifications, and training.

Future Facility Actions: Future facility actions include, but are not limited to replacement/rehabilitation of roofs, siding, building interiors, water supply intakes, water supply gates, raceways/tanks, pipes, valves, other plumbing, electrical systems, fish lifts/pumps, and other items (e.g., asphalt parking lot). See Operational Condition Reports for additional information.

Unscheduled and Non-Routine Maintenance

Unscheduled maintenance is reactive maintenance that addresses issues as they arise. It can occur any time there is a problem, unforeseen maintenance issue, or emergency that requires a project feature, such as a generating unit, be taken offline to resolve the problem. The timing, duration, and extent of these events are unforeseeable. Unscheduled maintenance events are coordinated through the appropriate teams under a regional forum, such as the WFPOM and WATER, to minimize negative effects on fish.

Non-routine maintenance is proactively planned but not performed at regular intervals (e.g., unit overhauls, major structural modifications, or rehabilitations). Non-routine maintenance includes tasks that may be more significant in nature than routine maintenance and these tasks may or may not constitute major maintenance and rehabilitation.

Major maintenance and major rehabilitation are defined in Engineering Circular 11-2-222. Major maintenance is defined as a non-repetitive item of work or aggregate items of related work for which the total estimated cost exceeds the limit set forth by Engineering Circular 11-2-222, and which does not qualify as major rehabilitation. Major rehabilitation is defined as structural modifications to restore or ensure continuation of an existing facility's functions or outputs. This does not include normal maintenance of existing capabilities or prevention of deterioration. Examples of non-routine maintenance include power plant modernization and major upgrades of project features.

Non-routine maintenance and major maintenance and rehabilitation may be considered major federal actions. Each action would be assessed for environmental compliance prior to implementation, and any action that may result in impacts to the human environment would undergo additional analysis under the tiered NEPA process described in Chapter 7.

2.8 INTERIM OPERATIONS

2.8.1 Overview 2021 Court Ordered Interim Injunction

On September 1, 2021, the U.S. District Court for the District of Oregon issued an interim injunction directing USACE to implement interim injunction measures intended to improve conditions for fish passage and water quality in the WVS to avoid irreparable harm to ESA-listed salmonids during the interim period until completion of the reinitiated ESA consultation. These include measures that require changes to how one or more of the WVS dams are operated and three measures that modify existing structures. These 16 measures are described in Chapter 2, Alternatives.

The Court assigned an Expert Panel to define implementation plans of specific measures, which are then to be implemented by USACE until the WVS EIS and associated ESA consultation Biological Opinion are implemented. If an injunction measure is superseded by one or more measures under the implemented alternative, then the injunction measure will be carried out until the superseding WVS EIS/ Biological Opinion measure is implemented; otherwise, the injunction measure will be carried out through the 30-year implementation timeframe. Chapter 2, Alternatives, details what measures under each Alternative would supersede an injunction measure.

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

The Interim Operations were not developed as a complete, stand-alone practicable alternative because these measures would not contain sufficient fish survival and passage rates as demonstrated in modeling efforts under Alternative 3A and Alternative 3B. Operational passage and survival measures such as deep drawdowns and fish collection and transport were incorporated into the reasonable range of alternatives based on modeling results, which presents a more realistic implementation scenario targeting fish impact issues than would occur under an alternative comprised solely of Interim Operations.

END NEW TEXT

Chapter 3, Affected Environment and Environmental Consequences, includes an analysis of the direct, indirect, and cumulative effects of the 16 operational interim injunction measures. Although these measures could potentially be superseded immediately by measures under the implemented alternative, there may be unforeseen complexities to their implementation that need to be addressed over an unknown period. Therefore, the effects analyzed in Chapter 3, for the Interim Operations are assumed to occur over the 30-year implementation period to ensure all possible impacts are adequately addressed.

In addition to the immediate implementation of the operational interim injunction measures, the Court order includes consideration of three structural measures (Table 2.8.1a). Any structural injunction measure that is constructed will undergo a separate NEPA review that will assess the direct, indirect, and cumulative impacts of their effects on the human environment. As the direct and indirect effects of these structural measures will be fully assessed under tiered NEPA reviews, they are generally not included in the analyses (Chapter 3, Affected Environment and Environmental Consequences). However, Chapter 4, Cumulative Effects, includes the construction, operations, and maintenance of these measures.

Table 2.8.1a Three Structural Injunction Measures.

Dam	No	Description
Dexter	18	Design and Construct upgrades to the Dexter adult fish facility.
Big Cliff	10b	Determine whether operational measures alone are sufficient to maintain acceptable TDG levels below Big Cliff Dam and, if not, develop a schedule for the design and construction of a structural solution for mitigating excess TDG levels during spill operations.
Cougar	15b	Determine whether structural improvements/modifications need to be made to Cougar Dam's ROs to ensure safer fish passage and reduce TDG.

2.8.2 Summary of Interim Operations

Table 2-25 provides a summary description for each of the sixteen operations (including the injunction number assigned by the court), a short description, the location, the duration of the operation during a year, the outlet priorities for use to release flow through the dam, the target elevation of the reservoir for the operation, and where to find the more detailed descriptions. The more detailed descriptions are also provided after the table, copied from the resources referenced in the table. These operations would be implemented while the long-term management measures are being developed and cease when the long-term operations and/or structures are fully operational.

Table 2-25. Interim Operations.

No	Description	WVS Dam	Duration of Operation	Priority Outlet	Target Elevation	Description provided	Action Alt Equivalent
10	Spring downstream fish passage and operational downstream temperature management	Detroit	mid-March - Fall	Spillway/ Turbines/ ROs (ties in with 10a)	n/a	2/28/22 Biannual Report	No Equivalent, check Biannual Report
10	Nighttime RO prioritization for improved downstream fish passage	Detroit	Winter	Upper ROs/Lower ROs	< El. 1500 ft.	2/28/22 Biannual Report	3A, 3B: measure 166
10	Spread spill across spillways to reduce downstream TDG exceedances	Big Cliff	Year-Round	Spillway	Discharges > Powerhouse Capacity	2/28/22 Biannual Report	No Equivalent, check Biannual Report
11	Outplanting plan for the reintroduction of adult Chinook salmon above Green Peter Dam	Green Peter	Summer	n/a	n/a	2/28/22 Biannual Report	Measure common to all: Maintenance of existing and new fish release sites above dams
12a	Utilize spillway for improved downstream fish passage in the spring; perform spill operation until 01 May or for 30 days, whichever is longer	Green Peter	mid-March – April/May	Spillway	> El. 971 ft. (spillway crest)	2/28/22 Biannual Report – focus on 2023	2A and 2B; measure 714

No	Description	WVS Dam	Duration of Operation	Priority Outlet	Target Elevation	Description provided	Action Alt Equivalent
12b	Deep drawdown and RO prioritization for improved downstream fish passage	Green Peter	Early September - mid-December	RO	El. 780 ft.	3/23/22 Draft Implementation Plan	2A, 2B, 3A, 3B; measure 40
13b	Delay refill and utilize spillway in the spring for improved downstream fish passage; use the fish weir in the summer for improved downstream temperature management and upstream fish migration/passage	Foster	01-February - 15-June; 16 June - ~late-July	FOS Spillway (spring) Fish Weir (summer)	El. 613 ft. (Feb - May); 637 ft. (May - Jul)	2/28/22 Biannual Report	No Equivalent, check Biannual Report
13a	Utilize the spillway for improved downstream fish passage in the fall	Foster	01-October - 15-December	Spillway	min con (El. 613 ft.)	2/28/22 Biannual Report	No Equivalent, check Biannual Report
14	Deep drawdown and RO prioritization for improved downstream fish passage	Cougar	early Nov - 15 Dec	RO	El. 1505 ft.	2/28/22 Biannual Report	3A; measure 40

No	Description	WVS Dam	Duration of Operation	Priority Outlet	Target Elevation	Description provided	Action Alt Equivalent
15a *	Delayed reservoir refill and RO prioritization for improved downstream fish passage	Cougar	February - May/June	RO	El. 1520-1532 ft.	2/28/22 Biannual Report	No Equivalent, check Biannual Report
8	Nighttime RO prioritization for improved downstream fish passage (downstream fish passage)	Hills Creek	~November - March	RO	< El. 1460 ft.	2/28/22 Biannual Report	No Equivalent, check Biannual Report
17	Utilize spillway for improved downstream fish passage in the spring; RO use in the fall for downstream temperature management	Lookout Point	mid-March - May/June (spring); July - 15-October (RO)	Spillway/RO	El. 890-893 ft. (spring spill); < El. 887.5 ft. (late summer/fall RO)	2/28/22 Biannual Report	Spillway Op: No Equivalent, check Biannual Report RO Op: 3A; measure 166
16*	Deep drawdown and RO prioritization for improved downstream fish passage	Lookout Point	15 November - 15December	RO	El. 750 ft.	No Implementation Plan – modeling results with assumed drawdown	3A: measure 40

2.8.3 North Santiam River Interim Operations

Detroit Fall/Winter Downstream Fish Passage (Injunction Measure 10/Interim Measure 5)

Description: Prioritize flow releases through the upper regulating outlets (UROs) during the fall/winter once Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1419 ft); target el. 1450 -1500 ft. The timing of the operation results in approximately 60% of the daily flow going through the upper regulating outlet and approximately 40% through the penstock and turbines.

Purpose: Provide downstream passage for juvenile chinook and steelhead, during the fall and winter months.

Intended Benefit: Improved downstream fish passage

Table 2.8.3.1a Detroit Dam Interim Operation.

Dam	Detroit Dam
Duration (hours/days)	6pm to 7am (dusk to dawn)
Est. Start Date	Fall (when rule curve reaches 1500'; or Sep 21)
Est. End Date	Spring (when rule curve reaches 1500')
Recurrence Interval	Annually
Max pool elevation (ft, proj datum)	1500 ft; start using upper RO once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1419 ft)
Outlet (RO/spillway/etc.)	Upper RO (when reservoir 1500 ft – 1450 ft)
Min flow (cfs)	NA
Max flow (cfs)	NA
Additional Information (ex., head restrictions)	NA

This operation consists of prioritizing flow releases through the upper regulating outlet (URO) during the fall/winter, once the Detroit Reservoir elevation is less than 100 feet over the turbine intakes (1419 ft), with a target elevation 1450 -1500 ft. Operate the turbines during the day (unless otherwise dictated by downstream water temperature conditions), while the URO is prioritized to pass flow at night (from dusk until dawn), with no turbine operation (no power generation) during this period (except for Station Service[5] if needed for emergencies or for downstream TDG management). When the Detroit reservoir reaches 1500 ft. elevation in the Fall (September timeframe) continue using the Upper ROs to release flow for downstream water temperature management.

[5] Station Service outflow varies by elevation, but averages ~300 cfs when the reservoir is at or near minimum conservation pool elevations.

The upper and lower ROs at Detroit Dam are known to produce elevated levels of TDG downstream of the dam. One challenge during implementation of this operation will be balancing the RO operations with downstream TDG. During implementation of the fall downstream passage operation and the spring downstream passage operation (details below), holding downstream TDG levels below the State water quality standard of 110% TDG saturation while trying to comply with, and maximize the benefits of, the operation may pose some difficulties.

Depending on whether sensitive life-stages of fish are present, USACE with input from NMFS will consider how exceedances to the State water quality standard compare to benefits of the temperature reduction operations. In instances where less sensitive salmonid life history stages are present below Detroit and Big Cliff dams, then elevated TDG is likely a lower risk. However, if sensitive species are present below Detroit and Big Cliff dams, then RO use will be reduced or temporarily curtailed until the TDG levels decline. Curtailment should primarily be considered when sac-fry are present in the reach between Big Cliff and the Minto Fish Facility. Accumulated thermal units (ATUs) should be closely tracked to identify the timing of the emergence of sac-fry, and during this period, RO releases should be modified so as not to exceed 110% as measured downstream of Detroit and Big Cliff dams.

Detroit Spring Downstream Fish Passage and Temperature Management (Injunction Measure 10a/Interim Measure 7)

Description:

Provide downstream fish passage in the spring and water temperature management throughout late spring and summer at Detroit and Big Cliff Dams through strategic use of the spillway, turbines and regulating outlets. Spillway operations will start when the reservoir reaches spillway crest elevation (El. 1541.0 ft) and continue until the reservoir is drafted below the spillway crest. From there, a combination of turbine and regulating outlet (RO) discharges will be implemented until water temperature management is no longer possible due to reservoir turnover. With adaptive management, the spill ratio will be adjusted so water temperature releases (as measured at the USGS gage downstream of Big Cliff) can best meet targets. This is a split spill operation for passage where water is released through the turbines to generate during the day and over the spillway at night until the reservoir gets too low to use the spillway. The split outlet operation is expected to result in approximately 60% of the daily flow to go over the spillway (or RO once within 100’ and 40% through the penstock and turbines.

Total dissolved gas (TDG) conditions downstream of Detroit and Big Cliff dams will also be used to shape spill operations, and elevated TDG should be avoided when sensitive species (e.g., sac-fry) are present below Detroit and Big Cliff dams.

Purpose: Strategic use of the spillway and turbines for downstream fish passage and temperature management.

Intended Benefit: to provide downstream fish passage in the spring.

Table 2.8.3.2a. Detroit Dam Interim Operation.

Dam	Detroit
Duration (hours/days)	Dusk to dawn
Estimated Start Date	1 Apr (when rule curve rises to 1541’) to prevent modeling spill during flood events.
Estimated End Date	15 Nov (End of conservation season) to prevent modeling spillway spill during flood events.
Recurrence Interval	Annually
Max pool elevation (ft, proj datum)	Rule curve
Outlet (RO/spillway/etc.)	Spillway
Min flow (cfs)	–
Max flow (cfs)	–
Additional Information (ex head restrictions)	Minimum gate opening of 1.5 ft (this isn’t included in the ResSim model)

Big Cliff Spread Spill for TDG Abatement (Injunction Measure 10/Interim Measure 6)

Description:

Spread spill across multiple spill bays at Big Cliff Dam, when operating the spillway, to reduce TDG levels. When spill is necessary at Big Cliff Dam, some benefit can be realized from spreading spill across the spillway, using multiple spill bays; however, minimum gate opening constraints preclude USACE from spreading spill under many flow regimes. Additionally, TDG is also generated by Detroit Dam operations, particularly when a non-turbine unit is used to discharge water. In this case, spreading spill at Big Cliff Dam does not prevent/abate TDG levels that are generated by Detroit Dam.

Purpose: Spread spill across spillways

Intended Benefit: reduce downstream TDG exceedances

Table 2.8.3.1a. Big Cliff Interim Operation.

Dam	Big Cliff
Duration (hours/days)	24/7
Estimated Start Date	–
Estimated End Date	–
Recurrence Interval	Annually
Max pool elevation (ft, proj datum)	1182 ft (min. conservation pool); 1206 ft (max. conservation pool)
Outlet (RO/spillway/etc.)	Spillway
Min flow (cfs)	4740
Max flow (cfs)	5070
Additional Information (ex head restrictions)	The minimum gate opening for spill operations of each spill bay at Big Cliff is 0.75 feet.
Notes	Operation is to spread spill when spillway flows are above 4,740 cfs; no change in amount spilled, just number of bays. Therefore, not modeled.

Elevated TDG is generated when water is passed through the non-turbine outlets at Detroit and Big Cliff dams. The turbine units at either project are not known to produce increased levels of TDG. The Big Cliff turbine is less harmful on fish and downstream water temperature and should be utilized to the extent possible to reduce downstream TDG levels. When spill is necessary at Big Cliff Dam, due to maintenance activities or involuntary high flow events (when outflow exceeds the capacity of the turbine), spreading spill across multiple spill bays at Big Cliff Dam will reduce TDG.

Implementation: The total volume of water that can pass through the turbine intakes varies by reservoir elevation and ranges from 2810 – 3200 cfs. Flows that exceed this range must be split between the powerhouse and spillway and are generally observed during high flow, or involuntary spill events.

The minimum gate opening for spill operations of each spill bay at Big Cliff is 0.75 feet. This equates to discharges that range from 770 cfs – 1130 cfs for reservoir elevations of 1182 ft. (min. conservation pool) and 1206 ft. (max. conservation pool), respectively. Under the lowest of reservoir elevations, flows cannot be spread between two bays until the total outflow is greater than 4740 cfs, which is the sum of the discharge from two spill bays at minimum gate opening plus powerhouse capacity [(770 cfs + 770 cfs = 1540 spill) + (3200 cfs powerhouse) = 4740 cfs total flow]. Under the highest reservoir elevations, flows cannot be spread between two bays until the total outflow is greater than 5070 cfs, which is the sum of the discharge from two spill bays at minimum gate opening plus powerhouse capacity [(1130 cfs + 1130 cfs = 2260 cfs spill) + 2810 cfs (powerhouse) = 5070 cfs (total flow)]. Without large flow conditions, spreading spill is limited at Big Cliff Dam.

2.8.4 South Santiam River Interim Operations

Green Peter Outplanting Plan (Injunction Measure 11)

Description:

Adult fish, captured at the Foster adult fish facility, will be outplanted above Green Peter from May –September. Offspring from these adult salmon are expected to emerge and pass Green Peter Reservoir and dam. Potential outplanting sites have been identified. USACE is working with the U.S. Forest Service, Bureau of Land Management, and private landowners.

Purpose: Reintroduction (outplanting) of adult Chinook salmon in the watershed upstream of Green Peter

Intended Benefit: benefit the salmon population in the South Santiam basin due to large areas of spawning habitat.

Green Peter Spring Downstream Fish Passage (Injunction Measure 12a)

Description:

Flows of 800 to 1,000 cfs have been shown to successfully pass juvenile fish at other projects in the region and therefore, are expected to successfully pass fish in the Green Peter reservoir from the spillway for downstream passage. Begin spill once the reservoir reaches spillway crest, or El. 971 ft. and implement continuous spill release until May 1 or for at least 30 days, whichever is longer. Reservoir elevations during this operation are expected to range from 971 ft. to 1005 ft. and spill is expected to range from a minimum of 460 cubic feet per second (cfs) to 3,000 cfs, based on the Green Peter spillway rating table, with a minimum gate opening of 1.5 feet. Based on optimal gate openings, 60% of the daily flow will be passed over the spill when the reservoir is between elevations 971’ and 985’. Once the reservoir is at 986’ or higher, then the spillway will be used to pass all flow.

Purpose: continuous spill

Intended Benefit: improved fish passage

Table 2.8.4.2a. Green Peter Spring Interim Operation

Dam	Green Peter
Duration (hours/days)	Continuous
Estimated Start Date	Begin spill once the reservoir reaches spillway crest, or El. 971 ft.
Estimated End Date	May 1 or for at least 30 days, whichever is longer.
Recurrence Interval (X yrs)	Annually
Min pool elevation (ft, proj datum)	971 ft
Max pool elevation (ft, proj datum)	Rule curve
Outlet (RO/spillway/etc.)	Spillway
Min flow (cfs)	800
Max flow (cfs)	2,825 cfs
Additional Information (ex head restrictions)	Flows based on the Green Peter spillway rating table, with a minimum gate opening of 1.5 feet

Green Peter Fall Downstream Fish Passage (Injunction Measure 12b)

Description:

In early September, begin drawing Green Peter Reservoir down to reach a targeted elevation of 780 ft. by early- to mid-November. This targeted elevation is approximately 35 feet over the regulating outlets (ROs) at Green Peter Dam. As soon as the reservoir is drawn down below minimum power pool (El. 887 ft.), all water will be discharged through the ROs exclusively unless downstream water quality and/or high flow events dictate otherwise. The reservoir will be held at El. 780 ft. until 15 December. On 16 December, refill will begin and continue, according to rule curve for the spring spill operation. When refilling Green Peter, outflows may be very low, if not zero.

Purpose: Draw down Green Peter Reservoir to approximately 35 feet over the ROs (780 ft).

Intended Benefit: improved fish passage.

Table 2.8.4.3a. Green Peter Fall Interim Operation.

Duration (hours/days)	Continuous
Estimated Start Date	Early September
Estimated End Date	15 December
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	780 ft
Outlet (RO/spillway/etc.)	RO
Min flow (cfs)	800 during spillway fish spill operations
Max flow (cfs)	2,825 (1 Sep – 15 Oct)
Additional Information (ex head restrictions)	Flows based on the Green Peter spillway rating table, with a minimum gate opening of 1.5 feet

To supply power to the dam during this operation, electricity will be pulled from the grid to power the regulating outlets and auxiliary systems as much as possible. In addition, a backup power source is required to ensure redundancy in the event that the primary power source is unavailable and will be supplied by back-up diesel generators. Although the dam has an emergency backup diesel generator, the cooling water supply is located about 100 ft above the targeted elevation for this fall drawdown, so the current generator will not be useable. This generator is also undersized for this project and is not reliable at remote start. Therefore, a temporary diesel generator will be installed at the powerhouse to supply backup to the line.

Also, because of previously identified issues with north side of Spillway/RO stilling basin, priority usage of the south (#2) RO gate is recommended. Under high flow events, spreading spill is acceptable to Dam Safety, but to the extent possible avoid use of the north (#1) regulating outlet and/or spillway gate.

Minimum gate openings will be observed at all times to avoid gate vibrations.

Foster Spring Downstream Fish Passage (Injunction Measure 13b)

Description: From February 1 – May 15, delay the refill of Foster Reservoir and hold at minimum conservation pool (El. 613-615 ft.). The spillway will be operated at night from one hour before sunset to one-half hour after sunrise; one turbine unit will be operated for station service (~300 cfs), and to reduce/balance TDG levels created by the spill operation. From May 16 – June 15, Foster Reservoir will refill using storage from Green Peter Reservoir and South Santiam inflow. The night spillway-only operations will continue with flows from one turbine as described above.

The fish weir provides warmer surface water from the reservoir to raise river temperatures and aid in attracting adult salmon to the Foster Adult Fish Facility (AFF) for collection, from June 16 to mid/late July. The fish weir will be operated at a 300 cfs flow with the duration of operation depending on storage in both Green Peter and Foster Reservoirs, and biological need (i.e., numbers of adult Chinook salmon collected at the AFF). Close coordination with the Flow Management and Water Quality Team (FMWQT) and the Foster Fish Facility manager will be necessary for the intra-seasonal management of this operation.

Purpose: Delayed Refill followed by fish weir flow.

Intended Benefit: Improved fish passage.

Table 2.8.4.4a. Foster Spring Interim Operation.

Dam	Foster
Duration (hours/days)	4pm – 8am (at night from one hour before sunset to one-half hour after sunrise)
Estimated Start Date	Delayed Refill start: 1 February Operate Fish Weir: 16 June
Estimated End Date	Delayed Refill end: 16 May Operate Fish Weir: Mid/late July - the duration of operation depending on storage in both Green Peter and Foster Reservoirs and biological need
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	minimum conservation pool (El. 613-615 ft.) until refill starts on 16-May
Outlet (RO/spillway/etc.)	Spillway at night, one turbine unit will be operated for station service (~300 cfs), and to reduce/balance TDG levels created by the spill operation.
Min flow (cfs)	Fish weir flow: 300
Max flow (cfs)	NA

Foster Fall Downstream Fish Passage (Injunction Measure 13a)

Description: Starting just after Labor Day weekend, gradually draw down Foster reservoir to target a forebay elevation of 620-625 ft by October 1. Beginning on October 1, utilize the spillway to pass fish at night, while generation occurs during the day. Carry out through December 15.

Purpose: Fall drawdown and night-time spillway operation.

Intended Benefit: Improved fish passage.

Table 2.8.4.4a. Foster Fall Interim Operation.

Dam	Foster
Duration (hours/days)	Drawdown: continuous Spillway Operation: at night Turbines: day
Estimated Start Date	1 October
Estimated End Date	15 December
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	620-625 ft by October 1
Outlet (RO/spillway/etc.)	Spillway at night
Min flow (cfs)	NA
Max flow (cfs)	NA
Additional Information (ex head restrictions)	–
Notes	–

2.8.5 McKenzie River Interim Operations

Cougar Fall and Spring Drawdown for Downstream Fish Passage (Injunction Measures 14 and 15a)

Description:

Fall Operation: Draw down Cougar Reservoir below minimum conservation pool (El. 1532 ft.) to provide a surface-oriented flow through the regulating outlets. This drawdown targets an elevation of El. 1505 +/- 5 ft in the fall, or approximately 27 ft below normal winter reservoir elevation.

Prioritize the ROs throughout the implementation of this operation. However, some station service (a 150 cfs release through the turbine unit) may be required early on to ensure no loss of remote flood risk management capability due to issues with the operability of the emergency diesel generator, which is the only automatic back-up power source for the facility in the event of an unanticipated loss of line power. Refill begins in December and operations will transition to nighttime RO releases and daytime generation.

During storms and flood risk reduction events, USACE and NMFS may jointly decide to allow the reservoir to fill rather than use the turbines to increase outflows out of Cougar Dam and develop a strategy to manage water releases following this and future storm events. Once the storm passes, RO discharges will be increased to draw the reservoir back to the targeted elevation of 1505 ft. as quickly as possible.

The ROs at Cougar Dam are known to produce elevated downstream TDG when releases are in excess of 800 cfs. Modest increases in downstream TDG are expected to be less detrimental to the life history stages in the reach downstream of Cougar at that time of year than passing juvenile fish through the turbine units.

Cougar will be allowed to refill back to El. 1532 ft. starting on December 15, along with nighttime RO usage and daytime generation.

Spring Operation: On February 01, the refill of Cougar Reservoir will be delayed until May or June depending on water conditions (i.e., wet, average, dry). In dry years, Cougar Reservoir may be refilled as early as May 01, while in wet years, refill may not begin until June 01. The goal is to start refill early enough that the reservoir can reach El. 1571 ft. by summer so that the Cougar Water Temperature Control Tower (WTCT) weirs can be used for downstream water temperature management.

On June 2, switch to all powerhouse.

Cougar Reservoir should not be drawn down below the elevation of the saddle dam during fish passage operations.

Table 2.8.5.1a. Cougar Dam Fall and Spring Interim Operations.

Dam: Cougar	Fall	Spring
Duration (hours/days)	Continuous RO	
Est. Start Date	1 September	Drawdown starting 1 March; reach target elevation by 1 April
Est. End Date	15 December Post refill Nighttime RO/Daytime Turbine Operation ends: continue through early summer and while the spring delayed refill operation (Inunction Measure 15a) is being implemented. 16 Dec refill to min con (1532) hold until 1 March	15 May; refill as high as possible with min flow of 300 cfs
Recurrence Interval (X yrs)	Annually	Annually
Max pool elevation (ft, proj datum)	Drawdown: 1505 ft +/- 5 ft (November target date)	1520 ft
Outlet (RO/spillway/etc.)	Prioritize RO for drawdown RO (night) and Turbine (day) during refill	Prioritize RO for drawdown RO (night) and Turbine (day) during refill
Min flow (cfs)	N/A	–

Dam: Cougar	Fall	Spring
Max flow (cfs)	880 cfs (spawning Sep - Dec) 750 cfs RO max	–
Additional Information (ex head restrictions)	Add turbines if flow above 800 cfs	–

Purpose: Fall and Spring Drawdowns to below minimum conservation pool.

Intended Benefit: Improved downstream fish passage.

2.8.6 Middle Fork River Interim Operations

Hills Creek Dam Downstream Fish Passage (Injunction Measure 8/Interim Measure 20)

Description: USACE will implement regulating outlet spill operations daily from 6:00 PM to 10:00 PM at Hills Creek Dam once the reservoir elevation is 50 feet or less above the regulating outlets in the fall through March 1.

Purposed: Prioritize discharges through the RO at night rather than through the turbines.

Intended Benefit: To improve downstream passage conditions for juvenile Upper Willamette River Chinook salmon by encouraging juvenile fish passage through the ROs instead of the turbines during periods when juvenile fish are most likely to be migrating downstream.

Table 2.8.6.1a. Hills Creek Dam Fall Interim Operation.

Dam	Hills Creek
Duration (hours/days)	daily from 1800 to 2200 (equates to ~17% of daily flow)
Estimated Start Date	once the reservoir elevation is 50 feet or less above the regulating outlets in the fall
Estimated End Date	March
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	1,459 ft or below
Outlet (RO/spillway/etc.)	RO
Min flow (cfs)	NA
Max flow (cfs)	NA
Additional Information (ex head restrictions)	NA
Notes	–

***Lookout Point Fall Downstream Passage Operations (Injunction Measure* 16)**

Description: Drawdown the reservoir, starting in July, to reach target elevation of 761' in mid-November.

Purpose: Deep drawdown and RO prioritization for improved downstream fish passage

Intended Benefit: To improve downstream passage conditions for juvenile Upper Willamette River Chinook salmon by encouraging juvenile fish passage through the ROs instead of the turbines during periods when juvenile fish are most likely to be migrating downstream.

Table 2.8.6.2a. Lookout Point Dam Fall Interim Operation.

Dam	Lookout Point
Duration (hours/days)	24/7
Estimated Start Date	1) Draft reservoir beginning July 1, at a rate to achieve the Oct 1 rule curve elevation on Sept 1. 2) During the spawning season (Sept 1 to Oct 15), the total discharge from the dam will be maintained at or below the maximum flows for spawning (3500 cfs). 3) After the spawning season ends Oct 15, the draft rate will then be revised as needed to achieve the Nov 15 target elevation of 761 ft on November 10. 4) Pool target elevation will be achieved beginning at the earliest Nov 15, and the latest Dec 15.
Estimated End Date	Maintain target elevation as feasible for 3 weeks, but no later than Dec 15. Then refill to minimum conservation pool as feasible.
Recurrence Interval (X yrs)	Annually
Max pool elevation (ft, proj datum)	761 ft
Outlet (RO/spillway/etc.)	RO Limit turbine operations to between the hours of 1000 to 1800 between July 1 and December 15 whenever the reservoir elevation is at or below 50 ft over the top of the penstock
Min flow (cfs)	NA
Max flow (cfs)	NA
Additional Information (ex head restrictions)	NA

Lookout Point Spring Downstream Passage and Summer/Fall Temperature Management Operations (Injunction Measure 17)

Description:

Use storage from Hills Creek Reservoir to begin refilling Lookout Point Reservoir in early March. Once Lookout Point Reservoir elevation is 2.5 feet over spillway crest (El. 890 ft.), start continuous, ungated spill using as many gates (5 are available) as needed to approximate the rate of inflow to maintain the reservoir level between El. 890-893 ft. for as long as water conditions allow, for at least 30 days at both Lookout Point and Dexter dams. Operate the Lookout Point powerhouse only as needed to remain within the desired reservoir elevation limits, or to control downstream TDG. After that initial 30-day period, refill pool as hydrology allows and spill (gated) at night at both projects, with generation during the day, for as long as water is available and downstream conditions allow. Then manage Lookout Point Reservoir to achieve elevation 887.5 ft by July 15 and operate the regulating outlets as needed to reduce downstream water temperatures when water temperatures downstream of Dexter Dam near 60 degrees.

Purpose: Utilize spillway for improved downstream fish passage in the spring; use RO in the summer and fall for downstream temperature management

Intended Benefit: To improve downstream passage conditions for juvenile Upper Willamette River Chinook salmon by encouraging juvenile fish passage through the ROs instead of the turbines during periods when juvenile fish are most likely to be migrating downstream and improve water temperatures downstream of Lookout Point dam.

Table 2.8.6.3a. Lookout Point Spring Downstream Passage and Summer/Fall Temperature Interim Operations.

–	Spring Fish Passage (Spillway)	Spring Fish Passage (Spillway)	Summer/Fall Temperature (ROs)
Duration (hours/days)	24 /7	Spillway: 50% (daily) Turbine: 50% (daily)	–
Estimated Start Date	15 March	1 May	15 July
Estimated End Date	1 May (or until reservoir is below 890')	31 May (or until reservoir is below 890')	~15 October
Recurrence Interval (X yrs)	Annually	Annually	Annually
Min pool elevation (ft, proj datum)	890 ft	890 ft	
Max pool elevation (ft, proj datum)	893 ft	926 ft	887.5 ft
Outlet (RO/spillway/etc.)	Spillway (ungated)	Spillway (gated) Turbine	RO (with turbine use)
Min flow (cfs)	NA	NA	–
Max flow (cfs)	NA	NA	–

CHAPTER 3 - REFERENCES

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Attachment 1. Initial Measures Screening

THE DEIS HAS BEEN MODIFIED TO INCLUDE THE FOLLOWING INFORMATION IN THE FEIS

Measures Used to Develop a Preliminary Range of Reasonable Alternatives

A list of measures, or actions, that would meet at least one of the objectives was developed. These measures were formulated based on input from the public scoping comments and Cooperating Agencies.

Potential measures were then screened. Each measure had to meet the purpose and need for the Proposed Action, life safety constraints, and achieve at least one of the seven objectives. Each measure also had to be technically feasible, and not result in unacceptable adverse environmental effects. Section 1.1, Overview of Alternatives Development, provides detail on how measures were developed, screened, and incorporated into an alternative.

Those measures retained after applying screening criteria were then incorporated into alternative options. Measures were incorporated in combinations or around unifying management strategies. An alternative is, therefore, a combination of one or more measures that, together, would address one or more of the USACE objectives described in Section 1.1.1, Overview of Alternatives Development.

Screening criteria including the purpose and need statement were painstakingly developed after significant input from Cooperating Agencies and consideration of the scoping comments; these criteria were then reevaluated after comments on the DEIS. Several measures were proposed during scoping and during the public comment period that were formally analyzed against these screening criteria and then dismissed from further analysis because they failed to meet the criteria. For example, several commentors suggested measures that would abandon hydropower while others asked for measures that would only allow USACE to operate for flood control. These measures were not carried forward for further analysis for the reasons below.

NEPA requires the analysis of a reasonable range of alternatives. Screening criteria were used to ensure a hard look at actions was taken that would accomplish the objectives. NEPA does not require endless resources and time to conduct a detailed analysis of every permeation of an alternative that could exist. Instead, the agency is charged with not arbitrarily narrowing the scope of analysis, while also using screening criteria and professional judgement to focus resources on a reasonable range of alternatives that would accomplish its objectives.

USACE drafted its purpose and need statement to address the immediate need of complying with the ESA because of ongoing litigation challenging its compliance with the Act. The ESA requires that agencies act, not complete endless studies in hopes of eventually taking an action. Given this important charge under the ESA, USACE chose to draft a purpose and need statement that would screen out measures that would eliminate a project purpose. USACE took a broad interpretation of this phrase to include measures that would significantly impact those purposes but would not eliminate them from being carried out once in the period of record analyzed. For example, if hydropower could be generated at a project for even a single day across the 50 years analyzed then the measure was not screened out. This broad interpretation was developed with the help of Cooperating Agencies requesting meaningful actions considered for the species that were not limited by the USACE's current authorities. In contrast, if a measure prevented hydropower generation completely, it was screened from further analysis.

USACE understands that NEPA allows agencies to look outside their current authorities when analyzing alternatives, so it included measures in the EIS that are beyond its current Congressional authorities. It did not analyze the elimination of a Congressionally authorized purpose as more appropriate studies to evaluate measures or alternatives that require the deauthorization of a purpose include, but are not limited to, general investigations and disposition studies. For example, as authorized by Section 216 of the Flood Control Act of 1970, a Disposition Study could evaluate and determine whether the hydropower purpose at WVS dams should be deauthorized. Whereas a general investigation study would allow a broad look at how the projects could be operated with or without any of the current authorities providing significantly more operational flexibility than the deauthorization of hydropower alone.

END NEW TEXT

Measure No.	Developed By	Project Purpose	Measure Name	Measure Category	General Description	Marked 'X' if kept for further analysis	Measure outside of USACE Authorities	Measure is part of NAA	Measures outside of the scope of the WVS EIS	Duplicate under the same theme	This is an objective, not a measure	Measure being addressed by other projects/entities (Flow Chart #1)	Measure completely eliminates one or more project purposes (Flow Chart #2)	Measure Compromises Dam Safety (Flow Chart #3)	Structural measure NOT for ESA-listed species (Flow Chart #4)	Measures removed to Impacts Analysis	Potential Mitigation Measure
1	USACE	FRM	FRM - easements	Real Estate	Aquire flowage easement in downstream areas (between bankfull and floodstage) to provide flexability on FRM and potentially provide env benefits.	X											
2	USACE	O&M	Lower Minimum Conservation Pool Elevation	Water Control Diagram	Lower Minimum Conservation Pool at non-hydropower dams (more space in reservoir during FRM period for flood storage)	X											
3	USACE	O&M	Lower Maximum Conservation Pool Elevation	Water Control Diagram	Lower Maximum Conservation Pool (further reduce flood risk)	X											
4	USACE	FRM	Adaptive Water Control Diagram	Water Control Diagram	Create Climate Adaptive Rule Curves - long-term adaptive management actions	X											
5	USACE	FRM	Improved Forcasting Water Control Diagram	Water Control Diagram	Utilize improved forecasting capability (flexibility band around existing rule curve) - short-term management actions	X											
6	USACE	FRM	Watershed Response Based Water Control Diagram	Water Control Diagram	Develop and apply better understanding of watershed response in context of better weather forecasting	X											
7	USACE	O&M (FRM)	Delay Spring Refill	Water Control Diagram	Delay spring refill					X, captured by other measures							
8	USACE	FRM	Reconnect Floodplains - revetments	Revetments	Remove revetments - reconnecting flooplain to increase FRM.	X											
9	USACE	FRM	Revetment as-built repairs	Revetments	Repair revetments	X											
10	USACE	FRM	Setback levees - revetments	Revetments	Add levees (as mitigation to F&W measure)												X
11	USACE	FRM	Revetment as-built repairs	Revetments	Maintain/repair existing levees				X								
12	USACE	FRM	Create additional storage (ponds)	Structural	Create Storage Ponds										X		
13	USACE	FRM	Additional Control Points	Structural	Expand Control Points - improve how we measure unregulated flow/real time flood management	X											
14	USACE	O&M (FRM)	Clear spillway channels	Operations	Clean out spillway channels.					X							
15	USACE	FRM	Dredge reservoirs	Flood Risk Management	Expand existing storage - dredge reservoir sediment	X											
16	USACE	O&M (FRM)	Armor Dams	Structural	Armor dam structures					X							
17	USACE	F&W	Reduce Ramping Rates	Ramp Rates	Reduce ramping up/down rates to minimize damage to archeological site and F&W habitat (mussels, turtles etc.)	X											
18	USACE	FRM	Maximum Discharge Rates	Water Control Diagram	Better understanding of max discharge rates to manage floods (when can we go above max discharge rates and not effect FRM)	X											
19	USACE	F&W	Reduce Drawdown Flow Rates	Water Control Diagram	Reduce drawdown flow rates	X											
20	USACE	FRM	Earlier Drawdown (Fall)	Water Control Diagram	Evacuation earlier to increase fall FRM	X											
21	CTGR	FRM	Cultural Resources	Operations	Cultural Resource impact study											X	
22	CTGR	F&W	Floodplain connectivity	Habitat	Explore opportunities/strategies for floodplain reconnection and passage improvement, targeting "bottlenecks" that would open up large areas of habitat / reconnect important floodplain areas.	X											

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23	USACE	WQ	Limit Spill	Water Control Diagram	Limit spill at dams						X						
24	USACE	WQ	Variable Hydrology Flexible Water Control Diagram	Water Control Diagram	Flexible rule curves for adaptively manage variable hydrology	X											
25	USACE	WQ	Power Pool Modification	Water Control Diagram	Modify/remove power pool [would need congressional authorization] (BPA Edit in Red)								X				
26	USACE	WQ		Structural	Temperature Control Structure					X							
27	USACE	WQ		Water Control Diagram	Operate reservoir as run of river												
	CTGR	WQ		Operations	Cultural Resource impact study												
29	USACE	HDR		Water Control Diagram	Change ramp rates for improved flexibility.					X							
30	USACE	HDR		Downstream Flows	Change minimum flows for increased flexibility.	X											
31	USACE	HDR		Operations	Flow continuation valves/ structural [or operational] fish passage measures/ structural temperature control =>maintain flexibility and use	X											
32	USACE	HDR		Operations	Prioritize based on market demand and eliminate where not needed. [would need deauthorization]					X							
33	USACE	HDR		Operations	Minimize days of spill and [?] and optimize turbine operations in deficit water years.					X							
34	USACE	HDR		Water Control Diagram	Hold reservoir higher at key hydro dams. [This is ambiguous- operations would need to be consistent with existing authorizing legislation and other relevant statutes, HD 531, and water control manuals, plans, and diagrams]	X											
35	USACE	HDR		Operations	Add flow continuation valves to turbines.					X							
36	CTGR	HDR		Operations	Cultural Resource impact study					X							
37	BPA	HDR	Caretaker Status	Operations	Put hydropower generation and equipment on caretaker status at one or more project hydropower facilities.	X											
38	BPA	HDR	Levels of Service	Operations	Consider alternative operations, maintenance and capital reinvestment practices that align with each hydropower facility's relative importance in the power system	X											
39	USACE	F&W		Revetments	Revetment modification/removal to increase habitat connectivity for ESA and native fish needs in main stem					X							
40	USACE	F&W		Fish Passage	Deeper fall drawdowns to RO for downstream passage	X											
41	USACE	F&W		Fish Passage	Deep drawdown to lower RO					X							
42	USACE	F&W		Habitat	Improve/ restore stream habitat U/S from Foster for ESA fish spawning and incubation	X											
43	USACE	F&W		Habitat	Improve/ restore stream habitat in Breitenbush, N. Santium U/S from Detroit for ESA fish spawning, incubation, and rearing.					X							
44	USACE	F&W		Habitat	Restore off-channel habitat for non-ESA	X											
45	USACE	F&W		Fish Passage	Eliminate/control sea lions at Willamette Falls and downstream							X					
46	USACE	F&W		Revetments	Remove revetments from areas of low value (for bank protection) to improve habitat. Setback levees (revetments for others).					X							
47	USACE	F&W		Fish Passage	Operate for run of river at Detroit, Green Peter, Cougar, Blue River, Hills Creek, Lookout Point [would need deauthorization]								X				
48	USACE	F&W		Structural	Create alternate river channels around populated areas to increase river flows generally while controlling/maintaining flood risk										X		
49	USACE	F&W		Habitat	Designate habitat restoration projects that may enhance the flood plain for ESA listed habitat and remove only select revetments with more minor impact and build set-back levees with cost share project with BPA to protect assets while expanding ESA habitat. Use large projects to offset having to do too many "smaller" projects.	X											
50	USACE	F&W		Authorized Purposes	Forego/ modify authorized hydropower purposes in order to increase water availity and operational flexibility for F&W needs. [unlikely to meet hydropower objective; or would need deauthorization]	X											
51	USACE	F&W		Fish Passage	Go to run-of-river in winter (stop hydropower) to pass juvenile fish where possible. [unlikely to meet hydropower objective]								X				
52	CTGR	F&W		Fish Passage	Explore Pacific lamprey passage and reintroduction at projects where deep drawdown/run of river are implemented	X											
53	CTGR	F&W		Operations	Cultural Resource impact study					X							

Measure No.	Developed By	Project Purpose	Measure Name	Measure Category	General Description	Marked 'X' if kept for further analysis	Measure outside of USACE Authorities	Measure is part of NAA	Measures outside of the scope of the WVS EIS	Duplicate under the same theme	This is an objective, not a measure	Measure being addressed by other projects/entities (Flow Chart #1)	Measure completely eliminates one or more project purposes (Flow Chart #2)	Measure Compromises Dam Safety (Flow Chart #3)	Structural measure NOT for ESA-listed species (Flow Chart #4)	Measures removed to Impacts Analysis	Potential Mitigation Measure
54	CTGR	F&W		Fish Passage	Explore opportunities/strategies for floodplain reconnection and passage improvement, targeting "bottlenecks" that would open up large areas of habitat / reconnect important floodplain areas.						X						
55	USACE	Rec		Operations	THEME: Promote & Improve Off-Water Recreation							X					
56	USACE	Rec		Operations	THEME: Improve Water Access at Low Pool							X					
57	USACE	Rec		Operations	THEME: Maintain Pool for Rec / Lower flows during recreation season	X											
58	USACE - 8 Jan	Rec	Non-motorized boating	Recreation	Increase non-motorized boat access - kayaks, drift boats, rafts.				X								
59	USACE - 8 Jan	Rec	More Beaches	Recreation	Create/ maintain public beaches at certain project reservoirs.				X								
60	CTGR	Rec		Operations	Cultural Resource impact study					X						X	
61	CTGR	Rec		Operations	Historic Properties Management Plans at reservoirs							X					
63	USACE	WS		Operations	Create plan for climate change impacts						X						
62	USACE	WS		Authorized Purposes	Prioritize Demand						X						
64	USACE	WS		Water Control Diagram	Modify rule curve					X							
65	USACE	WS		Water Control Diagram	Refill reservoirs earlier	X											
66	USACE	WS		Water Supply	Prioritze reservoirs for storage allocation (e.g., not all reservoirs provide H2O)					X							
67	USACE	WS		Water Control Diagram	Eliminate ramp rates	X											
68	USACE	WS		Operations	Maintain current WVP water supply operations			X									
69	USACE	WS		Downstream Flows	Reduce minimum flows to allow for more storage							X					
70	USACE	WS		Operations	Maximize storage for WS	X											
71	USACE	WS		Operations	Ensure water use is recorded and accounted for			X									
72	USACE	WS		Authorized Purposes	Consider deviation from shared water allocation during water shortages					X							
73	CTGR	WS		Operations	Cultural Resource impact study					X							
74	CTGR	Cultural		Authorized Purposes	Prioritize Demand							X					
75	CTGR	Cultural		Operations	Cumulative Effects							X					
76	ODFW	FRM	(Corps) Create Climate Adaptive Rule Curves - long-term adaptive management actions	Water Control Diagram	Provide rule curve guidance that mimics natural flow regimes and provides needed flexibility in a changing climate.							X					
77	ODFW	FRM	(Corps) Utilize improved forecasting capability (flexibility band around existing rule curve) - short-term management actions	Water Control Diagram	Provide rule curve flexibility that allows/mimics natural flow regimes and provides needed flexibility to anticipate and respond to near-term weather events.				X								
78	ODFW	F&W	(Corps) Delay spring refill	Water Control Diagram	Maintain reservoir lower longer in spring to allow outmigration through lowest, fish-friendly surface outlets, or using spill.	X											
79	ODFW	F&W	(Corps-rev) Change ramp rates for improved flow management flexibility and benefits to F&W.	Fish Passage	Prioritize fish and wildlife resources when developing and implementing ramping rates.							X					
80	ODFW	F&W	(Corps) Reduce drawdown flow rates	Fish Passage	Outflow should mimic inflow with some additional constant flow to evacuate reservoir.						X						
81	ODFW	WQ	(Corps) Flexible rule curve to adaptively manage variable hydrology	Water Control Diagram	Modify rule curves to allow downstream flows to better mimic natural hydrograph where possible.					X							
82	ODFW	F&W	(Corps-rev) Lower/remove power pool to bring pool down to lowest outlets for fish passage	Fish Passage	Part of larger revision of rule curve, incorporate flexibility to draw down reservoirs to improve downstream fish passage success through lower, fish-friendly outlets.	X											
83	ODFW	WQ	(Corps) Operate reservoir as run of river	Water Control Diagram	Operate reservoirs as run-of-river, maintaining flood control operations as needed.								X				
84	ODFW	F&W	Deep fall/winter drawdown to access RO or other low elevation surface outlet with high fish passage survival.	Fish Passage	Deep fall/winter drawdown (below power pool if appropriate) to provide safe and effective downstream fish passage.							X					
85	ODFW	F&W	(Corps) Operate for run of river at Detroit, Green Peter, Cougar, Blue River, Hills Creek, Lookout Point	Water Control Diagram	Operate reservoirs as run-of-river, maintaining flood control operations as needed.				X								
86	ODFW	F&W	(Corps) Forego/ modify authorized hydropower purposes in order to increase water availability and operational flexibility for F&W needs.	Hydropower	Prioritize F&W needs over hydropower by operating for elevations that spill or use lower outlets as surface outlets.						X						
87	ODFW	F&W	(Corps) Go to run-of-river in winter (stop hydropower) to pass juvenile fish where possible.	Water Control Diagram	Operate reservoirs as run-of-river, maintaining flood control operations as needed.					X							
88	ODFW	WS	Evaluate minimum flow requirements in context of increased flexibility to maximize benefits to F&W	Fish Passage	Consider minimum flows in context of maximizing benefits to F&W under current and anticipated conditions, recognizing need to manage trade-offs between listed species. Consistent with BiOps and RPAs.					X							

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89	ODFW	FRM	Allow rule curve flexibility	Water Control Diagram	Replace current rule curve with "rule curve-like" tool to provide management flexibility under a variety of conditions without increasing flood risk.	X											
90	ODFW	F&W	Operate LOP to maximize fish passage spring and fall. Use HCR to augment LOP as needed/appropriate/available.	Fish Passage	Operate HCR and LOP together to provide spill opportunities at LOP while maintaining water supply for various purposes in HCR.					X							
91	ODFW	FRM	(Corps-rev) Acquire property via flowage easement or fee title in downstream areas (between bankfull and floodstage) to provide flexibility on FRM and potentially provide environmental benefits.	Real Estate	Expand functional floodplain by purchasing floodplain via flowage easements or fee title, reducing need to manage flows at lower levels, and possibly reducing flood risk to other vulnerable areas.					X							
92	ODFW	FRM	(Corps) Remove revetments - reconnecting flooplain to increase FRM.	Revetments	Remove revetments of low social/economic value or with high ecological value of removal.				X								
93	ODFW	FRM	(Corps) Repair revetments	Revetments	Repair revetments necessary for flood control/infrastructure protection in an ecologically friendly way. Target revetments prioritized in previous supported studies.				X								
94	ODFW	FRM	(Corps) Add levees (as mitigation to F&W measure)	Revetments	Add new levees set back to protect infrastructure - assumes this action allows other levees less "fish-friendly" to be removed etc				X								
95	ODFW	FRM	(Corps) Maintain/repair existing levees	Revetments	Repair revetments needed for flood control in an ecologically friendly way					X							
96	ODFW	F&W	(Corps) Remove revetments from areas of low value (for bank protection) to improve habitat. Set back levees (revetments for others).	Revetments	Remove or modify revetments of low protective value, prioritizing those that will provide highest F&W benefits. Target to reconnect to habitat, allow gravel movement and floodplain connectivity. Encourage set back levees where protection is necessary.	X											
97	ODFW	F&W	(Corps) Revetment modification/removal to increase habitat connectivity for ESA and native fish needs in main stem, also accomplishes FRM in certain areas	Revetments	Remove/modify high ecological-value priority revetments - prioritize those that will reconnect to habitat, allow gravel movement, improve floodplain connectivity.	X											
98	ODFW	F&W	(Corps-rev) Improve/ restore stream habitat upstream from Green Peter for ESA fish spawning, incubation and rearing. Some habitat improvement opportunities also exist above Foster.	Habitat	Emphasis on improving habitat above Green Peter, although opportunities exist above Foster (area above Foster has more bedrock and incision-transport reach).					X							
99	ODFW	F&W	(Corps) Improve/ restore stream habitat in Breitenbush, N. Santium upstream from Detroit for ESA fish spawning, incubation, and rearing.	Habitat	(Corps) Improve/ restore stream habitat in Breitenbush, N. Santium upstream from Detroit for ESA fish spawning, incubation, and rearing.	X											
100	ODFW	F&W	(Corps) Restore off-channel habitat (and natural function to maintain for fish species) for non-ESA (seasonality - warm summer chub and minnows, winter salmonid rearing)	Habitat	Provide adequate flows to restore natural habitat-forming processes.					X							
101	ODFW	F&W	(Corps) Designate habitat restoration projects that may enhance the flood plain for ESA listed habitat and remove only select revetments with more minor impact and build set-back levees with cost share project with BPA to protect assets while expanding ESA habitat. Use large projects to offset having to do too many "smaller" projects.	Habitat	Strategic large investments in habitat restoration, revetment removal/modifications, set-back levees and acquisitions to maximize impacts for ESA habitat.						X						
102	ODFW	F&W	Gravel/sediment augmentation below dams	Habitat	Augment below-dam habitats with sediment on regular basis.	X											
103	ODFW	F&W	Augment LWD to facilitate natural processes that aren't taking place due to dams, altered flow regimes	Habitat	Augment below-dam habitats with large woody material on regular basis.	X											
104	ODFW	F&W	Sustainable river flows to transport wood, gravel, and other native materials, create new channels etc.	Habitat	Provide ecologically meaningful flows to allow for transport of materials and to create dynamic floodplain habitats.	X											
105	ODFW	WQ	(Corps) Temperature Control Structure	Water Quality	Needed if operate dams under current scenarios (not needed for run of river). See also "Creative use of reservoirs for temperature control…".	X											
106	ODFW	HDR	Operate turbines to reduce impacts to outmigrating fish.	Fish Passage	Capitalize on fish behavior by prioritizing power generation (turbine opration) during the day when fewer fish are migrating. Turn turbines off at night when more fish are migrating.								X				
107	ODFW	F&W	(Corps) Eliminate/control sea lions at Willamette Falls and downstream	Wildlife	Continue successful program of removal of chronic offenders (sea lions) below Willamette Falls.		X		X								

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108	ODFW	F&W	Reactivate historic side channels to reduce flood risk and build flood capacity.	Flood Risk Management	Increase flood capacity by reconnecting historic side channels on the mainstem Willamette.	X											
109	ODFW	Rec	(Corps) THEME: Improve Water Access at Low Pool	Recreation	Extend boat ramps to provide low pool access.										X		
110	ODFW	WS	Prioritize water demands consistent with existing and revised BiOp.	Operations	Prioritize F&W water needs consistent with BiOp.	X											
111	ODFW	WS	(Corps) Ensure water use is recorded and accounted for	Operations	Protect instream flows for F&W consistent with BiOps and RPAs by monitoring water use to inform availability and management.							X					
112	ODFW	WQ	Creative use of reservoirs for temperature control to off-set climate impacts downstream	Water Quality	Recognize reservoirs as cold water assets to be used for downstream temperature moderation. Effects may have limited area of impact, but localized benefits may be realized - use to degree possible.	X											
113	ODFW	F&W	Design and implement ways to reduce to TDG when spilling	Water Quality	Allow increased spill without elevating TDG below dams.	X											
114	ODFW	F&W	Restore as near as possible normative temperatures downstream	Habitat	Consider various ways to achieve more normative water temperatures downstream of dams: run of river, using outlets at different elevations, temperature control structure, remove Dexter (or other dam)	X											
115	ODFW	WS	Change authorizations to put more emphasis on F&W water	Authorized Purposes	Implement requirements from the Willamette Basin Reallocation process to provide flows to benefit F&W resources.	X											
116	ODFW	WS	Implement current and new BiOps fully (F&W flows)	Operations	Implement outcomes from the Willamette Basin Reallocation process to provide flows to benefit F&W resources.	X											
117	ODFW	WS	Maximize storage and operations to address current and future drought/climate change effects and to reduce impacts on F&W.	Water Control Diagram	Evaluate flow and storage under changing environmental condition, building protections for F&W, reservoirs managed to allow flexibility to manage effects of climate change on stream flows (may need higher reservoirs to augment later in season, slower fall drawdown, flexibility to adjust to changing environment.)	X											
118	ODFW	O&M	Manage maintenance schedules to prioritize reduced impacts or risk of impacts to F&W	Operations	Refine maintenance schedules to prioritize reduced impacts to F&W resources.	X											
119	ODFW	F&W	Remove turbines to provide extra outlets for fish passage	Hydropower	Remove turbines to provide safer outlet for fish passage.								X				
120	ODFW	F&W	Create low water outlets at dams to provide fish passage	Structural	Construct low elevation outlets in dams to provide fish-friendly passage option. Requires low pool elevations during peak outmigration periods.	X											
121	ODFW	F&W	Remove dams	Structural	Remove dams.				X								
122	ODFW	WS	Winter storage for improved water availability	Structural	Store "excess" winter water (ex. in off-channel storage ponds, underground, other) to make available when water is less abundant. Maintains flood risk management.										X		
123	ODFW	F&W	Maintain conservation hatchery production to support reintroduction efforts .	Operations	Maintain conservation hatchery production to support reintroduction efforts (includes adequate funding for RME to inform reintroduction efforts and adaptive management into future).	X											
124	NMFS	F&W	Provide access to habitat for Chinook above Hills Creek, Lookout Point and Green Peter; also for steelhead above Green Peter	Habitat	Restore access for adult Chinook and steelhead in areas currently blocked by dams without passage.	X											
125	NMFS	F&W	Operate improved Foster fish weir year-round to improve juvenile migration	Structural	Provide outmigration through Foster weir once improved for safe fish passage							X					
126	NMFS	F&W	Fund and build temperature control tower and fish passage at Detroit and Cougar with modifications to optimize collection and survival.	Structural	Provide safe downstream passage			X									
127	NMFS	F&W	Rebuild Dexter fish facility and improve operations to benefit fish migrating upstream.	Structural	Provide safe upstream passage					X							
128	NMFS	F&W and O&M	Implement and fund monitoring for abundance, productivity, spatial structure, and diversity.	Operations	Implement monitoring of fish populations and changes to benefit F&W	X											
129	ODEQ	WQ		Water Quality	Model and monitor real-time WQ impacts for suite of flows on mainstem (Albany & Salem) in Biop insuficient and deficit years						X						
130	ODEQ	WQ		Water Quality	Confirm and establish that all dams/reservoirs that propose structural improvements in BiOp for water quality are federally authorized for water quality improvement funding						X						
131	ODEQ	WQ		Water Quality	Fund and O&M and restoration of Willamette Greenways and public access areas along the mainstem to protect intact riparian, floodplains, and off channel habitats				X								X

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132	ODEQ	WQ		Water Quality	Fund incentives for private landowners to protect intact riparian, floodplains, and off-channel habitats				X								
133	ODEQ	WQ		Habitat	Improve/restore stream habitat above and below reservoirs in conjunction with passage for ESA fish (e.g. replace lost gravel and habitat below dams) for non-esa and other aquatic life.					X							
134	ODEQ	WQ		Water Quality	Modify land management activities that alter habitat in the tributaries (below dams) in preperation for long term impacts to WQ from change in climate (state, county, and city level)				X								
135	ODEQ	WQ			Revetment modification/removal to increase habitat connectivity for ESA and native fish needs in main stem					X							
136	ODEQ	WQ		Habitat	Establish trading for flow, cold water refugia, riparian protection	X											
137	ODEQ	WQ		Water Quality	Utilize powerpool - Modify authorized hydropower purposes in order to increase water availability for water quality temp improvements					X							
138	ODEQ	WS		Water Quality	Acquire rights for return of instream water supply; trading water amongst users to extend downstream flows							X					
139	ODEQ	WQ		Water Quality	Continue funding for USGS gaging stations			X									
140	ODEQ	WQ		Structural	Explore feasibility of temperature control interim and structural modifications	X											
141	ODEQ	WQ		Habitat	Implement Willamette Basin TMDL actions such as increase the amount of riparian vegetation to improve shade function on tributaries												X
142	ODEQ	WQ		Habitat	Implement Willamette Basin TMDL actions such as incrase the amount of riparian vegetation to improve shade function on tributaries; correct fall flows below projects that lead to elevated fall water												X
143	ODEQ	WQ		Habitat	Implement Willamette Basin TMDL actions such as reserve and increase complexity and connectivity of riparian, confluence, and off-channel habitats					X							
144	ODEQ	WQ		Water Quality	Implement upland BMPs and nutrient management plans that reduce nonpoint source runoff from urban, forestry, industrial, and agricultural practices				X								
145	USACE	F&W		Habitat	Gravel mining from reservoir and move below dams for aquatic habitat	X											
146	USACE	Rec		Structural	Place aeratators where algae blooms occur (recreational areas)										X		
147	USACE	F&W		Wildlife	Reintroduce native mussels												X
148	USACE	O&M			Lower Maximum Conservation Pool (further reduce flood risk)					X							
149	USACE	O&M		Water Control Diagram	Lower minimum conservation pool elevations					X							
150	Public Scoping	F&W		Floodplains	Increase the frequency and duration of inundation of floodplains and side channels refugia and foraging habitat for native fish, including ESA listed species						X						
151	Public Scoping	F&W		Habitat	innovations around flow releases and timing to attempt to mimic historic temperature conditions as much as is practically possible.	X											
152	Public Scoping	F&W		Passage	Upstream and downstream passage at Hills Creek, Lookout Point, and Dexter will be critical for sustaining successful populations of spring Chinook, steelhead, Pacific lamprey, and bull trout.					X							
153	Public Scoping	FRM		Revetments	Develop a cost share program to repair and replace stone revetments on the Willamette River and tributaries.				X								
154	Public Scoping	F&W		Passage	Develop upstream fish passage strategy and operate Cougar Dam as a run-of-river reservoir to promote downstream passage of juvenile salmonids. Investigate similar opportunities for Blue River and other facilities.								X				
155	Public Scoping	FRM		Water Control Diagram	Modify rule curve to provide more natural flow regime downstream to increase floodplain ecosystem functions					X							
156	Public Scoping	F&W		Flood Risk Management	altered flood control operations in low and mid-range water years to guarantee flows downstream of project	X											
157	Public Scoping	WS		Downstream Flows	Consider alternatives for protecting stream flows for the benefit of fish and wildlife						X						
158	Public Scoping	F&W		Passage	Analyze draw-downs of more reservoirs where possible to benefit out-migrating ESA-listed fish. placing fish flow needs as priority after flood control					X							
159	Public Scoping	WS		Authorized Purposes	Evaluate alteratives that do not reserve water in reservoirs for power pools and minimum storage. That could make more water available to meet downstream flow needs and better allow reserovir "drawdown" to aid fish migration					X							
160	Public Scoping	F&W		Floodplains	Manage winter/early spring releases to increase river-floodplain connectivity. Increase inundation frequency and duration of floodplain habitats that provide more productive, lower velocity habitats for juvenile native fish						X						

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161	Public Scoping	Rec		Recreation	Please consider summertime weekend releases in late July through August for the North Santiam. Other rivers become low during this time, and having additional water in the Santiam would help provide for whitewater recreation and bring more people to that area as well providing economic opportunity.	X											
162	Public Scoping	Rec		Recreation	There is a small whitewater feature below the Fern Ridge Dam that is usable in the narrow range from 900-1500 CFS. This is a great & safe spot for beginners to advanced boaters. Please consider adjusting fall draw down schedules to increase whitewater paddling opportunities.	X											
163	Public Scoping	Rec		Recreation	Please consider improving whitewater flows during the fall draw down of Dorena Lake.					X							
164	Public Scoping	Rec		Recreation	Optimization and scheduling (and improved awareness) of fall draw down to support whitewater paddlers on the lower river would support access and use of this resource for intermediate paddlers.	X											
165	Public Scoping	Rec		Recreation	A predictable flow schedule within safe boatable ranges would be ideal build some certainty into the opportunities available for local paddlers. Additionally, one or two planned summer releases for local paddlers would be a huge value to the local community and add to the summer recreation opportunities available that support the local economy.	X											
166	Public Scoping	WQ		Water Quality	1) Reduce water temperatures below Lookout Point and Detroit dams in fall and winter by using the lowest ROs to discharge colder water during drawdown operations.	X											
167	Public Scoping	F&W		Habitat	implementing gravel augmentation below Cougar Dam					X							
168	Public Scoping	F&W		Passage	providing both upstream and downstream fish passage at Fern Ridge										X		
169	Public Scoping	FRM		Flood Risk Management	intentionally allowing flooding to reconnect floodplains					X							
170	Public Scoping	F&W		ESA	North Santiam Subbasin: *Proposed list of additional actions to be considered as part of action alternatives (these actions are in addition to 2008 BiOp requirements, or were included in the RPA but are not currently planned in USACE 2015 Configuration and Operations Plan)*: 1) Drawdown fish passage operations in spring and fall; 2)Spill fish passage operations at Detroit Dam in the spring; 3)Structural improvements at Big Cliff Dam to address TDG	X											
171	Public Scoping	F&W		ESA	South Santiam subbasin: *Proposed list of additional actions to be considered as part of action alternatives (these actions are in addition to 2008 BiOp requirements, or were included in the RPA but are not currently planned in USACE 2015 Configuration and Operations Plan) :* 1) Reintroduction of UWR Chinook and steelhead above Green Peter Dam; 2) Downstream fish passage structures and operations and Green Peter Dam; 3)Temperature control structure or operations at Green Peter Dam					X							
172	Public Scoping	F&W		ESA	South Fork McKenzie subbasin: *Proposed list of additional actions to be considered as part of action alternatives (these actions are in addition to 2008 BiOp requirements, or were included in the RPA but are not currently planned in USACE 2015 Configuration and Operations Plan) :* 1)Drawdown fish passage operations at Cougar Dam in the spring and fall	X											
173	Public Scoping	F&W		ESA	Middle Fork Willamette subbasin: *Proposed list of additional actions to be considered as part of action alternatives (these actions are in addition to 2008 BiOp requirements, or were included in the RPA but are not currently planned in USACE 2015 Configuration and Operations Plan)* : 1)Dexter adult fish facility improvements; 2) Downstream fish passage facility construction at Lookout Point Dam or head of reservoir; 3)Drawdown or delayed refill fish passage operations at Lookout Point Dam in the spring and fall; 4) Spill fish passage operations at Lookout Point Dam in the spring and fall; 5 Reintroduction of UWR Chinook salmon above Hills Creek Dam; 6) Downstream fish passage facility construction at Hills Creek Dam; 7) Drawdown fish passage operations at Hills Creek Dam in the spring and fall; 8) Spill fish passage operations at Hills Creek Dam in the spring and fall; 9)Temperature control structure or operations at Hills Creek Dam; 10) Drawdown or delayed refill fish passage operations at Fall Creek Dam in the spring	X											

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174	Public Scoping	F&W		ESA	System wide: *Proposed list of additional actions to be considered as part of action alternatives (these actions are in addition to 2008 BiOp requirements, or were included in the RPA but are not currently planned in USACE 2015 Configuration and Operations Plan) : 1)* Improve or replace some adult release sites above dams; 2) Remove or modify revetments to improve floodplain connectivity; 3) Maintenance of mainstem Willamette River juvenile monitoring/sampling facility; 4) Interim passage operations prior to completion of downstream passage facilities; 5) Installation and maintenance of new instream flow gages; 6) Research regarding passage design and effectiveness at new facilities and in subbasins with new adult reintroductions above dams; 7) Structural improvements to reduce water quality impacts during emergency and unusual events; 8) Structural improvements to reduce TDG where needed as a result of passage operations; 9) Additional habitat improvement/restoration projects in the lower tributaries and mainstem	X											
175	Public Scoping	FRM		Flood Risk Management	flood storage management using Forecast Based Reservoir Operations (FIRO) application on a programmatic scale leaving each reoperation study the lighter lifts of an EA for any impacts beyond those disclosed in the EIS. Using factors such as weather forecasts, basin wetness, etc., operators can release stored water in advance of a large incoming storm. In doing so, an increase in flood risk management benefits, and in certain cases, an increase in conservation storage, can be accomplished using the existing infrastructure. Use of FIRO would involve conducting review and modification of the Water Control Diagram and possibly the Emergency Spillway Release Diagram for each reservoir.												
176	Public Scoping	F&W		Passage	Interim Measure: Improve volitional downstream passage for juvenile fish using existing facilities. Annually draw down Detroit reservoir to the regulating outlet invert elevation (1,370') by November 15 and hold until December 15, and prioritize discharge through the regulating outlets over power turbines for that time. T	X											
177	Public Scoping	F&W		ESA	Interim Measure: Annually prioritize discharge through the regulating outlets at Green Peter from November 15 through January 31 to enhance juvenile passage; and reinitiate transporting a portion (determined in consultation with NMFS) of the UWR Chinook salmon and steelhead collected at the Foster trap to release points upstream from Green Peter reservoir. This measure would: restore salmon and steelhead to the Middle Santiam River upstream of Green Peter Dam; provide outmigrating salmon and steelhead access to the safest means of passing Green Peter Dam; likely not provide the same level of benefit as deeper drafts or a system that safely and effectively collected and passed fish more frequently; and reduce electrical generation during the period of prioritizing the regulating outlets.	X											
178	Public Scoping	F&W		ESA	Interim measure: Draw down Cougar reservoir to the regulating outlets (elevation 1,505') by November 15 and hold until December 15. Maintain Cougar reservoir at minimum conservation pool (1,532') from March 1 to May 1 and prioritize use of regulating outlets over power turbines for that time. This measure would: provide outmigrating juvenile salmon access to the safest means of passing Cougar Dam; reduce juvenile travel time through Cougar reservoir by reducing the cross-secctional area of the lake, maintaining lower water surface elevation in the spring coincides with juvenile entry, allowing for rapid passage and maintenance of life-history diversity and this measure would reduce the time juveniles were exposed to parasitic copepods; likely not provide the same level of benefit as a system that safely and effectively collected fish more frequently; increase the amount of storage available for flood events during the 30 days of deep draft operation; reduce electrical generation during the period of prioritizing the regulating outlets and refill; slightly reduce the likelihood of refill during dry years	X											

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179	Public Scoping	F&W		ESA	Interim measure: Draw down Lookout Point reservoir to the regulating outlets (elevation 750') by November 15 and hold until at least December 15 and provide free, ungated spill at Lookout Point dam for 2-4 weeks in spring (tentatively March – April, dates to be determined in cooperation with ODFW and NMFS,). This measure would: provide outmigrating salmon access to the safest means of passing Lookout Point Dam; reduce juvenile travel time through Lookout Point reservoir; likely not provide the same level of benefit as a system that safely and effectively collected fish more frequently; increase the amount of storage available for flood events during the 30 days of deep draft operations; reduce electrical generation during the perior of regulating outlets and refill; slightly reduce the likelihood of refill during dry years					X							
180	Public Scoping	F&W		ESA	Interim measure: Maintain the water surface elevation at Fall Creek reservoir at or below 685 feet year-round except as needed to provide downstream flood damage reduction benefits. This measure would be permanent and would: provide salmon access to the safest means of passing Fall Creek Dam; reduce juvenile travel time through Fall Creek reservoir; expose long segments of Fall Creek upstream of the dam, extending available spawning habitat; increase the amount of storage available for flood events by drafting the project deeper; provide the least possible effect on critical habitat throughout Fall Creek while increasing the downstream flood damage reduction benefit; eliminate refill and summer flatwater recreation at Fall Creek Reservoir, however other forms of recreation would be improved; facilitate revegetation of the reservoir footprint and stabilization of the Fall Creek channel upstream from the dam. Under current temporary drawdown operations, drawdown exposes large areas of unvegetated sediment and considerable sediment is entrained in the project's discharge stream. This adversely affects both water quality (turbidity) and channel morphometry (aggradation). Because over 50 years of sediment has accumulated in the reservoir footprint, there is ample supply to continue this process if not arrested. By eliminating refill and inundation of the reservoir footprint, a permanent drawdown would facilitate revegetating the disturbed reservoir footprint and stabilizing the active channel banks, thereby reducing sediment movement.; Because this measure is likely to be highly successful, information gleaned through research, monitoring, and evaluation would provide valuable information for improving passage at other facilities	X											
181	Public Scoping	F&W		Water Quality	Interim measure: Improve downstream water quality using existing facilities. Use the lower and upper regulating outlets at Detroit Dam as needed to control discharge water temperatures and prioritize meeting downstream water temperature targets over power generation during the fall. This measure would improve the reproductive success of Chinook salmon that spawn downstream from the project.	X											
182	Public Scoping	F&W		Flood Risk Management	Long term measures: Evaluate flood damage reduction operations to determine if more moderate operations could provide the same flood and project protection as current operations with less severe impacts on streamflow and fish habitat. Specifically, currently during flood events the Corps reduces project discharge by storing incoming water, then releases the stored water once the peak flow has passed and the flood risk abated. In the past this has resulted in the project going from minimum discharge to very high discharge rates very fast. This is hard on the ESA-listed fish and other aquatic biota. At times, such operations are prudent as one storm can come after another and storage is needed quickly. At other times, storm events are spaced out and such operations are overly harsh. The Corps should evaluate using available meteorological and hydrological data, predictive models, and professional judgement to reduce the difference in discharge during and immediately after flood events.						X						
183	Public Scoping	F&W		ESA	Long term measure: The Corps and NMFS should develop and implement a long-term WVP configuration and operation plan that provides a high potential for recovery of the species. Such a plan will include both water temperature control and fish passage systems and an aggressive time-line for design and construction of these facilities, as well as a protective instream flow regime. However, it is clear that full implementation of a long-term solution will take more than ten years and additional interim measures to those listed above may be appropriate. The alternative adopted should provide for adaptive management throughout the duration of the proposed action						X						

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184	Public Scoping	Rec		Water Control Diagram	usability of Fern Ridge Reservoir to operate in March and October	X											
185	USACE - 4-6 DEC Charrette	HDR		Hydropower	Add more capacity to add more power to existing facilities.	X											
186	USACE - 4-6 DEC Charrette	HDR		Hydropower	Be more efficient with our current hydropower technology.						X						
187	USACE - 4-6 DEC Charrette	HDR		Structural	Add new power to the Willamette Valley (i.e., wind, solar).										X		
188	USACE - 4-6 DEC Charrette	HDR		Structural	Build more hydropower dams.										X		
189	USACE - 4-6 DEC Charrette	HDR		Structural	Add pump storage to dams.										X		
190	USACE - 4-6 DEC Charrette	HDR		Structural	Build solar panel fields.										X		
191	USACE - 4-6 DEC Charrette	HDR		Structural	Add hydropower to all dams.										X		
192	USACE - 4-6 DEC Charrette	HDR		Structural	Add instsream power generating units in tailrace.										X		
193	USACE - 4-6 DEC Charrette	HDR		Water Control Diagram	Go to run-of-river in winter (stop hydropower) to pass juvenile fish where possible.								X				
194	USACE - 4-6 DEC Charrette	HDR		Structural	Construct new penstock intake at tower elevation to use more of the pool.	X											
195	USACE - 4-6 DEC Charrette	HDR		Structural	Look at alternative renewable energy resources.										X		
196	USACE - 4-6 DEC Charrette	HDR		Structural	Transmission line upgrades.							X					
197	USACE - 4-6 DEC Charrette	HDR		Hydropower	Optimize turbine operations in deficit water years.					X							
198	USACE - 4-6 DEC Charrette	HDR		Structural	Consider pumping to refill at night to capture solar/ wind energy (i.e., maximize redwable energy between wind/ pump storage/ solar/ hydro).										X		
199	USACE - 4-6 DEC Charrette	HDR		Structural	Supplement hydropower with other energy to redue need for power pool.										X		
200	USACE - 4-6 DEC Charrette	HDR		Hydropower	Ensure most efficient equipent is installed at all hydro dams.						X						
201	USACE - 4-6 DEC Charrette	HDR		Structural	Add units to projects (and add penstock capacity).										X		
202	USACE - 4-6 DEC Charrette	HDR		Structural	Flow continuation valves/ structural fish passage measures/ structural temperature control =>maintain flexibility and use										X		
203	USACE - 4-6 DEC Charrette	HDR		Structural	Build solar or wind power in resevoir footprint so that you use same transmission system, then dam water flows through outlet that is better for fish passage.										X		
204	USACE - 4-6 DEC Charrette	HDR		Hydropower	Prioritize based on market demand and eliminate where not needed.							X					

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205	USACE - 4-6 DEC Charrette	HDR		Hydropower	Replace turbines with bigger and better units.	X											
206	USACE - 4-6 DEC Charrette	HDR		Hydropower	Run HDR only part of the year (to maximize fish recovery).								X				
207	USACE - 4-6 DEC Charrette	HDR		Hydropower	Minimize days of spill and [?] and optimize turnbine operations in deficit water years.					X							
208	USACE - 4-6 DEC Charrette	HDR		NAA	Continue current operations.			X									
209	USACE - 4-6 DEC Charrette	HDR		Water Control Diagram	Hold reservoir higher at key hydro dams.					X							
210	USACE - 4-6 DEC Charrette	HDR		Structural	Add hydropower units to all dams.										X		
211	USACE - 4-6 DEC Charrette	HDR		Structural	Add instream power generating units in tailrace.										X		
212	USACE - 4-6 DEC Charrette	HDR		Downstream Flows	All more (or less) spill?	X											
213	USACE - 4-6 DEC Charrette	HDR		Structural	Stop producing hydropower - build solar panel fields.										X		
214	USACE - 4-6 DEC Charrette	HDR		Structural	Other power generating resoures may help offset hydro in WV.										X		
215	USACE - 4-6 DEC Charrette	HDR		Hydropower	Stop producing hydropower.								X				
216	USACE - 4-6 DEC Charrette	HDR		Authorized Purposes	Produce more [hydropower] and forget about everything else.								X				
217	USACE - 4-6 DEC Charrette	HDR		Authorized Purposes	Modify storage to enhance hydro as priority.					X							
218	USACE - 4-6 DEC Charrette	HDR		Structural	Add additional generating units at non-generating dams.	X											
219	USACE - 4-6 DEC Charrette	HDR		Structural	Assess pump storage as feasibility.										X		
220	USACE - 4-6 DEC Charrette	HDR		Water Control Diagram	Keep pools higer all year for more head/generation with similar flow.					X							
221	USACE - 4-6 DEC Charrette	HDR		Hydropower	Operate to provide more power for estimated/predicted high-use power days/events = higher demand.	X											
222	USACE - 4-6 DEC Charrette	HDR		Authorized Purposes	Priortize hydrolpower above recreation to ensure objecties are met.					X							
223	USACE - 4-6 DEC Charrette	HDR		Structural	Transmission line maintenance upgrades (assessment to resources)							X					
224	USACE - 4-6 DEC Charrette	HDR		Cultural	NHPA assessment (assessment to resources).						X						
225	USACE - 4-6 DEC Charrette	HDR		Hydropower	More head, more power.						X						

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226	USACE - 4-6 DEC Charrette	HDR		Hydropower	More water going through the turbins, the more power created.						X						
227	USACE - 4-6 DEC Charrette	HDR		Hydropower	Eliminate power peaking if market demand doesn't need.							X					
228	USACE - 4-6 DEC Charrette	HDR		Authorized Purposes	Prioritize hydro production year round.	X											
229	USACE - 4-6 DEC Charrette	HDR		Hydropower	As much water throught turbines as possible						X						
230	USACE - 4-6 DEC Charrette	HDR		NAA	Routine maintenance.			X									
231	USACE - 4-6 DEC Charrette	HDR		Ramp Rates	Change ramp rates for increased flexibility.					X							
232	USACE - 4-6 DEC Charrette	HDR		Water Control Diagram	Maintain exclusive power pool.			X									
233	USACE - 4-6 DEC Charrette	HDR		Hydropower	For multi-unit powerhouses, run only 1 unit at a time, or rotate between them (assuming that effects flows, temps, or fish passage survival).	X											
234	USACE - 4-6 DEC Charrette	HDR		Water Control Diagram	Go to run-of-river in winter (stop HY) to pass juvenile fish - where technically possible.								X				
235	USACE - 4-6 DEC Charrette	HDR		Structural	Construct new penstoke intake at lower elevation to use more of the pool.					X							
236	USACE - 4-6 DEC Charrette	WS		Authorized Purposes	Prioritize demands especially in dry years/ events/ summers [Note: Not within our authority].	X											
237	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Plan ahead for climate change impacts.						X						
238	USACE - 4-6 DEC Charrette	WS		Structural	Raise height of dams.										X		
239	USACE - 4-6 DEC Charrette	WS		Structural	In-ground reservoir/ aquifer storage.										X		
240	USACE - 4-6 DEC Charrette	WS		Structural	Construct additional dams for more supply.										X		
241	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Eliminate the rule curve to provide more flexibility in management of storage.					X							
242	USACE - 4-6 DEC Charrette	WS		Water Supply	Prioritze reservoirs for storage (keep some full year round).					X							
243	USACE - 4-6 DEC Charrette	WS		Habitat	Dredge rivers.					X							
244	USACE - 4-6 DEC Charrette	WS		Habitat	Dredge reservoirs to increase storage behind dam.					X							
245	USACE - 4-6 DEC Charrette	WS		Ramp Rates	Eliminate ramp rates.						X						
246	USACE - 4-6 DEC Charrette	WS		NAA	No action alternative.			X									
247	USACE - 4-6 DEC Charrette	WS		Structural	Build canals.										X		

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248	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Change rule curver to allow fllexible managemnet of storage.					X							
249	USACE - 4-6 DEC Charrette	WS		Structural	Maximize storage somehow.						X						
250	USACE - 4-6 DEC Charrette	WS		Downstream Flows	Reduce minimum flows for F&W to allow for more storage.					X							
251	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Refill earlier.						X						
252	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Prioritize refill by May 15.					X							
253	USACE - 4-6 DEC Charrette	WS		Water Supply	Prioritize releases for consumptive uses.					X							
254	USACE - 4-6 DEC Charrette	WS		Water Supply	Require water shareholders to make up for over consumption in a previous year by giving up planned consumption in the next.							X					
255	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Climate change - Anticipate longer, hotter drought in summer, more rain less snow in winter, in how dams operate in response to "flashier" hydrograph.						X						
256	USACE - 4-6 DEC Charrette	WS		Structural	Construct supplemental small reservoirs near areas of greater need.										X		
257	USACE - 4-6 DEC Charrette	WS		Water Supply	Prioritze consumptive use of water in conservation pools.	X											
258	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Ensure each reservoir fills by May 15 of each year, even drought years (prioritze reservoir refill).	X											
259	USACE - 4-6 DEC Charrette	WS		Water Supply	Maintain current water supply operations.			X									
260	USACE - 4-6 DEC Charrette	WS		Downstream Flows	Reduce fish and wildlife flows to pre-dam releases (focus on upstream production).	X											
261	USACE - 4-6 DEC Charrette	WS		Water Supply	Prioritize reservoirs for storage allocation (e.g., not all reservoirs provide H_2O).					X							
262	USACE - 4-6 DEC Charrette	WS		Water Supply	Modify operations to increase flows to meet contractural water supply requirements.							X					
263	USACE - 4-6 DEC Charrette	WS		Water Supply	Make supply proportional amount, so that it isn't the first irrigators downstream that benefit and later irrigators don't get enough.							X					
264	USACE - 4-6 DEC Charrette	WS		Structural	Construct alternate water sources for municipal water (i.e., wells) so they are less reliant on stored water or new intakes on flowing stream portions.							X			X		
265	USACE - 4-6 DEC Charrette	WS		Real Estate	RE review of all water withdrawls - What are we legally required to keep (deeds?) and where can we stop providing access?				X								
266	USACE - 4-6 DEC Charrette	WS		Water Supply	Prioritize water withdrawals for example, does a hazelnut farm rank above a pot grow, over city drinking water? Or does it go to who's first downstream? Or who got water rights first?							X					
267	USACE - 4-6 DEC Charrette	WS		Water Supply	Make it rain.				X								
268	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Start refill earlier to achieve full pools.					X							
269	USACE - 4-6 DEC Charrette	WS		Structural	Store winter flows in groundwater reservoirs.										X		

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270	USACE - 4-6 DEC Charrette	WS		Structural	Pipe water during winter to supplemental reservoirs.										X		
271	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Change rule curve to allow flexibility.					X							
272	USACE - 4-6 DEC Charrette	WS		Structural	Maximize storage.					X							
273	USACE - 4-6 DEC Charrette	WS		Water Supply	Decrease minimum flows in order to provide additional water for AG and M&I.					X							
274	USACE - 4-6 DEC Charrette	WS		Structural	Move or modify M&I intakes to meet needs during low flows.							X					
275	USACE - 4-6 DEC Charrette	WS		Water Control Diagram	Eliminate rule curve - provide more flexibiity in management of reservoir storage.	X											
276	USACE - 4-6 DEC Charrette	WS		Structural	Raise the height of the dams										X		
277	USACE - 4-6 DEC Charrette	WS		Ramp Rates	Eliminate ramp rations to maintain more water in the reservoirs.					X							
278	USACE - 4-6 DEC Charrette	WS		Structural	Construct additional storage dams.										X		
279	USACE - 4-6 DEC Charrette	WS		Structural	Increase storage capacity structurally (i.e., build more reservoirs).										X		
280	USACE - 4-6 DEC Charrette	WS		Structural	Build storage along banks of rivers.										X		
281	USACE - 4-6 DEC Charrette	WS		Habitat	Dredge all rivers for additional storage and maintian as part of O&M.	X											
282	USACE - 4-6 DEC Charrette	WS		Water Supply	Reallocate pool to provide more water for MI & Ag.							X					
283	USACE - 4-6 DEC Charrette	WS		Structural	Create new areas in WV to store water - new reservoir.										X		
284	USACE - 4-6 DEC Charrette	WS		Recreation	Recreational uses						X						
285	USACE - 4-6 DEC Charrette	WS		Water Supply	Irrigators/ BOR						X						
286	USACE - 4-6 DEC Charrette	WS		Cultural	Affects to cultural sites						X						
287	USACE - 4-6 DEC Charrette	WS		Water Supply	Require water shareholders to commit to standardized accounting and annual reporting.				X								
288	USACE - 4-6 DEC Charrette	WS		Water Supply	Climate change - Consider deviation from shared water allocation during shortages - all uses/demands not equal.	X											
289	USACE - 4-6 DEC Charrette	WS		Water Supply	Climage change - Integrate management of watershed uplands into water supply planning. Forests and fires greatly influence watershed services/inputs to hydrology.							X					
290	USACE - 4-6 DEC Charrette	WS		Structural	Have off-river storage of extra water for dry periods in locations below the dams.										X		
291	USACE - 4-6 DEC Charrette	WS		Water Supply	Ensure water use is metered.							X					

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292	USACE - 4-6 DEC Charrette	WS		Water Supply	Change crops to those that require less water.				X								
293	USACE - 4-6 DEC Charrette	WS		Downstream Flows	Reduce minimum flows to leave water for later in the season.					X							
294	USACE - 4-6 DEC Charrette	F&W		Habitat	Establish wetland habitat around reservoir/ river. [Note: from water supply small group].												X
295	USACE - 4-6 DEC Charrette	F&W		Structural	Add better fish ladders.										X		
295	USACE - 4-6 DEC Charrette	F&W		Hatchery	Use hatchery fish to supplement reintroduction.	X											
296	USACE - 4-6 DEC Charrette	F&W		Revetments	Remove select revetments.						X						
297	USACE - 4-6 DEC Charrette	F&W		Revetments	Modify select revetments (setback, bioenginerring, relief culverts).					X							
298	USACE - 4-6 DEC Charrette	F&W		Passage	Deep drawndowns for D/S passage.					X							
299	USACE - 4-6 DEC Charrette	F&W		Wildlife	Seeding/ Planting of mussels.												X
300	USACE - 4-6 DEC Charrette	F&W		Passage	Fish ladders where applicable (Long Tom?)							X					
301	USACE - 4-6 DEC Charrette	F&W		Passage	Fish passage on Long Tom.							X					
302	USACE - 4-6 DEC Charrette	F&W		ESA	Eliminate harvest of ESA stocks.		X		X								
303	USACE - 4-6 DEC Charrette	F&W		Habitat	Restore off-channel habitat D/S.												X
304	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Augment flows by tapping power pool.	X											
305	USACE - 4-6 DEC Charrette	F&W		Structural	Structural measures for wildlife habitat.				X								
306	USACE - 4-6 DEC Charrette	F&W		Passage	Create bypasses around reservoirs for juvenile fish D/S passage					X							
307	USACE - 4-6 DEC Charrette	F&W		Downstream Flows	Revise minimum flow targets.					X							
308	USACE - 4-6 DEC Charrette	F&W		Wildlife	Eliminate non-native predators.			X									
309	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Draw down while fish are spawning.					X							
310	USACE - 4-6 DEC Charrette	F&W		Passage	U/S Passage and Green Peter at base of dam.	X											
311	USACE - 4-6 DEC Charrette	F&W	General modifications for downstream passage at Lookout	Passage	D/S passage at Lookout.					X							
312	USACE - 4-6 DEC Charrette	F&W	General modfications for upstream passage at Lookout	Passage	Improve U/S passage trap at Lookout					X							

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313	USACE - 4-6 DEC Charrette	F&W		Passage	U/S passage at GPR using Foster Trap.					X							
314	USACE - 4-6 DEC Charrette	F&W		Hatchery	S. Santiam - Adjust hathery production to credit for existing passage.	X											
315	USACE - 4-6 DEC Charrette	F&W		Hatchery	S. Santiam - eliminate hatchery trout releases.					X							
316	USACE - 4-6 DEC Charrette	F&W		Habitat	Improve/ restore stream habitt U/S from Foster.					X							
317	USACE - 4-6 DEC Charrette	F&W		Sport Fish	N. Santiam - Elminiate atchery trout releases upon completion of D/s passage (about 2028).					X							
318	USACE - 4-6 DEC Charrette	F&W		Recreation	N. Santiam - Reduce kokanee production.		X					X					
319	USACE - 4-6 DEC Charrette	F&W		Habitat	Improve/ restore stream habitat in Breiten Bush, N. Santium U/S from Detroit.												X
320	USACE - 18 Dec	F&W	Restore off-channel habitat for non-ESA	Habitat	Maintain flows for connectivity of D/S offstream habitat (chub, turtle).					X							
321	USACE - 4-6 DEC Charrette	F&W		Habitat	Modify/ restore conectivity of off-cannel habitat D/S from X Dam.												X
322	USACE - 4-6 DEC Charrette	F&W	Prioritize conservation hatchery production	Hatchery	Prioritize conservation hatchery production over mitigation production (re-balance).	X											
323	USACE - 4-6 DEC Charrette	F&W	Prioritize conservation hatchery production	Hatchery	Do not dip conservation hatchery production (to avoid catch in fishery).	X											
324	USACE - 18 Dec	F&W	early spring storage	Water Control Diagram	Store more water in spring (earlier) to provide more storage.					X							
325	USACE - 18 Dec	F&W	Construct temperature control towers	Structural	Add more temperature structures at dams.					X							
326	USACE - 4-6 DEC Charrette	F&W	Augment temperatures at Green Peter	Operations	Modify operations at GP for changing temperatures.	X											
327	USACE - 4-6 DEC Charrette	F&W		Ramp Rates	Study and adjust ramp rates to increase operational flexibility.					X							
328	USACE - 4-6 DEC Charrette	F&W	New Passage at Blue River	Passage	Provide fish passage at Blue River.					X							
329	USACE - 4-6 DEC Charrette	F&W		Passage	Provide fish passage at Coast Fk dams.										X		
330	USACE - 4-6 DEC Charrette	F&W		Wildlife	Manage water for frogs and turtles.			X									
331	USACE - 4-6 DEC Charrette	F&W		Wildlife	Structural measures for frogs and turtle aquatic habitat.				X								
332	USACE - 4-6 DEC Charrette	F&W		Wildlife	Remove structures supporting predators of F/W/												X
333	USACE - 4-6 DEC Charrette	F&W		Habitat	Sediment augmentations below dams.					X							
334	USACE - 4-6 DEC Charrette	F&W		Wildlife	Control sea lions.		X		X								
335	USACE - 4-6 DEC Charrette	F&W		Habitat	Import gravel and add sediments to outflow [Note: from WQ card].					X							

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336	USACE - 4-6 DEC Charrette	F&W		Habitat	Change flow rates to change sediment deposition. [From WQ card.]	X											
337	USACE - 18 Dec	F&W	Revetment modification/removal	Revetments	Remove revetments from areas of low value to improve habitat. Setback levees (revetments for others).					X							
338	USACE - 4-6 DEC Charrette	F&W		Structural	Construct different facilties (trap and haul, ladders, juvenile fish collectors, etc.).	X											
339	USACE - 4-6 DEC Charrette	F&W		Wildlife	Identify, restore/ retrofit unused infrastrucutre for wildlife use (bats, birds, etc.).			X	X								
340	USACE - 4-6 DEC Charrette	F&W		Revetments	Remove some revetments to provide more habitat.					X							
341	USACE - 4-6 DEC Charrette	F&W		Floodplains	Re-connect Long Tom River with floodplain to provide refugia for smolts during flood events.							X					
342	USACE - 4-6 DEC Charrette	F&W		Floodplain	Restore off-channel abitat downstream of dams.				X								X
343	USACE - 4-6 DEC Charrette	F&W	Reduce non-conservation hatchery production	Hatchery	Reduce use of hatchery fish. Mitigate in other wasy, show negative impmacts from thes fish and ecological imbalance.	X											
344	USACE - 4-6 DEC Charrette	F&W		Wildlife	Eliminate non-native predator fish.							X					
345	USACE - 4-6 DEC Charrette	F&W		Authorized Purposes	Use water in power pool for flow augmentation.					X							
346	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Draw reservoirs down when fish are laying eggs in anticipation off water being low later in the season.	X											
347	USACE - 4-6 DEC Charrette	F&W		Hatchery	Leave some hatchery fish unclipped at release to better support reintroduction efforts.	X											
348	USACE - 4-6 DEC Charrette	F&W		Passage	Deep drawdowns for DS passage.					X							
349	USACE - 4-6 DEC Charrette	F&W		Passage	Provide passage at GP instead of LOP.					X							
350	USACE - 4-6 DEC Charrette	F&W		Hatchery	Eliminate mitigation hatcheries in place of conservation hatcheries.	X											
351	USACE - 4-6 DEC Charrette	F&W		Structural	Build nesting boxes for migratory birds.				X								
352	USACE - 4-6 DEC Charrette	F&W		Habitat	Manage habitat for potentially listed species (turtle or the frog).			X									
353	USACE - 4-6 DEC Charrette	F&W		Structural	Evaluate structural changes to reduce TDG.						X						
354	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Store more water in spring to release through summer/fall for minimum flow targets.	X											
355	USACE - 4-6 DEC Charrette	F&W		Structural	Fish ladders wher applicable.	X											
356	USACE - 4-6 DEC Charrette	F&W		Structural	Temperature towers where applicable to control H2O temperature release.					X							
357	USACE - 4-6 DEC Charrette	F&W		Structural	Structures to reduce TDG.					X							

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358	USACE - 4-6 DEC Charrette	F&W		Structural	WTCTs for each dam not meeting temperature goals.					X							
359	USACE - 4-6 DEC Charrette	F&W		Revetments	Remove all revetments to provide more habitat.								X				
360	USACE - 4-6 DEC Charrette	F&W		Revetments	Bioengineer banks.					X							
361	USACE - 4-6 DEC Charrette	F&W		Recreation	Time of year restrictions for all human activities.				X								
362	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Change rule curves.						X						
363	USACE - 4-6 DEC Charrette	F&W		Revetments	Breach un-needed revetments.					X							
364	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Run of river (e.g., fall ~~create~~ (creek)) at other dams.				X								
365	USACE - 4-6 DEC Charrette	F&W		Cultural	Tribal uses.				X								
366	USACE - 4-6 DEC Charrette	F&W		Habitat	Habitat development in uplands as well as river/reservoir.												X
367	USACE - 4-6 DEC Charrette	F&W		Water Control Diagram	Run of river projects.					X							
368	USACE - 4-6 DEC Charrette	F&W		Passage	Big slides for downstream passage.					X							
369	USACE - 4-6 DEC Charrette	F&W		Authorized Purposes	Operate conservation pool for F&W as first priority.	X											
370	USACE - 4-6 DEC Charrette	F&W		Wildlife	Optimize releases for wildlife species.						X						
371	USACE - 4-6 DEC Charrette	F&W		Habitat	Plant trees along all river banks to reduce temperature.												X
372	USACE - 4-6 DEC Charrette	F&W		Passage	Is trucking the most efficient way to transport fish?			X									
373	USACE - 4-6 DEC Charrette	F&W		Hatchery	Eliminate hatchery program.	X											
374	USACE - 4-6 DEC Charrette	F&W		Wildlife	Provide safe passage around Will Falls to avoid sea lion predation.				X								
375	USACE - 4-6 DEC Charrette	F&W		Wildlife	Eliminate sea lions from Col River system.		X		X								
376	USACE - 4-6 DEC Charrette	F&W		Wildlife	Eliminate Caspian terns or cormorants from MCR.				X								
377	USACE - 4-6 DEC Charrette	F&W		Wildlife	Continue to move Caspian terns or commorants from MCR.							X					
378	USACE - 4-6 DEC Charrette	F&W		Wildlife	Record mussel populations in each reservoir (also a biological indicator for salmon).							X					
379	USACE - 4-6 DEC Charrette	F&W		Wildlife	Mussel farming in reservoirs/streams.				X								

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380	USACE - 4-6 DEC Charrette	F&W		Structural	Make reservoirs smaller/ less surface area/ less direct surface sunlight/ lower temperatures for aquatic wildlife.										X		
381	USACE - 4-6 DEC Charrette	F&W		Structural	Remove dams.				X								
382	USACE - 4-6 DEC Charrette	F&W		Wildlife	Remove invasive game fish from reservoirs (bass).					X							
383	USACE - 4-6 DEC Charrette	F&W		Wildlife	Restore beaver role in ecosystem.												X
384	USACE - 4-6 DEC Charrette	F&W		Habitat	Import/add sediment at outflows.	X											
385	USACE - 4-6 DEC Charrette	F&W		Passage	Use alternate release conduits to reduce juvenile mortality.	X											
386	USACE - 4-6 DEC Charrette	F&W		Ramp Rates	Protective ramp rats: minimum flows.					X							
387	USACE - 4-6 DEC Charrette	F&W		Hatchery	Increase use of conservation hatchery.	X											
388	USACE - 4-6 DEC Charrette	F&W		Hatchery	Decrease use of production hatchery.	X											
389	USACE - 4-6 DEC Charrette	F&W		Habitat	Restore habitat below dams instead of fish passage.												X
390	USACE - 4-6 DEC Charrette	F&W		Revetments	Culverts on revetments.	X											
391	USACE - 4-6 DEC Charrette	F&W		Passage	Drawdown CGR, DET and LOP for juvenile fish passage instead of floating collectors.					X							
392	USACE - 4-6 DEC Charrette	F&W		Passage	Provide/construct high head bypass at Cougar and Detroit.	X											
393	USACE - 4-6 DEC Charrette	F&W		Hatchery	Provide hatchery mitigation on crediting based on availability of suitable habitat - reassess mitigation responsibility after passage implemented.	X											
394	USACE - 4-6 DEC Charrette	F&W		Structural	Add more temperature control features.					X							
395	USACE - 4-6 DEC Charrette	F&W		Structural	Add better fish ladders.					X							
396	USACE - 4-6 DEC Charrette	F&W		Habitat	Designate habitat restoration projects that may enhance the flood plain for ESA listed habitat and remove only select revetments with more minor impact and build set-back levees with cost share project with BPA to protect assets while expanding ESA habitat. Use large projects to offset having to do too many "smaller" projects.												X
397	USACE - 4-6 DEC Charrette	F&W		Structural	Dam removal.				X								
398	USACE - 4-6 DEC Charrette	F&W		Operations	Change in operations.						X						
399	USACE - 4-6 DEC Charrette	F&W		Authorized Purposes	Forego/ modify authorized purposes.								X				
400	USACE - 4-6 DEC Charrette	F&W		Structural	Add structural features for fish passage & water quality.					X							

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401	USACE - 4-6 DEC Charrette	F&W		Revetments	Remove/modify revetments.					X							
402	USACE - 4-6 DEC Charrette	F&W		Hatchery	Eliminate/change hatchery program.					X							
403	USACE - 4-6 DEC Charrette	F&W		Wildlife	Control exotic/predatory fish species in reservoir.		X										X
404	USACE - 4-6 DEC Charrette	F&W		Wildlife	Control sea lion predaton.		X		X								
405	USACE - 4-6 DEC Charrette	F&W		Recreation	Eliminate/ reduce fish harvest of impacts on salmon/steelhead.							X					
406	USACE - 4-6 DEC Charrette	F&W		Habitat	Stream restoration (downstream)												X
407	USACE - 4-6 DEC Charrette	F&W		Habitat	Shoreline habitat improvements in lakebed (but how to sustain during drawdown?).												X
408	USACE - 4-6 DEC Charrette	F&W		Wildlife	Remove structures that support predatory fish (i.e., DEX docks).							X					
409	USACE - 4-6 DEC Charrette	F&W		Wildlife	Remove non-native fish if they compete for resources.												X
410	USACE - 4-6 DEC Charrette	F&W		Habitat	Examine habitat conditions for all aquatic F&W (not just salmonids).			X									
411	USACE - 4-6 DEC Charrette	WQ		Authorized Purposes	Modify authorized purpose (power pool) to enhance water quality releases (construct).					X							
412	USACE - 4-6 DEC Charrette	WQ		Structural	Selective withdrawal structure for temperature (construct).					X							
413	USACE - 4-6 DEC Charrette	WQ		Structural	Flip lips, physical stracture to de gas water to reduce TDG (construct).	X											
414	USACE - 4-6 DEC Charrette	WQ		Habitat	Construct wetlands w/ plant species to improve water quality.	X											
415	USACE - 4-6 DEC Charrette	WQ		Revetments	Construct/modify revetments using bioengineer techniques.					X							
416	USACE - 4-6 DEC Charrette	WQ		Habitat	Construct or add large woody debris.					X							
417	USACE - 4-6 DEC Charrette	WQ		Structural	Instream structures to reduce TDG (boulders).					X							
418	USACE - 4-6 DEC Charrette	WQ		Habitat	Construct floating wetland to reuce algae, turbidity in reservoir.	X											
419	USACE - 4-6 DEC Charrette	WQ		Structural	Install bubble aeration system with multiple structures.										X		
420	USACE - 4-6 DEC Charrette	WQ		Habitat	Upland watershed mitigation to prevent nutrient loading into reservoir after fire.							X					
421	USACE - 4-6 DEC Charrette	WQ		Structural	Modify spillway so water is evenly dispersed to reduce TDG.	X											
422	USACE - 4-6 DEC Charrette	WQ		Wildlife	Improve mussel habitat to encourage filtration and produce cleaner water.												X

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423	USACE - 4-6 DEC Charrette	WQ		Structural	Modify existing outlets to allow greater flexibility to improve water quality.									X			
424	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Change rule curvess to be flexible with climate change.					X							
425	USACE - 4-6 DEC Charrette	WQ		Authorized Purposes	Remove hydropower from dams.								X				
426	USACE - 4-6 DEC Charrette	WQ		Hydropower	Minimize power outages that create TDG problems.			X									
427	USACE - 4-6 DEC Charrette	WQ		Operations	Remove or remediate legacy contamination sites (i.e., Big Cliff, cottage Grove).							X					
428	USACE - 4-6 DEC Charrette	WQ		Habitat	Plant riparian plants to increase shading (cool temperatures).	X											
429	USACE - 4-6 DEC Charrette	WQ		Wildlife	Add carp to keep reservoirs clean.					X							
430	USACE - 4-6 DEC Charrette	WQ		Water Quality	Treat algae blooms in reservoir.	X											
431	USACE - 4-6 DEC Charrette	WQ		Water Quality	Expand regultion buffer to reduce nutrient input from agriculture.		X		X								
432	USACE - 4-6 DEC Charrette	WQ		Water Quality	Increase water quality education outreach.				X								
433	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Operate reservoirs as run of river during conservation season.					X							
434	USACE - 4-6 DEC Charrette	WQ		Structural	Enhance groundwater seepage.										X		
435	USACE - 4-6 DEC Charrette	WQ		Structural	Filtration system w/in reservoir and instream to reduce turbidity.										X		
436	USACE - 4-6 DEC Charrette	WQ		Downstream Flows	Mainstem flow augmentation.			X									
437	USACE - 4-6 DEC Charrette	WQ		Structural	Increase storage capacity to augment water quality.										X		
438	USACE - 4-6 DEC Charrette	WQ		Structural	Flow continuatioin valve to re-regulate dams.	X											
439	USACE - 4-6 DEC Charrette	WQ		Operations	Move bathrooms at or near water.							X					
440	USACE - 4-6 DEC Charrette	WQ		Downstream Flows	Return to pre-dam flow releases below projects.								X				
441	USACE - 4-6 DEC Charrette	WQ		Water Quality	Work with other agencies to study and determine algaue concentration and causes.						X						
442	USACE - 4-6 DEC Charrette	WQ		Floodplains	Expand floodplain through land acquisition in the mainstem.				X								
443	USACE - 4-6 DEC Charrette	WQ		Wildlife	Mussel presence = filter feeders = better water qualtiy.					X							

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444	USACE - 4-6 DEC Charrette	WQ		Operations	Put bathrooms near reservoirs/ on water floating restrooms.							X					
445	USACE - 4-6 DEC Charrette	WQ		Water Quality	Work with other agencies to study blue-green algae impacts and causes local to each reservoir (but especially those heavy in recreation).						X						
446	USACE - 4-6 DEC Charrette	WQ		Structural	Instream structures/boulders to assist with off-gassing to reduce TDG (wing deflectors, tainter gates).	X											
447	USACE - 4-6 DEC Charrette	WQ		Structural	Temperature control tower.					X							
448	USACE - 4-6 DEC Charrette	WQ		Structural	Turbidity - some filter to reduce fine silt.										X		
449	USACE - 4-6 DEC Charrette	WQ		Habitat	Floating wetlands - depends on reservoir size.					X							
450	USACE - 4-6 DEC Charrette	WQ		Habitat	Native plant species.						X						
451	USACE - 4-6 DEC Charrette	WQ		Wildlife	Fish and other aquatic species.						X						
452	USACE - 4-6 DEC Charrette	WQ		Recreation	Recreational uses.						X						
453	USACE - 4-6 DEC Charrette	WQ		Water Supply	Municiple uses.						X						
454	USACE - 4-6 DEC Charrette	WQ		Water Supply	Irrigation.						X						
455	USACE - 4-6 DEC Charrette	WQ		Structural	Evaluate and develop structural changes for reduction of TDG.	X											
456	USACE - 4-6 DEC Charrette	WQ		Water Quality	Nutrient removal from wildfires.		X		X								
457	USACE - 4-6 DEC Charrette	WQ		Structural	More temperature control towers.					X							
458	USACE - 4-6 DEC Charrette	WQ		Revetments	Use bio-engineering for revetments (instead of rock).					X							
459	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Change rule curves to be flexible with changing climate.					X							
460	USACE - 4-6 DEC Charrette	WQ		Authorized Purposes	Remove hydropower from dams - may free up water for other purposes.								X				
461	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Operate reservoir's as run-of-river during conservation season.					X							
462	USACE - 4-6 DEC Charrette	WQ		Structural	Build towers at HC and LOP and GP dams.					X							
463	USACE - 4-6 DEC Charrette	WQ		Habitat	Add large wood debris to streams and mainstem.												X
464	USACE - 4-6 DEC Charrette	WQ		Downstream Flows	Mainstrem flow augmentation.			X									
465	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Modify power pool to increase flexibility for water quality releases.								X				

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466	USACE - 4-6 DEC Charrette	WQ		Water Quality	Modify Detroit to remove TDG U/S from Big Cliff.	X											
467	USACE - 4-6 DEC Charrette	WQ		NAA	Continue temperature operations at Detroit.			X									
468	USACE - 4-6 DEC Charrette	WQ		Water Quality	Active management of algal blooms.					X							
469	USACE - 4-6 DEC Charrette	WQ		Structural	Aerate reservoirs.										X		
470	USACE - 4-6 DEC Charrette	WQ		Structural	Temperature contol towers, or like, at all reservoirs.					X							
472	USACE - 4-6 DEC Charrette	WQ		Operations	Limit spill at dams.					X							
473	USACE - 4-6 DEC Charrette	WQ		Wildlife	Add carp to keep reservoirs clean - eat all algae (and everything else).				X								
474	USACE - 4-6 DEC Charrette	WQ		Habitat	Create more riparian buffers, especially along agricultural areas.		X		X								
475	USACE - 4-6 DEC Charrette	WQ		Structural	WTCTs at each dam not currently having one.					X							
476	USACE - 4-6 DEC Charrette	WQ		Structural	Operate temperature control at Detroit to reduce risk of algal blooms.			X									
477	USACE - 4-6 DEC Charrette	WQ		Structural	Implement structural measures at Big Cliff to spread out spill and reduce TDG.	X											
478	USACE - 4-6 DEC Charrette	WQ		Structural	Build temperature control towers where useful.					X							
479	USACE - 4-6 DEC Charrette	WQ		Structural	Modify outlets to allow releases at varying levels for temperature control.	X											
480	USACE - 4-6 DEC Charrette	WQ		Structural	Install underwater fine bubble aeration system to reduce temperature and blue-green algae levels. Would require structures throughout each project by funnel points to pump to tubes/aeratio system (e.g., Detroit).										X		
481	USACE - 4-6 DEC Charrette	WQ		Structural	Increase storage capacity in reservoirs.										X		
482	USACE - 4-6 DEC Charrette	WQ		Structural	Construct multi-gated intake towers where there are none.					X							
483	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Change or replace rule curve to allow climate - responsive management.					X							
484	USACE - 4-6 DEC Charrette	WQ		Structural	Flip lips below gassy spillways.					X							
485	USACE - 4-6 DEC Charrette	WQ		Structural	Flip lip below Cougar RO.	X											
486	USACE - 4-6 DEC Charrette	WQ		Structural	Engineer thermal temperature reduction in MF [Willamette R.] so not lethal for chinook (water chillers).										X		
487	USACE - 4-6 DEC Charrette	WQ		Habitat	Develop more off - Channel habitat that provides refuge and cooler water.												X
488	USACE - 4-6 DEC Charrette	WQ		Structural	Build sediment traps.					X							

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489	USACE - 4-6 DEC Charrette	WQ		Structural	Build sediment traps or build sediment movement structures to get sediment through the dams to downstream.							X			X		
490	USACE - 4-6 DEC Charrette	WQ		Water Quality	Provide instream water quality for attainment better than state standards.							X					
491	USACE - 4-6 DEC Charrette	WQ		Revetments	Bioengineer revetments.					X							
492	USACE - 4-6 DEC Charrette	WQ		Operations	Remove legacy contamination (or remediate) sites in lakes/streams (i.e., Big Cliff) (CTG/DOR - mercury).							X					
493	USACE - 4-6 DEC Charrette	WQ		Structural	Construct filters or something structural in the mainstem to alter water temperatures.										X		
494	USACE - 4-6 DEC Charrette	WQ		Habitat	Restore shoreline habitat to shade streams and cool temperatures.												X
495	USACE - 4-6 DEC Charrette	WQ		Habitat	Move woody debris and sediment downstream for a healther ecosystem (currently trapped behind the dams).												X
496	USACE - 4-6 DEC Charrette	WQ		Structural	Add hydropower units to all dams										X		
497	USACE - 4-6 DEC Charrette	WQ		Structural	Add instream power generating units in tailrace										X		
498	USACE - 4-6 DEC Charrette	WQ		Operations	Modify operations.						X						
499	USACE - 4-6 DEC Charrette	WQ		Water Control Diagram	Return to "pre-dam" normative flows & temperatures below projects	X											
500	USACE - 4-6 DEC Charrette	WQ		Habitat	Increase ripraian cover/ add cover components (LWD).												X
501	USACE - 4-6 DEC Charrette	WQ		Water Quality	Alter/remove [?] for more hypotheric connectivity for thermal benefits.						X						
502	USACE - 4-6 DEC Charrette	WQ		Floodplains	Restore historic Willamette Valley flood plain.						X						
503	USACE - 4-6 DEC Charrette	WQ		Habitat	Create bufers on Long Tom to reduce agricultural inputs (fertilizer).		X		X								
504	USACE - 4-6 DEC Charrette	WQ		Water Quality	Increase WQ education in Eugene to increase WQ in Amazon Canal/ Creek flowing into Fern Ridge.				X								
505	USACE - 8 Jan	Rec	Divest Rec Sites	Real Estate	Transfer all Corps managed recreation areas on certain lakes to another federal agency or others (e.g., state, tribe, outgrants).				X								
506	USACE - 8 Jan	Rec	Promote & Improve Off-Water Recreation	Recreation	Increase off-season and land-based uses (e.g.., hiking, bird watching, children's education, horse or OHV trails, bird blinds, snow sports). Build new trails or other land-based recreation infrastructure.				X								
507	USACE - 8 Jan	Rec	Improve Water Access at Low Pool	Recreation	Increase flexibility of existing boat access and marina moorings, other water access facilities to be functional under a range of elevations, or construct new water access infrastructure, to better facilitate boat access during low pool levels.												X
508	USACE - 8 Jan	Rec	Maintain Pool for Rec	Recreation	Maintain high and stable lake levels during recreation season, prioritizing lake-by-lake to balance with other missions. Possible specifics: Minimize drafting from Fern Ridge, Detroit, Foster. At Fern Ridge, moving the control point gauging system to the dam from Monroe may lower minimum releases.	X											
509	USACE - 8 Jan	Rec	Better below-dam fishing	Recreation	Enhance fishing below dams when lakes pools are low by not transporting hatchery fish past dams.	X											
510	USACE - 8 Jan	Rec	Build sup-impoundments	Structural	Create sub-impoundments at head of low-elevation reservoirs to increase waterfowl hunting opportunities.							X					

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511	USACE - 8 Jan	Rec	Purchase more lands	Real Estate	Buy out land owners along banks and convert lands to recreational areas.				X								
512	USACE - 8 Jan	Rec	Dynamic Recreation Season Management	Recreation	Match recreation season and facilities / opportunities provided to weather/climate with more operational flexibility at recreation sites.				X								
513	USACE - 8 Jan	Rec	Mobile Visitor Center	Operations	Travel trailer outfitted as a mobile rangers station / vistor information center. Can be moved to recreation sites following visitation patterns as they change over time.				X								
514	USACE - 8 Jan	Rec	Increase vehicle barriers around pool.	Operations	Lower pools expose more lands that may attract vehicle trespass into the lakebed. More barriers will be needed at many Projects near low water ramps and at other access points.												X
515	USACE - 15 Jan - Ernster	HDR		Water Control Diagram	Update the water control manual to permit regulators to retain water up to the top of the flood control pool (elevation 1485ft, or 35ft above minimum flood pool elevation 1450 ft), except when 10-day forecasts indicate a flood approaching the 1861 is imminent. Rough Example: DET can vacate 33,719 acre-ft of secondary storage per day at 17,000 cfs (upper normal discharge limit), which is over half of the existing secondary storage.	X											
516	USACE - 15 Jan - Ernster	HDR		Water Control Diagram	Explore increasing the top of the secondary flood pool (example – from elevation 1485 to 1500ft at Detroit), under the assumption that reservoir elevation can be returned to elevation 1450 ft at the upper normal discharge limit of 17,000 cfs within the limitations of the 10-day forecast and water travel times to Portland.	X											
517	USACE - 15 Jan - Ernster	HDR		Water Control Diagram	Create secondary storage volumes for the February-April refill months that allow regulators to retain water above the rule curve, discharging water to drop back down to the rule curve if a flood of some undefined magnitude is observed. This would allow capturing excess runoff during the February – April months.	X											
518	USACE - 14 Dec	WS	Prioritize Demand	Water Supply	Create a prioritization structure for uses (AI,M&I) during periods of high demand or drought years when supply is low					X							
519	USACE - 14 Dec	WS	Create plan for climate change impacts	Operations	Create a management plan that anticipates climate change impacts, e.g. longer drought in summer, less snow in winter					X	X						
520	USACE - 14 Dec	WS	Modify rule curve	Water Control Diagram	Modify/eliminate rule to allow for more flexible management of storage					X							
521	USACE - 14 Dec	WS	Refill reservoirs earlier	Water Control Diagram	Prioritize refill of reservoirs, e.g. by May 15					X							
522	USACE - 14 Dec	WS	Construction of storage	Structural	This measure would be construction of a variety of storage facilities (e.g. new reservoirs) to increase the amount of water stored in the system										X		
523	USACE - 14 Dec	WS	Raise the height of dams	Structural	This measure would involve construction to raise the height of dams to maximize storage in the conservation pool										X		
524	USACE - 14 Dec	WS	Prioritize reservoirs for storage (keep some full year round)	Water Control Diagram	This measure would prioritize some dams for year-round storage	X											
525	USACE - 14 Dec	WS	Prioritze reservoirs for storage allocation (e.g., not all reservoirs provide H2O)	Water Supply	This measure would prioritize some dams for maximum water storage vs. other dams that provide less water storage	X											
526	USACE - 14 Dec	WS	Dredge rivers	Habitat	Dredge rivers for additional storage and maintain as a part of O&M					X							
527	USACE - 14 Dec	WS	Dredge reservoirs	Habitat	Dredge reservoirs to increase storage behind dam					X							
528	USACE - 14 Dec	WS	Eliminate ramp rates	Ramp Rates	Eliminate ramp rates to maintain more water in the reservoirs					X							
529	USACE - 14 Dec	WS	Build canals	Structural	This measure would involve construction of canals downstream of the dams to ???										X		
530	USACE - 14 Dec	WS	Require water shareholders to make up for overconsumption	Water Supply	This measure would require water shareholders to make up for overconsumption in a previous year by giving up planned consumption in the next		X		X								
531	USACE - 14 Dec	WS	Maintain current WVP water supply operations	Water Supply	This measure would maintain current water supply operations (with accompanying assumptions/results of Kathryn's study for WVP)			X									
532	USACE - 14 Dec	WS	Reduce minimum flows to allow for more storage	Downstream Flows	This measure would reduce minimum flows for F&W, for AG and M&I demands, to allow for more storage	X											
533	USACE - 14 Dec	WS	Review all water withdrawals	Water Supply	Evaluate what we are legally required to keep and where we can stop providing access to water withdrawals						X						
534	USACE - 14 Dec	WS	Change crops to less water-demanding ones	Water Supply	This measure involves shifting crops to less water-demanding ones and proritizing water withdrawals based on user purposes (i.e. does a hazelnut farm rank above a pot grow, or over city drinking water?		X		X								
535	USACE - 14 Dec	WS	Make it rain	Water Supply	This measure involves rain dances to encourage more rain		X		X								

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536	USACE - 14 Dec	WS	Maximize storage somehow	Water Supply	This measure involves a general request to maximize storage					X							
537	USACE - 14 Dec	WS	Move or modify M&I intakes	Structural	Move or modify M&I intakes to meet water demands during low flows										X		
538	USACE - 14 Dec	WS	Reallocate pool to provide more water for M&I and Ag	Authorized Purposes	This measure would reallocate the pool to provide more water for M&I and Ag uses.							X					
539	USACE - 14 Dec	WS	Ensure water use is recorded and accounted for	Operations	This measure would require water shareholders to commit to standardized accounting and annual reporting to ensure water use is metered							X					
540	USACE - 14 Dec	WS	Integrate managemnet of watershed uplands into water supply planning to adjust for climate change impacts	Habitat	This measure would integrate management of watershed uplands into water supply planning to adjust for potential climate change impacts. Forests and fires greatly influence watershed services/inputs to hydrology.	X											
541	USACE - 14 Dec	WS	Construct alternate water sources for municiple water (i.e. wells)	Structural	This measure would construct alternate water sources for municipal water (i.e. wells) so they are less reliant on stored water or new intakes on flowing stream portions										X		
542	USACE - 14 Dec	WS	Consider deviation from shared water allocation during water shortages	Authorized Purposes	This measure considers climate change impacts to involve considering deviation from shared water allocation during water shortages, because all uses/demands are not equal.					X							
543	USACE - 20 Dec	WQ	Instream structures to reduce TDG	Structural	construct physical structures on the spillway or tailrace									X			
544	USACE - 20 Dec	WQ	Minimize power outages	Operations	schedule power outages for maintenance/construction			X									
545	USACE - 20 Dec	WQ	Modify/remove power pool	Water Control Diagram	allow more current uses of the power pool								X				
546	USACE - 20 Dec	WQ	Temperature Control Structure	Structural	construct temperature control tower					X							
547	USACE - 20 Dec	WQ	Modify existing outlets	Structural	would require construction?					X							
548	USACE - 20 D	WQ	Operate reservoir as run of river		Operate reservoir as run of river					X							
549	USACE - 20 Dec	WQ	Operational control temperature at Detroit for algal blooms	Structural	Construct physical structure							X					
550	USACE - 20 Dec	WQ	In reservoir aeration	Structural	Deploy aeration equipment which helps to lessen stagnation										X		
551	USACE - 20 Dec	WQ	Filter to reduce turbidity in the reservoir	Structural	Filter to reduce turbidity in the reservoir							X					
552	USACE - 20 Dec	WQ	Construct structure in the mainstems to alter temperatures	Structural	Construct structure in the mainstems to alter temperatures										X		
553	USACE - 20 Dec	WQ	Construct shoreline wetlands (reservoir and downstream)	Habitat	Construct shoreline wetlands (reservoir and downstream)					X							
554	USACE - 20 Dec	WQ	Riparian zone buffers	Habitat	Riparian zone buffers				X								
555	USACE - 20 Dec	WQ	Floating wetlands for algal bloom/turbidity	Habitat	Floating wetlands for algal bloom/turbidity					X							
556	USACE - 20 Dec	WQ	Treat algal blooms in reservoir	Habitat	Treat algal blooms in reservoir					X							
557	USACE - 20 Dec	WQ	Add woody debris to instream	Habitat	Add woody debris to instream					X							
558	USACE - 20 Dec	WQ	Sediment traps	Structural	Sediment traps							X					
559	USACE - 20 Dec	WQ	Bioengineered revetments	Revetments	Bioengineered revetments					X							
560	USACE - 20 Dec	WQ	Introduce non native Carp to consume algae	Wildlife	Introduce non native Carp to consume algae				X								
561	USACE - 20 Dec	WQ	Introduce native mussels to improve water quality clarity	Wildlife	Introduce native mussels to improve water quality clarity					X							
562	USACE - 20 Dec	WQ	Flexible rule curves for climate change	Water Control Diagram	Flexible rule curves for climate change					X							
563	USACE - 20 Dec	WQ	Enhance groundwater seepage	Structural	Enhance groundwater seepage						X						
564	USACE - 20 Dec	WQ	Remove legacy contamination	Operations	Remove legacy contamination							X					
565	USACE - 20 Dec	WQ	Post fire watershed mitigation	Habitat	Post fire watershed mitigation		X										
566	USACE - 20 Dec	WQ	Mainstem flow augmentation	Downstream Flows	Mainstem flow augmentation			X									
567	USACE - 20 Dec	WQ	Expand floodplain through land acquisition in the mainstem	Floodplains	Expand floodplain through land acquisition in the mainstem					X							

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568	USACE - 20 Dec	WQ	Expand regulation buffer to reduce nutrient input from agriculture	Habitat	Expand regulation buffer to reduce nutrient input from agriculture		X										
569	USACE - 20 Dec	WQ	Water quality outreach education	Water Quality	Water quality outreach education						X						
570	USACE - 20 Dec	WQ	Increase storage capacity to augment water quality	Structural	would require construction on dam and structure?										X		
571	USACE - 20 Dec	WQ	Move bathrooms away from water	Operations	Move bathrooms away from water							X					
572	USACE - 20 Dec	WQ	Put bathrooms on reservoirs as a floating structure	Operations	Put bathrooms on reservoirs as a floating structure	X											
573	USACE - 20 Dec	WQ	Return to pre dam flow releases	Water Control Diagram	Return to pre dam flow releases					X							
574	USACE - 20 Dec	WQ	Work with other agencies to study algae concentrations and causes	Water Quality	Work with other agencies to study algae concentrations and causes						X						
575	USACE - 20 Dec	WQ	Develop more off channel habitat and temperatures	Habitat	Develop more off channel habitat and temperatures	X											
576	USACE - 20 Dec	WQ	Provide instream water quality better than state standards	Water Quality	Provide instream water quality better than state standards							X					
577	USACE - 18 Dec	HDR	Add pumped storage to dams.	Structural	Pump water back into reservoir at night when costs are low										X		
578	USACE - 18 Dec	HDR	Go to run-of-river in winter (stop hydropower) to pass juvenile fish where possible.	Passage	Stop hydropower to pass juvenile fish when possible								X				
579	USACE - 18 Dec	HDR	Transmission line upgrades.	Structural								X					
580	USACE - 18 Dec	HDR	Optimize turbine operations in deficit water years.	Hydropower				X									
581	USACE - 18 Dec	HDR	Flow continuation valves/ structural fish passage measures/ structural temperature control =>maintain flexibility and use	Passage						X							
582	USACE - 18 Dec	HDR	Prioritize based on market demand and eliminate where not needed.	Hydropower								X					
583	USACE - 18 Dec	HDR	Run HY only part of the year (to maximize fish recovery).	Hydropower	Minimize Hydropower to pass juvenile fish when possible								X				
584	USACE - 18 Dec	HDR	Minimize days of spill and [?] and optimize turbine operations in deficit water years.	Hydropower		X											
585	USACE - 18 Dec	HDR	Continue current operations.	Operations				X									
586	USACE - 18 Dec	HDR	Hold reservoir higher at key hydro dams.	Operations						X							
587	USACE - 18 Dec	HDR	Construct selective withdrawal structures.	Structural						X							
588	USACE - 18 Dec	HDR	Construct "de-gassing" structures below dams.	Structural						X							
589	USACE - 18 Dec	HDR	Add flow continuation valves to turbines.	Hydropower						X							
590	USACE - 18 Dec	HDR	SUPPLEMENT HYDROPOWER WITH RENEWABLE ENERGY	Hydropower	Reduce demand on hydrower and provide back-up power and reliability				X								
591	USACE - 18 Dec	HDR	ADD POWER PRODUCTION CAPACITY TO CURRENT DAMS	Structural											X		
592	USACE - 18 Dec	FRM	Build new dams	Structural	Build more dams to hold back more water										X		
593	USACE - 18 Dec	FRM	Allow flooding downstream	Flood Risk Management	Change ops so flooding is ok. Implementation to occur in combination with other measures.				X								
594	USACE - 18 Dec	FRM	Buy out downstream property	Real Estate	Purchase property in flood prone areas to eliminate flood damage							X					
595	USACE - 18 Dec	FRM	Clear floodplain	Floodplains	Move existing structures and do not allow future development							X					

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596	USACE - 18 Dec	FRM	Expand Floodplain	Floodplains	Extend natural floodplain area by breaching revetments and creating flood channel bypass areas								X				
597	USACE - 18 Dec	FRM	Protect Structures in Floodplain	Floodplains	Increase structure height or make floatable							X			X		
598	USACE - 18 Dec	FRM	Increase dam height	Structural	Increase the height of the dam to be able to hold more water during flood events										X		
599	USACE - 18 Dec	FRM	Lower Conservation Pool	Water Control Diagram	Lower the max conservation pool to allow more space to hold water during flood events					X							
600	USACE - 18 Dec	FRM	Fill reservoirs higher	Flood Risk Management	Overfill lakes if flooding is only on government property (may damage private property- so change shoreline dock permit program, or real estate outgrants (i.e., marinas).									X			
601	USACE - 18 Dec	FRM	Armor dam structures	Structural	Improve outlet/spillway so able to release higher flows (mange the PMF)	X											
602	USACE - 18 Dec	FRM	Add levees	Revetments	Protect downstream locations with levees										X		
603	USACE - 18 Dec	FRM	Fortify levees	Revetments	Improve levee system so that dams can release more water without damaging structures/property										X		
604	USACE - 18 Dec	FRM	Remove revetments	Revetments	Remove revetments that are not necessary for FRM to allow channel migration					X							
605	USACE - 18 Dec	FRM	Repair revetments	Revetments	Repair or improve (bioengineer) revetments.					X							
606	USACE - 18 Dec	FRM	Modify Rule Curve	Water Control Diagram	Evaluate rule curves to allow for more flexibility in operating for FRM.					X							
607	USACE - 18 Dec	FRM	Create Climate Adaptive Rule Curves	Water Control Diagram	Modify rule curves so that they can respond to current climate (climate change, storm forecasts)					X							
608	USACE - 18 Dec	FRM	Utilize Improved forecasting capability	Water Control Diagram	Pre-draft for storm events using improved forecasts.					X							
609	USACE - 18 Dec	FRM	Create Storage Ponds	Structural	Build ponds and pumps/conveyance for storing excess flood water										X		
610	USACE - 18 Dec	FRM	Lower Flood Pool	Water Control Diagram	Maintain a deeper reservior elevation in winter					X							
611	USACE - 18 Dec	FRM	Change weather patterns	Natural Processes	Change climate so there are less flood events, for example move the jet stream		X										
612	USACE - 18 Dec	FRM	Expand Control Points	Structural	Create more control points for reservior operations. Install gages where necessary.					X							
613	USACE - 18 Dec	FRM	Update Early Warning and Reponse Plans	Flood Risk Management	Evaluate early warning system functionality and update response plans as needed.			X									
614	USACE - 18 Dec	FRM	Continued Management Direction	Operations	Maintain current release rules for flow frequency, routine maintenance, rule curves.			X									
615	USACE - 18 Dec	FRM	Clean out spillway channels.	Operations	Clean out spillways so that if spillways are used debris doesn't cause downstream damage.	X											
616	USACE - 18 Dec	FRM	Implement NEPA in WCM	Operations	Implement the updated NEPA on water control plan.			X									
617	USACE - 18 Dec	FRM	Extend releases	Water Control Diagram	Release water over longer time period.						X						
618	USACE - 18 Dec	FRM	Use flood damages prevented for metric	Flood Risk Management	Metric - $ in flood damages prevented (compare to previous years data).						X						
619	USACE - 18 Dec	FRM	Maintain flows for other missions	Downstream Flows	Maintain flows to ensure public safety, water supply and aquatic fish and wildlife survival.			X									
620	USACE - 18 Dec	FRM	Proioritize FRM operations	Flood Risk Management	Prioritize FRM higher (i.e., above recreation).											X	
621	USACE - 18 Dec	FRM	Expand existing storage	Structural	Create more storage behind the dams.										X		
622	USACE - 18 Dec	FRM	Delay spring refill	Water Control Diagram	Delayed refill in spring when last five years have been abundant water years. This helps downstream passsage					X							
623	USACE - 18 Dec	FRM	Improve Regulatation of Summer Drought	Water Control Diagram	Change reservoir regulation "practices" for summer drought. Change practices for fall/early winter draught.					X							
624	USACE - 18 Dec	FRM	Reduce ramping up/down rates to minimize damage to archeological sites	Operations	Consider prioritizing archaeological sites in lakebed to minimize damage (how fast/slow does the lake drop water levels).					X							
625	USACE - 18 Dec	FRM	Lower summer lake level	Water Control Diagram	Change summer lake level (lower) to minimize shoreline erosion at some lakes (CTG, FRN, DOR, etc.).	X											
626	USACE - 18 Dec	FRM	Outgrants	Operations	?						X						

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627	USACE - 18 Dec	FRM	Landowners	Operations	?						X						
628	USACE - 18 Dec	FRM	Cultural Resources	Operations	?						X						
629	USACE - 18 Dec	FRM	Native uses	Operations	?						X						
630	USACE - 18 Dec	FRM	Slumpage & Affects.	Operations	?						X						
631	USACE - 18 Dec	FRM	Change spill requirements to reduce potential flood.	Flood Risk Management	?						X						
632	USACE - 18 Dec	FRM	Reduce drawdown flow rates	Water Control Diagram	Change flows to minimize erosion downstream (when emptying the lake).					X							
633	USACE - 18 Dec	F&W	Habitat Modification at Reservoir	Habitat	Establish wetland habitat around reservoirs/ rivers system-wide. [Note: from water supply small group].					X							
634	USACE - 18 Dec	F&W	Hatchery supplement for reintroduction	Hatchery	System-wide use hatchery fish to supplement reintroduction efforts.					X							
635	USACE - 18 Dec	F&W	Revetment modification/removal	Revetments	Remove select revetments system-wide.					X							
636	USACE - 18 Dec	F&W	Drawdown for downstream passage	Passage	System-wide deep drawndowns for D/S passage.					X							
637	USACE - 18 Dec	F&W	Ecological enhancement for ESA	Wildlife	System-wide seeding/ planting of mussels.					X							
638	USACE - 18 Dec	F&W	Fish Ladder construction	Structural	Fish ladder construction (Monroe Drop Structure on Long Tom River)							X					
639	USACE - 18 Dec	F&W	New passage at Long Tom	Passage	Restore passage on Long Tom (Stroda Drop Structure, Cox Butte, Ferguson) for ESA and non-ESA fish	X											
640	USACE - 18 Dec	F&W	Fish Elevator Construction	Passage	System-wide fish elevators (instead of trucking).										X		
641	USACE - 18 Dec	F&W	No ESA harvests	Recreation	Eliminate harvest of ESA stocks system-wide.		X										
642	USACE - 18 Dec	F&W	Habitat Modification off reservoir	Habitat	System-wide restore off-channel habitat D/S.					X							
643	USACE - 18 Dec	F&W	Flow Augmentation to power pool	Operations	System-wide augment flows by tapping power pool.	X											
644	USACE - 18 Dec	F&W	General structural mods/additions	Wildlife	System-wide structural measures for wildlife habitat.							X					
645	USACE - 18 Dec	F&W	Construct bypass for d/s passage	Passage	System-wide create bypasses around reservoirs for juvenile fish D/S passage	X											
646	USACE - 18 Dec	F&W	Flow augmentation from current targets	Downstream Flows	System-wide revise minimum flow targets.					X							
647	USACE - 18 Dec	F&W	Eliminate non-native fishes	Recreation	System-wide eliminate non-native predators.		X										
648	USACE - 18 Dec	F&W	DownstreamA24:C24 passage at LOP	Passage	Downstream passage at LOP					X							
649	USACE - 18 Dec	F&W	Enhance habitat at Foster	Habitat	Improve/ restore stream habitat U/S from Foster.					X							
650	USACE - 4-6 DEC Charrette	F&W		Hatchery	N. Santiam - Elminiate hatchery trout releases upon completion of D/s passage (about 2028).					X							
651	USACE - 18 Dec	F&W	Enhance stream habitat in the N. Santiam	Habitat	Improve/ restore stream habitat in Breitenbush, N. Santium U/S from Detroit.					X							
652	USACE - 18 Dec	F&W	Restore off-channel habitat	Habitat	System-wide modify/ restore conectivity of off-cannel habitat D/S from X Dam.					X							
653	USACE - 18 Dec	F&W	Optimize flows for flexibility for fish	Water Control Diagram	System-wide RM&E and adjust ramp rates to increase operational flexibility.	X											
654	USACE - 18 Dec	F&W	Import gravel/sediments downstream	Habitat	Import gravel and add sediments to outflow system-wide [Note: from WQ card].					X							
655	USACE - 18 Dec	F&W	Update existing infrastructure for non-ESA	Wildlife	System-wide, identify, restore/ retrofit unused infrastrucutre for wildlife use (bats, birds, etc.).				X								
656	USACE - 4-6 DEC Charrette	F&W		Habitat	Restore off-channel habitat downstream of dams.					X							
657	USACE - 18 Dec	F&W	Fin clipping for reintroduction efforts	Hatchery	Leave some hatchery fish unclipped at release to better support reintroduction efforts and improve escapement of reintroduction fish.	X											
658	USACE - 18 Dec	F&W	Spring storage/summer spill	Water Supply	Store more water in spring to release through summer/fall for minimum flow targets system-wide.	X											

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659	USACE - 18 Dec	F&W	Operate for run of river	Water Control Diagram	Run of river (e.g., Fall Creek) at other dams.					X							
660	USACE - 18 Dec	F&W	Enhance tribal resource use	Cultural	Enhance tribal resource uses.						X						
661	USACE - 18 Dec	F&W	Downstream passage slides at dams	Passage	Big slides for downstream passage system-wide.	X											
662	USACE - 18 Dec	F&W		Recreation	Eliminate sport fishing.		X										
663	USACE - 18 Dec	F&W	MCR ecological management for ESA		Continue to move or Actic (Caspian) terns or commorants from MCR.				X								
664	USACE - 18 Dec	F&W	Augment flows to current targets	Downstream Flows	Protective ramp rates: minimum flows.	X											
665	USACE - 18 Dec	F&W	Revetment modification/removal and culverts	Revetments	Colverts on revetments.					X							
666	USACE - 18 Dec	F&W	Cost-share for habitat projects	habitat	Designate habitat restoration projects that may enhance the flood plain for ESA listed habitat and remove only select revetments with more minor impact and build set-back levees with cost share project with BPA to protect assets while expanding ESA habitat. Use large projects to offset having to do too many "smaller" projects.	X											
667	USACE - 18 Dec	F&W	Revetment modification/removal	Revetments	Removemoify revetments.					X							
668	USACE - 18 Dec	F&W	Reduce harvest for low run returns	Recreation	Reduce harvest rates within season when run returns are less than the 10 year average		X										
669	USACE - 18 Dec	F&W	Reduce NOR collection for broodstock	Hatchery	Cease NOR collection for broodstock when temperature and densities are high below Dexter.	X											
670	USACE - 18 Dec	F&W	Upgrade Dexter	Hatchery	Update Dexter Facility using specs and handling practices that do not increase the risk of PSM and cease using CO2	X											
671	USACE - 18 Dec	F&W	Reduce hatchery by 30%	Hatchery	Scale back the recreational fishery to 30% of the current catch effort basin-wide							X					
672	USACE - 18 Dec	F&W	Reduce hatchery by 60%	Hatchery	Scale back the recreational fishery to 60% of the current catch effort basin-wide							X					
673	USACE - 18 Dec	F&W	Foster Reservoir outplanting	Passage	Outplant adults in Foster Reservoir	X											
674	USACE - 18 Dec	F&W	HHB at WVP dams	Passage	Develop high head bypass at all WVP's					X							
675	USACE - 18 Dec	F&W	Reduce TDG at Big Cliff	Water Quality	Manipulate spill at Big Cliff to reduce TDG					X							
676	USACE - 18 Dec	F&W	Big Cliff reach outplants	Passage	Outplant adults below Big Cliff							X					
677	USACE - 18 Dec	F&W	No steelhead fisheries in the Santiams	Recreation	Eliminate the summer steelhead progam in the Santiam's		X										
678	USACE - 18 Dec	F&W	Construct juvenile facilities at LOP	Passage	Build an off-channel juvenile collector at LOP	X											
680	USACE - 18 Dec	F&W	Management for ESA in the estuary	Wildlife	Implement avian management at ESI to improve survival of juveniles in the estuary				X								
681	USACE - 18 Dec	F&W	Management for ESA in the estuary	Wildlife	Implement avian management at Rice Island to improve survival of juveniles in the estuary				X								
682	USACE - 18 Dec	F&W	Ecological management for ESA in the estuary	Wildlife	Implement avian management at the Astoria Bridge to improve survival of juveniles in the estuary				X								
683	USACE - 18 Dec	F&W	Construct access roads at precariously placed WVP dams	Structural	Build more access roads at Cougar and other dams to support fish surveys and access/exit during summer and fall fire seasons.		X										
684	USACE - 18 Dec	F&W	Optimize winter flows for conservation over hydroelectric	Downstream Flows	Better balance stable winter flows with peak power demands to avoid distuptions to outmigrating juveniles	X											
685	USACE - 18 Dec	F&W	General install fish friendly turbines	Hydropower	Install fish friendly turbines at WVP dams	X											
686	USACE - 18 Dec	F&W	Eliminate fish recycling	Recreation	Eliminate the fish recycling program		X										
687	USACE - 18 Dec	F&W	Prioritize wild fish targets over hatchery production	Recreation	Decrease adult recreational harvest rates until annual conservation standards for HOR and NOR outplants are met.		X										
688	USACE - 18 Dec	F&W	Real-time outplanting schedule based on counts at Willamette Falls	Hatchery	Adjust outplanting needs based in real time based on observed counts at Willamette Falls.												
689	USACE - 18 Dec	F&W	PIT arrays for juvenile survival assessment.	Operations	Install and maintain PIT arrays within reaches to allow for reach specific survival estimation before and after passage is implemented.	X											
690	USACE - 18 Dec	F&W	Revetment modification/removal	Revetments	Remove obsolete revetements to promote riparian growth and predation refuge for juvenile outmigrants.					x							

Measure No.	Developed By	Project Purpose	Measure Name	Measure Category	General Description	Marked 'X' if kept for further analysis	Measure outside of USACE Authorities	Measure is part of NAA	Measures outside of the scope of the WVS EIS	Duplicate under the same theme	This is an objective, not a measure	Measure being addressed by other projects/entities (Flow Chart #1)	Measure completely eliminates one or more project purposes (Flow Chart #2)	Measure Compromises Dam Safety (Flow Chart #3)	Structural measure NOT for ESA-listed species (Flow Chart #4)	Measures removed to Impacts Analysis	Potential Mitigation Measure
691	USACE - 18 Dec	F&W	Habitat enhancement at Cougar	Habitat	Transport woody debris caught in collectors and the temperature control tower at Cougar downstream to stabilize sediment transport.					x							
692	USACE - 18 Dec	F&W	reduce hatchery trout overlap with ESA	Hatchery	Reduce trout hatchery outplants where they overlap with ESA listed species.	X											
693	USACE - 18 Dec	F&W	Antibiotics for juvenile salmonids	ESA	Inject juveniles captured by collectors with antibiotics to control copepod infections in the summer and fall	X											
694	USACE - 18 Dec	F&W	Sterilize carcasses	Operations	Sterilize all carcasses before outplanting them into other tribs.	X											
695	USACE - 18 Dec	F&W	Ecology enhancement for ESA/non-ESA	Recreation	Introduce brook trout instream above reservoirs to control copepod proliferation.		X										
696	USACE - 18 Dec	F&W	Ecology enhancement for ESA/non-ESA	Recreation	Introduce brook trout to WVP reservoirs to control copepod proliferation.					X							
697	USACE - 18 Dec	F&W	Hatchery production based on habitat	Hatchery	Reduce the number of hatchery smolts released based on the available habitat (ie, R2, Parkhurst, etc.).	X											
698	USACE - 18 Dec	F&W	Fin clipping for reintroduction efforts	Hatchery	Acclimate and fin clip hatchery smolts intended for harvest downstream where fisheries are most active. Acclimate hatchery smolts intended for conservation upstream and leave upclipped to support reintroduction efforts.	X											
699	USACE - 18 Dec	F&W	Hatchery supplement historic abundance	Hatchery		X											
700	USACE - 29 May	FRM	Aquire flowage easement in downstream areas (between bankfull and floodstage) to provide provide flexability on FRM and potentially provide env benefits.	Real Estate						X							
701			Acquire flowage easesments to surcharge within reservoirs	Real Estate						X							
702	USACE - 18 Dec	F&W	Drawdown for spawning fish	Habitat	System-wide drawdowns while fish are spawning.	X											
703	Public Scoping	Water Quality	Structural improvements to reduce water quality impacts during emergency and unusual events.	WQ		X											
704	Public Scoping	Water Manage	Installation and maintenance of new instream flow gages			X											
705	Public Scoping	F&W	Improve or replace some adult release sites above dams			X											
706	Public Scoping	F&W	Spill in SPRING and FALL for fish passage (particularly at LOP, Hills Creek)			X											
707	Public Scoping	F&W	Delayed refill in spring for fish passage (particularly at LOP)			X											
708	Public Scoping	Water Quality	Structural improvements to address TDG (particularly at Detroit)			X											
709	Corps PDT	F&W	Drawdown in SPRING for fish passage			X											
710	Corps PDT	Water Quality	Operate using outlets at different elevations to achieve more normative water temperatures downstream of dams			X											
711	Corps PDT	Water Quality	Mechanical degassing methods in fish collection/hatchery areas below the dams (construct)			X											
712	Corps PDT	Water Manage	For reservoirs designated with primary and secondary flood storage (HCR, LOP, CGR, BLU, DET, & GPR), change the secondary flood storage to carryover storage. This would allow the water to remain in storage during the winter months to meet minimum flow or downstream flow requirements. In the event of a forecast of a large flood event, the secondary flood storage would be evacuated to minimum pool prior to the event, regaining the secondary flood storage in the pool.			X											

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713	Corps PDT		Modify ramp rate (goal to save stored water)			X											
714	Corps PDT		Use spillway to pass fish in spring			X											
715	Corps PDT		Operate at run of river at lowest outlet for downstream passage			X											
716	Corps PDT		Improve spawning and incubation flows to reduce stranding and dewatering			X											
717	Corps PDT	HDR	Fill secondary FRM storage in winter to allow for maximized hydropower value			X											

Attachment 2. Objectives Measures Screening

Measures									Objectives						
Measure No.	**Project Purpose**	**Measure**	**Measure Type**	**General Description**	**Notes**	**Marked 'X' if kept for further analysis**	**Measure outside of scope of WVS EIS**	**Does Not Meet An Objective**	**1-Increase water management flexibility (refill, drawdown timing, etc.)**	**2-Increase nature-based structure opportunities during maintenance of Corps owned revetments**	**3-Increase hydropower production flexibility**	**4-Increase anadromous ESA-listed fish passage survival at WS dams**	**5-Optimize conservation season draft rates to benefit anadromous ESA-listed fish**	**6-Reduce impaired water quality below the WS dams to benefit andadromous ESA-listed species.**	**7-Reduce spawning and rearing habitat competition from hatchery fish.**
1	FRM	FRM - easements	Real Estate	Aquire flowage easements in downstream areas (between bankfull and floodstage) to provide flexibility on FRM and potentially provide env benefits.		X			X	X				X	
2	O&M	Lower Minimum Conservation Pool Elevation	Water Control Diagram	Lower Minimum Conservation Pool at non-hydropower dams (more space in reservoir during FRM period for flood storage)		X			X						
3	O&M	Lower Maximum Conservation Pool Elevation	Water Control Diagram	Lower Maximum Conservation Pool (further reduce flood risk)- not within scope- not changing flood risk management	Not within scope of the WVS EIS		X								
4	FRM	Adaptive Water Control Diagram	Water Control Diagram	Create Climate Adaptive Rule Curves - long-term adaptive management actions- not in scope to do climate change study	Not within scope of the WVS EIS		X								
5	FRM	Improved Forcasting Water Control Diagram	Water Control Diagram	Utilize improved forecasting capability (flexibility band around existing rule curve) - short-term management actions		X			X						
6	FRM	Watershed Response Based Water Control Diagram	Water Control Diagram	Forecast Based Reservoir Operations (FIRO) on a programmatic scale leaving each reoperation study the lighter lifts of an EA for any impacts beyond those disclosed in the EIS. Develop and apply better understanding of watershed		X			X						
8	FRM	Reconnect Floodplains - revetments	Revetments	Remove revetments - reconnecting flooplain to increase FRM. Not formulate to increase FRM- or ecosystem restoration	Not within scope of the WVS EIS		X								
9	FRM	Revetment as-built repairs	Revetments	Repair revetments using bioengineering		X				X				X	
13	FRM	Additional Control Points	Structural	Expand Control Points - improve how we measure unregulated flow/real time flood management		X			X						
15	FRM	Dredge reservoirs	Flood Risk Management	Expand existing storage - dredge reservoir sediment		X			X				X		
17	F&W	Reduce Ramping Rates	Ramp Rates	Reduce ramping up/down rates to minimize damage to archeological site and F&W habitat (mussels, turtles etc.)		X			X	X		X			
18	FRM	Maximum Discharge Rates	Water Control Diagram	Better understanding of max discharge rates to manage floods (when can we go above max discharge rates and not effect FRM)- This is a study not a measure	Not a measure (study)			X							
19	F&W	Reduce Drawdown Flow Rates	Water Control Diagram	Reduce drawdown flow rates		X			X			X	X	X	
20	FRM	Earlier Drawdown (Fall)	Water Control Diagram	Evacuation earlier to increase fall FRM- not changing flood risk management	No change (increase) to FRM			X							
22	F&W	Floodplain connectivity	Habitat	Explore opportunities/strategies for floodplain reconnection and passage improvement, targeting "bottlenecks" that would open up large areas of habitat / reconnect important floodplain areas.	Outside of P&N scope		X								
24	WQ	Variable Hydrology Flexible Water Control Diagram	Water Control Diagram	Flexible rule curves to adaptively manage variable hydrology		X			X						
30	HDR		Downstream Flows	Change minimum flows for increased flexibility.		X			X				X		
31	HDR		Operations	Flow continuation valves/ structural (or operational) fish passage measures/ structural temperature control =>maintain flexibility and use				X							
34	HDR		Water Control Diagram	Hold reservoir higher at key hydro dams.				X							
37	HDR	Caretaker Status	Operations	Put hydropower generation and equipment on caretaker status at one or more project hydropower facilities. Doesn't meet any objectives	Does not meet any objectives			X							
38	HDR	Levels of Service	Operations	Consider alternative operations, maintenance and capital reinvestment practices that align with each hydropower facility's relative importance in the power system doesn't meet an objective	Does not meet any objectives			X							
40	F&W		Passage (DS Operations)	Deeper FALL drawdowns to RO for downstream passage (particularly at LOP).		X			X			X	X	X	
42	F&W		Habitat	Improve/ restore stream habitat U/S for ESA fish spawning and incubation (particlarly at Foster) after effects analysis hold for mitigation	Does not meet any objectives - hold for mitigation consideration			X							
44	F&W		Habitat	Restore off-channel habitat for non-ESAafter effects analysis hold for mitigation	Does not meet any objectives - hold for mitigation consideration			X							

Measures									Objectives						
Measure No.	**Project Purpose**	**Measure**	**Measure Type**	**General Description**	**Notes**	**Marked 'X' if kept for further analysis**	**Measure outside of scope of WVS EIS**	**Does Not Meet An Objective**	**1-Increase water management flexibility (refill, drawdown timing, etc.)**	**2-Increase nature-based structure opportunities during maintenance of Corps owned revetments**	**3-Increase hydropower production flexibility**	**4-Increase anadromous ESA-listed fish passage survival at WS dams**	**5-Optimize conservation season draft rates to benefit anadromous ESA-listed fish**	**6-Reduce impaired water quality below the WS dams to benefit andadromous ESA-listed species.**	**7-Reduce spawning and rearing habitat competition from hatchery fish.**
49	F&W		Habitat	Designate habitat restoration projects that may enhance the flood plain for ESA listed habitat and remove only select revetments with more minor impact and build set-back levees with cost share project with BPA to protect assets while expanding ESA habitat. Use large projects to offset having to do too many "smaller" projects.	Covered by other measure(s) - hold for mitigation consideration			X							
50	F&W		Authorized Purposes	Forego/ modify authorized hydropower purposes in order to increase water availity and operational flexibility for F&W needs. - doesn't meet P&N	Does not meet P&N		X								
52	F&W		Passage	Explore Pacific lamprey passage and reintroduction at projects where deep drawdown/run of river are implemented											
57	Rec		Operations	Maintain Pool for Rec / Lower flows during recreation season		X			X				X	X	
65	WS		Water Control Diagram	Refill reservoirs earlier				X							
67	WS		Water Control Diagram	Eliminate ramp rates		X			X		X				
70	WS		Operations	Maximize storage for WS- covered by another study (WBR)	Covered by another study (WBR)		X								
78	F&W	(Corps) Delay spring refill	Water Control Diagram	Maintain reservoir lower longer in spring to allow outmigration through lowest, fish-friendly surface outlets, or using spill.		X			X		X	X	X	X	
82	F&W	(Corps-rev) Lower/remove power pool to bring pool down to lowest outlets for fish passage	Passage (DS Operations)	Lower/remove power pool to bring pool down to lowest outlets for fish passage. Part of larger revision of rule curve, incorporate flexibility to draw down reservoirs to improve downstream fish passage success through lower, fish-friendly outlets.		X			X		X	X	X	X	
89	FRM	Allow rule curve flexibility	Water Control Diagram	Replace current rule curve with "rule curve-like" tool to provide management flexibility under a variety of conditions without increasing flood risk. Not a rule curve study	Outside of the WVS EIS scope - not a rule curve study		X								
96			Revetments	Remove revetments of low protective value, prioritizing those that will provide highest F&W benefits. Target to reconnect to habitat, allow gravel movement and floodplain connectivity. Not meet purpose and need- not maintain current flood risk level New wording: Modify revetments of low protective value, prioritizing those that will provide highest F&W benefits. Target to reconnect to habitat, allow gravel movement and floodplain connectivity.	Does not meet P&N - does not maintain current FRM	X				X					
97			Revetments	Remove high ecological-value priority revetments - prioritize those that will reconnect to habitat, allow gravel movement, improve floodplain connectivity. Not meet purpose and need- not maintain current flood risk level New wording: Modify high ecological-value priority revetments - prioritize those that will reconnect to habitat, allow gravel movement, improve floodplain connectivity.	Does not meet P&N - does not maintain current FRM	X				X					
99	F&W	(Corps) Improve/ restore stream habitat in Breitenbush, N. Santium upstream from Detroit for ESA fish spawning, incubation, and rearing.	Habitat	Improve/restore stream habitat upstream from Corps for ESA fish spawning, incubation, and rearing. Effect analysis possible mitigation	Effects analysis - possible mitigation			X							
102	F&W	Gravel/sediment augmentation below dams	Habitat	Augment below-dam habitats with sediment on regular basis. Effects analysis possible mitigation	Effects analysis - possible mitigation			X							
103	F&W	Augment LWD to facilitate natural processes that aren't taking place due to dams, altered flow regimes	Habitat	Augment below-dam habitats with large woody material on regular basis. Effects analysis possible mitigation	Effects analysis - possible mitigation			X							
104	F&W	Sustainable river flows to transport wood, gravel, and other native materials, create new channels etc.	Habitat	Provide ecologically meaningful flows to allow for transport of materials and to create dynamic floodplain habitats.		X						X			
105	WQ	(Corps) Temperature Control Structure	Water Quality	Temperature Control Structure - Needed if operate dams under current scenarios (not needed for run of river).		X			X		X	X		X	

Measures									Objectives						
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108	F&W	Reactivate historic side channels to reduce flood risk and build flood capacity.	Flood Risk Management	Increase flood capacity by reconnecting historic side channels on the mainstem Willamette. Not meet purpose and need	Does not meet P&N		X								
110	WS	Prioritize water demands consistent with existing and revised BiOp.	Operations	Prioritize F&W water needs consistent with BiOp.- no action alternative	Is part of NAA			X							
112	WQ	Creative use of reservoirs for temperature control to off-set climate impacts downstream	Water Quality	Operate reservoirs to provide cold water where needed in localized areas downstream		X						X		X	
113	F&W	Design and implement ways to reduce TDG when spilling	Water Quality	Allow increased spill without elevating TDG below dams.		X						X			
114	F&W	Restore as near as possible normative temperatures downstream	Habitat	Operate at run of river (achieve more normative water temperatures downstream of dams and downstream passage)		X						X			
115	WS	Change authorizations to put more emphasis on F&W water	Authorized Purposes	Implement requirements from the Willamette Basin Reallocation process to provide flows to benefit F&W resources. - no action alternative	Part of NAA			X							
116	WS	Implement current and new BiOps fully (F&W flows)	Operations	Implement outcomes from the Willamette Basin Reallocation process to provide flows to benefit F&W resources.	Part of NAA			X							
117	WS	Maximize storage and operations to address current and future drought/climate change effects and to reduce impacts on F&W.	Water Control Diagram	Evaluate flow and storage under changing environmental condition, building protections for F&W, reservoirs managed to allow flexibility to manage effects of climate change on stream flows (may need higher reservoirs to augment later in season, slower fall drawdown, flexibility to adjust to changing environment.)	Covered by other measure(s)			X							
118	O&M	Manage maintenance schedules to prioritize reduced impacts or risk of impacts to F&W	Operations	Refine maintenance schedules to prioritize reduced impacts to F&W resources.		X						X			
120	F&W	Create low water outlets at dams to provide fish passage	Structural	Construct low elevation outlets in dams to provide fish-friendly passage option. Requires low pool elevations during peak outmigration periods.		X						X			
123	F&W	Maintain conservation hatchery production to support reintroduction efforts	Operations	Maintain conservation hatchery production to support reintroduction efforts (includes adequate funding for RME to inform reintroduction efforts and adaptive management into future).- no action alternative	Part of NAA			X							
124	F&W	Provide access to habitat for Chinook above Hills Creek, Lookout Point and Green Peter; also for steelhead above Green Peter	Passage (US)	Restore access for adult Chinook and steelhead in areas currently blocked by dams without passage (i.e. provide upstream passage) .		X						X			X
128	F&W and O&M	Implement and fund monitoring for abundance, productivity, spatial structure, and diversity.	Operations	Implement monitoring of fish populations and changes to benefit F&W correct no a measures- possible conservation measure in BA (part of an ADM?)	Not a measure - possible conservation measure within BA			X							
136	WQ		Habitat	Establish trading for flow, cold water refugia, riparian protection		X									X
140	WQ		Structural	Explore feasibility of temperature control interim and structural modifications	Covered by other measure(s)			X							
145	F&W		Habitat	Gravel mining from reservoir and move below dams for aquatic habitat		X									X
151	F&W		Habitat	Dam release timing and flows that mimic historic temperature conditions		X			X			X	X	X	X

Measures									Objectives						
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156	F&W		Flood Risk Management	Altered flood control operations in low and mid-range water years to guarantee flows downstream of project- wouldn know if we are in low year until after flood control season- not technically feasible.	Not technically feasible			X							
161	Rec		Recreation	Summertime weekend releases in late July through August for the North Santiam for downstream recreation does not meet an objective	Does not meet any objectives			X							
162	Rec		Recreation	Adjusting fall draw down schedules (specifically at Foster) to increase whitewater paddling opportunities. There is a small whitewater feature below the Fern Ridge Dam that is usable in the narrow range from 900-1500 CFS.	Doest not meet any objectives			X							
164	Rec		Recreation	Optimization and scheduling (and improved awareness) of fall draw down to support whitewater paddlers on the lower river would support access and use of this resource for intermediate paddlers. does not meet an objective- effects analysis	Does not meet any objectives			X							
165	Rec		Recreation	A predictable flow schedule within safe boatable ranges.does not meet an objective- effects analysis. One or two planned summer releases for local paddlers. does not meet an objective- effects analysis	Does not meet any objectives			X							
166	WQ		Water Quality	Use lowest ROs to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below dams (particularly at Lookout Point and Detroit dams)		X								X	
170	F&W		Passage (DS Operations)	Drawdown in SPRING and FALL for fish passage (particularly at Hills Creek)		X			X			X		X	
172	F&W		Passage (DS Operations)	Implement drawdowns for fish migration.		X			X			X			
173	F&W		Passage (US)	Adult fish facility improvements (particularly at Dexter)		X						X			X
174	F&W		ESA	Structural improvements to reduce TDG where needed as a result of passage operations		X								X	
176	F&W		Passage (DS Operations)	Interim Measure: Improve volitional downstream passage for juvenile fish using existing facilities. Annually draw down (particularly at Detroit reservoir) to the regulating outlet invert elevation by November 15 and hold until December 15, and prioritize discharge through the regulating outlets over power turbines for that time.		X						X			
177	F&W		ESA	Interim Measure: Annually prioritize discharge through the regulating outlets (particularly at Green Peter) from November 15 through January 31 to enhance juvenile passage		X						X			
178	F&W		ESA	Maintain pool at minimum conservation pool (particularly at Cougar) from March 1 to May 1 and prioritize use of regulating outlets over power turbines for that time.		X							X	X	
180	F&W		ESA	Interim measure: Maintain the water surface elevation at Fall Creek reservoir at or below 685 feet year-round except as needed to provide downstream flood damage reduction benefits. (run of river except for flood)		X						X		X	
181	F&W		Water Quality	Interim measure: Improve downstream water quality using existing facilities. Use the lower and upper regulating outlets at Detroit Dam as needed to control discharge water temperatures and prioritize meeting downstream water temperature targets over power generation during the fall. This measure would improve the reproductive success of Chinook salmon that spawn downstream from the project.		X								X	
184	Rec		Water Control Diagram	Usability of Fern Ridge Reservoir to operate in March and October - doesn't meet objective as it is specifically for recreation	Does not meet any objectives			X							
185	HDR		Hydropower	Add more capacity to add more power to existing facilities - measure too vague, more capacity would require major new infrastructure or dam safety issues	Require major new infrastructure		X								
194	HDR		Structural	Construct new penstock intake at tower elevation to use more of the pool. requires major new infrastructure	Require major new infrastructure		X								
205	HDR		Hydropower	Replace turbines with bigger and better units. requires major new infrastructure	Require major new infrastructure		X								
212	HDR		Downstream Flows	All more (or less) spill? too vague				X							
218	HDR		Structural	Add additional generating units at non-generating dams. major new infrastructure	Require major new infrastructure		X								
221	HDR		Hydropower	Operate to provide more power for estimated/predicted high-use power days/events = higher demand. no action alternative	Part of NAA			X							
228	HDR		Authorized Purposes	Prioritize hydro production year round.		X					X				

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233	HDR		Hydropower	For multi-unit powerhouses, run only 1 unit at a time, or rotate between them (assuming that effects flows, temps, or fish passage survival).		X					X	X			
236	WS		Authorized Purposes	Prioritize demands especially in dry years/ events/ summers - does not meet objectives	Does not meet any objetives			X							
257	WS		Water Supply	Prioritze consumptive use of water in conservation pools. Does not meet objectives	Does not meet any objetives			X							
258	WS		Water Control Diagram	Ensure each reservoir fills by May 15 of each year, even drought years (prioritize reservoir refill).		X			X			X		X	
260	WS		Downstream Flows	Reduce fish and wildlife flows to pre-dam releases (focus on upstream production). Out due to impacting one or more authorized purposes	Impacts one or more authorized purposes			X							
275	WS		Water Control Diagram	Eliminate rule curve - provide more flexibiity in management of reservoir storage. Duplicate to other measures	Covered by other measure(s)			X							
281	WS		Operations	Dredge all rivers for additional storage and maintian as part of O&M. Does not meet objectives; high cost; env impacts	Does not meet any objetives			X							
288	WS		Water Supply	Climate change - Consider deviation from shared water allocation during shortages - all uses/demands not equal. Outside of Corps authorities	Outside of Corps authorities		X								
295	F&W		Hatchery	Use hatchery fish to supplement reintroduction. - Doesn't meet objectives	Does not meet any objetives			X							
304	F&W		Water Control Diagram	Augment flows by tapping power pool.		X			X					X	
314	F&W		Hatchery	Adjust hathery production to credit for existing passage (particularly in S. Santiam)		X									X
322	F&W	Prioritize conservation hatchery production	Hatchery	Prioritize conservation hatchery production over mitigation production (re-balance).		X									X
323	F&W	Prioritize conservation hatchery production	Hatchery	Do not dip conservation hatchery production (to avoid catch in fishery).		X						X			
326	F&W	Augment temperatures at Green Peter	Operations	Modify operations for changing temperatures.	Covered by other measure(s)			X							
336	F&W		Habitat	Change flow rates to change sediment deposition.		X						X			
338	F&W		Passage (DS Structural)	Construct structural downstream passage facilty (trap and haul, ladders, juvenile fish collectors, head of reservoir collector, etc.).		X						X			
343	F&W	Reduce non-conservation hatchery production	Hatchery	Reduce use of hatchery fish. Mitigate in other ways, show negative impacts from these fish and ecological imbalance.		X									X
346	F&W		Water Control Diagram	Draw reservoirs down when fish are laying eggs in anticipation off water being low later in the season.		X						X			
347	F&W		Hatchery	Leave some hatchery fish unclipped at release to better support reintroduction efforts. Does not meet objectives	Does not meet any objectives			X							
350	F&W		Hatchery	Eliminate mitigation hatcheries in place of conservation hatcheries.		X									X
354	F&W		Water Control Diagram	Store more water in spring to release through summer/fall for minimum flow targets.		X			X		X				
355	F&W		Passage (US)	Fish ladders where applicable.		X									X
369	F&W		Authorized Purposes	Operate conservation pool for F&W as first priority.		X						X	X	X	X?
373	F&W		Hatchery	Eliminate hatchery program.		X									X
384	F&W		Habitat	Import/add sediment at outflows.		X									X
385	F&W		Passage (DS)	Use alternate release conduits to reduce juvenile mortality.		X						X			
387	F&W		Hatchery	Increase use of conservation hatchery. Does not meet objectives	Does not meet any objectives			X							
388	F&W		Hatchery	Decrease use of production hatchery.		X									X
390	F&W		Revetments	Culverts in revetments.		X				X					X
392	F&W		Passage (DS Structural)	Provide/construct high head bypass		X						X			
393	F&W		Hatchery	Provide hatchery mitigation on crediting based on availability of suitable habitat - reassess mitigation responsibility after passage implemented.		X									X
413	WQ		Structural	Flip lips, physical structure to de gas water to reduce TDG (construct).		X								X	

Measures									Objectives						
Measure No.	**Project Purpose**	**Measure**	**Measure Type**	**General Description**	**Notes**	**Marked 'X' if kept for further analysis**	**Measure outside of scope of WVS EIS**	**Does Not Meet An Objective**	**1-Increase water management flexibility (refill, drawdown timing, etc.)**	**2-Increase nature-based structure opportunities during maintenance of Corps owned revetments**	**3-Increase hydropower production flexibility**	**4-Increase anadromous ESA-listed fish passage survival at WS dams**	**5-Optimize conservation season draft rates to benefit anadromous ESA-listed fish**	**6-Reduce impaired water quality below the WS dams to benefit andadromous ESA-listed species.**	**7-Reduce spawning and rearing habitat competition from hatchery fish.**
414	WQ		Water Quality	Construct wetlands w/ plant species to improve water quality.		X				X				X	X
418	WQ		Water Quality	Construct floating wetland to reuce algae, turbidity in reservoir.		X								X	
421	WQ		Water Quality	Modify spillway so water is evenly dispersed to reduce TDG.		X								X	
428	WQ		Water Quality	Plant riparian plants to increase shading (cool temperatures).		X								X	
430	WQ		Water Quality	Treat algae blooms in reservoir.		X								X	
438	WQ		Structural	Flow continuation valve to re-regulate dams.		X								X	
446	WQ		Structural	Instream structures/boulders to assist with off-gassing to reduce TDG (wing deflectors, tainter gates).		X								X	
455	WQ		Structural	Evaluate and develop structural changes for reduction of TDG. Duplicate to another measure	Covered by other measure(s)			X							
466	WQ		Water Quality	Modify Detroit to remove TDG U/S from Big Cliff. Too vague/duplicate				X							
477	WQ		Structural	Implement structural measures at Big Cliff to spread out spill and reduce TDG. Duplicate	Covered by other measure(s)			X							
479	WQ		Structural	Modify outlets to allow releases at varying levels for temperature control.		X			X			X		X	
485	WQ		Structural	Flip lip below Cougar RO. Duplicate	Covered by other measure(s)			X							
499	WQ		Water Control Diagram	Return to "pre-dam" normative flows & temperatures below projects - Duplicate	Covered by other measure(s)			X							
508	Rec	Maintain Pool for Rec	Recreation	Maintain high and stable lake levels during recreation season, prioritizing lake-by-lake to balance with other missions. Possible specifics: Minimize drafting from Fern Ridge, Detroit, Foster. At Fern Ridge, moving the control point gauging system to the dam from Monroe may lower minimum releases. Does not meet objectives	Does not meet any objectives			X							
509	Rec	Better below-dam fishing	Recreation	Enhance fishing below dams when lakes pools are low by not transporting hatchery fish past dams. Does not meet objectives	Does not meet any objectives			X							
515	HDR		Water Control Diagram	Update the water control manual to permit regulators to retain water up to the top of the flood control pool (elevation 1485ft, or 35ft above minimum flood pool elevation 1450 ft), except when 10-day forecasts indicate a flood approaching the 1861 is imminent. Rough Example: DET can vacate 33,719 acre-ft of secondary storage per day at 17,000 cfs (upper normal discharge limit), which is over half of the existing secondary storage. [How is this different than forcasting measure]		X			X		X				
516	HDR		Water Control Diagram	Explore increasing the top of the secondary flood pool (example – from elevation 1485 to 1500ft at Detroit), under the assumption that reservoir elevation can be returned to elevation 1450 ft at the upper normal discharge limit of 17,000 cfs within the limitations of the 10-day forecast and water travel times to Portland.		X			X		X				
517	HDR		Water Control Diagram	Create secondary storage volumes for the February-April refill months that allow regulators to retain water above the rule curve, discharging water to drop back down to the rule curve if a flood of some undefined magnitude is observed. This would allow capturing excess runoff during the February – April months.		X			X		X				
524	WS	Prioritize reservoirs for storage (keep some full year round)	Water Control Diagram	Prioritize some dams for year-round storage (keep some full year round)	violate FRM constraint			X							
525	WS	Prioritze reservoirs for storage allocation (e.g., not all reservoirs provide H2O)	Water Supply	Prioritize some dams for maximum water storage vs. other dams that provide less water storage (e.g., not all reservoirs provide H2O)	Covered by other measure			X							
532	WS	Reduce minimum flows to allow for more storage	Downstream Flows	Reduce minimum flows for F&W, AG and M&I demands, to allow for more storage	Does not meet any objectives			X							
540	WS	Integrate managemnet of watershed uplands into water supply planning to adjust for climate change impacts	Habitat	Integrate management of watershed uplands into water supply planning to adjust for potential climate change impacts. Forests and fires greatly influence watershed services/inputs to hydrology.	Outside of cCorps authorities/MP for USACE lands		X								
572	WQ	Put bathrooms on reservoirs as a floating structure	Operations	Put bathrooms on reservoirs as a floating structure	Does not meet objectives/being done by others			X							

Measures									Objectives						
Measure No.	**Project Purpose**	**Measure**	**Measure Type**	**General Description**	**Notes**	**Marked 'X' if kept for further analysis**	**Measure outside of scope of WVS EIS**	**Does Not Meet An Objective**	**1-Increase water management flexibility (refill, drawdown timing, etc.)**	**2-Increase nature-based structure opportunities during maintenance of Corps owned revetments**	**3-Increase hydropower production flexibility**	**4-Increase anadromous ESA-listed fish passage survival at WS dams**	**5-Optimize conservation season draft rates to benefit anadromous ESA-listed fish**	**6-Reduce impaired water quality below the WS dams to benefit andadromous ESA-listed species.**	**7-Reduce spawning and rearing habitat competition from hatchery fish.**
575	WQ	Develop more off channel habitat and temperatures	Habitat	Develop more off channel habitat for temperatures		X				X				X	X
584	HDR	Minimize days of spill and [?] and optimize turbine operations in deficit water years.	Hydropower	Minimize days of spill and [?] and optimize turbine operations in deficit water years.		X					X				
601	FRM	Armor dam structures	Structural	Improve outlet/spillway so able to release higher flows (mange the PMF)		X			X						
615	FRM	Clean out spillway channels.	Operations	Clean out spillways so that if spillways are used debris doesn't cause downstream damage.		X			X						
625	FRM	Lower summer lake level	Water Control Diagram	Change summer lake level (lower) to minimize shoreline erosion at some lakes (CTG, FRN, DOR, etc.).		X								X	
639	F&W	New passage at Long Tom	Passage	Restore passage on Long Tom (Stroda Drop Structure, Cox Butte, Ferguson) for ESA and non-ESA fish		X				X		X			X
643			Operations	System-wide augment flows by tapping power pool.	Covered by other measure(s)			X							
645	F&W			System-wide create bypasses around reservoirs for juvenile fish D/S passage		X			X			X			
653	F&W	Optimize flows for flexibility for fish	Water Control Diagram	System-wide RM&E and adjust ramp rates to increase operational flexibility.		X			X						
657	F&W	Fin clipping for reintroduction efforts	Hatchery	Leave some hatchery fish unclipped at release to better support reintroduction efforts and improve escapement of reintroduction fish.	Does not meet any objectives			X							
658	F&W	Spring storage/summer spill	Water Supply	Store more water in spring to release through summer/fall for minimum flow targets system-wide.	Covered by other measure(s)			X							
661	F&W	Downstream passage slides at dams	Passage (DS Structural)	Big slides for downstream passage system-wide.	Covered by other measure(s)			X							
664	F&W	Augment flows to current targets	Downstream Flows	Protective ramp rates: minimum flows.	Covered by other measure(s)			X							
666	F&W	Cost-share for habitat projects	habitat	Restore floodplain habitat	Covered by other measure(s) - hold for mitigation consideration			X							
669	F&W	Reduce NOR collection for broodstock	Hatchery	Cease NOR collection for broodstock when temperature and densities are high below Dexter.		X						X			
670	F&W	Upgrade Dexter	Hatchery	Update Dexter Facility using specs and handling practices that do not increase the risk of PSM and cease using CO2	Keep - is part of 2008 BiOp RPA; is this part of the NAA?	X						X			
673	F&W			Outplant adults in Foster Reservoir		X						X			X
678	F&W	Construct juvenile facilities at LOP	Passage (DS Structural)	Build an off-channel juvenile collector(s)	Covered by other measure(s)			X							
684	F&W	Optimize winter flows for conservation over hydroelectric	Downstream Flows	Better balance stable winter flows with peak power demands to avoid distruptions to outmigrating juveniles		X			X			X			
685	F&W	General install fish friendly turbines	Hydropower	Install fish friendly turbines at WVP dams		X						X			
689	F&W	PIT arrays for juvenile survival assessment.	Operations	Install and maintain PIT arrays within reaches to allow for reach specific survival estimation before and after passage is implemented.	Use for adaptive mngt?	X						X			
692	F&W	reduce hatchery trout overlap with ESA	Hatchery	Reduce trout hatchery outplants where they overlap with ESA listed species.		X									X
693	F&W	Antibiotics for juvenile salmonids	ESA	Inject juveniles captured by collectors with antibiotics to control copepod infections in the summer and fall		X						X			
694	F&W	Sterilize carcasses	Operations	Sterilize all carcasses before outplanting them into other tribs.	Does not meet objectives - mitigation			X							
697	F&W	Hatchery production based on habitat	Hatchery	Reduce the number of hatchery smolts released based on the available habitat (ie, R2, Parkhurst, etc.).		X									X

Measures									Objectives						
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698	F&W	Fin clipping for reintroduction efforts	Hatchery	Acclimate and fin clip hatchery smolts intended for harvest downstream where fisheries are most active. Acclimate hatchery smolts intended for conservation upstream and leave upclipped to support reintroduction efforts.	Does not meet objectives - conservation measure			X							
699	F&W	Hatchery supplement historic abundance	Hatchery	Hatchery supplement historic abundance	Does not meet objectives			X							
702	F&W	Drawdown for spawning fish	Habitat	System-wide drawdowns while fish are spawning.		X						X			
703	F&W		ESA	Structural improvements to reduce water quality impacts during emergency and unusual events		X								X	
704	F&W		ESA	Installation and maintenance of new instream flow gages- does not meet objective	Does not meet any objectives			X							
705	F&W		ESA	Improve or replace some adult release sites above dams		X									X
706	F&W		Passage (DS Operations)	Spill in SPRING and FALL for fish passage (particularly at LOP, Hills Creek).		X			X			X		X	
707	F&W		Passage (DS Operations)	Delayed Refill in spring for fish passage (particularly at LOP).		X			X			X			
708	F&W		ESA	Structural improvements to address TDG (particularly at Detroit)		X								X	
709	F&W		Passage (DS Operations)	Drawdown in SPRING for fish passage		X			X			X			
710	F&W	Restore as near as possible normative temperatures downstream	Habitat	Dam removal to achieve more normative water temperatures downstream of dams- does not meet purpose and need New wording: Operate using outlets at different elevations to achieve more normative water temperatures downstream of dams		X			X		X	X		X	
717	HDR	Fill secondary FRM storage in winter to allow for maximized hydropower value		Fill secondary FRM storage in winter to allow for maximized hydropower value		X			X		X				

Attachment 3. Technical Measure Screening

Date: 10/31/19					**Technical Feasibility- Practicality of a proposed measure, including whether it can be delivered with available technology, techniques, skills and resources.**		**Unacceptable Environmental Impacts Adverse effects caused by a measure to the human or natural environment**	**Implementation Risk- Potential for failure during planning, design or after construction or initiation of measure**
Project Purpose	**Measure Number**	**Measure**	**Marked 'X' if kept for further analysis**	**Should have been screened based on redundancy to another measure or on prior screening critteria (new structure, changes FRM, etc.)**	**Available information (citeable and objective - i.e. scientific support/consensus across several agencies) is not sufficient to support implementation of the measure; proof of concept or information clearly demonstrates major risk of failure**	**Expected benefit/change is minimal within the study timeframe and spatial scale (not distiguishable from measures in No Action)**	**The measure would result in detrimental changes to habitat or life history that would result in the potential listing of a species.**	**If the cost/benefit ratio is likely to be very low**
FRM	1	Aquire flowage easements in downstream areas (between bankfull and floodstage) to provide flexibility on FRM and potentially provide env benefits.						X
O&M	2	Lower Minimum Conservation Pool at non-hydropower dams (more space in reservoir during FRM period for flood storage)	X					
FRM	5	Utilize improved forecasting capability (flexibility band around existing rule curve) - short-term management actions		X	X			
FRM	6	Forecast Based Reservoir Operations (FIRO) on a programmatic scale leaving each reoperation study the lighter lifts of an EA for any impacts beyond those disclosed in the EIS. Develop and apply better understanding of watershed response in context of better weather forecasting			X			
FRM	9	Repair revetments using bioengineering	X					
FRM	13	Expand Control Points - improve how we measure unregulated flow/real time flood management				X		X
FRM	15	Expand existing storage - dredge reservoir sediment				X	X X	X
F&W	17	Reduce ramping up/down rates to minimize damage to archeological site and F&W habitat (mussels, turtles etc.)	X			X		

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F&W	19	Reduce drawdown flow rates	X					
WQ	24	Flexible rule curves to adaptively manage variable hydrology			X			
HDR	30	Change minimum flows for increased flexibility.	X					
HDR	31	Flow continuation valves/ structural (or operational) fish passage measures/ structural temperature control =>maintain flexibility and use		X				
HDR	34	Hold reservoir higher at key hydro dams.		X				
F&W	40	Deeper FALL drawdowns to RO for downstream passage (particularly at LOP).	X				X	X
F&W	52	Explore Pacific lamprey passage and reintroduction at projects where deep drawdown/run of river are implemented	X		X			
Rec	57	Maintain Pool for Rec / Lower flows during recreation season		X				
WS	67	Eliminate ramp rates					X	
F&W	78	Maintain reservoir lower longer in spring to allow outmigration through lowest, fish-friendly surface outlets, or using spill.	X					
F&W	82	Lower/remove power pool to bring pool down to lowest outlets for fish passage. Part of larger revision of rule curve, incorporate flexibility to draw down reservoirs to improve downstream fish passage success through lower, fish-friendly outlets.	X					

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F&W	96	Modify revetments of low protective value, prioritizing those that will provide highest F&W benefits. Target to reconnect to habitat, allow gravel movement and floodplain connectivity. Prioritize for low protective value.	X					
F&W	97	Modify high ecological-value priority revetments - prioritize those that will reconnect to habitat, allow gravel movement, improve floodplain connectivity.		X				
F&W	104	Provide ecologically meaningful flows greater than baseline to allow for transport of materials (gravel and woody debris) and to create dynamic floodplain habitats.	X					
WQ	105	Temperature Control Structure - Needed if operate dams under current scenarios (not needed for run of river).	X					
WQ	112	Operate reservoirs to provide cold water where needed in localized areas downstream			X			
F&W	113	Allow increased spill without elevating TDG below dams.			X			
F&W	114	Operate at run of river (achieve more normative water temperatures downstream of dams and downstream passage)	X					
O&M	118	Refine maintenance schedules to prioritize reduced impacts to F&W resources.	X					
F&W	120	Construct low elevation outlets in dams to provide fish-friendly passage option. Requires low pool elevations during peak outmigration periods.	X					

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F&W	124	Restore access for adult Chinook and steelhead in areas currently blocked by dams without passage (i.e. provide upstream passage) .	X					
WQ	136	Establish trading for flow, cold water refugia, riparian protection						
F&W	145	Gravel mining from reservoir and move below dams for aquatic habitat						
F&W	151	Dam release timing and flows that mimic historic temperature conditions	X					
WQ	166	Use lowest ROs to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below dams (particularly at Lookout Point and Detroit dams)	X		**elevation constraints in WCM**			
F&W	170	Drawdown in SPRING and FALL for fish passage (particularly at Hills Creek)		X				
F&W	172	Implement drawdowns for fish migration.		X X				

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F&W	173	Adult fish facility improvements (particularly at Dexter)		X				
F&W	174	Structural improvements to reduce TDG where needed as a result of passage operations	X					
F&W	176	Interim Measure: Improve volitional downstream passage for juvenile fish using existing facilities. Annually draw down (particularly at Detroit reservoir) to the regulating outlet invert elevation by November 15 and hold until December 15, and prioritize discharge through the regulating outlets over power turbines for that time.	X					
F&W	177	Interim Measure: Annually prioritize discharge through the regulating outlets (particularly at Green Peter) from November 15 through January 31 to enhance juvenile passage	X					
F&W	178	Maintain pool at minimum conservation pool (particularly at Cougar) from March 1 to May 1 and prioritize use of regulating outlets over power turbines for that time.	X					
F&W	180	Interim measure: Maintain the water surface elevation at Fall Creek reservoir at or below 685 feet year-round except as needed to provide downstream flood damage reduction benefits. (run of river except for flood)	X					

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F&W	181	Interim measure: Improve downstream water quality using existing facilities. Use the lower and upper regulating outlets at Detroit Dam as needed to control discharge water temperatures and prioritize meeting downstream water temperature targets over power generation during the fall. This measure would improve the reproductive success of Chinook salmon that spawn downstream from the project.	X					
HDR	228	Prioritize hydro production year round.				X	X	
HDR	233	For multi-unit powerhouses, run only 1 unit at a time, or rotate between them (assuming that effects flows, temps, or fish passage survival).				X		X
WS	258	Ensure each reservoir fills by May 15 of each year, even drought years (prioritze reservoir refill).						
F&W	304	Augment flows by tapping power pool.	X					
F&W	314	Adjust hatchery production to credit for existing passage (particularly in S. Santiam)	X					
F&W	322	Prioritize conservation hatchery production over mitigation production (re-balance).	X					
F&W	323	Do not clip conservation hatchery production (to avoid catch in fishery).	X					
F&W	336	Change flow rates to change sediment deposition.		X				
F&W	338	Construct structural downstream passage facilty (trap and haul, ladders, juvenile fish collectors, head of reservoir collector, etc.).	X					

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F&W	343	Reduce use of hatchery fish.		X				
F&W	346	Draw reservoirs down when fish are laying eggs in anticipation off water being low later in the season.			X			
F&W	350	Eliminate mitigation hatcheries in place of conservation hatcheries.		X				
F&W	354	Store more water in spring to release through summer/fall for minimum flow targets.		X	X			
F&W	355	Fish ladders where applicable.	X		X			
F&W	369	Operate conservation pool for F&W as first priority.	X					
F&W	373	Eliminate hatchery program.	X					
F&W	384	Import/add sediment at outflows.	X					
F&W	385	Use alternate release conduits to reduce juvenile mortality.	X					
F&W	388	Decrease use of production hatchery.	X					
F&W	390	Culverts in revetments.	X					
F&W	392	Provide/construct high head bypass	X					
F&W	393	Provide hatchery mitigation on crediting based on availability of suitable habitat - reassess mitigation responsibility after passage implemented.	X					
WQ	413	Flip lips, physical stracture to de gas water to reduce TDG (construct).	X					
WQ	414	Construct wetlands w/ plant species to improve water quality.				X		

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WQ	418	Construct floating wetland to reduce algae, turbidity in reservoir.				X		
WQ	421	Modify spillway so water is evenly dispersed to reduce TDG.		X				
WQ	428	Plant riparian plants to increase shading (cool temperatures).				X		
WQ	430	Treat algae blooms in reservoir	X					
WQ	438	Flow continuation valve to re-regulate dams.	X					
WQ	446	Instream structures/boulders to assist with off-gassing to reduce TDG (wing deflectors, tainter gates).						
WQ	479	Modify outlets to allow releases at varying levels for temperature control.	X					
WS	515	Update the water control manual to permit regulators to retain water up to the top of the flood control pool (elevation 1485ft, or 35ft above minimum flood pool elevation 1450 ft), except when 10-day forecasts indicate a flood approaching the 1861 is imminent. Rough Example: DET can vacate 33,719 acre-ft of secondary storage per day at 17,000 cfs (upper normal discharge limit), which is over half of the existing secondary storage.		X	X			
WS	516	Explore increasing the top of the secondary flood pool (example – from elevation 1485 to 1500ft at Detroit), under the assumption that reservoir elevation can be returned to elevation 1450 ft at the upper normal discharge limit of 17,000 cfs within the limitations of the 10-day forecast and water travel times to Portland.		X	X			

Date: 10/31/19					**Technical Feasibility- Practicality of a proposed measure, including whether it can be delivered with available technology, techniques, skills and resources.**		**Unacceptable Environmental Impacts Adverse effects caused by a measure to the human or natural environment**	**Implementation Risk- Potential for failure during planning, design or after construction or initiation of measure**
Project Purpose	**Measure Number**	**Measure**	**Marked 'X' if kept for further analysis**	**Should have been screened based on redundancy to another measure or on prior screening critteria (new structure, changes FRM, etc.)**	**Available information (citeable and objective - i.e. scientific support/consensus across several agencies) is not sufficient to support implementation of the measure; proof of concept or information clearly demonstrates major risk of failure**	**Expected benefit/change is minimal within the study timeframe and spatial scale (not distiguishable from measures in No Action)**	**The measure would result in detrimental changes to habitat or life history that would result in the potential listing of a species.**	**If the cost/benefit ratio is likely to be very low**
HDR	517	Create secondary storage volumes for the February-April refill months that allow regulators to retain water above the rule curve, discharging water to drop back down to the rule curve if a flood of some undefined magnitude is observed. This would allow capturing excess runoff during the February – April months.		X				
WQ	575	Develop more off channel habitat for temperatures				X		
HDR	584	Minimize days of spill and optimize turbine operations in deficit water years.			X		X	
FRM	601	Improve outlet/spillway so able to release higher flows (mange the PMF)		X		X		X
O&M	615	Clean out spillways so that if spillways are used debris doesn't cause downstream damage.				X		X
FRM	625	Change summer lake level (lower) to minimize shoreline erosion at some lakes (CTG, FRN, DOR, etc.).		X		X X		
F&W	639	Restore U/S and D/S passage at drop structureson Long Tom (Stroda Drop Structure, Cox Butte, Ferguson) and Coast Fork Willamette for ESA and non-ESA fish	X					
F&W	645	System-wide create bypasses around reserovoirs for juvenile fish D/S passage						X
F&W	653	System-wide RM&E and adjust ramp rates to increase operational flexibility.	X					
F&W	669	Cease NOR collection for broodstock when temperature and densities are high below Dexter.	X					
F&W	670	Update Dexter Facility using specs and handling practices that do not increase the risk of PSM and cease using CO2	X					
F&W	673	Outplant adults in Foster Reservoir	X					

Date: 10/31/19					Technical Feasibility- Practicality of a proposed measure, including whether it can be delivered with available technology, techniques, skills and resources.		Unacceptable Environmental Impacts Adverse effects caused by a measure to the human or natural environment	Implementation Risk- Potential for failure during planning, design or after construction or initiation of measure
Project Purpose	Measure Number	Measure	Marked 'X' if kept for further analysis	Should have been screened based on redundancy to another measure or on prior screening critteria (new structure, changes FRM, etc.)	Available information (citeable and objective - i.e. scientific support/consensus across several agencies) is not sufficient to support implementation of the measure; proof of concept or information clearly demonstrates major risk of failure	Expected benefit/change is minimal within the study timeframe and spatial scale (not distiguishable from measures in No Action)	The measure would result in detrimental changes to habitat or life history that would result in the potential listing of a species.	If the cost/benefit ratio is likely to be very low
F&W	684	Better balance stable winter flows with peak power demands to avoid distruptions to outmigrating juveniles	X					
F&W	685	Install fish friendly turbines at WVP dams	X					
F&W	689	Install and maintain PIT arrays within reaches to allow for reach specific survival estimation before and after passage is implemented.	X					
F&W	692	Reduce trout hatchery outplants where they overlap with ESA listed species.	X					
F&W	693	Inject juveniles captured by collectors with antibiotics to control copepod infections in the summer and fall	X					
F&W	697	Reduce the number of hatchery smolts released based on the available habitat (ie, R2, Parkhurst, etc.).	X					
F&W	702	System-wide drawdowns while fish are spawning.	X					
WQ	703	Structural improvements to reduce water quality impacts during emergency and unusual events	X					
F&W	705	Improve or replace some adult release sites above dams	X					
F&W	706	Spill in SPRING and FALL for fish passage (particularly at LOP, Hills Creek).		X				
F&W	707	Delayed Refill in spring for fish passage (particularly at LOP).		X				
WQ	708	Structural improvements to address TDG (particularly at Detroit)		X				
F&W	709	Drawdown in SPRING for fish passage		X				
F&W	710	Operate using outlets at different elevations to achieve more normative water temperatures downstream of dams		X				

Date: 10/31/19					Technical Feasibility- Practicality of a proposed measure, including whether it can be delivered with available technology, techniques, skills and resources.		Unacceptable Environmental Impacts Adverse effects caused by a measure to the human or natural environment	Implementation Risk- Potential for failure during planning, design or after construction or initiation of measure
Project Purpose	**Measure Number**	**Measure**	**Marked 'X' if kept for further analysis**	**Should have been screened based on redundancy to another measure or on prior screening critteria (new structure, changes FRM, etc.)**	**Available information (citeable and objective - i.e. scientific support/consensus across several agencies) is not sufficient to support implementation of the measure; proof of concept or information clearly demonstrates major risk of failure**	**Expected benefit/change is minimal within the study timeframe and spatial scale (not distiguishable from measures in No Action)**	**The measure would result in detrimental changes to habitat or life history that would result in the potential listing of a species.**	**If the cost/benefit ratio is likely to be very low**
WQ	711	Mechanical degassing methods in fish collection/hatchery areas below the dams (construct)	X					
HDR	712	For reservoirs designated with primary and secondary flood storage (HCR, LOP, CGR, BLU, DET, & GPR), change the secondary flood storage to carryover storage. This would allow the water to remain in storage during the winter months to meet minimum flow or downstream flow requirements. In the event of a forecast of a large flood event, the secondary flood storage would be evacuated to minimum pool prior to the event, regaining the secondary flood storage in the pool.	X					
WS	713	Modify ramp rate (goal to save stored water)				X		
F&W	714	Use spillway to pass fish in spring	X					
F&W	715	Operate at run of river at lowest outlet for downstream passage	X					
F&W	716	Improve spawning and incubation flows to reduce stranding and dewatering	X					
HDR	717	Fill secondary FRM storage in winter to allow for maximized hydropower value	X					

Attachment 4. DEIS Chapter 5, Preferred Alternative and Implementation

5 .0 PREFERRED ALTERNATIVE IDENTIFICATION AND IMPLEMENTATION

CHAPTER 5 HAS BEEN DELETED FROM THE EIS AND MOVED TO APPENDIX A, ALTERNATIVES DEVELOPMENT. MINIMAL REVISIONS FROM THE DEIS WERE MADE IN RESPONSE TO PUBLIC COMMENTS AND FOR CLARITY

Summary of Changes from the DEIS:

- **Chapter 5 was appropriately removed to Appendix A because it only described how the Preferred Alternative was identified for the DEIS and was not a full and commensurate analysis of the alternative itself. This analysis is provided in FEIS Chapter 3, Affected Environment and Environmental Consequences, and FEIS Chapter 4, Cumulative Effects.**
- **All references to "selected alternative" have been modified to clarify that no alternative has been selected, but that Alternative 5 was "identified" as the Preferred Alternative in the DEIS.**
- **The DEIS chapter title has been changed from "Chapter 5 – Preferred Alternative Selection and Implementation" to "Chapter 5 – Preferred Alternative Identification and Implementation."**
- **The description for Section 5.5, Adaptive Management Plan, has been revised for clarity in Section 5.1, Introduction (chapter organization).**
- **Additional information on climate change has been added to Section 5.2, Comparison of Alternatives.**
- **Information on costs under Objective 3 has been added in Section 5.2.2, Objective 3 – Effectiveness Criteria Metric.**
- **Additional information about the Adaptive Management Plan has been added to Section 5.5, Adaptive Management Plan.**
- **Analysis data and costs to implement each alternative provided in this former DEIS Chapter 5 have not been updated below, but are provided in each FEIS resource section (Chapter 3, Affected Environment and Environmental Consequences) and in FEIS Appendix M, Costs.**

Introduction

This chapter focuses on development of the Preferred Alternative for inclusion in the DEIS and the FEIS. CEQ's NEPA regulations require an agency to disclose the Preferred Alternative in its DEIS if one has been identified, 40 CFR 1502.14(e). Identification of the Preferred Alternative does not preclude USACE from selecting a different alternative for implementation once it has had the benefit of public review and comment. Identification of the Preferred Alternative and discussion of the rationale for identification of that alternative as preferred does not predetermine the agency's final decision based on completion of the FEIS, rather it provides the public with the opportunity to understand the agency's reasoning at the time the DEIS was published so that they may provide meaningful comments to inform agency selection of an possible alternative.

Given the complexity of continued operations and management of the Willamette Valley System (WVS), this chapter also summarizes a timeline for implementation of the Preferred Alternative, the framework for adaptive management of a selected alternative, and the governance framework or structure for working with WATER forum to implement the selected alternative. The Implementation and Adaptive Management Plan is discussed solely for the purpose of providing the public an understanding of how USACE would structure these plans as applied to the alternative that is ultimately selected and documented in the ROD (Appendix N, Implementation and Adaptive Management Plan).

The Preferred Alternative is provided in the EIS to provide important context and to comply with NEPA requirements to identify a Preferred Alternative. The Implementation and Adaptive Management Plan and governance structure described in this chapter and in more detail in Appendix N would apply broadly to any alternative selected in the ROD, though specific components of the Implementation and Adaptive Management Plan (e.g., metrics) may need to be refined for a particular measure in an alternative. A unique implementation plan would need to be developed for whatever alternative is ultimately selected because construction timing and sequencing for large structural changes cannot be as easily adjusted or translated across different alternatives.

Chapter 5 is organized as follows:

5.1 Comparison of Alternatives – Summarizes the evaluation criteria and process for comparing the alternatives and identifying the Preferred Alternative; also evaluates the differences between the alternatives.

5.2 Summary of the Preferred Alternative – Summarizes the Preferred Alternative. The DEIS Preferred Alternative will be analyzed in the Final EIS as Alternative 5.

5.3 Implementation Plan – Summarizes how USACE would execute the Preferred Alternative under the Implementation and Adaptive Management Plan.

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5.4 Adaptive Management Plan – Summarizes the framework for implementing actions for the Preferred Alternative under an adaptive management plan. This includes assessment of actions taken, assessing hypotheses and outcomes, and introducing new actions, should they become necessary.. It also describes the process including the potential for additional NEPA and ESA consultation to implement different actions.

END REVISED TEXT

This section also summarizes the Governance Program used to make decisions based on recommendations from the Willamette Action Team for Ecosystem Restoration (WATER) resulting from adaptive management assessments.

5.1 COMPARISON OF ALTERNATIVES

The potential effects associated with each of the alternatives have been assessed and the analyses are discussed in detail in Chapter 3 and further described in the associated appendices. This section provides an overview of how the alternatives were evaluated and compared for the identification of the Preferred Alternative.

USACE developed multiple criteria to evaluate how effectively each alternative met the Proposed Action objectives described in Section 2.1 with consideration of cost and the economic, environmental, and social effects and then performed a tradeoff analysis using these criteria to compare the alternatives. To develop criteria, USACE considered the benefits and environmental and social consequences as reflected in Chapters 3 and 4 and then assessed the tradeoffs presented under each alternative within and outside of current authorities.

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There was little differentiation among the levels of general environmental and social impacts across alternatives. Similarly, although climate change impacts and an alternatives resilient to changing climate conditions is an important considerations, there was little differentiation between the impacts of climate change on any alternative or their relative climate change resilience. In contrast, the cost to design, construct, and operate and maintain the WVS under each alternative in combination with impacts to recreation, hydropower production, water supply, and ESA-listed fish specifically did provide clear tradeoffs for comparing alternatives. Therefore, the effects to environmental and social resources and the effects of climate change were not deemed an applicable criterion to evaluate how effectively an alternative met the Proposed Action objectives.

To develop criteria to capture this combination of costs and impacts, one or more metrics were developed to measure how effectively an alternative would meet each of the primary objectives outlined in Section 2.1 except for Objectives 2 and 7.

END REVISED TEXT

Objective 2, to increase opportunities for the creation of nature-based structures during maintenance of USACE-owned revetments, and Objective 7, to reduce spawning and rearing habitat competition caused by hatchery fish, would be effectively met by including the revetment and hatchery measures, respectively, under each action alternative. As all action alternatives include revetment and hatchery measures, there is no measurable difference in how well they meet these objectives.

In addition to metrics evaluating how effective an alternative is at meeting the Proposed Action objectives, metrics for cost and the economic effects resulting from impacts to recreation were also assessed. The metrics for the remaining objectives, the economic metrics for impacts to recreation, and the metrics for costs are described below.

5.1.1 Objective 1- Effectiveness Criteria Metrics

Two metrics were used to measure how effectively each alternative met Objective 1 to allow greater flexibility in water management:

- conservation storage
- impacts to downstream flows

Conservation storage identifies the total peak volume of water in acre-feet the WVS can store in the conservation season. Basically, the more water the WVS can store in the spring, fall, and summer the more responsive USACE can be to operate the system to support all the competing uses, including flows for water supply, hydropower production, water quality, and fish and wildlife as well as the maintenance of reservoir elevations for recreational use. Conservation storage was assessed for each alternative using ResSim as described in Section 3.2. The difference between the total conservation storage under the NAA and each action alternative is provided in Table 3.1-1.

The impact to flows at downstream control points is a qualitative assessment of the difference in flows at Salem between the NAA and each action alternative. Flows at Salem were assessed under each alternative using ResSim as described in Section 3.2. The difference between flows at Salem under the NAA and each action alternative is provided in Table 3.1-1.

Details on this analysis can be found in Section 3.2.2 and 3.13.2 and Appendices B and J.

5.1.2 Objective 3 - Effectiveness Criteria Metric

Net Present Value (NPV) is the metric USACE used to measure how effectively each alternative meets Objective 3 to allow greater flexibility in hydropower production when compared to the no action alternative. An alternative's NPV assesses the long-term economic viability of the hydropower plants, given implementation of the alternative.

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As discussed in Section 3.12, NPV measures the impact to the economic viability of hydropower at WVS hydropower dams by comparing the expected revenue produced at the hydropower facility across the WVS to the expected future costs at the facilities, including the cost to implement the structural and operational measures proposed in the alternative. This analysis includes not only the cost to construct proposed measures in the alternative but other projected costs from asset plans, etc. as well as the impact of reduced generation and reduced revenue. This metric helps assess the changes in hydropower generation, including any potential resulting effects on the regional energy environment, and the impact the cost to implement each alternative has on hydropower revenues.

END REVISED TEXT

Details on this analysis can be found in Section 3.12.2 and Appendix G.

5.1.3 Objectives 4 through 6 Effectiveness Criteria Metrics

Objectives 4 through 6 all pertain to meeting the needs of ESA-listed fish species and include:

- Objective 4. Increase anadromous ESA-listed fish passage survival.
- Objective 5. Improve water management during the conservation season to benefit anadromous ESA-listed species.
- Objective 6. Reduce pollutant levels to restore impaired water quality to benefit anadromous ESA-listed species.

As described in Section 3.8.2, this draft EIS evaluates effects on ESA-listed fish species and aquatic habitat using a quantitative (ESA-listed salmon and steelhead and critical habitat) and qualitative (bull trout and habitat) framework. The quantitative framework relies on output from a suite of models developed for ESA-listed salmon and steelhead including the Ecological Diagnosis Treatment (EDT) model, the Integrated Passage Asses (IPA) model, and the National Oceanic and Atmospheric Administration Life Cycle Model (LCM).

The fish models account for effects at a population scale of the measures under the alternatives cumulatively with the other major factors occurring in the watershed as described in Chapter 4. As all major factors outside the alternative measures are the same across alternatives, the model outputs inform the level of effects each alternative would have on the species at a population level.

These models incorporate inputs for passage survival (Objective 4), appropriate flows for habitat conditions supportive of the different life stages within the river system during the conservation season (Objective 5), and improved water quality (Objective 6). Therefore, metrics derived from the outputs of these population models demonstrate the effectiveness of an alternative for all three ESA-specific objectives identified in Section 2.1.

For example, to illustrate how the models measure improved water quality per Objective 6 (see figure below) provides an influence diagram that shows how the water quality parameters important for ESA species survival (Total Dissolved Gas [TDG] and temperature) are intrinsic to the life cycle models used to evaluate the alternatives' effects on the listed salmonid species. This demonstrates how the quantitative framework integrates water quality parameters and, therefore, addresses Objective 6 specifically.

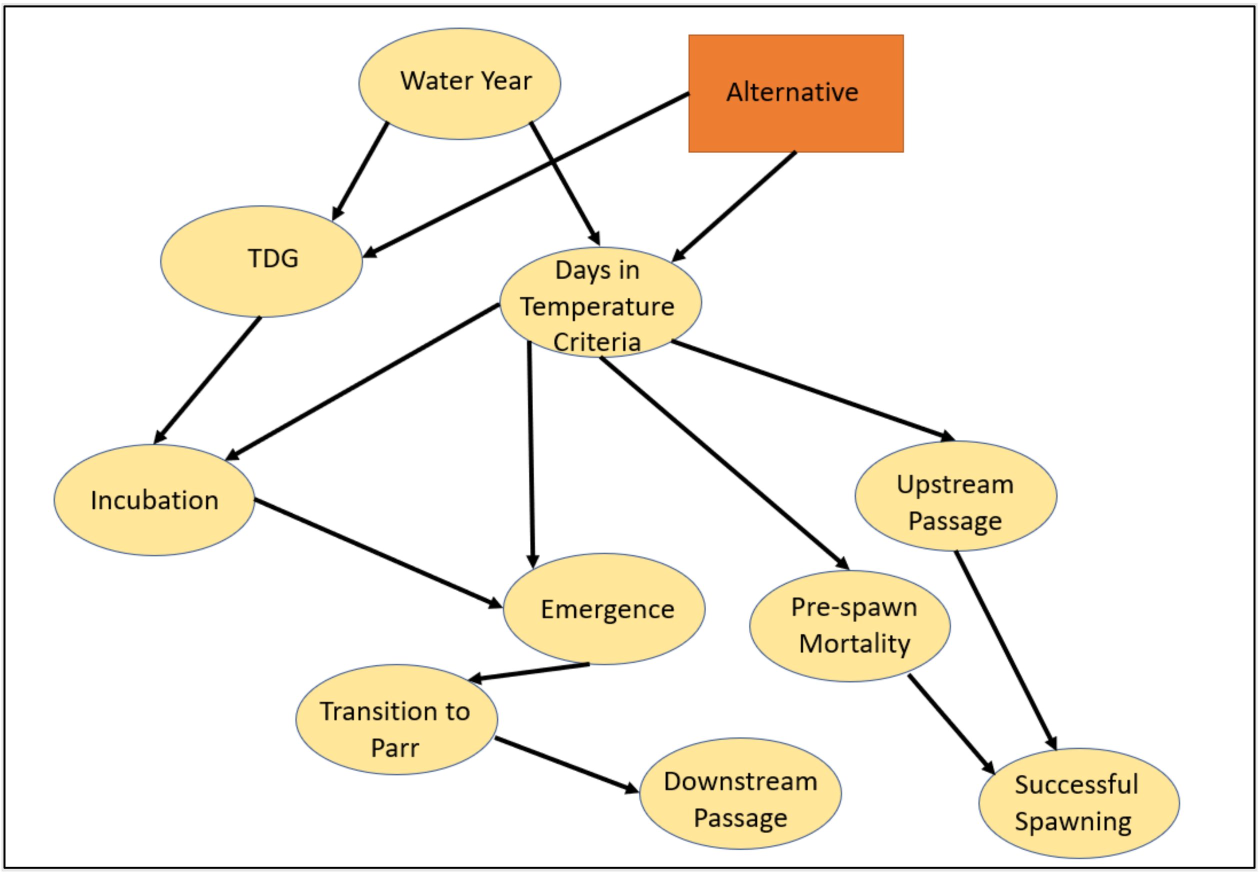

Figure 5.1-1. Water Quality Influence Diagram for WVS ESA-listed Salmonids.

Five metrics were developed based on the outputs from these models to assess how effectively each alternative meets Objectives 4, 5, and 6. At the time the alternatives comparison and identification process occurred, only the UWR spring Chinook salmon modeling results were available; therefore, metrics specific to UWR steelhead are not included. However, USACE did review the UWR steelhead results; the UWR steelhead information does not change the rankings of the alternatives.

The five metrics used for evaluating and comparing how effectively the alternatives meet Objectives 4, 5, and 6 include:

- **Number of populations where maximum recruits/spawner (R/S) is greater than (>) 1:** The number of UWR spring Chinook salmon populations (a total of four are affected by the

WVS) modeled to achieve spawner replacement on average over a 30-year timeframe. A high number is preferred. Spawner replacement occurs when offspring return to spawn in numbers equal to or greater than the number of parental spawners they were produced from. When the population replacement rate is less than 1, on average the population declines.

- **Number of populations with high persistence:** The number of UWR spring Chinook salmon populations modeled to exceed a minimum adult abundance threshold. A higher number is preferred. The minimum adult abundance thresholds for each UWR spring Chinook salmon population were identified by the Technical Recovery Team.
- **Legacy population risk of extinction:** Indicates McKenzie Core Legacy spring Chinook salmon population risk of extinction.
- **Downstream survival relative rank**: Relative rankings of model results of UWR spring Chinook salmon and UWR steelhead survival below dams as affected by flow and water temperatures. A higher number is preferred. See appendix A for details on the ranking process.
- **Number of bull trout populations with habitat gains:** Number of bull trout populations with habitat gains from fish passage improvements allowing access downstream of WVS dams. A higher number is preferred. This assessment assumes bull trout are reintroduced above Detroit Dam. Bull trout currently reside above Cougar and Hills Creek Dams among WVS dams.

  Risk level refers to the assessment score for bull trout under each alternative, primarily relating to accessing habitat below dams. Biological risk is generally assumed to increase with downstream passage improvements.

Details on this analysis can be found in Section 3.8.2 and Appendix E. There are no metrics for UWR steelhead populations because this model output was not available at the time of the alternatives evaluation and comparison phase for identifying the Preferred Alternative. However, when UWR steelhead results became available, USACE determined the results would not change the decision.

5.1.4 Cost Criteria and Metrics

The cost of an alternatives was evaluated using the annual costs over the 50-year period of analysis in 2021 dollars. The annual cost includes annualized first costs for design and construction as well as the annual cost for Operations, Maintenance, Repair, Replacement and Rehabilitation as described in Section 1.8.7. Costs were estimated based on existing studies for similar projects. Cost estimate details for each alternative can be found in Appendix M.

5.1.5 Economic Metrics for Effects to Recreation

During public scoping, effects to recreation and the associated economic effects were identified as important to stakeholders as described in Appendix Q. For this reason, these effects were considered in evaluating and comparing the alternatives. The following economic metrics were used to assess effects to recreation:

Average annual recreation benefits (total for all reservoirs): This metric measures changes in availability of reservoir boat ramps and the changes in visitation across various recreation activities that are estimated to occur when boat ramps are available versus when they are not available across the Willamette River Basin from the NAA. The measure of changes is in the dollar value of reservoir recreational visitations during the recreation season (April 15 through Sept 15). The dollar value of visitations is derived from Unit Day Value data provided by the Institute for Water Resources (USACE 2021). The higher the value, the greater the economic benefits as compared to the NAA.

Regional economic impact from recreation effects: This is a qualitative assessment considering the full-time jobs created/lost by the changes in water levels resulting from the measures under each alternative, making conditions more/less conducive to water-based recreation and the regional (subbasin) output. The regional output is equal to the sum of employee compensation, plus proprietor income, plus other property type income, and plus indirect business taxes.

This analysis was predicated on the potential effects to localized jobs associated with dollars gained or lost as a function of water level fluctuation at a particular project's county. The higher the impact the greater the projected number for jobs lost and reduction in regional output. An assessment of a low impact means there would be negligible impact to the numbers of jobs lost and little to no reduction in regional output. The analysis does not reflect the transfer of recreation utility from one site to another within the collective basin.

An assessment of a medium impact means there would be greater than one job lost in any basin and a reduction in regional output less than $150,000 in multiple basins. An assessment of a high impact means greater numbers projected for jobs lost and a corresponding reduction in regional output greater than $150,000 in multiple counties or basins.

Details on this analysis can be found in Section 3.14.2 and Appendices K and I.

5.1.6 Summary of Alternatives Comparison

Although absolute values provide important context, it is more relevant for decision-makers to consider the estimated differences between each of the action alternatives and the NAA. Table 5.1-1 shows the differences in the performance that would occur under Alternatives 1 through 5 in relation to the NAA.

The methodology and analysis for each metric is provided in the associated analyses of environmental consequences in Chapter 3, and the associated appendices. Table 5.1-1 summarizes and compares the results of the evaluation criteria for each alternative as compared to the NAA.

Table 5.1-1. Alternatives Criteria Comparison to NAA.[1]

Criteria	Metric	No Action Alternative	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5
Effectiveness meeting Objective 1	Change in Conservation Storage from NAA (acre-feet)	1,329,000	+168,000	+122,000	-64,000	-590,000	-669,000	+122,000	-98,536
Effectiveness meeting Objective 1	Impact to flows compared to NAA	–	Low	Low	Medium	High	High	Low	Medium
Effectiveness meeting Objective 3	Change in NPV from NAA ($ millions)	$225	-$1,159	-$863	-$933	-$853	-$829	-$1,162	-$939
Effectiveness meeting Objectives 4-6	UWR spring Chinook salmon populations reaching replacement	2 of 4 UWR spring Chinook salmon populations reach replacement	+1 population	+2 populations	+2 populations	+2 populations	+2 populations	+1 population	+2 populations
Effectiveness meeting Objectives 4-6	UWR spring Chinook salmon population persistence	1 of 4 UWR spring Chinook salmon populations with high persistence	+1 population	+2 population	+1 population	+0 populations	+1 population	+1 population	+1 population
Effectiveness meeting Objectives 4-6	McKenzie Core Legacy spring Chinook	McKenzie Core Legacy spring Chinook	No change in risk	Risk reduced	Risk reduced	No change in risk	No change in risk	Risk reduced	Risk reduced

Criteria	Metric	No Action Alternative	Alt 1	Alt 2A	Alt 2B	Alt 3A	Alt 3B	Alt 4	Alt 5
	salmon population risk	salmon population is at risk							
Effectiveness meeting Objectives 4-6	Downstream survival relative rank: 1=best, 7=worst	7	1	2	4	5	6	3	4
Effectiveness meeting Objectives 4-6	Bull trout habitat gains	No habitat gains for bull trout	Least habitat gains for bull trout	Habitat gains for bull trout	Habitat gains for bull trout	Habitat gains for bull trout	No habitat gains for bull trout	Habitat gains for bull trout	Habitat gains for bull trout
Estimated Total Annual Cost	Millions of US $	$9	+$87	+$51	+$46	+$17	+$21	+$88	+$46
Economic impact to recreation	Change in Average Annual NED Recreation Benefits (total for all reservoirs in millions of dollars) from NAA	$20.45	+$0.31	+$0.17	+$0.02	-$0.76	-$1.27	+$0.17	+$0.02
Acceptability Criteria: Economic	Impact to RED from Recreation Effects	–	Low	Medium	Medium	High	High	Medium	Medium

[1]No color indicates no, negligible, or minor effects
Green indicates a positive/beneficial effect
Yellow indicates a moderate negative/adverse effect
Orange indicates a high negative/adverse effect

5.1.7 Discussion of Consequences

This section summarizes the differences between alternatives, including relative costs and hydrologic differences as well as some of the implications of these differences for hydropower, water supply, recreation, and endangered species in terms of relative benefits and adverse effects compared with the NAA. As all alternatives have similar outcomes for the environmental and social effects metrics, these effects will not be discussed further. This section also provides a brief summary of the USACE evaluation, including key risks and uncertainty, that influenced the decision-making process in identifying the Preferred Alternative.

5.1.7.1 *No-action Alternative*

The NAA is a continuation of the operation of the WVS and management actions being used to comply with the 2008 BiOp (NMFS 2008) as operated at the start of this effort in the spring of 2019. Per CEQ 40 Most Asked Questions regarding NEPA, no action means no change from current management direction or level of management intensity. This EIS defines no action similarly - no change in direction from existing O&M of the WVS as of 2019. The NAA is designed to continue the management practices and operation of the WVS, with the addition of increased releases for municipal and industrial (M&I) water storage agreements. The NAA serves as a benchmark to compare effects across action alternatives.

5.2.2.1.1 Tradeoffs

The NAA is predicted to have major adverse effects on UWR spring Chinook salmon and UWR winter steelhead. High extinction risk in all subbasins is predicted for both species. The NAA would be insufficient in meeting the Proposed Action ESA Objectives (objectives 4-6). Of the four Chinook salmon populations, two populations would decline and only one population would have high persistence (e.g., have low extinction risk). Additionally, under the NAA the McKenzie Core Legacy spring Chinook salmon population would be at risk and, there would be major adverse effects to the UWR winter steelhead resulting in a high risk of extinction.

The NAA would not result in habitat gains for bull trout, and it is the lowest ranked (7) of all alternatives for downstream survival. Adverse effects on bull trout are predicted to be minor. Bull trout above Cougar have been stable for several years and have been increasing above Hills Creek. Habitat scores for bull trout are reasonable, with 100 percent of the available spawning habitat available, and 70 percent of the rearing habitat available. Passage conditions at dams limit bull trout access to below dam rearing habitat.

Climate change is predicted to further degrade habitat below dams and will reduce the ability to meet operational fish passage, minimum flows, and water temperature objectives below dams. See Appendix F for details on climate change effects on the Willamette River Basin.

The NAA is the only alternative to utilize the BiOp flows targets established in 2008 as described in Section 2.4.1.1. Under the NAA the 75 percent exceedance level of system-wide stored water is estimated to be 1,331,864 acre-feet, and there would be no to negligible effect on hydrologic processes or flows downstream. However, this means that, under the NAA, there would not be flexibility in water management related to refill, drawdown timing, and other water management measures. For example, under the NAA operations that use the power pool or inactive pool (Sections 2.2.1.3 and 2.2.1.4 respectively) when needed to augment flows for biological purposes would not be available. Instead under the NAA only the conservation pool may be used to meet flow targets late in the fall, reducing operational flexibility for meeting flow targets. Since the WVS would be operated as designed and there would be no new structural modifications that would increase complexity, there would be a low mechanical and operational risk associated with the NAA.

Under the NAA, power generation for combined WVS projects would continue to be marginally economically viable. The median NPV for the combined WVS is about $225 million. Conservation storage would result in enough stored water to meet the M&I and agricultural irrigation (AI) demands in almost all years. Water would be released from the reservoirs to satisfy projected demands of stored water for M&I uses at the 2050 demand level and existing, as of April 2019, AI water service contracts. Additionally, the recreational experience would not change compared to current conditions, meaning there would be no effects to average annual visits or average annual benefits, and no changes to full-time jobs or the regional output.

The DEIS estimated total annual cost estimate for the NAA is $9,279 million (see Appendix M for details). The NAA provides a baseline for understanding the costs associated with operating and maintaining the WVS. The NAA also provides a starting point for determining how costs will change as various structural or operational changes or both are made under action alternatives. Under the NAA, agencies will continue to maintain system infrastructure, while routine O&M costs would occur for hydropower, cultural resources, recreation, fish and wildlife, and other routine costs. The NAA includes some proposed funding increases in routine O&M activities at Detroit/Big Cliff, Foster, Cougar, Lookout Point/Dexter, and Fall Creek reservoirs.

Overall, the NAA would perform the best for hydropower and recreational interests with marginal benefits to storage compared to some the action alternatives. Although there would be a low mechanical and operational risk under the NAA, power generation would only be marginally viable. This alternative would also have the greatest adverse effects on listed fish species. Given that USACE must comply with the ESA to continue to operate and maintain the WVS, and an appropriate level of action is necessary, the NAA is not an alternative that could be implemented. The primary purpose of the NAA is to serve as a benchmark against which to compare the relative benefits and adverse effects of the action alternatives.

5.1.7.2 *Alternative 1. Improve Fish Passage Through Storage-focused Measures*

The purpose of Alternative 1, also referred to as the Project Storage Alternative, is to maximize the refill volumes of conservation pools at WVS reservoirs to meet authorized purposes that depend on full reservoirs, including M&I and AI water supply, recreation, and water quality as well as to improve fish passage through the WVS dams to increase the survival of ESA-listed fish species. Alternative 1 is designed to increase the probability of refilling the WVS reservoirs and use a greater portion of the total reservoir volume for conservation storage, including the inactive and power pools than under the NAA. One goal of alternative 1 is to fill the reservoirs as often as possible and to supply water from storage as late into the conservation season as possible through changes in operations.

The main operational features under Alternative 1 are to reduce minimum flows to congressionally authorized minimum flow requirements from the NAA 2008 BiOp flows, as well as, to augment instream flows by using the power and inactive pools which is not done under the NAA. Alternative 1 also proposes only structural measures for fish passage and water quality as shown in Table 5.1-2.

Table 5.1-2. Water Quality and Passage Measures Under Alternative 1.

Dam	Temperature Control	TDG Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	Structural*	–	–
Lookout Point	Structural*	–	Structural*	–
Hills Creek	–	–	–	–
Fall Creek	–	–	–	Structural*
Cougar	–	Structural*	–	–
Blue River	–	–	–	–
Foster	Structural	Structural*	Structural	–
Green Peter	Structural*	Structural*	Structural*	Structural*
Big Cliff	–	–	–	–
Detroit	Structural	–	Structural	–

*Distinctive feature of this alternative.

Alternative 1 is like Alternative 4, which focuses on structural measures to accomplish downstream passage and water quality management. For instance, Alternatives 1 and 4 are also the only alternatives to propose restoring upstream and downstream passage at drop structures and structures to abate TDG which adds to their total costs. However, there would be several differences in the total number and the locations of these structures.

The difference between Alternative 1 and Alternative 4 with respect to structures is that they propose temperature control and downstream passage structures at different dams, and Alternative 4 proposes an additional downstream passage structure compared to Alternative 1. These differences allow for the comparison of the relative costs and benefits associated with the different combinations of structural measures across the action alternatives. There are no structures proposed under the NAA.

Table 5.1-3 shows this comparison of structural measures between Alternative 1 and 4.

Table 5.1-3. Alternatives 1 and Alternative 4 Structural Measure Comparison.

Dam	Alternative 1 water temperature structure	Alternative 4 water temperature structure	Alternative 1 structural downstream passage	Alternative 4 structural downstream passage
Detroit	X	X	X	X
Foster	X	X	X	X
Green Peter	X	–	X	–
Cougar	–	–	–	X
Hills Creek	–	X	–	X
Lookout Point	X	X	–	X

5.2.2.2.1 Tradeoffs

Under Alternative 1, large floating fish passage structures would be implemented in the North, South Santiam, and the Middle Fork Rivers. These structures do not require an increased release of conservation storage to facilitate passage or their use when compared to the NAA. A fall[1] deep drawdown at Fall Creek would also continue from the NAA. Flow targets from HD 531 support capturing increased amounts of water in reservoirs during spring as compared to all other alternatives including the NAA.

Despite the spending on structural measures, Alternative 1 would only marginally meet the Proposed Action ESA objectives (objectives 4-6). Although Alternative 1 did rank the highest out of all alternatives for downstream survival and three out of four Chinook salmon populations would reach replacement, only two out of four Chinook salmon populations would have high persistence (e.g., low risk of extinction). Additionally, the McKenzie Core Legacy spring Chinook salmon population would be at risk of extinction. Under Alternative 1, there would also be the least habitat gains for bull trout compared to the NAA due to lack of effective downstream passage at Cougar Dam. Alternative 1 implementation is predicted to have major effects on Chinook salmon and minor adverse effects on winter steelhead populations in the North and South Santiam subbasins. Scores and risks for bull trout would be like the NAA, with minor effects predicted. Habitat scoring for bull trout would be only marginally better than under the NAA with rearing habitat increases for North Santiam bull trout below Detroit.

Unlike the NAA, structural improvements for fish passage and water temperature would provide resilience to adverse climate change impacts by increasing operational flexibility in the North Santiam, South Santiam, McKenzie, and Middle Fork subbasins. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to the NAA, Alternative 1 would result in minor to major beneficial water temperature effects in the Middle Fork Willamette, South Santiam, and North Santiam subbasins due to the proposed temperature control structures at Lookout Point, Green Peter,

[1] The terms “fall” and “autumn” are synonymous in this chapter in reference to seasonal drawdown periods.

Detroit Dams. Minor to major beneficial TDG effects are expected in the North Santiam and South Fork McKenzie subbasins based on the reduced number of spill days and proposed TDG abatement structures under Alternative 1.

Because of many of the structural measures, reservoirs would not be drawn down for temperature management and downstream fish passage operations under Alternative 1. This, coupled with the proposed operation to reduce minimum flows to congressionally authorized minimum flow requirements, would result in the greatest increase in total water stored by mid-May of all alternatives, at an estimated increase in peak water stored system-wide under the NAA by 168,000 acre-feet in the driest year. This would result in a moderate beneficial effect to M&I water supply and AI users of the conservation storage space under Alternative 1.

The increase in total water stored and flow measures under Alternative 1 would result in the same or higher downstream flows in the summer as compared to the NAA. Flows in the mainstem Willamette River at Salem would be lower than under the NAA from mid-May through June, but flows would remain high and above 6,000 cfs. As modeled, flows at Salem during the summer would be higher than under the NAA, rarely dropping below 6,000 cfs. This would result in a minor beneficial effect to existing M&I water supply and AI users from increased summer flows in the driest years. However, as discussed in Section 3.13, in the driest years, the actual impact to M&I and irrigation is currently unquantifiable because the 2019 Willamette Basin Review (WBR) BiOp sets forth a theoretical plan to reduce contracted water availability to protect ESA-listed species that has not yet been formalized.

The additional stored water under Alternative 1 as compared to the NAA would contribute to an overall increase in average annual hydropower generation of 8 aMW (roughly enough to power 6,371 households annually; see Section 3.12.3.2 for details). However, the high capital and O&M cost of Alternative 1 would result in the greatest decrease in NPV from that provided under the NAA.

Under Alternative 1, there would be a $1.159 billion reduction in median NPV to -$934 million. Therefore, there would be long-term, major, adverse effects on economic viability of WVS power generation. There would, however, be negligible risk to local hydropower generation as Hills Creek and Cougar Dams would continue to be able to operate islanded (isolated) from the rest of the power system, providing power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires like the NAA.

Under Alternative 1, the increased stored water and reduction in minimum flows as compared to the NAA would mean that reservoir levels stay higher for more of the conservation season resulting in minor to moderate benefits to reservoir recreation. This would translate into slight increases in annual visitations, resulting in an approximate increase of $300,000 in annual economic benefits (a 1.5% increase) compared to the NAA.

The regional economic impact from recreation effects would be low under Alternative 1. The regional economic effects would be associated with the negligible effects to employment and regional output.

Alternative 1 would be the second costliest alternative to implement (surpassed only by Alternative 4) primarily driven by the cost to design, construct, operate, and maintain structural measures for temperature control, fish passage, and TDG abatement. The DEIS estimated total annual cost for Alternative 1 is $104,396 million, $95 million greater than the NAA (see Appendix M for details).

Alternative 1 would increase the probability of refilling the WVS reservoirs and the amount of water available for conservation purposes later in the season. This alternative would result in the greatest increase in total water stored by mid-May of all alternatives. Further, there would be an overall increase in average annual hydropower generation and minor to moderate benefits to reservoir recreation under Alternative 1.

However, due to the scale of actions required under Alternative 1, this is the second most expensive alternative. The high cost makes it unlikely this alternative would be acceptable to many stakeholders, agencies, and the public. Although there would be some benefits to fish species such as resilience to adverse climate change impacts from structural modifications, this Alternative 1 would result in fewer benefits to ESA species overall than several less costly alternatives, including Alternatives 2A, 2B, and 5. Therefore, Alternative 1 was not identified as the Preferred Alternative.

5.1.7.3 *Alternative 2A. Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Structural Downstream Passage at Cougar Dam)*

Alternative 2A, also referred to as the Hybrid Alternative with Cougar Floating Screen Structure (FSS), was developed to improve fish passage through the WVS dams, as compared to the NAA, utilizing a combination of modified operations and structural improvements, along with other measures to balance water management flexibility and to meet requirements for ESA-listed fish. Under Alternative 2A, the “Integrated Temperature and Habitat Flow Regime” operation replaces the 2008 BiOp flows under the NAA. This would shift the release of stored water from the spring to the summer and fall, most notably in dry years. Flows would be reduced within a range down to minimums needed for fish survival when reservoirs are under 90% of rule curve elevation as compared to NAA. While these minimums would be less than the BiOp targets, they would be adaptive within a water year and could return to levels that are higher than the BiOp flows under the NAA if reservoir levels are high. Alternatives 2B, 3A, 3B, and 4 also include this flow measure.

The other main operational features of Alternative 2A that differ from the operations in the NAA is the augmentation of instream flows by using the power and inactive pools and a spring spill and deep draw down for fish passage at Green Peter. Alternative 2A also proposes a combination of structural measures for fish passage and temperature control which are not in the NAA, as shown in Table 5.1-4. As under Alternative 1, and in contrast to the NAA, structural improvements for fish passage and water temperature would provide resilience to adverse climate change impacts on fish species by increasing operational flexibility.

As under the NAA, Alternative 2A does not include the structural improvements for TDG abatement included in Alternatives 1 and 4 or the fish passage and temperature structures at Hills Creek Dam under Alternative 4. In contrast to Alternative 1 but like all other action alternatives, Alternative 2A proposes operational measures utilizing the spillway and regulating outlets (ROs) for temperature management at Green Peter Dam. Alternative 2A also includes a deep fall drawdown and spring spillway operations for fish passage at Green Peter Dam, unlike Alternatives 1, 4, and the NAA .

The only difference between Alternative 2A and 2B is in their downstream passage measure at Cougar Dam. Alternative 2A proposes structural downstream fish passage at Cougar Dam whereas Alternative 2B proposes operational fish passage at Cougar Dam. The NAA does not provide operational or structural fish passage at Cougar Dam. Alternative 5 also proposes operational fish passage instead of structural fish passage as well as proposing a refined flow operation that slightly differs from the “Integrated Temperature and Habitat Flow Regime” operation under Alternatives 2A through 4 and the 2008 BiOp flow targets in the NAA.

Table 5.1-4. Water Quality and Passage Measures Under Alternative 2A.

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	–	–	–
Lookout Point	–	–	Structural	–
Hills Creek	–	–	–	–
Fall Creek	–	–	–	–
Cougar	–	–	Structural *	–
Blue River	–	–	–	–
Foster	Structural	–	Structural	–
Green Peter	Operational*	–	Operational*	Structural*
Big Cliff	–	–	–	–
Detroit	Structural	–	Structural	–

*Distinctive feature of this alternative.

5.2.2.3.1 Tradeoffs

Alternative 2A has an integrated management strategy theme. This alternative includes structural downstream passage at Detroit, Foster, Cougar and Lookout Point Dams, and operational passage at Green Peter Dam. A fall deep reservoir drawdown at Fall Creek Dam that is in the NAA would continue.

Alternative 2A would most effectively meet the Proposed Action ESA objectives (objectives 4-6) for most dams compared with all other alternatives. Alternative 2A ranks second for downstream survival, with all four Chinook salmon populations reaching replacement, and three out of four Chinook salmon populations with high persistence (e.g., low risk of extinction). Alternative 2A would also reduce risk to the McKenzie Core Legacy spring Chinook salmon population and provides more habitat gains for bull trout compared to the NAA due to the inclusion of effective downstream passage at Cougar. In addition, fish passage at Detroit Dam as part of Alternative 2A would provide access to more habitat for bull trout once they are introduced above that dam as compared the NAA. Alternative 2A would have moderate adverse effects on Chinook salmon, predicted to produce the most viable populations compared to the NAA and the other alternatives and would retain the McKenzie Core Legacy spring Chinook salmon population.

Alternative 2A would also produce the most optimistic outcomes for Chinook salmon in the Middle Fork subbasin among the alternatives, including the NAA, accomplished with a downstream passage structure at Lookout Point exclusive of passage at Hills Creek. Alternative 2A would have minor adverse effects to Santiam winter steelhead populations. Alternative 2A would have minor adverse effects for bull trout. Bull trout habitat scores and risks are comparable to Alternative 1, with a fish passage addition providing access to habitat below Cougar Dam. Habitat scores are higher as compared to the NAA.

Alternative 2A is almost identical to Alternatives 2B and 5. The primary difference in measures between Alternative 2A and Alternatives 2B and 5 is the downstream fish passage measure proposed at Cougar Dam. Alternative 2A proposes an FSS, and Alternatives 2B and 5 propose a deep drawdown to pass fish through the Diversion Tunnel (DT). In contrast to Alternative 2A, Alternatives 2B and 5 would result in high persistence for only three of the four Chinook salmon populations though all three perform better than the NAA. The difference in the anticipated number of populations with high persistence is because the ESA models assume more optimistic downstream fish passage performance with a structure at Cougar Dam. It is assumed that more extreme operations, like a deep drawdown, may have adverse effects on viable populations downstream.

Structural improvements for fish passage and water temperature would provide resilience to climate change by increasing operational flexibility in the North Santiam, South Santiam, Middle Fork subbasins, as compared to the NAA. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to NAA, Alternative 2A would result in minor to major beneficial water temperature effects in the North and South Santiam subbasins due to the proposed temperature control structure at Detroit Dam and the Green Peter Dam fall deep drawdown. A temperature control structure at these two locations would not occur under the NAA. Minor to moderate beneficial TDG effects are expected in the North Santiam subbasin when compared to the NAA due to the proposed temperature control structure at Detroit that removes the need for operational temperature control with non-turbine outlets. Moderate to major adverse TDG effects are expected in the South Santiam subbasin due to the Green Peter fall deep drawdown that relies on more spill flow under Alternative 2A than under the NAA.

As modeled, Alternative 2A would result in an estimated increase in the 75% exceedance level of total water stored system-wide by mid-May of 122,000 acre-feet from the NAA. The Integrated Flow Regime has lower spring mainstem requirements compared to the 2008 BiOp flows under the NAA. Additionally, because of many of the structural measures proposed under Alternative 2A, no reservoirs except Green Peter would be drawn down for temperature management and downstream fish passage during the conservation season. The combination of lower spring flow targets and minimal drawdowns during the conservation season would result in an increase from the NAA in water stored in the driest years.

Alternatives 2A and 4 are similar in this respect, tying for the second largest increase in mid-May stored water volumes when compared to the other alternatives. The increased stored water would result in a moderate beneficial effect to M&I water supply and AI users of the conservation storage space. However, as discussed in Section 3.13, in the driest years the actual impact to M&I and irrigation is currently unquantifiable because the 2019 WBR BiOp sets forth a theoretical plan to reduce contracted water availability in dry years to protect ESA-listed species that has not yet been formalized.

The anticipated increase in total system-wide stored water and flow measures would result in the same or higher downstream flows in the summer as compared to the NAA. The Integrated Flow Regime would require additional flow based on the air temperature, compared to the 2008 BiOp flows proposed under the NAA. Therefore, flows later in the summer and fall would be higher than the NAA due to the additional accumulated stored water.

Under Alternative 2A, flow in the mainstem at Salem would be lower than under the NAA from April through June about 25% of the time, but flows would remain high, usually above 10,000 cfs. During the summer, flows at Salem would be higher than under the NAA, rarely dropping below 6,000 cfs.

In most years, Alternative 2A would have a negligible effect to existing water rights for M&I water supply and AI in the spring and would have a minor beneficial effect in the summer by increasing summer flows in the driest years as modeled when compared to the NAA. However, as discussed in Section 3.13, in the driest years the actual impact to M&I and irrigation is currently unquantifiable.

The additional storage under Alternative 2A as compared to the NAA would contribute to an overall increase in average annual hydropower generation by 4 aMW (roughly enough to power 3,185 households annually) (see Section 3.12.3.3 for details). However, the high capital and O&M cost of Alternative 2A results in a reduction in NPV from that provided under the NAA.

Under Alternative 2A, there would be a $863 million reduction in median NPV to -$638 million. Therefore, there would be long-term, major, adverse effects on economic viability of WVS power generation as compared to effects under the NAA. However, there would be negligible risk to local hydropower generation as Hills Creek and Cougar dams would continue to be able to operate islanded (isolated) from the rest of the power system, providing power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires.

Under Alternative 2A, the additional water stored system-wide as compared to the NAA would also mean reservoir levels stay higher for more of the conservation season resulting in minor to moderate benefits to reservoir recreation except for at Green Peter Reservoir. Despite the fall drawn down at Green Peter Reservoir, Alternative 2A would translate into slight increases in annual visitations across the Willamette River Basin, resulting in an approximate increase of $169,000 in annual economic benefits (a 0.83% increase) compared to the NAA.

The regional economic impact from recreation effects would be medium. The regional economic effects would be associated with the potential loss of 1.7 jobs in the South Santiam subbasin due to the drawdown at Green Peter and a moderate reduction in regional output.

Alternative 2A would be the third costliest alternative to implement (surpassed by Alternative 1 and 4) due to the incorporation of numerous structural measures. The DEIS estimated total annual cost for Alternative 2A is $67,561 million, $58 million greater than the NAA (see Appendix M for details).

During the tradeoffs analysis it was difficult to discriminate the differences in effects to ESA species among the alternatives. However, Alternative 2A would have a higher risk of not meeting the Proposed Action ESA objectives at Cougar compared to Alternatives 2B and 5. This is due to a higher uncertainty recognized for the performance of the proposed FSS at Cougar Dam when compared downstream fish passage rates of a deep reservoir drawdown using the DT. However, if the structure is as successful as assumed in the modeling it would out preform the DT fish passage rates.

The topography of Cougar Reservoir presents some unique challenges for designing an FSS. Deep reservoir drawdowns have proven very effective at Fall Creek Dam for downstream passage of juvenile Chinook salmon (NMFS 2014) and would not be impacted by the layout of Cougar Reservoir. In comparison, the range of performance among the few examples of floating fish collectors in operation varies widely, and there is only one example of an FSS operating with similar attributes to WVS dams (large temperature stratified forebay with significant reservoir fluctuation) where juvenile Chinook salmon are present (SWIFT Dam and Reservoir on the Lewis River, Washington). This floating collector has a poor rate of juvenile Chinook salmon collection (Kock et al. 2019).

Finally, if collection rates proved to be low with an FSS at Cougar there are minimal post-operation mitigation options with current technology for improving collection into the FSS. The uncertainty that an FSS would effectively collect fish at Cougar Dam coupled with the cost to design, construct, and operate the facility eliminated Alternative 2A from consideration for the Preferred Alternative.

5.1.7.4 *Alternative 2B. Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel)*

Alternative 2B, also referred to as the Hybrid Alternative with Cougar Diversion Tunnel Modification, was developed to improve fish passage through the WVS dams as compared to the NAA utilizing a combination of modified operations and structural improvements, along with other measures to balance water management flexibility and meet ESA-listed fish obligations. Alternative 2B is almost exactly like Alternative 2A and 5. The difference between Alternatives 2A and 2B is the fish passage measure at Cougar Dam.

Alternative 2A would incorporate a structure that operates with existing reservoir fluctuations to pass fish downstream, whereas Alternative 2B includes an operation where the reservoir is drawn down to elevation 1330' to use the DT to pass fish. Alternative 5 also includes this measure but proposes a refined flow operation that slightly differs from the "Integrated Temperature and Habitat Flow Regime" operation under Alternatives 2A through 4.

Table 5.1-5 shows the major operational and structural features under Alternative 2B.

Table 5.1-5. Water Quality and Passage Measures under Alternative 2B.

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	–	–	–
Lookout Point	–	–	Structural	–
Hills Creek	–	–	–	–
Fall Creek	–	–	–	–
Cougar	–	–	Operational *	–
Blue River	–	–	–	–
Foster	Structural	–	Structural	–
Green Peter	Operational*	–	Operational*	Structural*
Big Cliff	–	–	–	–
Detroit	Structural	–	Structural	–

*Distinctive feature of this alternative.

5.2.2.4.1 Tradeoffs

Alternative 2B also has an integrated management strategy theme. The only difference with Alternative 2A is that 2B has an operational downstream fish passage measure at Cougar Dam (deep drawdown to near the DT in spring and fall) instead of a structural measure.

This deep drawdown operation is expected to result in most juvenile Chinook salmon migrating downstream of Cougar Dam in spring, along with many resident bull trout. The deep draft in spring would also negatively affect the ability to store water in the conservation pool, resulting in lower summer stream flows and changes in water temperatures below Cougar Dam. These differences would affect fish rearing patterns both above and below Cougar Dam.

Compared to Alternative 2A, 2B would result in increased adverse effects to UWR spring Chinook salmon (moderate) and bull trout (moderate) in the McKenzie subbasin. Otherwise, effects on listed fish species are predicted to be the same as under Alternative 2A.

Alternative 2B is more likely to effectively meet the Proposed Action ESA objectives (objectives 4-6), surpassed only by Alternative 2A. Alternative 2B ranks fourth for downstream survival with all Chinook salmon populations anticipated to reach replacement. Alternative 2B would also reduce risk to the McKenzie Core Legacy spring Chinook salmon population and would provide more habitat gains for bull trout compared to the NAA due to the inclusion of effective downstream passage at Cougar Dam.

In contrast to Alternative 2A, Alternative 2B would result in only two of the four Chinook salmon populations with high persistence. This is the primary difference in how Alternative 2B would perform for the Proposed Action ESA objectives compared to Alternative 2A This difference is a result of the downstream fish passage measure proposed at Cougar Dam. Alternative 2A proposes a FSS and Alternative 2B propose a deep drawdown to pass fish through the DT. The difference in the number of populations anticipated with high persistence is because the EIS ESA models assume more optimistic downstream survival with a structure at Cougar Dam. It is assumed that more extreme operations, like a deep drawdown, may have adverse effects on viable populations downstream.

Alternative 2B is identical to Alternative 5 except for refinements to the “Integrated Temperature and Habitat Flow Regime” measure proposed under Alternative 5. These minor refinements to the flow operation have not undergone the ESA modeling performed on the other alternatives because the minor changes could be qualitatively described. After considering available hydrologic modeling results for Alternative 5, the different outcomes for ESA species between Alternative 2B and Alternative 5 are considered negligible.

Structural improvements for fish passage and water temperature would provide resilience to climate change by increasing operational flexibility in the North Santiam, South Santiam, and Middle Fork subbasins when compared the NAA with no structural improvements. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to NAA, Alternative 2B would result in minor to major beneficial water temperature effects in the North Santiam, South Santiam, and South Fork McKenzie subbasins due to the proposed temperature control structure at Detroit Dam, Green Peter Dam autumn deep drawdown with operational temperature control, and a deep drawdown at Cougar Dam.

Minor to moderate beneficial TDG effects is expected in the North Santiam and South Fork McKenzie subbasins due to a reduced number of days with spill (at Detroit Dam, the proposed temperature control structure removed the need for operational temperature control with non-turbine outlets). Minor beneficial TDG effects are expected in the South Fork McKenzie subbasin under Alternative 2B due to the deep drawdown at Cougar Dam that involves use of the DT, which is expected to have lower TDG than the RO. Moderate to major adverse TDG effects, when compared to the NAA, are expected in the South Santiam subbasin due to the Green Peter Dam autumn deep drawdown that relies on more spill flow under Alternative 2B.

Under Alternative 2B, there would be an estimated decrease in total water stored by mid-May at the 75% exceedance level of 64,000 acre-feet from the NAA (1,328,542 acre-feet) primarily due to the fish passage operation at Cougar Dam. The small decrease in stored water would have a minor adverse effect to M&I water supply and AI users of the conservation storage space as compared to the NAA.

Under Alternative 2B, flow targets in the summer and fall would be met more frequently due to the additional accumulated stored water at WVS reservoirs other than Cougar and Green Peter. However, compared to the NAA, the spring and early summer flows would be similar or somewhat lower across the WVS. This would be a result of the spring drawdown at Cougar Dam that occurs during the NAA refill period.

The reduced storage at Cougar Dam would mean that other WVS reservoirs, notably in the Middle Fork of the Willamette River subbasin, would be required to release additional water to meet mainstem Willamette River flow targets. The drawdown of the Cougar Reservoir would effectively eliminate the conservation pool for use for water supply from Cougar. However, the Blue River Reservoir would fill more than under the NAA, partially offsetting the lost storage from Cougar Reservoir.

Cougar Dam is also situated on the South Fork of the McKenzie River, and its flow is a small portion of the overall McKenzie River flow. The flow on the McKenzie River would be only slightly less as compared to the NAA due to additional flow from Blue River. Therefore, Alternative 2B would have a negligible effect to live flow water rights in the McKenzie subbasin. Due to the expected limited level of demand for stored water on the McKenzie River, Alternative 2B would be expected to have only a minor adverse effect to M&I water supply and AI users in the McKenzie subbasin as compared to the NAA.

The decrease in stored water would contribute to an overall decrease in average annual hydropower generation by 18 aMW (roughly enough to power 14,334 households annually see Section 3.12.3.2 for details). This, coupled with the high cost of Alternative 2B, would result in a $933 million reduction in median NPV to -$708 million. Therefore, there would be long-term, major, adverse effects on economic viability of WVS power generation under Alternative 2B as compared to the NAA.

Additionally, the fish passage operation at Cougar Dam would result in infrequent, temporary moderate adverse effects on transmission services to Blue River as compared to the NAA. Deep fall and spring drawdowns at Cougar Dam would compromise the ability to provide power to Oakridge and serve this islanded (isolated) community under temporary weather or fire related outage conditions. Generation at Hills Creek Dam would remain able to operate islanded (isolated), providing transmission services to Oakridge, like the NAA.

Alternative would 2B results in the smallest increases in annual visitations, resulting in an approximate increase of $12,000 in annual economic benefits (a 0.06% increase) compared to the NAA. Although this would be a negligible adverse effect on recreation across the WVS, the near loss of the conservation pool at Cougar Reservoir would result in major adverse effects to reservoir recreation at this location. However, the regional economic effects would similar to those under Alternative 2A because there are no jobs associated with recreation at Cougar Reservoir.

The regional economic effects would be associated with the potential loss of 1.7 jobs in the South Santiam subbasin due to the drawdown at Green Peter Dam and a moderate reduction in regional output as compared to the NAA.

Alternative 2B would be the fourth costliest alternative to implement (surpassed by Alternatives 1, 2A, and 4) due to the incorporation of numerous structural measures. The estimated total annual cost for Alternative 2B is $62,291 million, $53 million greater than the NAA (see Appendix M for details).

The higher design costs compared to Alternative 2A is because the modification of the DT required to perform the fish passage operation at Cougar Dam under Alternative 2B would require new construction. The Cougar Dam FSS proposed under Alternative 2A has already undergone detailed design and would require limited additional design effort compared to Alternative 2B. Conversely, the annual O&M cost for Alternative 2B would be lower than under Alternative 2A because the FSS would require substantially more O&M than operation of the DT once it is constructed.

Although Alternative 2B would be beneficial for meeting the Proposed Action ESA objectives, during the tradeoffs analyses with input from USFWS and NMFS, USACE deemed Alternatives 2A, 2B, and 5 too similar to effectively differentiate between their effects on ESA-listed species. Additionally, Alternative 2A would have higher uncertainty in meeting Proposed Action ESA objectives at Cougar Dam as compared to Alternatives 2B and 5. In contrast, there is high confidence that when reservoirs are drafted very low, juvenile Chinook salmon would successfully pass downstream under Alternative 2B (NMFS, 2014).

In addition to the assumption that more extreme operations, like a deep drawdown, may have adverse effects on viable populations downstream, the main risk associated with Alternative 2B relates to modifications required to operate the DT. The DT was originally constructed to be used temporarily during dam construction and was not designed to be operated on a regular basis. Without detailed investigation and designs, the dam safety and operational feasibility of drawing down to the DT annually for fish passage is uncertain. However, unlike the FSS, which would have limited mitigation actions available for addressing the fish collection risks with current technology, there are clear engineering pathways for managing risk associated with dam safety and operational feasibility of a dam outlet.

In sum, Alternative 2B would effectively meet the Proposed Action ESA objectives at lower risk and substantially lower costs than under Alternative 2A. However, Alternative 2B was not chosen as the Preferred Alternative because discussions with cooperators revealed refinements to the "Integrated Temperature and Habitat Flow Regime" operation that could result in increased comparative beneficial effects on listed fish species. Subsequently, these refinements were included under Alternative 5, the Preferred Alternative and are not included under the NAA. Alternative 2B is identical to Alternative 5 but for these refinements to the "Integrated Temperature and Habitat Flow Regime" measure.

5.1.7.5 *Alternative 3A. Improve Fish Passage Through Operations-focused Measures (Includes Operational Downstream Passage at Cougar – Drawdown to Regulating Outlet)*

Alternatives 3A, also referred to as the Operations-focused Fish Passage Alternative, would primarily utilize WVS dam operations for water quality and fish passage. As under the NAA, Alternative 3A would not include structural measures for temperature control, TDG abatement, or downstream fish passage like Alternatives 1 and 4 and much of Alternatives 2A, 2B, and 5.

An important part of the operational focus under Alternative 3A, and a distinction from the NAA, would be the increased use of different flow outlets from the dams to control temperature, with the spillway supplying warmer water from the upper reservoir and the deeper outlets – ROs and turbines – supplying cooler water. Alternative 3A would also implement spring and fall drawdowns at some WVS reservoirs for volitional downstream fish passage, which would not occur under the NAA. Additionally, where Alternative 1, 2A, 2B, 4, and 5 only proposed a new adult fish facility for upstream fish passage at Green Peter Dam, Alternative 3A proposes new adult fish facilities at Hills Creek and Blue River Dams as well. No new fish facilities are proposed under the NAA.

Table 5.1-6 shows the major operational and structural features of Alternative 3A.

Table 5.1-6. Water Quality and Passage Measures Under Alternative 3A.

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	–	Operational – use spillway*	–
Lookout Point	Operational – spillway and RO releases*	–	Operational – spring and fall drawdown*	–
Hills Creek	Operational – spillway releases*	–	Operational – use spillway and fall drawdown*	Structural*
Fall Creek	–	–	Operational – use spillway*	–
Cougar	–	–	Operational – spring and fall	–

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
			drawdown (RO)*	
Blue River	Operational – spillway releases*	–	Operational –fall drawdown*	Structural*
Foster	Operational – spillway releases*	–	–	–
Green Peter	Operational – spillway and RO releases*	–	Operational – use spillway and fall drawdown*	Structural
Big Cliff	–	–	Operational – use spillway*	–
Detroit	Operational – spillway and RO releases*	–	Operational – spring and fall drawdown*	–

*Distinctive feature of this alternative.

Alternative 3A is very similar to Alternative 3B, with proposed differences in downstream fish passage operations in spring as shown in Table 5.1-7. Alternatives 3A and 3B also differ in the proposed drawdowns for fish passage operations at Cougar Dam.

Under Alternative 3A, the spring and fall drawdowns would target the Cougar Dam RO, whereas the Alternative 3B drawdowns would target the much lower DT (like Alternatives 2B and 5). By making these distinctions between Alternatives 3A and 3B, the unique effects associated with each of these operations for downstream passage to be identified at Cougar Dam and the tradeoffs between them can be assessed and compared.

Table 5.1-7. Differences in Spring Downstream Fish Passage Operations between Alternatives 3A and 3B.

Dam	Spring Drawdown	Spring Spill
DEX	–	3A & 3B
LOP	3A	3B
HCR	3B	3A
FCR	–	3A
CGR	3A- RO, 3B DT	–
BLU	–	–
FOS	–	–
GPR	3B	3A
BCL	–	3A & 3B
DET	3A	3B

Under Alternative 3A and Alternatives 2B, 3A, 3B, and 4, the "Integrated Temperature and Habitat Flow Regime" operation replaces the 2008 BiOp flows under the NAA. Alternative 3A would also augment instream flows by using the power and inactive pools and allows reservoirs to draft below the NAA rule curves to meet minimum flow requirements. This would usually occur during the fall of drier years at reservoirs that do not have a fall drawdown operation.

5.2.2.5.1 Tradeoffs

Alternative 3A has an operational theme (i.e., fish passage, water quality and other missions are accomplished by operation of existing structures). Unlike operations under the NAA, deep reservoir drawdowns would occur in spring and fall at Detroit, Cougar (to RO), and Lookout Dams. Spring surface spill and fall deep drawdowns would occur at Green Peter and Hills Creek Dams. A fall deep drawdown at Fall Creek would continue as under the NAA.

Alternative 3A would have major adverse effects for UWR spring Chinook salmon and UWR steelhead. Predicted performance for these species is very similar to those under the NAA, with some improvement in North Santiam Chinook salmon and South Santiam steelhead populations. Similarly, Alternative 3A would have major adverse effects for bull trout. Reservoir rearing area would be substantially reduced in both Detroit and Cougar Reservoirs. Consequently, bull trout would be expected to increase movement into more degraded rearing habitat below Detroit and Hills Creek Dams where spawning habitat does not exist, and human disturbance is high.

Alternative 3A would not effectively meet all the Proposed Action ESA objectives. Although all four Chinook salmon populations would reach replacement under Alternative 3A, only one out of four Chinook salmon populations would have high persistence (e.g., low risk of extinction), which would not be an improvement as compared to the NAA. Additionally, Alternative 3A ranks fifth for downstream survival, and the McKenzie Core Legacy spring Chinook salmon population is at risk of extinction. However, there would be habitat gains for bull trout as compared to the NAA.

Climate change is predicted to further degrade habitat for bull trout below dams and will reduce the ability to meet operational fish passage, minimum flows, and water temperature targets below dams for UWR spring Chinook salmon and UWR steelhead. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to the NAA, Alternative 3A would result in minor to major beneficial water temperature effects in the Middle Fork Willamette (between Hills Creek Dam and Lookout Point Dam) and South Santiam subbasins due to the proposed deep drawdowns at Hills Creek and Green Peter Dams. In the North Santiam subbasin, minor beneficial effects to water temperature are expected during the autumn while moderate adverse effects are expected during the spring-summer due to deep drawdown at Detroit Dam under Alternative 3A. In the South Fork McKenzie subbasin, minor adverse effects to water temperature are expected during the fall due to a partial drawdown at Cougar Dam under Alternative 3A. Minor to major adverse TDG effects are expected in the North Santiam, South Santiam, and Middle Fork

Willamette subbasins due to the deep drawdowns at Detroit, Green Peter (autumn) and Lookout Point Dams that rely on high outflows and/or spill flow under Alternative 3A.

By combining spring spill and drawdowns with fall drawdowns at 6 of the 11 storage projects, Alternative 3A would substantially affect the ability to refill the system-wide conservation storage. These operations would result in a 56% reduction of system-wide stored water compared to the NAA, or 590,000 acre-feet. Depending on how and when the Fish and Wildlife conservation storage allocation is takes priority over other consumptives uses it would leave very little conservation storage available for M&I water supply or AI. Therefore, Alternative 3A would have a major adverse effect to M&I water supply and irrigation.

Additionally, under Alternative 3A, flows during dry years would be lower than under the NAA starting in April, dropping below 5,000 cfs in August at Salem. This would likely cause water users in the system to be shut off more than under current conditions, resulting in a moderate adverse effect to M&I water supply and AI as compared to the NAA.

The decrease in stored water would contribute to an overall decrease in average annual hydropower generation by 87 aMW (roughly enough to power 69,283 households annually; see Section 3.12.3.2 for details). Coupled with the cost of Alternative 3A, there would be a $853 million reduction in median NPV to -$628 million. Therefore, long-term, major, adverse effects on the economic viability of WVS power generation would occur under Alternative 3A as compared to the NAA.

Additionally, the fish passage operations at Hills Creek and Cougar Dams would result in infrequent, temporary moderate adverse effects on transmission services to Oakridge and Blue River. Deep fall and spring drawdowns would compromise abilities to serve these communities from Hills Creek and Cougar Dams under temporary storm or fire related outage conditions which would not occur under the NAA where power generation would not be impacted.

Alternative 3A is one of two alternatives that would result in decreases in annual visitations as compared to the NAA. This would be a major, long-term adverse effect to recreation in the WVS, resulting in an approximate decrease of $769,000 in annual economic benefits (a 3.76% decrease) compared to the NAA.

The effects to recreation would also have a high regional economic impact with close to a 50% reduction in recreation-related jobs in the North Santiam (14 jobs lost) and Middle Fork Willamette (13.7 jobs lost) subbasins and a reduction in regional output greater than $150,000 in multiple basins.

Alternative 3A would be the least costly alternative to implement because it incorporates the fewest structural measures. Alternative 3A would be approximately $86 million less annually than the costliest alternative, Alternative 4. The estimated total annual cost for Alternative 3A is $26,442 million, $17 million greater than the NAA (see Appendix M for details).

Although one of the least costly alternatives, Alternative 3A would perform poorly for Proposed Action ESA objectives while substantially decreasing water stored in the conservation pools with adverse effects to hydropower, water supply, and recreation. Additionally, the autumn deep and spring drawdowns would compromise the abilities to serve nearby communities from Hills Creek and Cougar Dams under temporary storm or fire related outage conditions. These adverse effects without appreciable benefits for ESA-listed species makes it unlikely this alternative would be acceptable to stakeholders, agencies, and the public. Therefore, Alternative 3A was not identified as the Preferred Alternative.

5.1.7.6 *Alternative 3B. Improve Fish Passage Through Operations-focused Measures (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel)*

Alternatives 3B, also referred to as the Operations-focused Fish Passage Alternative using Diversion Tunnel at Cougar, would primarily utilize WVS dam operations for water quality and fish passage. Table 5.1-8 shows the major operational and structural features of Alternative 3B.

Alternative 3B is very similar to Alternative 3A, with differences in downstream fish passage operations in spring as shown in Table 3.1-7. Alternatives 3A and 3B also differ in the drawdowns for fish passage operations at Cougar Dam. Under Alternative 3B, the spring and fall drawdowns would target the DT (like Alternatives 2B and 5), resulting in a much lower drawdown than Alternative 3A, which proposes drawing down only to the RO. By making these distinctions between Alternatives 3A and 3B, the unique effects associated with each of these operations for downstream passage to be identified at Cougar Dam and the tradeoffs between them can be assessed and compared.

Table 5.1-8. Water Quality and Passage Measures Under Alternative 3B.

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	–	Operational – use spillway*	–
Lookout Point	Operational – spillway and RO releases*	–	Operational – use spillway and fall drawdown*	–
Hills Creek	Operational – spillway releases*	–	Operational – spring and fall drawdown*	Structural*
Fall Creek	–	–	–	–
Cougar	–	–	Operational – spring and fall drawdown (DT)*	–
Blue River	Operational – spillway releases*	–	Operational – fall drawdown*	Structural*

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Foster	Operational – spillway releases*	–	–	–
Green Peter	Operational – spillway and RO releases*	–	Operational – spring and fall drawdown*	Structural
Big Cliff	–	–	Operational – use spillway*	–
Detroit	Operational – spillway and RO releases	–	Operational – use spillway and fall drawdown	–

*Distinctive feature of this alternative.

5.2.2.6.1 Tradeoffs

Alternative 3B also has an operational theme, with a different combination of fish passage measures than 3A or the NAA. Deep reservoir drawdowns would occur in spring and fall at Green Peter, Cougar (to DT), and Hills Creek Dams. Spring surface spill and fall deep drawdowns would occur at Detroit and Lookout Point Dams. A fall deep drawdown at Fall Creek Dam would continue as under the NAA.

Alternative 3B would have moderate to major adverse effects on UWR spring Chinook salmon and UWR steelhead. Alternative 3B would have moderate to major adverse effects for bull trout. Reservoir rearing area is substantially reduced in Cougar Reservoir, and passage would result in increased movement into more degraded rearing habitat below Detroit and Hills Creek Dams where spawning habitat does not exist, and human disturbance is high.

Alternative 3B would not effectively meet all the Proposed Action ESA objectives (objective 4-6). Under Alternative 3B, all four Chinook salmon populations would reach replacement and two out of four Chinook salmon populations would have high persistence (e.g., low risk of extinction). However, Alternative 3B ranks sixth for downstream survival (the lowest ranking of the action alternatives) though it is still an improvement over the NAA. Additionally, the McKenzie Core Legacy spring Chinook salmon population is at risk of extinction, and there would be no habitat gains for bull trout as compared to the NAA.

As under the NAA, climate change is predicted to further degrade habitat for bull trout below dams and will reduce the ability to meet operational fish passage, minimum flows, and water temperature targets below dams for Chinook salmon and steelhead. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to NAA, Alternative 3B would result in minor to moderate beneficial water temperature effects in the Middle Fork Willamette, McKenzie, and South Santiam subbasins due to the proposed drawdowns at Hills Creek, Lookout Point, Cougar, and Green Peter Dams.

Minor to major adverse TDG effects would be expected in the North Santiam River, South Santiam River, and Middle Fork Willamette River Subbasins (below Dexter Dam) due to the deep drawdowns at Detroit (autumn), Green Peter, and Lookout Point Dams (autumn) that rely on high outflows, thereby increasing the number of days with spill under Alternative 3B as compared to the NAA or action alternatives with structural improvements for TDG like alternatives 1 and 4. Minor beneficial TDG effects are expected in the McKenzie River Subbasin under Alternative 3B due to the deep drawdown at Cougar Dam that would involve use of the DT, which is expected to have lower TDG than the RO.

By combining spring spill and drawdowns with fall drawdowns at 6 of the 11 storage projects, Alternative 3B would substantially affect the ability to store water system-wide. These operations would result in a 50% reduction of water stored system-wide compared to the NAA, or 669,000 acre-feet. Depending on how and when the Fish and Wildlife conservation storage allocation is takes priority over other consumptives uses it would leave very little conservation storage available for M&I water supply or AI. Therefore, Alternative 3B would have a major adverse effect to M&I water supply and irrigation.

Unlike Alternative 3A, the goal under Alternative 3B is to fill Detroit Reservoir for a spring spill fish passage operation; hence flows at Salem in Alternative 3B would rarely drop below 5,000 cfs in the summer, though they would be lower than under the NAA in dry years. Alternative 3B includes a spring drawdown at Hills Creek Dam instead of Lookout Point Dam, so water flowing through Hills Creek Dam can be stored in Lookout Point Dam, which would preserve a larger amount of water than under Alternative 3A.

The decrease in stored water would contribute to an overall decrease in average annual hydropower generation by 79 aMW (roughly enough to power 62,912 households annually; see Section 3.12.3.2 for details). This, coupled with the cost of Alternative 3B, would result in a $829 million reduction in median NPV to -$604 million. Therefore, there would be long-term, major, adverse effects on economic viability of WVS power generation under Alternative 3B as compared to the NAA.

Additionally, the fish passage operations at Hills Creek and Cougar Dams would result in infrequent, temporary moderate adverse effects on transmission services to Oakridge and Blue River. Deep fall and spring drawdowns would compromise abilities of Hills Creek and Cougar Dams to operate islanded and to serve these communities under temporary storm or fire related outage conditions, which would not occur under the NAA.

Alternative 3B would result in the largest decreases in annual visitations. This would be a major, long-term adverse effect to recreation in the WVS, resulting in an approximate decrease of $1,274,000 in annual economic benefits (a 6.23% decrease) compared to the NAA. The effects to recreation would also have a high regional economic impact with a 50% reduction in recreation related jobs in the South Santiam River Subbasin and a reduction in regional output greater than $150,000 in multiple basins.

Alternative 3B would be the second least costly alternative to implement due to incorporation of few structural measures. Alternative 3A would be the only less costly alternative in comparison. This is because Alternative 3B includes a lower drawdown operation at Cougar Dam that requires additional costs to modify the DT, as discussed under the Alternative 2B tradeoffs which also has a fish passage measure utilizing the DT at Cougar. The estimated total annual cost for Alternative 3B is $30,652 million, $21 million greater than the NAA (see Appendix M for details).

Although one of the least costly alternatives, Alternative 3B would perform poorly for Proposed Action ESA objectives while substantially decreasing water store system-wide with adverse effects to hydropower, water supply, and recreation. Additionally, the deep fall and spring drawdowns would compromise abilities of Hills Creek and Cougar Dams to serve nearby communities under temporary storm or fire related outage conditions. These adverse effects without appreciable benefits for ESA-listed species makes it unlikely this alternative would be acceptable to stakeholders, agencies, and the public. Therefore, Alternative 3B was not identified as the Preferred Alternative.

5.1.7.7 *Alternative 4. Improve Fish Passage with Structures-based Approach*

Alternative 4 takes a structures-based approach to improve fish passage through the WVS dams to increase the survival of ESA-listed fish. In contrast to the NAA but as under Alternative 1, Alternative 4 proposes only structures for water quality and downstream fish passage, shifting the release of stored water from the spring into the summer and fall and augmenting instream flows by using the power and inactive pools.

Also, in contrast to the NAA and Alternative 1, Alternative 4 proposes the “Integrated Temperature and Habitat Flow Regime” operation, the targets of which are generally higher and more variable than those in the congressionally authorized minimum flow requirements proposed under Alternative 1. Alternative 4 also proposes the most structural measures for fish passage and water quality of any alternative as shown in Table 5.1-90.

Table 5.1-9. Key measures under Alternative 4.

Dam	Temperature Control	TDG Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	Structural*	–	–
Lookout Point	Structural	–	Structural	–
Hills Creek	Structural*	–	Structural*	Structural*
Fall Creek	–	–	–	–
Cougar	–	Structural*	Structural*	–
Blue River	–	–	–	–
Foster	Structural	Structural*	Structural	–
Green Peter	Operational*	Structural*	–	–
Big Cliff	–	–	–	–

Dam	Temperature Control	TDG Improvements	Downstream Fish Passage	Upstream Fish Passage
Detroit	Structural	–	Structural	–

*Distinctive feature of this alternative.

In contrast to the NAA and Alternative 1, Alternative 4 would include a fish passage structure and WTC tower at Hills Creek Dam and a fish passage structure at Cougar Dam. Alternative 4 also replaces the WTC tower at Green Peter Dam proposed under Alternative 1 with using operational measures utilizing the spillway and ROs for temperature management. In contrast to the NAA and Alternatives 1, 2A, 2B, and 5, Alternative 4 proposes an upstream passage structure at Hills Creek Dam and not at Green Peter Dam. These differences allow for the comparison of the relative costs and benefits associated with the different combinations of structural measures.

5.2.2.7.1 Tradeoffs

Alternative 4 is a structural focused alternative and includes large floating fish passage structures coupled to temperature structures in the North Santiam River, McKenzie River, and the Middle Fork Willamette River Subbasins. Smaller structures are included at Foster Dam in the South Santiam River Subbasin. A fall deep drawdown at Fall Creek Reservoir would continue as under the NAA.

Under Alternative 4, adverse effects are predicted to be moderate for UWR spring Chinook salmon, minor for UWR winter steelhead, and moderate for bull trout. Habitat scoring for bull trout would be improved in all three subbasins due to passage actions as compared to the NAA. However, access to below-dam habitat would increase demographic risks especially below Hills Creek Dam and below Detroit Dam where human disturbance is higher. By increasing the number of bull trout passing downstream and becoming exposed to these disturbances compared to the NAA, there is an increase in demographic risk.

Despite the greatest spending on structural measures for ESA-listed species needs, Alternative 4 would not perform the best for meeting Proposed Action ESA objectives (objectives 4-6). Like Alternative 1, although Alternative 4 ranks moderately well for downstream survival (third), and three out of four Chinook salmon populations would reach replacement; only two out of four Chinook salmon populations would have high persistence (e.g., low risk of extinction). In contrast to Alternative 1, Alternative 4 would reduce risk to the McKenzie Core Legacy spring Chinook salmon population and would provide more habitat gains for bull trout compared to the NAA due to the inclusion of effective downstream passage at Cougar Dam. Alternative 2A would perform better than Alternative 4 for the replacement, persistence, and downstream survival metrics and Alternatives 2B and 5 for the replacement metrics.

Structural improvements for fish passage and water temperature would provide resilience to climate change by increasing operational flexibility in the North Santiam River, South Santiam River, and Middle Fork Willamette River Subbasins, as compared to the NAA. See Appendix F for details on climate change effects on the Willamette River Basin.

Compared to NAA, Alternative 4 would result in minor to major beneficial water temperature effects in the Middle Fork Willamette River Subbasin (between Hills Creek Dam and Lookout Point Dam), South Santiam River and North Santiam River Subbasins due to the proposed temperature control structures at Hills Creek, Lookout Point, and Detroit Dams as well as operational temperature control at Green Peter Dam. Minor to major beneficial TDG effects are expected in the North Santiam River and McKenzie River Subbasins based on the proposed TDG abatement structures below Detroit and Big Cliff Dams and the reduced number of spill days at Cougar Dam under Alternative 4.

Under Alternative 4, as under Alternative 2A, there would be an estimated increase in water stored system-wide at the 75% exceedance level of 122,000 acre-feet from the NAA. The combination of lower spring flow targets and no reservoir drawdowns during the conservation season would allow for the increase from the NAA in stored water. The increased stored water would likely result in a moderate beneficial effect to municipal and industrial water supply and AI users of the conservation storage space.

The Integrated Flow Regime would include additional flow based on the air temperature, compared to the 2008 BiOp flows implemented under the NAA. Therefore, flows later in the summer and fall would be higher than the NAA due to the additional accumulated stored water.

The additional stored water would contribute to an overall slight increase in average annual hydropower generation by 1 aMW (roughly enough to power 796 households annually; see Section 3.12.3.7 for details). However, the high capital and O&M cost of Alternative 4 would result in the second greatest decrease in NPV from that provided by the NAA.

Under Alternative 4, there would be a $1.162 billion reduction in median NPV to -$937 million. Therefore, there would be long-term, major, adverse effects on economic viability of WVS power generation. There would also be negligible risk to local hydropower generation as Hills Creek and Cougar Dams would continue to be able to operate islanded (isolated) from the rest of the power system, providing power to the communities of Oakridge and Blue River, respectively, during power system outages due primarily to weather events or fires.

Under Alternative 4, the additional stored water would mean the reservoirs stay higher for more of the conservation season as compared to the NAA, resulting in minor to moderate benefits to reservoir recreation. This would translate into slight increases in annual visitations, resulting in an approximate increase of $167,000 in annual economic benefits (a 0.82% increase) compared to the NAA.

The regional economic impact from recreation effects would be medium. The regional economic effects would be associated with a moderate reduction in regional output and the potential loss of 1.7 jobs in the South Santiam River and McKenzie River Subbasins due to the drawdown at Green Peter and operations at Blue River Dam.

Alternative 4 would be the costliest alternative to implement, primarily driven by the cost to design, construct, operate, and maintain the structural measures for temperature control, fish passage, and TDG abatement. Alternative 4 proposes the most structural measures of any alternative. The estimated total annual cost for Alternative 4 is $113,001 million, $104 million greater than the NAA (see Appendix M for details).

Due to the scale of the measures under Alternative 4, which are largely structural this would be the most expensive alternative. The high cost makes it unlikely this alternative would be acceptable to many stakeholders, agencies, and the public. This is compounded by the fact that Alternative 4 would result in fewer benefits to ESA species than several less costly alternatives, including Alternatives 2A, 2B, and 5. Therefore, Alternative 4 was not identified as the Preferred Alternative.

5.1.7.8 *Alternative 5. Refined Integrated Water Management Flexibility and ESA-listed Fish Alternative (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel) - Preferred Alternative*

Alternative 5, also referred to as the Refined Hybrid Alternative with Cougar Diversion Tunnel Modification, is the same as Alternative 2B except for the proposed flow regime. Alternative 5 was ultimately identified as the Preferred Alternative. This alternative was the most successful at finding a balance between cost and meeting the proposed action ESA objectives.

The flow operation proposed under Alternative 5 is a modified version of the “Integrated Temperature and Habitat Flow Regime” proposed under all action alternatives except for Alternative 1 and the NAA.

Following discussions with cooperators on how the “Integrated Temperature and Habitat Flow Regime” could be improved to better meet the species needs during the lowest low flows, USACE refined the flow operation, which is incorporated into Alternative 5. As shown in Section 3.2.2.10, the key difference of the refined flow operation would be higher flows at Foster, Detroit, and Cougar Dams as compared to the NAA and the other action alternatives.

The refinement for Cougar Dam flows would be much smaller, however, because the drawdown operation to the DT for fish passage results in much less storage compared to Foster and Detroit Dams to supplement flow. Additionally, the mainstem Willamette River flows would have different flow levels reflective of a basin-wide hydrology forecast.

Table 5.1-10 shows the major operational and structural features of Alternative 5.

Table 5.1-10 . Water Quality and Passage Measures Under Alternative under Alternative 5.

Dam	Temperature Control	TDG structural Improvements	Downstream Fish Passage	Upstream Fish Passage
Dexter	–	–	–	–
Lookout Point	–	–	Structural	–
Hills Creek	–	–	–	–
Fall Creek	–	–	–	–
Cougar	–	–	Operational *	–
Blue River	–	–	–	–
Foster	Structural	–	Structural	–
Green Peter	Operational*	–	Operational*	Structural*
Big Cliff	–	–	–	–
Detroit	Structural	–	Structural	–

*Distinctive feature of this alternative.

5.2.2.8.1 Tradeoffs

The tradeoffs under Alternative 5 are the same as those discussed under Alternative 2B except that Alternative 5 would have a greater reduction by $6 million in NPV compared to Alternative 2B. Under Alternative 5, there would be a $939 million reduction in median NPV to -$714 million as compared to the NAA. The effects to UWR spring Chinook salmon, UWR steelhead, and bull trout would be the same under Alternative 5 as under Alternative 2B.

As discussed, Alternative 5 is identical to Alternative 2B except for refinements to the “Integrated Temperature and Habitat Flow Regime” measure. Despite refinements to the “Integrated Temperature and Habitat Flow Regime” measure, little to no difference between Alternative 2B and 5 is predicted regarding reservoir volumes or flows below dams, since reservoir drafting during the conservation season and early flood seasons would result in stream flows remaining above minimums. Therefore, these refinements to the flow operation have no to negligible change to the outcomes as described under Alternative 2B for hydropower, water supply, and recreation.

Alternative 5 has been identified as the Preferred Alternative by USACE. Like Alternative 2B, Alternative 5 would meet the Proposed Action ESA objectives. During the tradeoffs analyses, with input from cooperators, USACE deemed the effects on ESA listed species under Alternatives 2A, 2B, and 5 to be so similar that it was difficult to differentiate between them on that basis, however they are all an improvement for ESA species given the fish passage, flow, and water quality measures as compared to the NAA.

As discussed in the evaluation of Alternatives 2A and 2B, Alternative 5 would effectively meet the Proposed Action ESA objectives (objectives 4-6) at lower risk and substantially lower costs than Alternative 2A, 1, or 4. Alternative 5 was chosen as the Preferred Alternative due to the flow operation refinements and subsequent beneficial effects that resulted from engagement with cooperators.

5.2 SUMMARY OF THE PREFERRED ALTERNATIVE

The Preferred Alternative is Alternative 5 . The Preferred Alternative contains a variety of structural and operational measures to meet the Proposed Action objectives developed for the EIS. The measures are intended to improve conditions for ESA-listed fish while providing more flexible ways for USACE to meet demands for fish and wildlife, FRM, water supply for M&I, water quality, water supply, irrigation, hydropower generation, and recreation in the Willamette River Basin. This alternative was the most successful at finding a balance costs, impacts and the Proposed Action's ESA objectives.

The Preferred Alternative includes the measures that USACE would implement over the 30-year implementation timeframe as well as monitoring and evaluation as described in the Implementation and Adaptive Management Plan. Sections 3.3 and 3.4 summarize how the Preferred Alternative would be executed under the Implementation and Adaptive Management Plan. Appendix N provides a more detailed description of implementation and adaptive management of the Preferred Alternative.

Additionally, as described in Section 2.2.5, USACE is proposing to continue a suite of Interim Operations until structural measures in the Preferred Alternative are operational. When all the measures in the Preferred Alternative are implemented, any remaining Interim Operations will cease. How and when an operation at a location is superseded or replaced by measure in the Preferred Alternative is described in the Implementation Plan. If the Preferred Alternative is refined or changes as a result of the ongoing ESA consultation or as a result of comments from the public on the DEIS, a new implementation plan would be developed for that alternative.

5.3 IMPLEMENTATION PLAN SUMMARY

The Implementation Plan is a companion document to the WVS EIS (Appendix N, Implementation and Adaptive Management). It describes the implementation sequencing of the measures in the Preferred Alternative. This plan links immediate operations to improve fish passage and water quality (e.g., Interim Operations) to the longer-term structural measures, such as the downstream fish passage construction projects, and identifies check-ins, or points along the implementation timeline where course correction (i.e., "on-ramps/off-ramps") may be necessary based on research, monitoring, and evaluation (RM&E). Any change would be evaluated for any additional NEPA or environmental compliance that would be necessary.

The Implementation Plan is considered a roadmap or high level, tentative schedule that lays out a strategy and plan for implementation of the measures developed through the EIS process. Considerations such as basin-wide priorities, risk and uncertainty, research and development, and research, monitoring, and evaluation of data gaps and other factors have been used to shape this plan and to develop a schedule that is both reasonable and implementable given the information available to USACE at present.

5.3.1 Preferred Alternative Implementation and Replacement of the Interim Operations Timeline

Figure 5.3-1 provides the proposed implementation timeline of the operations and construction of the structural measures in the Preferred Alternative. This implementation timeline is highly dependent on the timing of design and construction funding (i.e., when this funding becomes available).

In Figure 5.3-1, the check-in stars indicate when USACE will evaluate the effectiveness of the measure and determine if changes should be made based on the framework for addressing such changes in the Implementation and Adaptive Management Plan. For instance, there is currently uncertainty that the FSS structural downstream passage measures proposed at some dams would be effective. The check-ins will provide opportunities to refine future designs based on information and lessons learned from other recently constructed similar structures. There will be additional costs for refining designs in the future, however it is not possible to estimate those costs at this time.

The EIS environmental consequences analyses assumed all operations in the Interim Operations would be in place for the duration of the 30-year implementation timeframe of analysis to capture the full the effects of these operations, given the difficulty and uncertainty in implementing these large-scale construction projects. While uncertain, Table 5.3-1 summarizes what measure under the Preferred Alternative would replace each operation at a specific location and provides the proposed implementation timeline for when each would be replaced, which is based on USACE's experience in constructing these large-scale projects.

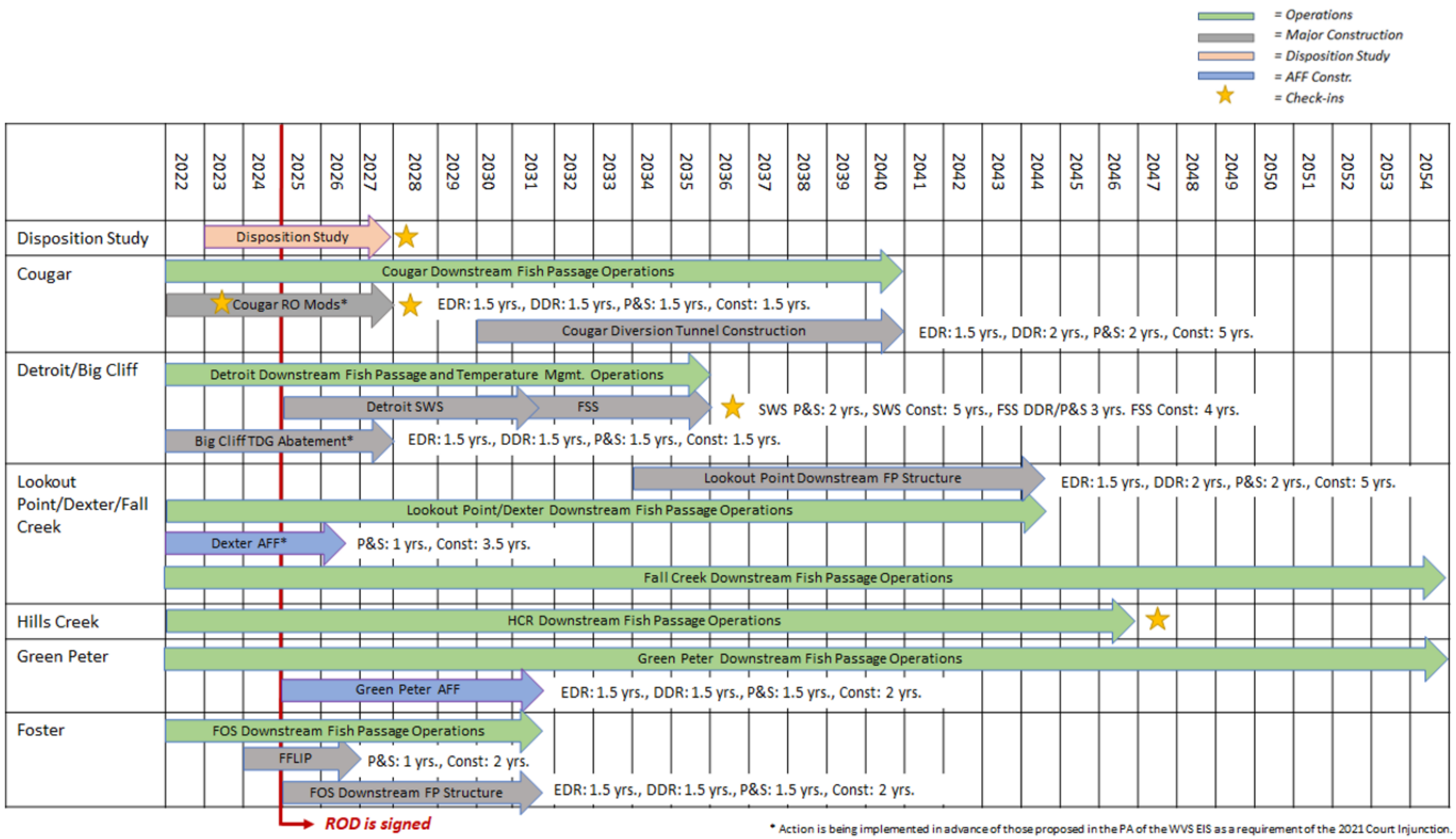

Figure 5.3-1. Best-Case Scenario for the Preferred Alternative Implementation Timeline (funding-dependent).

Table 5.3-1. Base-case scenario timeline for replacing the Preferred Alternative Measures to replace Interim Operations.

Dam	Interim Operations	Preferred Alternative Measure(s) to Replace Interim Operations	Approximate Replacement Year
Detroit	Spring downstream fish passage and operational downstream temperature management	105. Construct water temperature control tower 392. Construct structural downstream fish passage	2031 2035
Detroit	Nighttime RO prioritization for improved downstream fish passage	392. Construct structural downstream fish passage	2035
Big Cliff	Spread spill across spillbays to reduce downstream TDG exceedances	This operation would continue until the TDG structural solution is constructed as required by the injunction.	2027
Green Peter	Outplanting plan for the reintroduction of adult Chinook salmon above Green Peter Dam	722. Construct adult fish facility	2031
Green Peter	Utilize spillway for improved downstream fish passage in the spring; perform spill operation until 01 May or for 30 days, whichever is longer	721. Use spillway for surface spill in summer	2025
Green Peter	Deep drawdown and RO prioritization for improved downstream fish passage	40. Deeper fall reservoir drawdowns for downstream fish passage	2025
Foster	Delay refill and utilize spillway in the spring for improved downstream fish passage. Use the fish weir in the summer for improved downstream temperature management and upstream fish migration/passage	392. Construct structural downstream fish passage 479. Foster Dam Fish Ladder Temperature Improvement	2031 2027
Foster	Utilize the spillway for improved downstream fish passage in the fall	392. Construct structural downstream fish passage	2031
Cougar	Deep drawdown and RO prioritization for improved downstream fish passage	40. Deeper fall reservoir drawdown to the DT for downstream fish passage	2041
Cougar	Delayed reservoir refill and RO prioritization for improved downstream fish passage	40. Deeper fall reservoir drawdown to the DT for downstream fish passage	2041

Dam	Interim Operations	Preferred Alternative Measure(s) to Replace Interim Operations	Approximate Replacement Year
Hills Creek	Nighttime RO prioritization for improved downstream fish passage	This operation would continue until the check-in. At which point USACE would evaluate if changes should be made per the Implementation and Adaptive Management Plan.	2047–Check-in
Lookout Point	Utilize spillway for improved downstream fish passage in the spring; RO use in the fall for downstream temperature management	392. Construct structural downstream fish passage	2044
Lookout Point	Deep drawdown and RO prioritization for improved downstream fish passage	392. Construct structural downstream fish passage	2044
Fall Creek	Deep drawdown and RO prioritization for improved downstream fish passage	This operation would continue for the duration of the 30-year period of analysis.	2054
Fall Creek	Delayed reservoir refill and RO prioritization for improved downstream fish passage	This operation would continue for the duration of the 30-year period of analysis.	2054

5.4 ADAPTIVE MANAGEMENT PLAN SUMMARY

THE DEIS HAS BEEN MODIFIED TO REVISE THE FOLLOWING INFORMATION IN THE FEIS

The Adaptive Management Plan is also a companion document to the WVS EIS (Appendix N, Implementation and Adaptive Management Plan). The Implementation and Adaptive Management Plan outlines the governance[2] structure to be used for adaptive decision-making, the annual adaptive management process for engaging with stakeholders and incorporating new learning into management priorities, and outlines the decision criteria including performance metrics, targets, and decision triggers relevant to monitoring and evaluating the success of management measures at achieving stated objectives.

USACE's adaptive management technical guide defines adaptive management as a formal, science-based, risk management strategy that permits implementation of actions despite uncertainties (USACE 2019r). Knowledge gained from monitoring and evaluating results will be used to adjust and direct future decisions. Adaptive Management is learning while doing in the face of uncertain outcomes. These Adaptive Management concepts are consistent with those

[2] Governance is the framework for how USACE will continue to work with the WATER forum to implement the Preferred Alternative. It describes the entities involved, the various forums set up to advise on different subject matter, and how information from those forums will be considered by USACE in implementing the Preferred Alternative.

presented in the U.S. Department of Interior's Adaptive Managment technical guide (Williams et al., 2009). Figure 5.4-2 illustrates the steps in an Adaptive Management cycle compatible with USACE projects.

The use of decision criteria plays a key role in the evaluation of management measures and in the adaptive decision-making process. Decision criteria is a broad reference to the set of pre-determined criteria used to make Adaptive Management decisions. Performance metrics, targets, and decision triggers are different types of decision criteria. They can be qualitative or quantitative based on the nature of the performance metric and the level of information necessary to decide. As described in Appendix N, Implementation and Adaptive Management, performance metrics, targets, and decision triggers are defined as follows:

END REVISED TEXT

- Performance Metric – A specific metric or quantitative indicator that is monitored and can be used to estimate and report consequences of management alternatives with respect to a particular objective.
- Target – A specific value or range of performance metric that defines success. Targets can be quantitative values or overall trends (directional or trajectory).
- Decision Trigger - A pre-defined commitment (population or habitat metric for a specific objective) that triggers a change in a management action. Decision triggers are addressed in the Evaluate step (Step 4 of the Adaptive Management process shown in Figure 5.4-2) and specify the metrics and actions that will be taken if monitoring indicates performance metrics are or are not reaching target values. In some cases, a decision trigger may be learning a new piece of information that triggers the Continue/Adjust/Complete step (Step 5 of the Adaptive Management process shown in Figure 5.4-2).

The process described in the Implementation and Adaptive Management Plan is consistent with the NEPA purpose of informed decision-making and takes the process further in addressing uncertainties and data gaps that may be revealed during implementation of the selected alternative (40 CFR 1500.1(c)). This allows decision makers to adjust based on new information while observing project performance, thereby enabling transition from the planning and designing efforts associated with this WVS EIS to implementation of the selected management actions using Adaptive Management. The Implementation and Adaptive Management Plan is a living document that will be updated as new information is learned from monitoring of actual performance of the selected alternative and processed through a governance structure.

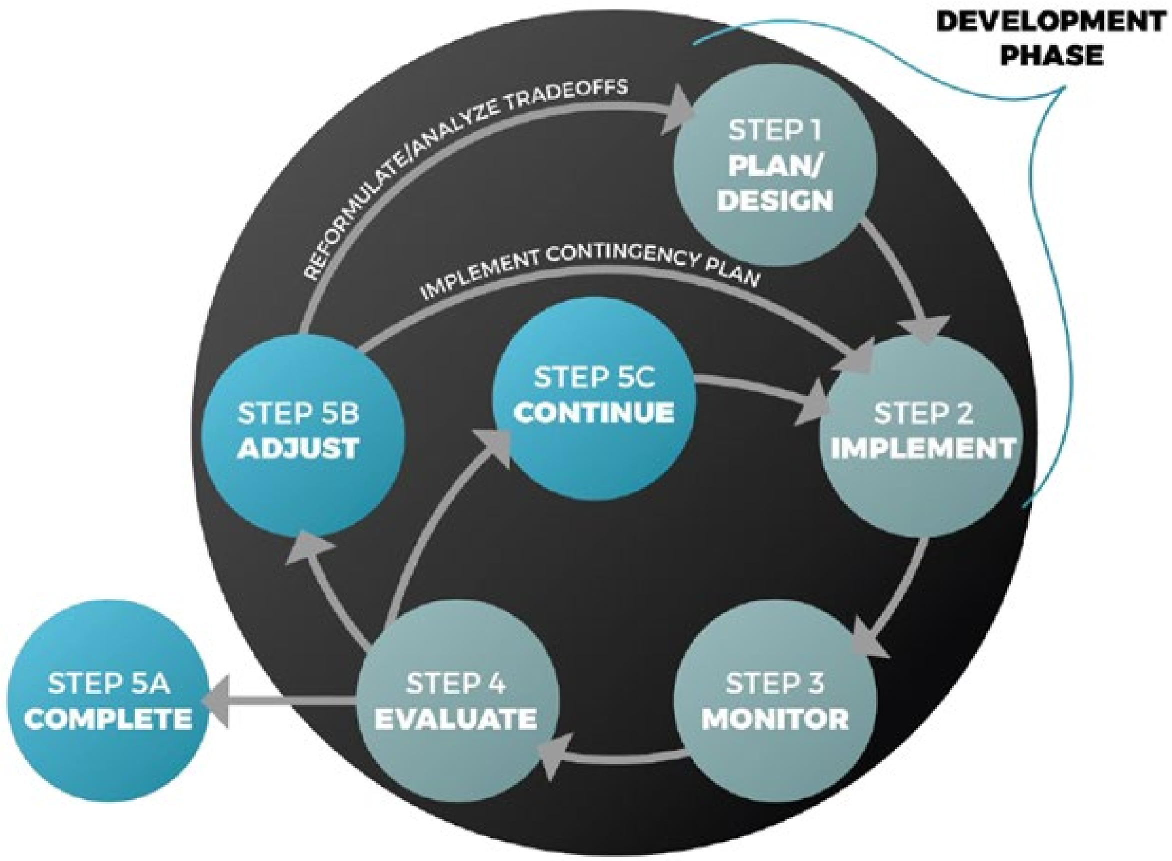

Figure 5.4-2. USACE Adaptive Management Cycle.