



US Army Corps
of Engineers®
Portland District

Willamette Fish Operations Plan Willamette Valley Project



November 2014

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) constructed and operates a system of 13 dams and reservoirs, associated bank protection program, and mitigation fish hatcheries known as the Willamette Project within the Willamette River Basin of northwest Oregon.

In 2008, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service released their Biological Opinions on the continued operation of the Willamette Project. Reasonable and prudent alternative 4.3 calls for the development of the WFOP and specifies that the elements shown below be part of the plan.

- Identify optimal operating criteria for Green Peter, Foster, Detroit, Big Cliff, Cougar, Fall Creek, Dexter, Lookout Point, and Hills Creek dams to minimize adult and juvenile fish injury and mortality to the extent possible with existing facilities and operational capabilities.
- Identify protocols for optimal handling, sorting, and release conditions for ESA-listed fish collected at USACE-funded fish collection facilities, including but not limited to the Minto Fish Facility, Foster Dam Fish Facility, Fall Creek Fish Facility, Dexter Dam Fish Collection Facility, and at the Cougar Fish Facility.
- Identify the number, origin, and species of fish to be released into habitat upstream of USACE dams, incorporated into the hatchery broodstock, or taken to other destinations.
- Describe scheduled and representative types of unscheduled maintenance of existing infrastructure (dams, transmission lines, fish facilities, etc) that could negatively impact ESA-listed fish, and describe measures to minimize these impacts.
- Describe procedures for coordinating with federal and state resources agencies in the event of scheduled and unscheduled maintenance.
- Describe protocols for emergency events and deviations.

The main report for the WFOP provides the overarching conditions, effects on ESA-listed fish species, and protocols/procedures for the WVP as a whole. These items are then developed in more detail in the specific operational plans prepared for each individual Willamette subbasin that are appended to this document.

The WFOP will guide WVP personnel, including contractors and other agencies, responsible for carrying out fish hatchery and passage measures, and will help to ensure that fish facilities are operated using best practices and are consistent with the terms of the 2008 Biological Opinions for the WVP.

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
BiOp	Biological Opinion
BPA	Bonneville Power Administration
cfs	cubic feet per second
CO ₂	carbon dioxide
COP	Configuration/Operation Plan
CPUE	catch per unit effort
CWA	Clean Water Act
ESA	Endangered Species Act
EWEB	Eugene Water and Electric Board
FMWQ	Flow Management and Water Quality (Team)
FPHM	Fish Passage and Hatchery Management (Team)
GBT	gas bubble trauma
gpm	gallon(s) per minute
HGMP	Hatchery and Genetic Management Plan
IHOT	Integrated Hatchery Operations Team
IRRM	interim risk reduction measure(s)
mg/L	milligram(s) per liter
MOU	Memorandum of Understanding
MW	megawatt(s)
NMFS	National Marine Fisheries Service
NWS-RFC	National Weather Service Northwest River Forecast Center
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OERS	Oregon Emergency Response System
O&M	operations and maintenance
OMET	Operational Measures Evaluation Team
RM	river mile(s)
RM&E	research, monitoring, and evaluation
RO	regulating outlet(s)
RPA	reasonable and prudent alternative
SCAB	Steelhead and Chinook above Barriers (Committee)
SCADA	Supervisory Control and Data Acquisition
TDG	total dissolved gas
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upper Willamette River
WATER	Willamette Action Team for Ecosystem Restoration
WFOP	Willamette Fish Operations Plan
WTC	water temperature control
WVP	Willamette Valley Project

1. INTRODUCTION

1.1. OVERVIEW

In 2008, the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) released their Biological Opinions (BiOps) on the continued operation of the U.S. Army Corps of Engineers (USACE) Willamette Project (WVP). Reasonable and prudent alternative (RPA) 4.3 of the NMFS BiOp (NMFS 2008) requires the completion of a Willamette Fish Operations Plan (WFOP). The BiOp specifies that the WFOP is to be developed by the USACE in coordination with the Bonneville Power Administration (BPA), NMFS, USFWS, Oregon Department of Fish and Wildlife (ODFW), and other participants through the Willamette Action Team for Ecosystem Restoration (WATER). The WFOP describes project operations necessary to protect and enhance anadromous and resident fish species listed as endangered or threatened under the Endangered Species Act (ESA), as well as providing benefits to other native fish species. The WFOP guides USACE actions related to fish protection and passage at the 13 Willamette projects, where applicable. The WFOP and all future annual updates will be completed by the USACE in coordination with the WATER stakeholders.

1.2. PURPOSE OF THE WILLAMETTE FISH OPERATIONS PLAN

The purpose of the WFOP is to document procedures and processes that relate to the operation of all phases of the WVP. The WFOP will guide WVP personnel, including contractors and other agencies, responsible for carrying out fish facility operations and maintenance, and will help to ensure that fish facilities are operated using best practices and are consistent with the terms of the 2008 BiOps for the WVP.

1.2.1. Elements of the Plan

The NMFS BiOp (RPA 4.3) calls for the development of the WFOP and for the following elements to be part of the WFOP:

1. Identify optimal operating criteria for Green Peter, Foster, Detroit, Big Cliff, Cougar, Fall Creek, Dexter, Lookout Point, and Hills Creek dams to minimize adult and juvenile fish injury and mortality to the extent possible with existing facilities and operational capabilities.
2. Identify protocols for optimal handling, sorting, and release conditions for ESA listed fish collected at USACE-funded fish collection facilities, including but not limited to those at Minto fish facility, Foster Dam fish facility, McKenzie Hatchery, Fall Creek fish facility, Dexter Dam fish collection facility, and Cougar Dam.
3. Identify the number, origin, and species of fish to be released into habitat upstream of USACE dams, incorporated into the hatchery broodstock, or taken to other destinations.
4. Describe scheduled and representative types of unscheduled maintenance of existing infrastructure (dams, transmission lines, fish facilities, etc.) that could negatively impact listed fish, and describe measures to minimize these impacts.
5. Describe procedures for coordinating with federal and state resources agencies in the event of scheduled and unscheduled maintenance.

6. Describe protocols for emergency events and deviations (with the following guidance):
 - a. The USACE will establish a formal, written protocol for taking actions to prevent or minimize adverse impacts to ESA-listed fish, including water quality impacts, during unusual events/conditions. These protocols will guide the actions of project personnel.
 - b. In the event of an emergency outage or malfunction, the Action Agencies (USACE, BPA, Bureau of Reclamation) will inform the Services (NMFS and USFWS) of the emergency by phone or email, as soon as practical, but not later than 24 hours after the event.
 - c. The Action Agencies may initiate work prior to notifying the Services, when delay of the work will result in an unsafe situation for people, property, or fish. For each occurrence of unscheduled maintenance and each flood damage reduction operation that results in a deviation from BiOp goals such as minimum mainstem flow objectives, minimum and maximum tributary flow objectives, ramping rates, spill at Foster Dam, or adverse total dissolved gas (TDG) and water temperature conditions, the USACE will inform the Services in writing (or email) within 24 hours, and include a description of the problem, type of outage required, potential impact on ESA-listed fish, estimated length of time for repairs or flood damage reduction operation, and proposed measures to minimize effects on fish or their habitat. This approach will be taken only if it is not possible to coordinate with the Services prior to starting the maintenance event or flood damage reduction operation.
7. Coordination of fish operations will also be an element of this plan.

1.2.2. Goal and Objectives of the Plan

The goal (desired future condition) of the WFOP is: *Developing and documenting past, current, and future procedures and protocols for operating the WVP will guide operations to provide conditions that minimize negative impacts to listed fish and are within the scope of authorized purposes for WVP.*

The measureable objectives to assist the USACE in reaching this goal include:

- Document current operations that may affect ESA-listed species within the WVP;
- Document how the WVP affects ESA-listed species;
- Collaboratively through the WATER process, determine if and how operations can be modified to reduce, minimize, or eliminate negative impacts on ESA-listed fish species and ensure these changes are well documented; and
- Ensure all operations, including those performed by USACE contractors, are in compliance with the agreed-to modifications to operations.

1.3. ESA LISTED FISH

Upper Willamette River (UWR) spring Chinook (*Oncorhynchus tshawytscha*), UWR winter steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and Oregon chub (*Oregonichthys crameri*) are ESA-listed fish species found in the Willamette subbasins affected by operation of the WVP. Oregon chub were proposed for delisting in February of 2014. The distribution of each species by subbasin is provided in Table 1.

Table 1. ESA-listed Fish Presence by Willamette Subbasin

Subbasin	WVP Facilities	Fish Species			
		Spring Chinook	Winter Steelhead	Bull Trout	Oregon Chub
North Santiam	Detroit/Big Cliff	Present	Present	Absent	Present
South Santiam	Green Peter (Middle Santiam)/ Foster (South Santiam)	Present	Present	Absent	Present
McKenzie	Cougar (South Fork McKenzie)/ Blue River	Present	Absent ^b	Present	Present
Middle Fork Willamette	Hills Creek/Lookout Point/Dexter	Present	Absent ^b	Present	Present
Fall Creek	Fall Creek	Present	Absent ^b	Absent	Present
Long Tom	Fern Ridge	Absent ^a	Absent	Absent	Absent
Coast Fork Willamette	Dorena	Absent ^a	Absent	Absent	Present
Row River	Cottage Grove	Absent	Absent	Absent	Absent

^a Juvenile spring Chinook salmon have been documented using lower accessible reaches for winter off-channel use.

^b Winter steelhead in the McKenzie and Middle Fork Willamette rivers and in Fall Creek are not designated as part of the distinct population segment but may be present in small numbers. Source: NMFS 2008

2. OVERARCHING CONDITIONS, EFFECTS AND PROTOCOLS/ PROCEDURES FOR THE WILLAMETTE VALLEY PROJECT

This section of the WFOP discusses the conditions, effects on ESA-listed fish, and protocols/procedures for the WVP as a whole. These items are developed in more detail in the specific operations plans prepared for each individual Willamette subbasin that are appended to this document.

2.1. CONDITIONS

Operation of the WVP has had major impacts on ESA-listed fish in terms of flow, water quality (water temperature regime and total dissolved gas), downstream sediment and large wood transport, and channel complexity. Construction of WVP dams blocked access to a substantial proportion of historical fish habitat and adversely affected downstream habitats. Currently, the highest quality fish habitat is located in the headwater areas, but many of these areas are not accessible to fish due to impassable dams.

2.1.1. Maintenance

Turbine units, regulating outlets (ROs), and spillway gates at each WVP dam are placed out of service annually for routine and non-routine maintenance. All turbines are placed out of service for 1-2 weeks for annual maintenance. In almost all cases, this requires the units to be completely dewatered. The units are inspected, cleaned, and lubricated. Each unit is also on a rotating schedule for a more rigorous inspection and cavitation repair approximately every 5 years. This requires the unit to be completely dewatered and placed out of service for 4-8 weeks. In addition to routine maintenance, turbine units are placed out of service for non-routine maintenance. Each turbine unit undergoes a unit rewind every 25-50 years. Each rewind is about 5 months in duration. Turbine units may also be replaced every 25-50 years.

2.1.2. Operations

The WVP dams are operated to fulfill the objectives and project operations discussed in Sections 1.2 and 1.3 and include several authorized purposes such as storage for to provide flood damage reduction and hydropower. Operation of equipment including the opening of the various spillway gates and ROs must maintain certain criteria to maintain safe operation; failure to do so can jeopardize the equipment.

2.1.2.1. Optimum Operational Criteria

Minimum and Maximum Spillway Gate Openings. Operational restrictions are in place on many spillway tainter gates for various reasons. A minimum gate opening is used for spillway tainter gates to avoid conditions where vibrations (driven by flow conditions at small gate openings) could cause excessive wear and/or damage to the gate. A maximum gate opening is used for all spillway gates to ensure flow control is maintained at the gate (avoid approaching condition where weir flow is possible, bypassing the spillway gate). The maximum gate opening for a tainter gate is 0.625 times the head on the weir crest. Various methods can be used to determine the minimum spillway gate opening, which varies at a specific project: minimum gate opening is equal to 10% of the head on the gate or limiting velocity fluctuations to $\pm 5\%$ average velocity. Portland District Hydraulic Design recommends the $\pm 5\%$ velocity fluctuation method as a reasonably conservative estimate for minimum gate opening. Minimum and maximum gate openings have been established and are followed whenever possible.

Minimum and Maximum Regulating Outlet Gate Openings. The ROs at many of the dams have various restrictions on operations that are dependent on the size of the openings and other criteria. RO minimum gate openings are 10% with a max of 80% or full open meaning they shouldn't be throttled between 80% and 100% open.

Maximum Head on Regulating Outlet Gate for Throttled Flow. The ROs at many of the dams have criteria that are maintained to ensure safe operation.

2.1.2.2. Interim Risk Reduction Measures (IRRM)

Spillway Gates and Reservoir Restrictions. As part of the ongoing dam safety and infrastructure rehabilitation program, USACE engineers determined that Interim Risk Reduction Measures were needed to reduce the stress placed on the gates, allowing for continued safe operation until the gates are strengthened. The gates are structurally adequate to withstand the static head of the pool; however, the modifications are necessary in response to dam safety concerns associated with structural stability of the spillway tainter gates if operated under high head. The USACE will repair or replace components at all 42 WVP spillway gates over the next several years. Until this work is completed, Interim Risk Reduction Measures will be in place at Detroit, Big Cliff, Green Peter, Hills Creek, Fall Creek, Lookout Point, Blue River, and Cougar. These measures are assumed to be temporary, but there is no firm timetable to repair or replace all needed components.

Public safety is the first priority. While the USACE plans to generally operate the dams much the same as in any other flood season, gate operating restrictions at some projects could result in increased peak flows for extreme events. River flows downstream of the dams, while likely remaining within the banks of the river, could be higher than normal for longer periods depending on the amount and duration of rain events system-wide. The spillway gate operating restrictions also exist during the conservation season; however, most projects have enough RO capacity to regulate events during the conservation season. The exceptions are Big Cliff, which does not have ROs, and Lookout Point where the decision was made to not fill the reservoir above the IRRM elevation for conservation season purposes since the ROs cannot be used when the reservoir is above elevation 915 feet.

2.1.3. Unscheduled Operations or Maintenance

Turbine units, spillway gates, and ROs may malfunction or be placed out of service for an emergency, which results in an unscheduled outage. The timing of these outages is unpredictable and their durations are uncertain. Turbine unit, RO, or spillway gate outages result in a number of potential effects to ESA-listed fish including:

- Dewatering draft tubes for turbine maintenance can trap fish.
- Increased spill can result in increased TDG below dams depending on spill patterns, duration, and quantity. Increased TDG can negatively affect all life stages of fish.
- Flow fluctuations caused by unscheduled outages can result in rapid changes in flow over periods of minutes, hours, and days. These fluctuations can be immediately lethal to fish or result in delayed or indirect effects including stranding, interference with spawning, redd dewatering, changes in migration, and increased predation, as well as reductions in aquatic invertebrate diversity, biomass, and species composition.

2.1.4. Streamflow

WVP dams were designed and constructed to modify the streamflow characteristics of their respective tributaries and the mainstem Willamette River. The storage facilities are drafted each fall to provide storage space for flood damage reduction and are refilled each spring to provide water for conservation season uses. In general, WVP operations have resulted in higher flows in the summer and reduced peak flows in the winter. These hydrologic effects, seasonally, modify fish habitat characteristics in the downstream stream reaches.

2.1.5. Water Temperature

The construction and operation of the WVP dams have altered water temperature regimes, disrupting the natural cues for fish migration, spawning, and emergence timing. The typical operation of the WVP dams with hydropower is to route water through the powerhouse of each dam, generating hydropower for regional energy demand. During the summer months, when reservoirs are at full pool, the water released through the turbine outlets is deep (hypolimnetic) water, which produces downstream water temperatures cooler than inflow temperatures (Figure 2). During fall as the reservoirs are drawn down, the thermocline is pulled deeper and water released through the turbine outlets increases downstream water temperatures, which are much warmer than inflow temperatures (Figure 3).

It is likely that the increase in downstream water temperatures during fall and winter is exacerbated by the removal of the reservoirs' cold hypolimnetic water throughout the summer, which increases the volume of warm epilimnetic waters for release from October through December (Gore and Petts 1989). The altered water temperatures below WVP dams have been identified as one of the primary limiting factors preventing the recovery of UWR Chinook and UWR steelhead (USACE 2000, Angilletta et al. 2008, NMFS 2008).

2.1.6. Total Dissolved Gas (TDG)

Spill at WVP dams can cause downstream waters to become supersaturated with dissolved atmospheric gasses. Supersaturated TDG conditions can cause gas bubble trauma (GBT) in adult and juvenile salmonids that may result in injury or death. Biological monitoring at dams on the Columbia River shows that the incidence of GBT in both migrating smolts and adults remains between 1% to 2% when TDG concentrations in the upper water column do not exceed 120% of saturation. When those levels are exceeded, there is a corresponding increase in the incidence of GBT symptoms. At times, TDG in WVP dam discharges has exceeded 120% of saturation concentration.

Oregon Administrative Rules 340-041-0031 states that waters will be free from dissolved gases, such as carbon dioxide, hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such water. Except when stream flow exceeds the 10-year, 7-day average flood, the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 110% of saturation. However, in hatchery receiving waters and other waters of less than 2 feet in depth, the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 105% of saturation.

Figure 1. Schematic Showing the Influence of Typical Dam Operations on Downstream Water Temperatures During the Conservation Season

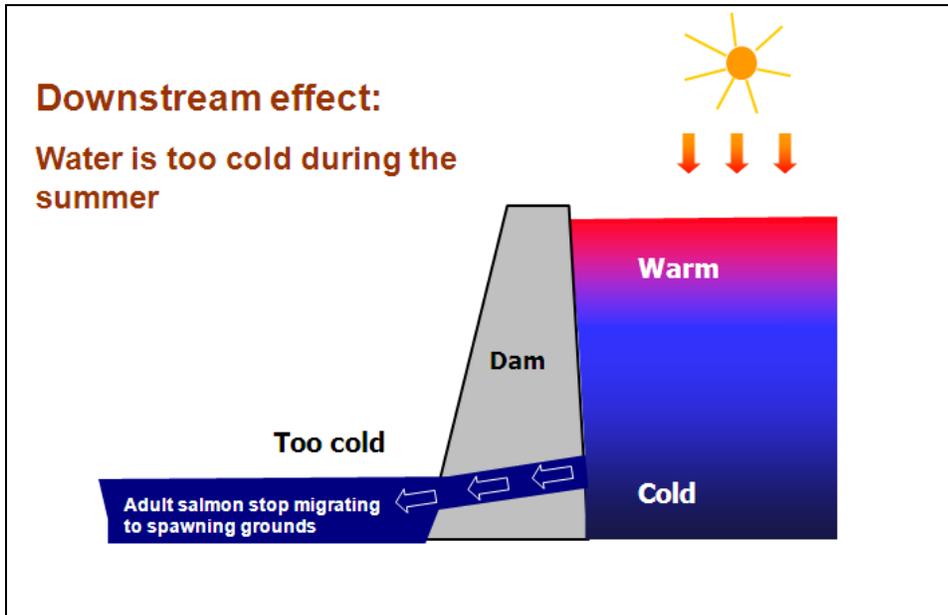
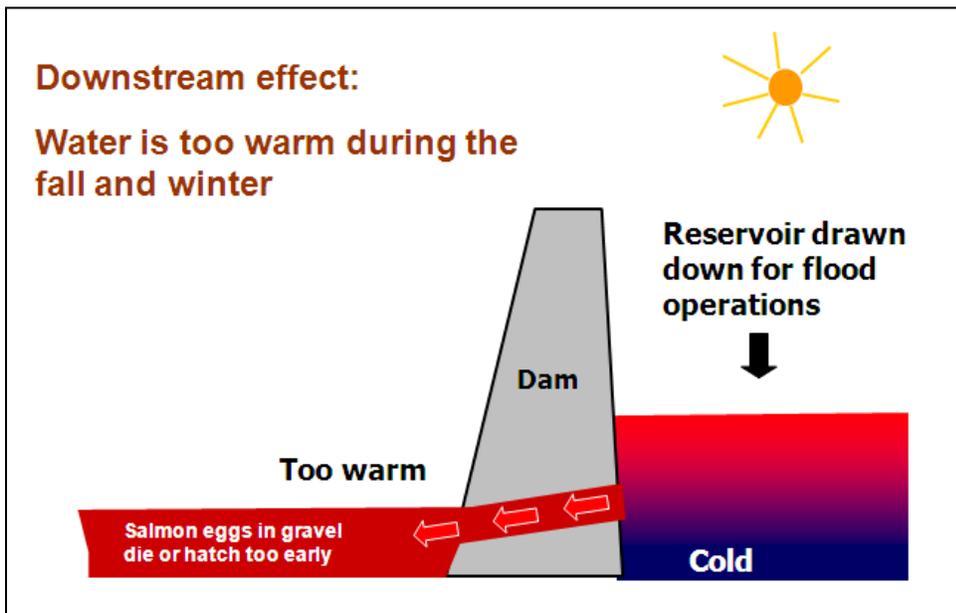


Figure 2. Schematic Showing the Influence of Typical Dam Operations on Downstream Water Temperatures During Reservoir Drawdown for Flood Damage Reduction



In 2009, the Oregon Department of Environmental Quality (ODEQ) issued a 5-year TDG waiver to the Federal Government allowing for seasonal violation of the TDG criteria in the Columbia River for the purpose of allowing increased dam spill operations for salmonid migration. The ODEQ Columbia River TDG waiver requires:

- GBT biological monitoring:
 - If 15% of the fish sampled show signs of GBT in non-paired fins, or
 - 5% of fish show signs of GBT (>25% of fin surface area occluded with gas bubbles) the fish passage spill operations will be halted.
- TDG physical monitoring in the tailrace:
 - Fish passage spill operations must be reduced when TDG measured in the tailrace exceeds 120%, measured as the average of the 12 highest hourly measurements per calendar day, or
 - If instantaneous TDG levels exceed 125% for any two hours per calendar day.
- Annual report documenting fish passage spill operations and TDG, including progress on any gas abatement measures put into place.

2.1.6.1. Water Quality Coordination

At this time, the USACE and ODEQ are working on a Memorandum of Understanding (MOU) to address issues with the direct and indirect effects of construction, operation and maintenance of the WVP on the fish and wildlife resources of the Willamette Basin and the implementation of the Willamette BiOps. This MOU documents the strategies for managing and controlling nonpoint source of water pollution from the operation of 13 WVP dams in a manner that satisfies the congressionally authorized purposes of the WVP and the requirements of the Clean Water Act (CWA) and ESA. This MOU defines the process by which the USACE and ODEQ will cooperatively implement the temperature total maximum daily load, the BiOp temperature recommendations, and other commitments and recommendations, such as juvenile fish passage, that have the potential to impact state water quality requirements and programs.

2.1.7. Mitigation Hatcheries

Hatcheries have been used to mitigate for the construction and operation of the WVP dams. Since completion of the dams, both anadromous and resident trout have been produced and released into the Willamette Basin (Table 5). These programs, intended to mitigate for the loss of winter steelhead, spring Chinook, and trout (rainbow and cutthroat), may have further impacted the wild populations of these species through direct and indirect interactions. Current hatchery production provides for sport and commercial harvest, tribal allocations, and brood stock production, as well as a stock source for reintroduction above WVP dams. As natural production increases as a result of actions implemented under the 2008 BiOp, consideration of reduced hatchery production may be considered to realize the full benefits of these actions. Hatchery operations are directed by Hatchery Genetic and Management Plans currently in review and will be referenced herein.

Table 2. Mitigation Hatchery Production for the Willamette Valley Project

Parameter	South Santiam Hatchery	Marion Forks Hatchery	Leaburg Hatchery	McKenzie Hatchery	Willamette Hatchery
Subbasin	South Santiam	North Santiam	McKenzie	McKenzie	Middle Fork Willamette
Managing Agency	ODFW	ODFW	ODFW	ODFW	ODFW
Mitigation Requirements	Up to 71,000 lbs. spring Chinook and steelhead	Up to 84,000 lbs. spring Chinook and steelhead	Up to 277,000 lbs. trout	Up to 80,800 lbs. spring Chinook	Up to 235,000 lbs. spring Chinook and steelhead
ODFW Responsibilities	Release mitigation production into South Santiam or other pertinent water bodies	Release mitigation production into North Santiam or other pertinent water bodies	Release mitigation production in Willamette Basin	Release mitigation production into McKenzie or other pertinent water bodies	Release mitigation production into Middle Fork Willamette or other pertinent water bodies

Source: 2012 Cooperative Agreement between the United States of America and the State of Oregon for the operation and maintenance of certain USACE Portland District hatcheries.

2.2. PROTOCOLS/PROCEDURES

Various protocols and procedures for different WVP operations can have a direct or indirect effect on the survival of UWR fish species. The protocols/procedures discussed in this section are common for the WVP as a whole. The protocols/procedures developed for each subbasin are discussed in the operational plan appended to this document.

2.2.1. Protocols for Fish Collection, Holding and Transportation to Spawning Habitat

The objective of this general protocol is to ensure that all efforts are given to minimize delay, avoid stress, and prevent fish injury during trapping, handling, holding and transport of fish. The general information included herein is designed to provide standardized protocols and reporting for each of the adult trapping/holding facilities, including adult outplanting activities, operated by the ODFW and USACE. In general, the collection and holding protocols discussed below for outplanting are also relevant for broodstock collection.

Trap Operations

- All adult trapping facilities shall be operated for adult spring Chinook salmon and winter steelhead in a manner that minimizes the duration of holding and delay.
- Adult spring Chinook salmon and winter steelhead will be collected upon return within the operating constraints of each trapping facility.

Handling

- All trapping, hatchery, and transport personnel must avoid excessive handling of adult fish to minimize stress and reduce the chance of injury.
- All transfer of fish shall be completed through water to water transfers, unless logistically infeasible.

Sorting

- Sorting of adult spring Chinook salmon and winter steelhead for outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time and not multiple times as was done in the past.
- No grading of fish for outplanting (e.g., fish of poor condition) or brood collection will occur, although, healthy fish should be used for both broodstock collection and outplanting efforts to increase the probability of survival and should represent the run.
- Sorting shall be completed to separate by species or origin (hatchery or natural origin) to ensure an adequate sex ratio for outplanting and brood production.
- The fish disposition table, developed collaboratively by the WATER Fish Passage and Hatchery Management (FPHM) Team and approved by NMFS, will be used to guide the management of anadromous and resident fish as they are encountered in adult fish traps.

Fish Anesthetic and Disposal

- MS-222/CO₂/AQUI-S 20E. At fish handling facilities in the Willamette Basin operated by ODFW, the ODFW and ODEQ have agreed upon a process of dispersal and evaporation (or volatilization) for the disposal of water treated with anesthetics, which are highly volatile substances. The USACE will continue to use eugenol (clove oil) at USACE-operated adult fish trapping facilities (Cougar and Fall Creek). Use of AQUI-S 20E will be implemented in 2013 at various fish facilities.
- Avoid multiple handling/anesthesia of fish during sorting for outplanting or brood production.

Treatment

- All transport tanks will be treated with NovAqua® or equivalent per manufacturer's instructions to reduce stress during transport.

Loading Density

- Transport adult spring Chinook at a density of ≤ 25 gallons of water per fish (60 fish/1,500 gallon tank).

Oxygen

- Oxygen levels above 100% should be minimized in the transport truck or should not drop below 7 parts per million [7 milligrams per liter (mg/L)].

Disease Control

- All trapping, hatchery, and transport personnel must adhere at all times to existing ODFW policies and procedures to reduce the transfer of pathogens.

Temperature

Due to the sensitivity of adult spring Chinook salmon to high water temperatures, the following procedures will apply.

- *No handling* will occur at adult trapping facilities when water temperatures exceed 70°F.
- In certain situations, the transfer of fish for outplanting or to cooler hatchery waters may occur if fish are being held, or may be held, in waters exceeding 70°F for an extended period of time.
- Coordination with NMFS prior to transfer and notification to the FPHM Team is required under these circumstances.
- When outplanting adult spring Chinook salmon, receiving water temperature shall be less than 68°F *as measured prior to release*.
- Monitoring of water temperature can be completed using USGS gages or temperature meters, where available.
- Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish.
- If the temperature difference between the receiving water and tank water is $> 7^{\circ}\text{F}$, the water will be tempered to a difference of $< 5^{\circ}\text{F}$ at a rate of $1^{\circ}\text{F}/6$ minutes.
- Fish facility personnel are responsible for recording the holding pool water temperature prior to transport, liberation truck water temperatures, and receiving water temperature upon release.

- If liberation truck waters require tempering, beginning and end temperature as well as time required for acclimation will also be recorded.

Release Site/Outplanting

- All outplanting shall be completed at designated outplanting sites consistent with the appropriate disposition table for each subbasin.
- Releases shall be made in a manner to minimize stress and chance of physical injury. In-season variances to either outplant site use, fish disposition, or other outplanting protocols can be completed with agreement from the FPHM Team with notification provided to the WATER Steering Team. NMFS must agree to any in-season variances proposed by the FPHM Team before the action is taken

Hauling Frequency

- Hauling frequency will depend on factors that include run size, stream temperatures, and transport/ holding constraints. Some fish will likely be held prior to outplanting to some extent depending on these constraints.
- It is the intent to reduce holding times and complete outplanting as soon as possible upon a fish’s return to the adult trapping facility.

Transport Period	Hauling Frequency
April 1 – May 15	2 times per week
May 16 – June 30	3 times per week
July 1 – October 15	2 times per week

Poaching/Harassment

- Any poaching, suspicion of poaching activities or observed harassment of outplanted fish shall be reported immediately to the Oregon State Patrol at 1-800-452-7888.

Facility Inspections

- Fish facility inspections will be performed in accordance with guidelines in the operations and maintenance (O&M) manual.
- The results of all inspections and the readiness of the facilities for operation will be reported to the Fish Passage and Hatchery Management (FPHM) Team at the meeting immediately prior to the fish passage season.
- More frequent inspections will occur as requested by the FPHM Team or at any time by facility personnel.
- Fish trapping facilities will be inspected prior to being removed from service for the year to assess facility condition and maintenance needs.
- An additional inspection will occur 1 month prior to startup of the fish passage season to ensure the facility is operating as expected.
- Staff gages and other water-level sensors will be installed, cleaned, and/or repaired as required to allow for monitoring facility performance.

QC Activities

During the field season, designated employees may visit fish facilities to evaluate adherence to protocols and SOPs. The site visit assessment activities include observing fish sorting and handling procedures. A check sheet will be filled out and initialed indicating whether procedures are or are not being performed according to protocol. Protocol drift for any activity must be reported to the immediate supervisor and corrective actions must be implemented immediately.

Maintenance

- Scheduled fish facility maintenance, to the extent practicable, will be conducted following the completion of passage, holding, or acclimation seasons when the facilities are closed.
- If not practical or when maintenance is needed during times when operating, maintenance will occur when impacts are determined to be the lowest based on adult returns or fish being held. This will minimize fisheries impacts during emergency maintenance during the adult fish passage season or during the holding of hatchery juveniles prior to release.
- No maintenance on Corps owned/installed equipment shall be performed by other agencies or organizations without prior coordination with the Corps.

Monthly Reports

- Fish facility personnel shall prepare monthly reports throughout the year summarizing project operations. These monthly reports will provide an overview of how the project operated during the prior month.
- The reports shall cover a monthly period and they shall be provided to WATER stakeholders at monthly FPHM Team meetings and recorded in a record of the meeting minutes.
- The reports shall include:
 - Any out-of-criteria situations, observed deviations from the WFOP, and subsequent corrective actions taken.
 - Any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities.
 - Progress in reaching outplant numbers targeted in the fish disposition table.
 - Mechanical and/or structural issues preventing optimum facility operation.
 - General hatchery operations including trap counts, transfer information, juvenile releases, and updates on hatchery research.
 - Adult outplanting data documenting release locations, numbers released, any observed transport or liberation mortalities, holding, transport and receiving water temperatures, and poaching/harassment issues.
 - Any adult mortality that occurs within the trapping facility during holding or handling prior to transport and must document species, origin, size, marks/injuries, cause and time of death, and future preventative measures. When mortality occurs, this should also be reported immediately to USACE that will be included in a memorandum to the Services.

Annual Reports

- The ODFW will produce an annual report summarizing the species, number, origin, and destination of all fish collected at USACE fish facilities in the Willamette Basin, as well as all variances regardless of magnitude. This annual report will be a summary of the monthly or quarterly progress reports. The report shall assist in identifying potential operational changes associated with the outplanting program. Reporting shall be included in baseline hatchery

monitoring or the annual hatchery operations reports and provided at dates specified in the 2012 Cooperative Agreement or task orders funding the O&M of each fish facility.

- The annual report will be distributed to the members of the FPHM Team.

2.2.2. General Dewatering Plan

Fish facilities and turbines are drained for regularly scheduled maintenance and sometimes for emergency maintenance. These activities may involve handling fish. This plan is subject to change as improvements are developed and will be revised on an annual basis as part of the WFOP. Not all dewatering efforts will require fish salvage; as such, the need will be determined by USACE and ODFW fish biologists.

2.2.2.1. Coordination

Facility outages will be scheduled to minimize impact on fish while accomplishing necessary repairs and maintenance on facilities. Fish facility personnel (either ODFW or USACE) will coordinate these activities with Portland District Operations Division fishery biologists and will ensure that the fisheries agencies, particularly those whose activities may be impacted, are kept informed. Primary points of contact include ODFW, NMFS, and USFWS.

The Willamette Project Supervisory Fisheries biologist coordinates fishway dewatering and salvage activities with the project operations and maintenance supervisor. This includes having the appropriate personnel and equipment on site. The designated fish facility lead, likely the Operations Division project biologist for USACE operated facilities, or an ODFW hatchery manager for ODFW operated facilities, directs execution of the drainage plan at least until fish removal is complete. Before or at the beginning of each draining operation, a pre-work briefing will be held to explain procedures, responsibilities and safety considerations for all participants. After the salvage activity, lead personnel are responsible for reporting species, number, and condition of fish. The reporting template is attached at the end of the document and will be provided to the FPHM Team.

2.2.2.2. Fish Handling

When facilities are drained, a primary objective is to minimize stress and injury to all fish. Generally, the best way to protect fish during facility draining is to avoid having to handle them. Instructions for draining most facilities involve steps, such as operating with low ladder flow just prior to draining, intended to minimize handling fish by encouraging the fish to exit the ladder. When it is necessary to handle fish, they are handled in plenty of fresh water, if possible. Holding fish in nets unnecessarily is avoided (e.g., tank not ready). When it is necessary to transport fish in bags, ensure that the salvage bags contain a sufficient amount of water and that fish return to fresh water as soon as possible.

Tanks should be large enough to carry plenty of water with the fish. Tanks should be covered to keep fish from leaping out. When large numbers of fish are placed in a tank, supplemental oxygen will be used to increase the level of dissolved oxygen. As a rule of thumb, fish placed in tanks will not exceed ½ pound per gallon of water. Reduce fish concentration when river temperature is greater than 65°F. During warm weather, the temperature in tanks will be monitored and kept within 2°F of the river release point temperature. Further, the time fish are kept in tanks will be minimized and not exceed 2 hours.

Fish will be released at a predetermined site. However, when the tank contains a mixed load, it can be released into the forebay or tailrace depending upon the recommendation of lead personnel.

When it is necessary to prioritize attention to different species, generally ESA-listed species and adult salmonids should be helped first. Lamprey are relatively stress resistant and can be collected as a lower priority. However, their populations are declining and care should be given to salvage them, as well as the more sensitive fish. All fish are to be salvaged.

Under some conditions a “safety pool” may be maintained in lieu of salvaging fish. However, it is very important that a very reliable method is used to ensure that fish will not be stranded. Low-water alarms will be utilized whenever possible. If it is not possible to use a low-water alarm, water level must be continuously monitored to prevent stranding fish.

2.2.2.3. Adult Fish Trap/Ladder

The general procedures for draining the adult fish trapping facilities are described below.

Prior to Dewatering

- 24 to 48 hours before draining, stop attraction flow by minimizing auxiliary water flow.

On Dewatering Day

- Convene safety meeting before starting activity. Describe the procedure for all participants and assign responsibilities (ensure clearances are in place)
- Stage fish bags or transport tank.
- Place ladder near the pre-sort holding pool
- The water supply level to the ladder should be reduced to approximately 1” to 2”.
- Begin visual inspection of ladder for stranded fish. Remove stranded fish with long handled net and put into a fish bag or gently guide fish down the ladder to the entrance pool.
- Drain pre-sort holding pool.
- Salvage fish with a net and put them into a fish bag
- Place fish from fish bag into post sort holding raceway for transport or into recovery tank for direct release to the river.
- Shut down facility water supply when fish salvage is complete.

2.2.2.4. Fish Salvage Equipment

The following fish salvage equipment is required.

- Dip nets/buckets
- Fish salvage bags
- Seine
- Extension ladder for access into the fish ladder
- Fish truck with oxygen bottle
- Personal protection equipment such as life vests/float coats, fall protection (harness/lanyard), waders w/felt soles, gloves (sealskins), hearing protection, and hardhats
- Communication devices
- Submersible pumps

2.2.3. Protocols for Emergency/Atypical Operations and Flow Target Deviations

In the 2008 NMFS BiOp, RPAs 2.2 and 4.3 require the development of ramp rate and instream flow deviation reporting protocol for inclusion in the WFOP. Provided below are protocols that the Action Agencies have developed for reporting flow target deviations. In addition to reporting deviations in instream flow and ramp rate targets, the Action Agencies will provide notification to the Services when water quality conditions, hazardous spills, or emergency operations may adversely impact ESA-listed fish. Additional coordination with the WATER teams, which also include the Services, will be completed as needed to insure stakeholder awareness and input is provided. The USACE is the lead Action Agency performing agency notification as directed by the RPAs.

2.2.3.1. Coordination

It is the intent of the Action Agencies to identify any maintenance or unscheduled operations that may impact ESA-listed fish and provide this information to the WATER Flow Management and Water Quality (FMWQ) Team for their consideration and input prior to any potential impacts occurring. Coordination will occur through either monthly team meetings, weekly calls during the conservation season, or through email notification. At times when prior coordination cannot be accomplished, the USACE will notify the Services regarding any emergency operations that may impact ESA-listed fish.

Oregon Department of Fish and Wildlife and the Army Corps of Engineers will be responsible for responding to any on the ground needs related to operational conditions that may impact ESA-listed fish. Willamette Project fisheries biologists will provide input on operations to minimize any potential impacts resulting from emergency operations and can also provide a quick response to assess any impacts that may have occurred.

The USACE will provide notification to researchers in the event of an emergency or other adverse conditions are identified that may impact research activities or result in potential unsafe conditions or damage to scientific equipment. Direct notification will be completed by the USACE for real-time events with coordination occurring through the WATER Research, Monitoring and Evaluation (RM&E) Team.

Notification directly to the Services will occur under the following situations:

- Ramp rate target deviations;
- Instream flow target deviations;
- Identified adverse water quality conditions;
- Emergency operations that may impact ESA-listed fish; and
- Hazardous spills.

For activities occurring in or around reservoirs, dams, or other facilities by researchers or other entities, notification must be made to the USACE. The notification must be formally written and should list the location, date and time located in vicinity, nature of research, and type of physical activity.

2.2.3.2. Ramp Rates, Flow Targets, and Flood Risk Management Operations

The USACE project operations staff that are onsite have the ability to identify and report deviations from the required ramp rates and instream flows. Although this would provide near-immediate notification for external reporting purposes, the USACE also initiated reviewing operations records at each Willamette project on a 48-hour basis to track project performance and report any deviations in a timely and

coordinated fashion. The purpose of this is to provide the ability to identify the more “minor” deviations that may occur that are not readily identified by staff in the field.

Flow data assessed for deviations from instream flow and ramp rate targets are based on preliminary data (provisional) that is subject to change. Flow data used for reporting is provisional and may be modified by the USGS following periodic updates to the rating curves for each gage site. Flows in the Willamette mainstem are measured at Salem and Albany. Specific gage sites are listed in subbasin appendices.

Down Ramp Rates. The USACE will report ramp rate deviations that exceed by two-fold the required down ramp rate. An example would be if the target is 0.1 foot/hour, reporting would occur if the ramping equals or exceeds 0.2 foot/hour. Similar reporting would occur if the daily maximum (24 hour) flow decrease (1 ft/24 hours) is exceeded by two-fold. These bounds alleviate excessive and unnecessary reporting and coordination between the USACE and Services that would be required unless otherwise modified herein. Ramp rate targets are in RPA 2.6.4 of the BiOp (NMFS 2008).

Instream Flows. The USACE will report instream flow deviations that exceed 5% of the target flow value due to project operations. For example, if the minimum flow required is 1,500 cubic feet per second (cfs), reporting would occur if the minimum flow dropped to 1,425 cfs or below. These bounds would alleviate excessive and unnecessary reporting and coordination between the USACE and Services that would be required unless otherwise modified herein. Instream flow targets are in RPA 2.4 of the BiOp (NMFS 2008).

Flow/Stage Reductions. The USACE will report any flow reduction below projects of more than 50% per hour or 1 foot per hour. Reporting will also occur if a flow reduction occurs that is 50% per 24 hours. Exceedances that are less than 25% outside of criteria will not be reported but may be discussed at interagency coordination meetings to reduce superfluous reporting. Flow reduction guidelines are in Table 9.2-4 of the BiOp (NMFS 2008).

2.2.3.3. Fish Facility Operations

Fish facility operations, including adult fish trapping facilities, hatcheries, and holding/acclimation ponds may be impacted by emergency events. These can include unscheduled maintenance events, hazardous spills, and adverse water quality conditions. The USACE will provide direct notification to the fish facility personnel when any potential or real-time conditions occur that may impact fish facility operations or directly impact fish health. Coordination with the FPHM Team will be completed as needed to insure stakeholder coordination.

2.2.3.4. Hazardous Spills

Hazardous spill notification will continue to be completed through the Oregon Emergency Response System (OERS). This system provides 24-hour service through Oregon Emergency Management of the Department of State Police. Local public safety agencies such as law enforcement, fire and emergency medical services normally provide the first response to an incident. Access to this local assistance is through 9-1-1. Once notified, local public safety agencies would call OERS at 800-452-0311 or in the Salem area at 503-378-6377. If necessary, responsible parties would then call the National Response Center at 800-424-8802. The USACE operations fisheries biologist will be included as an initial contact to address any immediate fisheries response needs, as well as to provide additional notification directly to the Services. Although the OERS serves to disseminate spill response notification to both the state and

federal fisheries agencies, the USACE operations fisheries biologist will notify the Services directly of the incident.

2.2.3.5. Adverse Water Quality Conditions

Project operations may influence the amount of TDG in the river reaches below the dams, as well as stream temperatures. Both of these water quality parameters may negatively influence ESA-listed fish depending on species, life stage and time of year. The USACE will report any identified water quality exceedences caused by project operations that may adversely impact ESA-listed fish.

2.2.3.6. Emergency Operations

At times when prior coordination with the Services through the FPHM Team is not possible due to unplanned/unanticipated project conditions (e.g. emergency unit outages), the USACE will provide notification to the Services that emergency operations are occurring and request input on those specific operations to reduce potential impacts to ESA-listed fish. A notification will also be sent to ODFW and a CENWP-PM biologist to notify researchers.

2.2.3.7. Requests for Changes in Power Generation

At times, BPA may request changes in generation produced at the WVP dams based on load needs. This can either be caused by excessive energy on the grid, or a need for more generation caused by weather conditions. Requests received by USACE Reservoir Regulation will be reviewed by operations fish biologists to determine if any impacts to aquatic resources, including ESA-listed fish, may result. The USACE will then request modifications or potentially deny the request if impacts are identified and cannot be avoided.

If a region wide power shortage is anticipated, a power system emergency could be declared. In this scenario, the USACE will identify impacts and provide notification to the USFWS and NMFS prior to implementation. Notification will address any perceived impacts on water quality, fish facility operations, or flow changes that may deviate from flow or ramp rate targets. Updates will be provided to WATER through the FMWQ Team.

2.2.3.8. Notification Protocol

This section describes specific reporting protocol to be followed for reporting events to the Services. Information will be provided to the WATER stakeholders regarding events reported to the Services as described above. The Action Agencies would provide the following information during reporting:

- Location of deviation - subbasin/project/specific site (if applicable);
- Date/time of deviation;
- Type of deviation (flow/ramp/hazardous spill/water quality exceedences);
- Type of emergency operation (if applicable);
- Type and severity of spill (if applicable);
- Magnitude of deviation;
- Duration of deviation;
- Cause of deviation;
- Measures taken to minimize the deviation;

- Measures implemented or proposed to ensure that similar incidents do not recur;
- Any identified or potential biological impacts; and
- Follow-up recommendations, if applicable.

Time of Notification. The USACE will contact (email or phone call) the Services within 24 hours of identifying any reportable incident. Although information relating to the incident may not be immediately available, initial contact will be made within the first 24 hours of when the incident is identified. A complete written notification (either letter or email) to the Services will be completed within 48 hours of identification and will include the reporting information previously discussed, if available at the time of reporting.

USACE Coordination. The following USACE staff has been identified as responding to and providing notification to NMFS and USFWS for unanticipated/emergency events or for flow target deviations.

Name	Duty Location	Email	Phone Number
Chris Walker	Portland District Office	Christopher.E.Walker@usace.army.mil	503-887-6452
Greg Taylor	On-project (Lowell Office)	Gregory.A.Taylor@usace.army.mil	541-514-6497

The following staff from the Services and ODFW have been identified as requiring notification for unanticipated or emergency events or for flow target deviations.

Agency	Name	Email	Phone Number
USFWS	Chris Allen	Chris_Allen@fws.gov	503-231-6179
USFWS	Ann Gray (alternate)	Ann_E_Gray@fws.gov	503-231-6179
NMFS	Richard Domingue	Richard.Domingue@noaa.gov	503-231-6858
NMFS	Anne Mullan (alternate)	anne.mullan@noaa.gov	503-231-6267
NMFS	Stephanie Burchfield (alternate)	Stephanie.Burchfield@noaa.gov	503-736-4720
ODFW	Tom Friesen	Tom.Friesen@oregonstate.edu	541-757-5151
ODFW	Tim Hardin (alternate)	Tim.S.Hardin@state.or.us	503-947-6093.

Annual Reporting. All deviations, regardless of magnitude, will be identified in annual reporting. This information is useful for not only evaluating project performance in meeting target rates, but also to assess possible changes in operations or potential equipment upgrades to more consistently meet the requirements. This data will be included in the annual operations “after action review” produced by the USACE and provided to the FMWQ Team. This annual operations review of the prior water year is typically provided by the end of January following each operations year.

Modifications to Notification Protocol. In summary, notification to these identified Services personnel, including the previously discussed reporting content and time requirements, meets the USACE commitments under RPAs 2.2 and 4.3. If, through practical application of this protocol, the Services or the Action Agencies identify the need to modify these procedures, either party can request revisions to the reporting protocol through annual updates to the WFOP. If consensus on proposed modifications cannot be achieved between the Action Agencies and the Services, the proposed modifications will be provided to the WATER Steering Committee for their review and consideration.

Other

Zebra Mussel Monitoring. The USACE has an established policy that requires measures be included in O&M that either prevent or reduce the establishment of invasive and non-native species. Non-native aquatic mussels, specifically zebra mussels, can have a significant impact on native species, as well as increase facility O&M costs. These organisms have become a serious problem elsewhere in the country and may become introduced into the Willamette Basin. Inspections will be made when dewatering all WVP fish facilities. Due to transfers of water and equipment both from within and outside the Willamette Basin, extreme diligence should be taken during transfers as the water or equipment may harbor invasive species. Immediate reporting of suspect or confirmed zebra mussels or other invasive aquatic species will be made to the USACE. If additional aquatic invasive species are identified and require monitoring, the WFOP will be revised to reflect these new species.

2.2.4. Fish Operations Coordination

Provided below is a summary of the WVP fish operations coordination process. This includes special and interim operations that result in a modification to typical project operations or the WFOP that could negatively impact fish or are implemented to benefit fish (e.g. fish passage, temperature management). These changes could influence flow routing, discharge, or reservoir elevations. The following steps would be followed.

1. The process begins if the Action Agencies, WATER stakeholder, or other agencies have a desire to modify operations that deviates from typical operations or the WFOP. If there is a deviation from the WFOP, a memorandum of coordination must be completed (see Appendix). The interested party proposes operation to the appropriate WATER technical team (FMWQ, FPHM, RM&E, etc) for further development.
2. The WATER technical team or Action Agency will develop a proposal for regional review that will be coordinated within the FMWQ or an operations team for concurrence from the Services. Proposal may contain:
 - A description of the proposed operation (e.g., desired flows, desired elevations, desired outlet use, duration of operation, fish passage operation, etc.);
 - Biological benefits/impacts; and
 - Monitoring Plan to assess biological benefits if applicable;
3. The WATER technical team will finalize and recommend the proposal for final evaluation by USACE. If regional consensus is not met at technical level, proposal is elevated to WATER Steering Team to decide if proposal merits further evaluation.
4. The recommended proposal will be vetted through the USACE special operations request process if needed (Special Operations Request Process Standard Administrative Process):
 - The proposal [and associated documentation] is submitted to the USACE Water Management SharePoint Site.
 - Proposal is reviewed by USACE Engineering, Water Management, Operations Division, and Willamette Valley Project.
 - A decision to reject or proceed with a special operation is made by Water Management.
 - The USACE may modify the proposal if necessary based on engineering analysis and make recommendations for final proposal.
5. The requesting WATER technical team reviews final proposal for final consensus.

The Operational Measures Evaluation Team (OMET) will summarize results of the operation in the OMET Annual Report for those related to fish passage and water quality. Results of special operations will be reviewed annually by their applicable WATER technical team based on the outcome of monitoring. The WATER technical team will recommend continuation of a special operation to the WATER Steering Team for regional coordination and approval. Special operations that are determined to be feasible to implement on an annual basis following the WATER coordination and consensus process will be included in annual updates to the WFOP and considered to be interim operations to occur on a regular basis. Regional coordination will not be required for interim operations previously vetted unless requested by the Services.

Modifications to standard operations in the WFOP will be made with the change form or in-season changes to fish operations will be documented in a memorandum of coordination and routed through the WATER FMWQ technical team or operations team. These will be considered for revision in the WFOP at least annually. Each subbasin appendix will explicitly list current special and interim operation for each project. Additional detail will be in the Fish Operations Appendix. The USACE retains ultimate authority for operating reservoir elevations and downstream flows to meet authorized project purposes, and maintains the final decision in any proposed operation.

3. OPERATIONAL PLAN

As described in Section 1, the operation of the 13 USACE WVP dams is carried out to meet authorized project purposes including flood damage reduction, irrigation, power generation, recreation, navigation, downstream water quality, municipal and industrial uses, and fisheries and wildlife enhancement. At times, these purposes result in operations that may impact aquatic species. Therefore, it is necessary to determine biologically based, project-specific operations that would eliminate or minimize impacts to aquatic species. The 2008 NMFS and USFWS BiOps require operational and structural changes to be implemented based on the need to address subbasin-specific project impacts.

Current WVP operations provide instream flows, ramp rates, and in some cases downstream fish passage operations as required by the 2008 BiOps. These are considered “standard operations” developed by the USACE and are used to guide WVP operations. As more information is attained through RM&E efforts, including special operations, additional operational or structural modifications to the WVP program may occur and be included as standard operations.

Current operations are intended to provide better functioning aquatic habitat conditions below WVP dams, as operationally feasible, and are based on information included in the 2008 BiOps. Instream flow and ramp rates are based on current knowledge regarding species periodicity and adhered within the operating limitations of each project. These instream flows may be modified over time due to on-going instream flow studies being completed through RM&E. Water temperature control operations are currently implemented at Cougar Dam on the South Fork McKenzie, Fall Creek in the Middle Fork Willamette, and at Detroit Dam on the North Santiam River. Total dissolved gas data is currently collected below Cougar Dam, Detroit/Big Cliff dams, and Lookout Point/Dexter dams on the Middle Fork Willamette to provide valuable in-sight on WVP operations and assist in guiding future operations.

Specific operational plans are arranged by subbasin (North Santiam, South Santiam, McKenzie, and Middle Fork Willamette subbasins), and each plan is appended to this document. Other subbasins that do not have a specific operational plan (e.g. Dorena, Cottage Grove), such as those in the Coast Fork Willamette, are operated as authorized as presented in the Proposed Actions in the BiOp.

The project operations addressed within each operational plan are shown below.

- I. Facilities (description)
- II. Operations
 - a. Tributary flow targets
 - b. Rates of flow change (24 hour, day, and nighttime)
 - c. Downstream fish passage operations
 - d. Operations to limit total dissolved gas (TDG)
 - e. Operational water temperature control
 - f. Recommended spillway gate and regulating outlet (RO) operations
- III. Fish Facilities and Operations
 - a. Juvenile
 - i. Facility description
 - ii. Maintenance schedule
 - b. Adult
 - i. Facility description
 - ii. Adult trap maintenance period

- c. Adult collection
 - i. Broodstock collection guidelines
 - ii. Annual adult fish disposition guidelines
- IV. Disposition of Fish Collected at Adult Trapping Facilities
 - a. Goals, objectives, strategies, and protocols for outplanting adults
- V. Scheduled and Unscheduled Maintenance
 - a. Scheduled maintenance
 - b. Unscheduled (atypical) O&M
- VI. Recommendations to Reduce Potential Effects of Unscheduled Maintenance/Operations
 - a. Spill (TDG)
 - b. Downstream temperatures
 - c. Instream flows and ramping

The Willamette Fish Operations Plan will be updated annually to capture any changes to operational, structural, or maintenance activities at Willamette Valley Projects. The plan will be provided to the Services for review by January 15 and comments will be due back to the USACE by February 15 as stated in the BiOp.

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5. GLOSSARY

Alevin – A newly hatched salmon when still attached to the yolk sac.

Anadromous – Pertaining to fish that spend a part of their life cycle in the sea and return to freshwater streams to spawn.

Barotrauma – Physical damage to body tissues caused by a difference in pressure between an airspace inside or beside the body and the surrounding fluid.

Basin – The portion of the surface of the earth that contributes water to a stream through overland run-off, including tributaries and impoundments.

Broodstock – A group of sexually mature individuals of a cultured species that is kept separate for breeding purposes.

Endangered species – Any species in danger of extinction throughout all or a significant portion of its range.

Epilimnetic – The upper well-mixed layer of water overlying the thermocline (transition layer between the mixed layer at a lake's surface and the deep water layer at the bottom) in a thermally stratified lake.

Francis turbine – A turbine that operates in a high-head range and primarily used for electrical power production.

Forebay – The water located immediately upstream of a hydraulic structure.

Head – The difference in elevation between intake and discharge points for a liquid.

Hydrodynamics – The branch of science that deals with the dynamics of fluids in motion.

Hypolimnetic – The dense bottom layer of water in a thermally-stratified lake.

Kaplan turbine – A turbine that allows for efficient power production in low-head applications.

Mainstem – The principle course of a river or a stream.

Monomictic – Lakes or reservoirs that are relatively deep, do not freeze over during the winter, and undergo a single stratification and mixing cycle during the year (usually in fall).

Parr – Final freshwater stage for a juvenile salmon.

Penstock – A sluice or gate used to control a flow of water; a channel for conveying water to a turbine.

Piscivorous – Feeding on fish.

Redd – A spawning nest made by a fish.

River reach – A river or stream segment of a specific length.

Smolt – A juvenile salmonid one or more years old that has undergone physiological changes to cope with a marine environment, the seaward migration stage of an anadromous fish.

Smoltification – The physiological process undergone by salmonids to allow them to migrate from freshwater to ocean as part of their life cycle.

Stage – The height of a water surface above some established reference point of datum.

Stratification – The arrangement of a body of water, such as a lake, into two or more horizontal layers of differing characteristics, such as temperature density, etc.

Stilling basin – A depressed area in a channel or reservoir that is deep enough to reduce velocity of flow.

Subbasin – A portion of a subregion or basin drained by a single stream or group of minor streams.

Tailrace – The water located immediately downstream of a hydraulic structure.

Tailwater – See tailrace.

Tainter gate – A type of radial arm floodgate used in dams and canal locks to control water flow.

Thermocline – The transition layer between the mixed layer at the surface of lake and the deep water layer at a lake's bottom.

Total maximum daily load (TMDL) – The maximum quantify of a particular water pollutant that can be discharged into a body of water without violating a water quality standard.

Weir – A barrier placed in a channel to divert fish or water.

Appendix A. North Santiam Subbasin Fish Operations Plan

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Appendix A. North Santiam Subbasin Fish Operations Plan

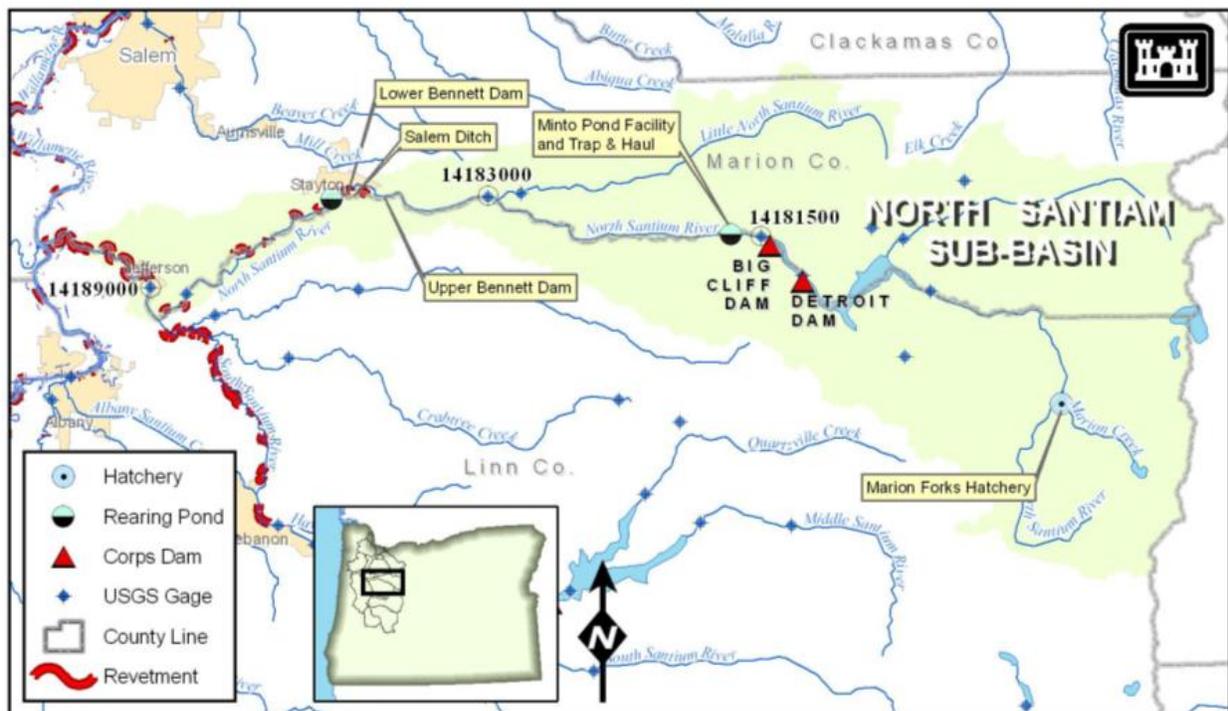
A.1. OVERVIEW

The North Santiam subbasin drains about 760 square miles (Figure A-1). Two U.S. Army Corps of Engineers (USACE) dams were constructed on the North Santiam River. Detroit and Big Cliff dams were both completed in 1953 and are a barrier to upstream fish passage. Multiple smaller diversions/canals are located on the North Santiam River downstream of Big Cliff Dam including:

- Lower Bennett Dam (5.3-feet high) at river mile (RM) 29 owned by the City of Salem.
- Upper Bennett Dam (5.7-feet high) at RM 31.5 owned by the City of Salem.
- Salem Ditch (diversion) just upstream of Lower Bennett Dam and owned by the City of Salem.
- Minto Dam (10-feet high) at RM 55 and owned by the USACE and operated by the Oregon Department of Fish and Wildlife (ODFW).

The North Santiam subbasin is inhabited by Upper Willamette River (UWR) winter steelhead, UWR spring Chinook salmon, and Oregon chub, all of which are listed on the Endangered Species Act (ESA).

Figure A-1. North Santiam Subbasin



A.2. FACILITIES

Detroit and Big Cliff are the two Willamette Valley Project (WVP) dams located on the North Santiam subbasin. No fish passage facilities are directly located at either dam, with trapping of adults occurring at the Minto Fish Facility located downstream of Big Cliff Dam, and rearing occurring at the Marion Forks Hatchery located upstream of Detroit Dam in Imnaha, OR. In 2013, the rebuild of the Minto Fish Facility

was completed. Spring Chinook salmon and winter steelhead trapped at this location are transported above the Minto barrier, to designated release sites, or used for hatchery brood stock collection.

The operation and maintenance of the Detroit and Big Cliff projects can impact downstream habitat conditions. The operations may alter flow conditions, both total flow and rate of change, and water quality, primarily temperature and total dissolved gas (TDG). To mitigate for these impacts, the USACE operates the Detroit and Big Cliff projects to meet specific flow and ramp rate targets (NMFS 2008). In addition to these flow constraints, the USACE has been providing interim operational temperature control in the North Santiam subbasin.

Both dams are operated from the Detroit Dam control room, which relies on the Supervisory Control and Data Acquisition (SCADA) system. Although SCADA allows for remote operation of Big Cliff Dam, it does have some limitations. The precision of SCADA controls are not tuned enough to adjust the amount of water through Big Cliff to meet small flow changes as required by the project schedule. Additionally, there can be a long lag time (30-60 minutes) from when an operational change is made at Big Cliff and when the control room sees the change recorded at the nearest downstream U.S. Geological Survey (USGS) gage at Niagara for verification.

A.2.1. Detroit Dam

Detroit Dam is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. The dam is 450-feet high and situated in the steep, rocky slopes of North Santiam Canyon. The dam is a concrete gravity structure with a gated spillway containing six spillbays and four regulating outlets (ROs).

A.2.1.1. Turbines

Detroit Dam has two Francis turbines rated at 50 megawatts (MW) each. For both turbines combined, the hydraulic capacity ranges from 4,300 to 5,300 cubic feet per second (cfs) depending on head (the difference between forebay and tailwater elevations).

A.2.1.2. Spillway Gates

Detroit Dam has six radial tainter spillway gates and a spillway crest at elevation 1,541 feet. The project cannot spill until water has risen above that elevation. The gates can only be controlled locally (not from control room) via a control panel with a mechanical dial detailing the spillway gate position.

A.2.1.3. Regulating Outlets

Detroit Dam has two sets of ROs (upper and lower) that are controlled with vertical sliding gates. The lower set of gates is unusable at this time. The two upper RO gates at elevation 1,340 feet are controlled with hydraulic gates either locally or from the Detroit control room. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning of RO flows. During emergency use, the RO outlet is controlled locally.

A.2.2. Big Cliff Dam

Big Cliff is a re-regulating dam with a small reservoir, located nearly 3 miles downstream from Detroit Dam. Big Cliff is used to smooth out the power generation water releases from Detroit Dam and to control downstream river level fluctuations. Big Cliff Dam is a 172-foot high concrete dam.

A.2.2.1. Turbines

Big Cliff Dam has one Kaplan turbine rated at 18 MW with a hydraulic capacity that ranges from 2,800 to 3,200 cfs. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

A.2.2.2. Spillway Gates

Big Cliff Dam has three radial tainter spillway gates. The spillway crest is at elevation 1,212 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the gate position or remotely through the SCADA system. One of the spillway gates automatically open to a specified opening (1 foot) if the turbine wicket gate opening goes to zero, indicating the turbine has tripped off.

At both Big Cliff and Detroit dams, there is only one speed that the spillway gate can be opened or closed (there is no variable frequency drive). The mechanical dial measures the amount of gate opening locally at the project. The SCADA dial is in 0.01-foot increments and the local dial is set to 1-foot increments. These settings limit the precision that flow changes can be made. The SCADA monitor provides the ability to set a specific gate opening at Big Cliff Dam. This is a unique feature for Big Cliff and is not used at other Willamette Projects.

A.2.2.3. Regulating Outlets

Big Cliff Dam does not have any ROs.

A.2.3. Minto Fish Facility

The Minto Fish Facility consists of a fish ladder, presort pool and crowder, sorting flume, eight post-sort holding ponds, and many other features that accommodates both holding adult salmon and steelhead as well as juveniles.

A.3. OPERATIONS

A.3.1. Tributary Flow Targets

The 2008 BiOp requires specific seasonal flow regimes below Big Cliff Dam. These operations include minimum and maximum flow targets, increasing and decreasing flow rate targets (ramp rates) and recommendations for operations during high flow periods.

Required minimum and maximum flows for Big Cliff Dam vary by time of year and are shown in Table A-1. Minimum outflow from Big Cliff Dam is 1,000 cfs from July 16 to August 31. Spring spawning flows for winter steelhead are 1,500 cfs from March 16 to May 15, followed by incubation flows of 1,200 cfs lasting until July 15. Spring Chinook salmon spawning requires flows of 1,500 cfs from September 1

to October 15, followed by incubation flows generally through January 31. Maximum requested flows during spawning are 3,000 cfs.

Table A-1. Flow Rates and Ramp Rate Requirements for Big Cliff Dam

Time Period or Criterion	Target
High Flow (> 2,000 cfs)	
Minimum Flow	1,000 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	17,000 cfs
Normal Rate of Increase per hour	
100-1,000 cfs	500 cfs
1,000-3,000 cfs	1,000 cfs
3,000-17,000 cfs	1,500 cfs
Maximum Rate of Increase per hour	2,000 cfs
Maximum Rate of Decrease per hour	20% of flow
Low Flow (< 2,000 cfs)	
February 1 – March 15	1,000 cfs
March 16 – May 31 (winter steelhead spawning)	1,500 cfs
June 1 – July 15 (winter steelhead incubation)	1,200 cfs
July 16 – Sept 4 (rearing)	1,000 cfs
Sep 5 – Oct 30 (Chinook spawning)	1,500 cfs
Nov 1 – Jan 31 (Chinook incubation)	1,200 cfs
Rate of Change (increase)	
Normal	based on a tailwater change of 0.3 feet/hour (ft/hr) and 0.5 ft/day
Special	use when there is an emergency – power requirements, boating accident; based on a tailwater change of 0.3 ft/hr and 0.5 ft/day
Rate of Change (decrease)	
Maximum Rate	- 0.1 ft/hr nighttime hrs, -0.2 ft/hr daytime hrs
Maximum Daily Decrease	0.5 ft/day

*Project outflows during major flood events may exceed these levels. Source: USACE 2009.

These flows are not always achievable in the case of flood damage reduction operations during years with wet springs or large snowpack accumulations. During the high water season (generally November through February), the normal evacuation rate of stored flood waters is 10,000 cfs with a maximum rate of 17,000 cfs. The primary goal of high water outflow regulation is to avoid exceeding bank full at downstream control points when evacuating the reservoir for potential future storm events, while making best efforts to adhere to the general ramping rate guidelines (discussed in next subsection). Additionally, higher spawning flows may result in desiccation of redds if spawning occurs at higher streambed elevations than can be maintained under the specified incubation flows.

A.3.2. Rates of Flow Change (24 hour, day and night)

The North Santiam River downstream from Big Cliff Dam was historically operated with ramping rates that allowed relatively aggressive ramp ups and ramp downs. Since 2006, the USACE has limited the maximum down-ramping rates below Big Cliff Dam to follow general ramping rate guidelines of 0.1 foot/hour during nighttime and 0.2 foot/hour during daytime unless such restrictions have been infeasible with existing equipment at the dam (Table A-1; USACE et al. 2007). Maximum up-ramping rates vary from 500 cfs per hour at initial flows between 100 and 1,000 cfs to 2,000 cfs per hour at initial flows above 17,000 cfs; Table A-1). Historically, during high flows the project was allowed to reduce outflow at 30% per half hour. During real-time storm events where a storm has been under forecast, it may be

necessary to ramp the project down at a faster rate than general guideline allowances. In this case, the guideline is 20% per hour at the operator's discretion for purposes of human health and safety.

A.3.3. Downstream Fish Passage Operations

The USACE does not operate Detroit or Big Cliff dams specifically for juvenile fish passage nor do specific downstream passage facilities exist. However, downstream passage of juvenile outmigrating spring Chinook, progeny of upstream outplanting, typically move through Detroit reservoir during water temperature control operations when the spillway is in use and at times of low reservoir elevations during late fall through early spring.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more detail):

Big Cliff Dam: None

Detroit Dam: The temperature management operation at Detroit Dam below may provide passage benefits and is being tested by RM&E activities.

A.3.4. Operations to Limit Total Dissolved Gas

Both Detroit and Big Cliff dams generate TDG supersaturation when their spillways are operated. The extent of TDG saturation is dependent on the type and duration of operation and whether both spillways are operated simultaneously. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms when Detroit reservoir is near full or full. The USACE will notify Minto Fish Facility operations personnel when it appears that conditions may produce supersaturation downstream of Big Cliff and Detroit dams as measured at the USGS Niagara gaging station (#14181500).

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

Big Cliff Dam: Spill may be spread through bays 1-3 to control TDG when not generating or when flows exceed turbine capacity between September 1st and July 31st for spring Chinook and winter steelhead incubation. Minimum gate openings may restrict this action depending on the desired outflow.

Detroit Dam: When units are off line or when capacity is exceeded spill will be spread through multiple spillway bays (1-6) or multiple ROs depending on elevation to reduce potentially high TDG levels (Figure A-3). Minimum gate openings may restrict this action depending on the desired outflow.

A.3.5. Operational Water Temperature Management

A.3.5.1. Current Operational Water Temperature Operation

Water temperature management operations will commence on June 1st. A blend of spillway and turbine releases (a 60%/40% split, respectively) from Detroit Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table A-2) throughout the summer. This operation will be carried out until Detroit Reservoir is drawn down below spillway crest. Once below spillway crest, water temperature management operations will shift to powerhouse-only discharges until

mid-October or when outflow water temperatures reach 50°F. From approximately October 22 through November 14, 2014, a blend of powerhouse and regulating outlet flow will be discharged to meet downstream water temperature goals (Table A-2). It is estimated that a 30%/70% split in RO to powerhouse discharge will be needed during this time; however, adaptive management should be used to ensure water temperatures stay below 50°F. The RO/powerhouse operation for fall water temperature management is based on water quality modeling results and operations conducted in previous years. Big Cliff will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Detroit/Big Cliff Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the operation. Should any flow management or dam safety concerns arise, these operations will be modified or suspended.

Table A-2. Monthly Temperature Targets for North Santiam River below Big Cliff Dam

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

Interim temperature control operations at Detroit Dam will typically be conducted from June 1 through mid-November. These operations consist of using the existing outlet configuration at the dam; spillway, powerhouse, and upper ROs throughout the year. When inflow exceeds the projects ability to regulate temperatures and/or flood damage reduction operations are required, the projects evacuate water as required to meet reservoir operations rule curve requirements.

Detroit Dam interim temperature control operations varies from a pulsing-type operation with release through a single spill bay, cycling open and closed on a daily basis, to a continuous-type operation with release through a single bay at a set gate opening for multiple days. Mixing occurs in Big Cliff pool and released below Big Cliff Dam to attain temperature targets.

A.3.5.2. Past Operational Water Temperature Operations

Historically, operations at Detroit Dam consisted mainly of turbine flows throughout the summer months, which sent abnormal water temperatures downstream impacting spring Chinook salmon migration, rearing, spawning, and incubation to emergence. Winter steelhead emergence was delayed by these operations with lower temperatures also impacting rearing conditions for juveniles. Spawning spring Chinook salmon were often exposed to warm water during reservoir operations in fall, causing elevated

spawning and incubation temperatures. This condition led to early emergence of spring Chinook salmon in the North Santiam River below the dams. Early emergence has been known to lead to mortality due to the excessive flows, abundant predators, or insufficient resources experienced by juvenile salmon that hatch early (Einum and Flemming 2000). To mitigate for this impact, Detroit and Big Cliff dams have been operated to provide more biologically appropriate temperatures for winter steelhead and spring Chinook salmon.

Temperature targets were developed during the temperature control tower work at Cougar Dam and were based on literature values as related to life stage. These were used in the North Santiam but were adjusted based on project limitations and to incorporate temperatures for winter steelhead. The USGS Niagara gaging station (#14181500) is used as the point of compliance for temperature targets, originally developed for the McKenzie River below Cougar Dam, were used to shape the temperature operations implemented at Detroit and Big Cliff dams (Table A-2). Although targets are listed for the November through May period, the Detroit project has limited or no capability of modifying temperatures during this period due to natural conditions (isothermal reservoir), elevations of available outlets, and current flood damage reduction operations.

The interim temperature control operations carried out at Detroit from 2007-2012 were met with some success. During the early years of implementing these operations, water temperature targets were missed periodically throughout the year due to lack of understanding, hydropower constraints, and structural issues. In recent years, however, the USACE has more fully optimized operations and downstream water temperatures remained within targeted ranges throughout most of the year. The exceptions in meeting these targets occur as the reservoir is drafted in the fall and warmer surface water is discharged through the dam's available outlets. Even though deep upper RO discharge is used in combination with powerhouse outflow during this time, there is typically not enough cold water available in the reservoir at these elevations to substantially cool downstream water temperatures and remain below the targeted range. The lower ROs are unavailable for use until Detroit reservoir is drawn down to minimum conservation pool elevation (1,450 feet), so even deeper, colder water is inaccessible during this time. It should be noted that the lower ROs have not been used since the 1950s so they will need to be evaluated by Operations Division and Engineering and Construction Division prior to the first use.

Interim temperature control operations may be modified annually based on water availability, meteorological conditions, project constraints/limitations, and from information gathered from prior operating year.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation. This section of the WFOP will be changed in the event that temperature targets, operating period, or the compliance monitoring point are modified.

A.3.6. Recommended Spillway Gate and Regulating Outlet Operations

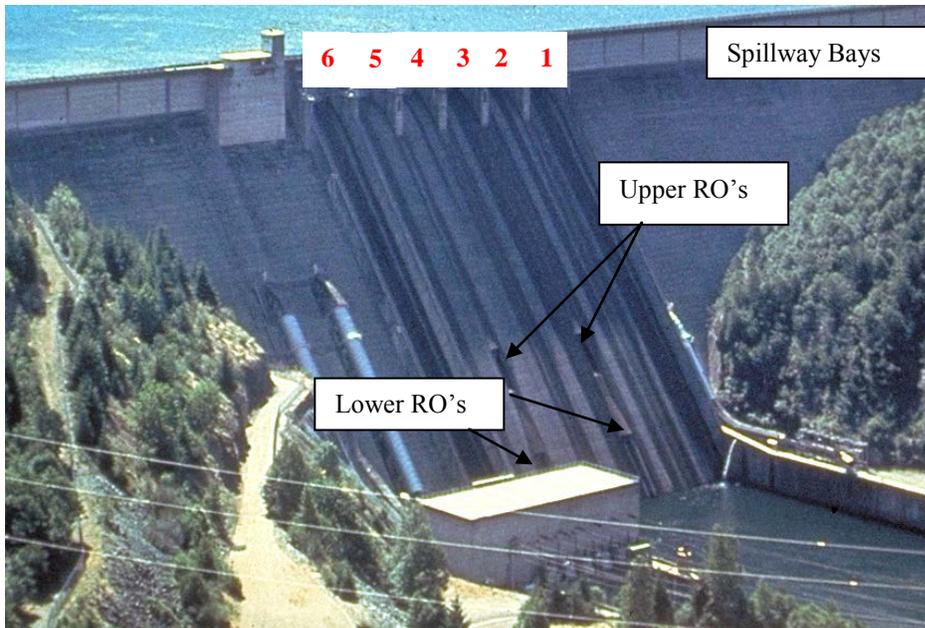
Big Cliff Dam. The configuration and numbering of the spillway bays at Big Cliff Dam are shown in Figure A-2. Spill is spread through bays 1-3 to control TDG when not generating or when flows exceed turbine capacity between September 1st and July 31st for spring Chinook and winter steelhead incubation. Minimum gate openings may restrict this action depending on the desired outflow.

Figure A-2. Big Cliff Dam Spillway Bays



Detroit Dam. Operational flexibility at Detroit Dam allows us to conduct interim temperature control operations, minimize TDG, and has potential to aid downstream passage of juvenile salmonids. When units are off line or when capacity is exceeded spill is spread through multiple spillway bays (1-6) or multiple ROs depending on elevation to reduce potentially high TDG levels (Figure A-3). Minimum gate openings may restrict this action depending on the desired outflow. Existing outlet use for interim temperature control June through November 15th is a biological priority. The focus should be on spreading spill or prioritizing use of the ROs all other times to limit TDG. Recent information suggests that ROs produce less TDG than the spillways. Furthermore, to prevent elevated TDG from being transported downstream, the Big Cliff turbines should be used when the Detroit spillways or ROs are in operation. Consideration should also be given to providing larger gate openings to benefit downstream juvenile passage survival.

Figure A-3. Detroit Dam Spillway Bays and Regulating Outlets



A.4. FISH FACILITIES AND OPERATIONS

A.4.1. Juvenile Fish

After spring Chinook broodstock are collected at the Minto Fish Facility and spawned, the eggs are transferred to Marion Forks Fish Hatchery upstream and reared until the fish reach smolt size. Smolts are then transferred back to the Minto Fish Facility and released. Summer steelhead are also released at the Minto Fish Facility. Broodstock for the summer steelhead program are collected at Foster Dam on the South Santiam River.

A.4.1.1. Marion Forks Fish Hatchery

Marion Forks Hatchery is located along Marion and Horn creeks on Highway 22 about 17 miles east of Detroit, Oregon, and is operated by ODFW (Figure A-1). The site area is 15 acres owned by the U.S. Forest Service Willamette National Forest. Marion Forks Hatchery began operation in 1951 with the USACE funding the majority of operational costs as mitigation for the development of Detroit and Big Cliff dams. The hatchery is used for egg incubation and rearing of spring Chinook salmon. All hatchery summer steelhead released into the North Santiam are from South Santiam brood and not from adults collected at the Minto Fish Facility. Juvenile acclimation prior to release into the North Santiam River occurs at the Minto Fish Facility and not at Marion Forks Hatchery.

Maintenance of the hatchery is primarily done on an as-needed basis. Such maintenance as repairing/upgrading/cleaning/painting incubation and rearing infrastructure, public access sites, safety areas, alarms, roads, lawns, housing, and vehicles are all done by hatchery personnel or contractors. Examples of maintenance that takes place at the hatchery can be found in Withalm and others (2011).

A.4.2. Adult Fish

As described in the 2008 National Marine Fisheries Service (NMFS) Biological Opinion (BiOp), only hatchery-origin spring Chinook salmon will be outplanted upstream of Big Cliff and Detroit dams until adequate downstream passage measures can be provided. Under the present direction of NMFS and ODFW, wild winter steelhead and unmarked spring Chinook salmon are allowed access to the 3-mile reach between the Minto Fish Facility and Big Cliff Dam, while all other remaining adults are captured and transported off-site from Minto either for outplanting, hatchery brood, or for recycling for the downriver fishery.

Other actions pertinent to this fish facility currently being pursued as stated in the 2008 BiOp is to complete the improvement of additional upstream release sites, as well as developing outplanting protocol (RPAs 4.7, 4.1, 4.3, 4.4). These actions should further reduce stress in fish and increase the chances of fish successfully reproducing.

A.4.2.1. Minto Fish Facility

Adult spring Chinook salmon and steelhead needed for ongoing fish management activities in the North Santiam subbasin are collected at the Minto Fish Facility located on the mainstem North Santiam River (Figure A-1). The facility is owned by the USACE and operated by ODFW. The Minto Fish Facility

consists of a fish ladder, presort pool and crowder, sorting flume, eight post-sort holding ponds, and many other features that accommodates both holding adult salmon and steelhead as well as juveniles.

A.4.2.2. Minto Fish Facility Operations and Maintenance

The Minto Fish Facility is a complex system that must be operated carefully to maintain hydraulics for efficient fish passage and holding. Many features of the facility are automated but can also be operated manually. The facility O&M manual (see Appendix) contains specific information regarding startup, normal and manual operations, as facility shutdown as well as how to maintain hydraulic criteria.

The Minto Fish Facility will operate most of the year except during shutdown if necessary for maintenance or other activities.

The following will be checked on a daily basis:

- Intake structure sump pumps
- PLC in intake structure for any alarms, make sure all systems are in AUTO
- FWS pumps oil level
- FWS pumps packing box for adequate water
- FWS pump VFD panels for any fault codes and proper lighting on panel
- Deck wash pump panel for light indication and check tank for pressure between 35 psi and 65 psi
- Intake pressure gages and flow meter working
- Intake air compressor oil level
- Air compressor condensate traps and drain if needed
- Intake air compressor for abnormal vibration or noise
- Intake header for any leaks
- Intake structure for any leaks
- Intake structure power panels
- Domestic water controller in Mechanical/Electrical room
- Presort pool for correct water level
- Post Sort pools for correct water level
- Diesel Generator block heater on
- Diesel Generator in AUTO
- Battery charger on generator working
- Any fuel leaks around generator and tank
- Lighting around facility working correctly

The proposed maintenance period where a shutdown is required for the ladder will be from December 1 to January 31. The following will be performed during the maintenance period:

- a) All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.
- b) The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

The proposed maintenance period where a shutdown is required for the post sort pools will be from April 15 to May 31. The following will be performed during the maintenance period:

- a) All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.
- b) The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

A.4.3. Adult Collection

A.4.3.1. Broodstock Collection Guidelines

Broodstock collection guidelines were presented in the NMFS BiOp (NMFS 2008) for the North Santiam Basin spring Chinook salmon program. Broodstock collection will be detailed in the spring Chinook salmon HGMP for the North Santiam Basin.

A.4.3.2. Annual Adult Fish Disposition Guidelines

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team and published or attached in the WFOP upon finalization.

A.5. DISPOSITION OF FISH COLLECTED AT ADULT TRAPPING FACILITIES

A.5.1. Goals, Objectives, Strategies and Protocols for Outplanting Adults

The 2014 draft Hatchery and Genetic Management Plan (HGMP), *North Santiam Chinook HGMP for North Santiam River Spring Chinook (Stock 21)*, developed goals, objectives, strategies, and protocols for releasing adult spring Chinook salmon into historical habitat in the North Santiam subbasin. The following information is modified from this HGMP.

A.5.1.1. Goals and Objectives

Overall Natural Production Goal

Manage the North Santiam spring Chinook salmon program and returns to fish collection facilities in the North Santiam subbasin to promote establishment and maintenance of a viable population of naturally reproducing spring Chinook salmon and winter steelhead in the North Santiam subbasin.

Objective 1. Evaluate the potential to establish a naturally reproducing population of spring Chinook salmon in historic habitat upstream of dams in the North Santiam subbasin to increase natural production, avoid jeopardy, and aid in the recovery of UWR spring Chinook salmon.

- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat upstream of USACE dams to evaluate the potential for long-term reintroduction.
- Release hatchery or a combination of hatchery and natural-origin fish into inaccessible habitat, with the long-term intention of releasing only naturally produced fish should it provide a net benefit to the North Santiam spring Chinook salmon population.
- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat in tributaries downstream of USACE dams that historically supported spring Chinook salmon.

Objective 2. Meet legal and policy standards, including those under the ESA, established by the Technical Recovery Team, and viability criteria identified in *Oregon Native Fish Status Report* (ODFW 2005) or other recovery planning efforts to minimize impacts of operations and maintenance activities on listed spring Chinook salmon and winter steelhead.

Objective 3. Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.

Objective 4. Reduce mitigation production of hatchery fish in the North Santiam Basin if natural production increases as a result of the outplanting program.

A.5.1.2. Strategies

Upstream of Detroit Dam and Reservoir

Proposed Releases. Continue to release hatchery-origin adult Chinook salmon in the areas upstream of Detroit Dam while evaluating the success of preliminary reintroduction efforts.

Long-term Strategy. The long-term intent of the program is to release only natural-origin fish when production and survival upstream of Detroit Dam and reservoir are high enough to support a self-sustaining run.

Accessible Areas Without Impassible Dams

Proposed Releases. Pending hatchery fish availability, ODFW may release adult fish into other areas not blocked by dams in an attempt to increase natural production of spring Chinook salmon in this subbasin.

Long-term Strategy. If outplanted fish successfully spawn and begin to produce progeny, then ODFW will likely continue outplanting. However, hatchery fish planted in these areas should ultimately be eliminated. The long-term fitness of fish produced within the Little North Fork Santiam are not given a chance to adapt to the local conditions with a continual influx of hatchery-origin fish.

A.5.1.3. Protocols for Outplanting Adults

Beidler and Knapp (2005) identified the following recommendations for outplanting spring Chinook salmon adults in the North Santiam subbasin.

- Implement better record keeping of environmental and transporting conditions of transported fish.
- Investigate potential for other adult release locations in Little North Santiam River.
- Investigate causes of high pre-spawn mortality rates in the Little North Santiam River.
- Install a smolt trap downstream of Big Cliff Dam to monitor juvenile outmigration production from upstream of the dams.
- Conduct a radio tag study in the Little North Santiam River to assess movement, pre-spawn mortality of outplanted adults.
- Collect fresh carcass samples for disease analysis.

The following information describes proposed and long-term protocols for the spring Chinook salmon reintroduction and outplanting program as well as for winter steelhead. A long-term strategy should

identify the protocol that would likely result in maximum survival of supplemented fish over the long term, but are likely not achievable in the short-term without significant structural modifications or large-scale changes in monitoring. The transition from proposed operations to a long-term strategy will be overseen by the WATER group, informed by results of monitoring and evaluation and described in annual updates to the WFOP.

1. Target Number of Fish to Release

Proposed Operation. The current program involves releasing fish according to the targets identified in Table A-3. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Fish Passage and Hatchery Management Committee. When numerical adult abundance recovery goals are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly. All unclipped spring Chinook salmon and winter steelhead are passed above the barrier at the Minto Fish Facility.

Table A-3. Proposed Number of Adult Spring Chinook to be Outplanted (short-term)

Location	Target Number of Fish (minimum in parentheses)	Origin	
		Hatchery	Natural
North Santiam River upstream Of Detroit Dam	900 (450)	X	
Breitenbush River upstream of Detroit Dam	600 (300)	X	
North Santiam River upstream of Minto ^a Dam	All		X
Little North Fork Santiam River	0	NA	NA

^a Until natural-origin fish are passed upstream of Detroit Dam, the area between Detroit and Big Cliff dams will be designated for naturally produced fish only.

Long-term Strategy

- Maximize adult survival to spawning and adjust target releases accordingly (based on reductions in pre-spawning mortality and improvements in survival at other life stages).
- Reduce the ratio of hatchery-origin fish released upstream of Detroit Dam; eventually, release only natural-origin fish in these areas.
- Eliminate the need to outplant hatchery-origin adults in areas upstream of dams. In the long term, collect and release only natural-origin adults collected at facilities into habitat upstream of each dam.

2. Sex and Age Composition of Outplanted Fish

Proposed Operation. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

Long-term Strategy. Explore the potential benefits of releasing adults according to the age and sex distribution that occurs naturally at Minto. Ensure that the minimum number of females are transported to achieve the desired target number of redds.

3. Run Representation of Outplanted Fish (seeding rate by run size by month)

Proposed Operation. Continue to collect adult fish at the new Minto Fish Facility. Due to interim temperature control operations, fish are arriving earlier at the adult collection facilities. The Fish Passage and Hatchery Management Committee will develop the annual guidelines regarding when to outplant fish from each location. The group will need to carefully consider the impacts of water temperature on arrival time and holding capability in the North Santiam.

Long-term Strategy. If Detroit/Big Cliff dams are operated with water temperature control, then collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of run strength. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be held at the Minto Fish Facility if found beneficial to reduce pre-spawning mortality. Fish will not be held longer than the agreed upon time to be developed through the WATER process.

4. Handling Protocols for Outplanted Fish

Proposed Operation. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplus (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date if not likely to survive. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur unless fish not likely to survive.¹
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

A more detailed protocol will be developed once the operations and maintenance manual is complete for the facility. The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

¹ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Detroit Dam.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for the Minto Fish Facility.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.
- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

Long-term Strategy. The Minto Fish Facility will be used for collection of broodstock, passage above Minto Dam, and for reintroduction efforts above the Detroit and Big Cliff projects. Most outplanted fish should be in good physical conditions (i.e., no lesions, fungus, etc) to increase the likelihood of surviving to spawn. During initial processing/sorting, CO₂ may be used as anesthetic because summer steelhead are also present, which are recycled into the fishery. During secondary processing prior to outplanting, alternate anesthetics (MS-222 or Aqui-S, if approved) will be used if fish will not be subjected to a fishery. Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date. The facility was designed to minimize stress to fish, thus, all activities should complement this by minimizing any fish handling that may need to occur (e.g. multiple crowds). Handling protocols are currently being updated as the facility is near completion.²

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur.³
- Healthy fish will be used in both broodstock selection and outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for the Minto Fish Facility.

² Protocols will need to be refined that set specific timeframes for: how many times a day the trap is checked, how long fish will remain in the trap, and how long fish are in anesthetic.

³ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Detroit Dam.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.
- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

5. Antibiotic Treatment Protocols for Outplanted Fish

Proposed Operation. Beginning in 2006, most fish have been treated with antibiotics (likely erythromycin and oxytetracycline) to prevent bacterial infections that cause pre-spawning mortality. This practice has constrained when fish can be released upstream because of the potential to be caught in Detroit reservoir.

Long-term Strategy. Experiment with reduced dependence on, or eliminating prophylactic antibiotic treatments.

6. Transport Protocols for Outplanted Fish

Proposed Operation. Elevated stress caused by high transport density has likely contributed to the high incidence of pre-spawning mortality observed in fish outplanted above Detroit reservoir. Fish are now loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified. In addition, fish handling will cease once temperatures reach 70°F.

All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

Table A-4. Approximate Hauling Times and Distances from Minto to Release Sites

Release Site	Distance (miles)	Transport Time (minutes) ^a
North Santiam Upstream of Detroit Dam (Parrish Lake Rd, RM 81.5)	42	120
North Santiam Upstream of Detroit Dam (Old Log Deck near Marion Forks; RM 62.8)	24	100
Breitenbush River (Villa Maria)	TBD	TBD
Little North Santiam River	24	60

^a Does not include loading time. Source: Modified from Beidler and Knapp 2005.

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gallons; 50 fish/1200 gallons), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified in Section 2.2.1 of the main report. In addition, fish handling will cease once temperatures reach 70°F.

7. Release Protocols for Outplanted Fish

Proposed Operations

- Release sites. Continue to use the existing and new release sites, but identify potential new release sites that have adequate temperatures, are located near suitable holding areas, and are not located near areas with heavy human use to reduce harassment potential.
- Release methods. Have a minimum of a 12-inch opening on all release trucks. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. See Section 2.2.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.
- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release.

Long-term Strategy

- Release sites. All fish would be released at sites that were selected based on suitable habitat and temperature.
- Release methods. All fish would be released using smooth-walled pipe as described above.
- Monitoring. Fish liberation truck driver and/or trained volunteer would observe released fish for mortality and unusual behavior immediately after release.

A.6. SCHEDULED AND UNSCHEDULED MAINTENANCE AT DAMS

A.6.1. Scheduled Maintenance

The annual maintenance periods discussed below for Detroit and Big Cliff dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Big Cliff Dam. Detroit contains two turbine units allowing for maintenance to be completed on individual units without impacting flow. Maintenance that requires both turbine units to be offline should be completed during the period identified to avoid impacts to interim operational water temperature control.

Value of Power to BPA

- Nov-Feb: High historical power demand (minimize outages if possible).
- Mid July-Aug: High historical power demand (minimize outages if possible).
- Sep-Oct: Power demand fluctuates year to year (secondary to March-June time frame).
- Mar-Jun: Low historical power demand (schedule outages during this period if possible).

Big Cliff

Target outage periods:

- Mar 1-Jun 30: Primary target period.
- Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.
- Sep 1-Oct 31: Secondary target period.
- **Nov 1-Feb 28: Restricted from outage scheduling.**

Considerations/Rationale for unit outage scheduling:

- Sep 1-Oct 31: The secondary outage period is not preferred but outages are allowed. If a unit is taken out of service, fluctuations in flow should be limited due to spawning spring Chinook salmon. Spring Chinook eggs will be present but are fairly hardy to impacts from excessive TDG.
- Nov 1-Mar 31: Minimize generation outages in order to maintain TDG below limit due to impacts on sac fry.

Detroit

Target outage periods:

- Mar 1-May 31: Primary target period.
- Jun 1-Nov 15: Restricted to one unit at a time in outage status.
- Nov 16-Feb 28: Limited outage scheduling due to power valuation considerations.

Considerations/Rationale for unit outage scheduling:

- Jun 1-Nov 15: At least one unit is required for temperature control.
- Nov 16-Feb 28: Minimize generation outages in order to maintain TDG below limit due to impacts on sac fry. TDG is not a large concern if Big Cliff is generating. When Big Cliff is not generating and spill is required at Detroit, spill should be spread across as many spill gates as possible.

A.6.2. Unscheduled Operations and/or Maintenance

Atypical operations may occur at Detroit or Big Cliff dams due to either RM&E activities, natural hydrologic conditions, planned maintenance, or during unforeseen events such as outages or unplanned maintenance. During these events, operations may not be optimal for aquatic species and may disrupt, or impact fisheries and/or water quality based operations depending on the specific project or time of year.

Real-time management of reservoir operations at Detroit or Big Cliff dams may require atypical or emergency operations (including maintenance) and may be implemented immediately depending on the severity of the issue.

Due to the size of Detroit reservoir, downstream water temperatures are most influenced by release made at Detroit Dam. Big Cliff reservoir's comparatively small size and water residence time limits the influence of this project on downstream water quality. Operation of the generating unit at Big Cliff Dam does provide some influence in controlling TDG levels below Big Cliff Dam that are generated through releases at Detroit Dam.

Instream flow reductions below the minimum targets identified in the 2008 BiOps and ramp rates exceeding current flow change targets may impact winter steelhead and spring Chinook salmon downstream of Big Cliff Dam, fish held at Minto, and Oregon chub. Additionally, high flows may impact Minto operations and disrupt spawning below the dam.

- December through July – Ramping from atypical operations may strand/isolate juvenile fish.
 - Period when winter steelhead and spring Chinook fry, susceptible to ramping, may be present below dams.
- May through November 15th – Ramping from atypical operations may impact spring Chinook salmon migration and spawning behavior and may strand juvenile winter steelhead.
 - Period of spring Chinook salmon migration, spawning and incubation.
 - Period of winter steelhead fry presence.
 - Period of adult trapping at the Minto Fish Facility.

A.7. RECOMMENDATIONS TO REDUCE POTENTIAL EFFECTS OF UNSCHEDULED MAINTENANCE/OPERATIONS

As discussed above, various operations and maintenance actions have the potential to adversely affect fish survival. Table A-5 is a periodicity table for spring Chinook salmon indicating level of use by life stage by month. Red shading indicates key periods of use when impacts are considered to be greatest based on use and life stage sensitivity. This information will be used to guide maintenance planning and assess possible impacts that may result from atypical/emergency operations, including unscheduled outages. Provided below are the recommendations to operations and/or maintenance (both planned and unplanned) that are suggested to minimize potential negative effects.

A.7.1. Spill

Spill should be maintained to a level below 110% TDG saturation during the following sensitive periods if possible.

- April through June:
 - Protects spawning and incubating winter steelhead that are located immediately below Big Cliff Dam and downstream mainstem reaches.
- September through December:
 - Protects spawning and incubating spring Chinook in downstream mainstem reaches.
- Utilize generating unit at Big Cliff during sensitive periods.
- Utilize generating units at Detroit (balance with temperature operations).

A.7.2. Downstream Water Temperatures

Detroit Dam is currently operated for operational water temperature control to meet specific temperature targets based on salmonid life stage specific needs. The 2008 BiOp requires the USACE to assess whether long-term operational control is feasible or if a structural solution is more appropriate. At this time, temperature control is limited by the existing outlets at Detroit with maximum flexibility occurring when reservoir elevations are at spillway crest. The project's ability to control temperatures by mixing releases is diminished when the reservoir elevation falls below the spillway crest. Temperature targets should be followed as closely as operationally feasible during the following periods.

- June through November (*General Consideration*) - maintain temperature targets:
 - Period within current operational control that protects ESA-listed salmon and steelhead adult, spawning, and incubation life stages.
 - Protects all fish maintained at Minto.
 - May afford benefits to ESA-listed Oregon chub in downstream off-channel areas.
- June through October - Avoid releases of high proportion of surface spill that may elevate temperatures during emergency/atypically operations.
 - Protects ESA-listed winter steelhead incubation and rearing and spring Chinook spawning and incubation life stages.
 - Protects all fish maintained at Minto.
 - May afford benefits to ESA-listed Oregon chub in downstream off-channel areas.
- June through October - Avoid high proportion of flow from low-level outlets that cause thermal barrier to migration (<50°F) or disrupt migration behavior during presence of adult spring Chinook.

Table A-5. Periodicity Table for Spring Chinook in North Santiam River below Big Cliff Dam

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Comments
Upstream Adult Migration				Peak	Peak	Peak	Peak	Peak	Peak				
Adult Spawning								Lesser	Critical	Critical	Lesser		
Adult Holding				Lesser	Lesser	Lesser	Lesser	Lesser	Lesser				
Egg Incubation through Fry Emergence	Critical	Critical						Lesser	Lesser	Lesser	Lesser	Lesser	incubation & emergence accelerated 2-3 mo. because of warm water dam releases Emergence based on field observations and TU calculations
Juvenile Rearing				Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	
All life stages	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	
Fry	Critical	Critical		Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	peak period of rearing of fry based on trapping (1998) & field data (2011-2012);
Subyearling			Lesser	Lesser	Lesser	Lesser	subyearling primary rearing period (May-Aug) based on seining data						
Fall migrant										Lesser	Lesser	Lesser	subyearlings that do not migrate in first summer
Yearling	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	fish that remain through first summer & winter
Downstream Juvenile Migration													
Dec-Mar = fry	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Fry movement based on field data (2011-2012)
April-mid July = subyearling				Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	
Mar-May = yearling smolts; mid-Oct-mid Dec = fall migrants			Lesser	Lesser	Lesser	Lesser	Migration data based on PIT tag data, except fry movement						

Represents periods of peak use based on professional opinion.
 Represents lesser level of use based on professional opinion.
 shaded cells represent information based on field data & direct knowledge
 red cells represent critical periods when flow fluctuations should be avoided to prevent disruption of spawning,
 to minimize disturbance of eggs during early incubation, and to minimize stranding or displacing newly emerged fry

Based on professional opinion, 90% of the life-stage activity occurs during the time frame shown as the peak use period.
 Based on professional opinion, 10% of the life-stage activity occurs during the time frame shown as the lesser use period.

A.7.3. Instream Flows and Ramping

Provided below are suggested operations that should minimize potential negative effects from deviations to normal flows.

- April through June - Maintain adequate flows for winter steelhead incubation.
- September through December - Maintain target flows for spring Chinook salmon incubation.
- September through October - Maintain flows, as feasible, below 3,000 cfs to discourage margin spawning and avoid disrupting spawning behavior.
- May through November - maintain flows, as feasible, below 4,000 cfs to allow access to Minto and below 8,000 cfs to prevent flooding of pump system.
- June through September - Maintenance of target flows during this period may benefit ESA-listed Oregon chub in downstream off-channel areas.

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Appendix B. South Santiam Subbasin Fish Operations Plan

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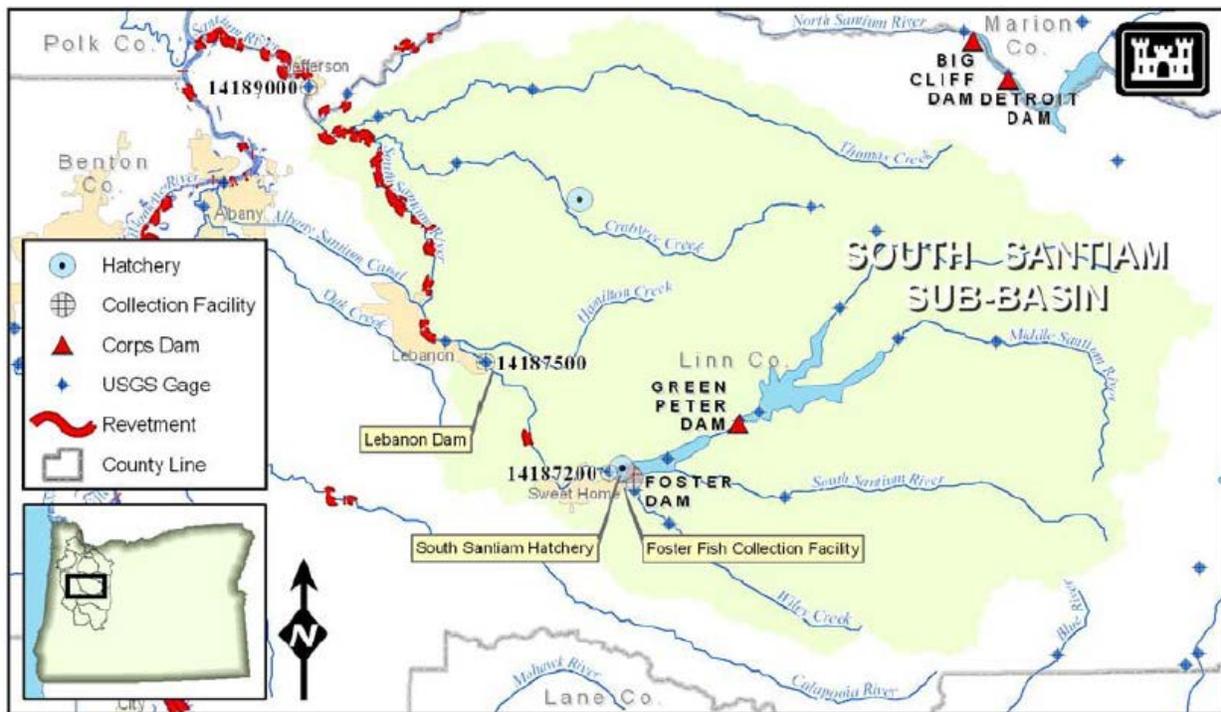
Appendix B. South Santiam Subbasin Fish Operations Plan

B.1. OVERVIEW

The South Santiam River is about 63 miles long and drains an area of about 1,000 square miles (Figure B-1). The construction of the two U.S. Army Corps of Engineers (USACE) dams in the subbasin, Green Peter and Foster, began in 1961 and was completed in 1967. A third dam was planned but never constructed. Most inflow to Foster Dam comes from a combination of outflows from Green Peter and the unregulated South Santiam River above Foster Lake.

The Lebanon Diversion Dam, owned by the city of Albany, is 8 feet high and located at river mile (RM) 21 downstream from Foster Dam. In 2005-2006, this dam was outfitted with new fish ladders and a screened diversion intake. The South Santiam subbasin is inhabited by Upper Willamette River (UWR) winter steelhead, UWR spring Chinook salmon, and Oregon chub, all of which are listed on the Endangered Species Act (ESA).

Figure B-1. South Santiam Subbasin



B.2. FACILITIES

Foster and Green Peter are the two Willamette Valley Project (WVP) dams located in the South Santiam subbasin. Adult fish passage facilities are directly located below Foster Dam on the south bank. Rearing of juvenile salmonids occurs at the South Santiam Hatchery located at the Foster project on the north bank. In 2014, the rebuild of the Foster Fish Facility was completed. Spring Chinook salmon and winter steelhead trapped at this location are transported above Foster Dam, to designated release sites, or used for hatchery brood stock collection.

The operation and maintenance of the Foster and Green Peter projects can impact downstream habitat conditions. The operations may alter flow conditions, both total flow and rate of change, and water quality, primarily temperature and total dissolved gas (TDG) under some circumstances. To minimize these impacts, the USACE operates the Green Peter and Foster projects to meet specific flow and ramp rate targets (NMFS 2008).

Both dams are operated from the Foster Dam control room, which relies on the Supervisory Control and Data Acquisition (SCADA) system. Although SCADA allows for remote operation of Foster Dam, it does have some limitations. The precision of SCADA controls are not designed to adjust the amount of water through Foster to meet small flow changes. In addition, there can be a lag time (30-60 minutes) from when an operational change is made at Foster before the control room observes the change at the nearest downstream U.S. Geological Survey (USGS) gage near Foster, Oregon.

B.2.1. Green Peter Dam

Green Peter Dam is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. Green Peter Dam is 380 feet high and is located on the Middle Santiam River, a tributary to the South Santiam River (Figure B-1). The dam is a concrete structure with a gated spillway, powerhouse, and two regulating outlets (ROs).

B.2.1.1. Turbines

Green Peter has two Francis turbines each rated at 40 megawatts (MW) each and an additional smaller unit, called the fish unit. The hydraulic capacity through the turbines ranges from 3,600 to 4,400 cubic feet per second (cfs) depending on head (the difference between forebay and tailwater elevations).

B.2.1.2. Spillway Gates

Green Peter has two radial tainter spillway gates and a spillway crest at elevation 967.8 feet. The project cannot spill through the spillway until water has risen above that elevation. The gates can be controlled remotely via the Supervisory Control and Data Acquisition (SCADA) system, or locally through a control panel with a mechanical dial detailing the spillway gate position. Green Peter does not have an automatic system in place that would open a discharge outlet to maintain flow if a unit were to trip offline.

B.2.1.3. Regulating Outlets

Green Peter has two ROs that are controlled with vertically sliding gates either locally or from the control room at Foster. Currently, there is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1-foot increments and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning of RO flows.

B.2.2. Foster Dam

Foster Dam is located on the South Santiam River just downstream from the mouth of the Middle Santiam River (Figure B-1). Foster Dam re-regulates the flow from Green Peter Dam and also acts as a storage project. Foster Dam is a rock-fill structure with a concrete-gated spillway.

B.2.2.1. Turbines

Foster has two Kaplan turbines rated at 10 MW each with a total hydraulic capacity that ranges from 2,700 to 3,400 cfs. The turbines (at both projects) are adjusted by making changes to the wicket gate openings. At both projects, turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

B.2.2.2. Spillway Gates

Foster has four radial tainter spillway gates. The spillway crest is at elevation 596.8 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the spillway gate position, or through the SCADA system. Currently, spillway gate #1 will automatically open to a set point of 3 feet in case the turbine wicket gate opening goes to zero indicating the turbine has tripped off. There is only one speed that the spillway gate can be opened or closed (there is no variable frequency drive). The mechanical dial measures the amount of gate opening locally at the project. The local dial is set to 0.5-foot increments. These settings limit the precision that flow changes can be made.

B.2.2.3. Regulating Outlets

Foster does not have any ROs.

B.2.3. Foster Fish Facility

The Foster Fish Facility consists of a fish ladder, presort pool and crowder, sorting flume, four short-term and five long-term post-sort holding pools, and many other features that accommodates both holding adult salmon and steelhead as well as juveniles.

B.3. OPERATIONS

B.3.1. Tributary Flow Targets

The 2008 BiOp requires specific seasonal flow regimes below Foster Dam. These operations include minimum and maximum flow targets, increasing and decreasing flow rate targets (ramp rates) and recommendations for operations during high flow periods.

Required minimum and maximum flows for Foster Dam vary by time of year and are shown in Table B-1. Minimum outflow from Foster Dam is 800 cfs from July 16 to August 31. Spring spawning flows for winter steelhead are 1,500 cfs from March 16 to May 15, followed by incubation flows of 1,100 cfs lasting until June 30. Spring Chinook salmon spawning requires flows of 1,500 cfs from September 1 to October 15, followed by incubation flows generally through January 31. Maximum requested flows during the spawning are 3,000 cfs.

At higher flow events, Foster Dam passes inflow until an outflow of 10,000 cfs is reached (Table B-1). During this time, Green Peter Dam flows are typically reduced as needed to a minimum of 50 cfs, which is maintained at this level throughout the event, unless high storage levels at Green Peter Dam mandate higher flows. Once flows at Foster reach 10,000 cfs, this release is held constant and the reservoir is allowed to fill. Outflows are not changed unless high storage levels at Foster Dam mandate higher releases, or the peak has passed and pool evacuation begins. During evacuation, Foster is drafted first

with releases as high as 15,000 cfs, but more typically 12,000 cfs. Drafting of stored water from Green Peter Dam is achieved by maintaining draft rates from Foster Dam and increasing Green Peter Dam as other inflows drop off. Under the spring spill operation at Foster Dam, about 92 to 238 cfs is typically spilled daily from 6 a.m. through 9 p.m. from April 15 through May 15 each year. This operation facilitates the passage of juvenile and kelt winter steelhead and juvenile spring Chinook from the reservoir.

B.3.2. Rates of Flow Change (24 hour, day and night)

Ramping rates below Green Peter are unrestricted and highly variable, causing water levels in Foster reservoir to change by 5 to 15 feet per day (USFWS 1961, USACE 1989). The magnitude and frequency of current flow fluctuations, due to Green Peter power peaking, may have rendered the length of the Middle Santiam River between Green Peter Dam and Foster reservoir unsuitable for fish habitation (USACE 2000). Prior to 2006, the maximum allowable down-ramping rate at Foster Dam was 30% of discharge per half hour. Up-ramping rates varied from 500 cfs per hour at initial flows between 500 and 1,000 cfs, to 2,500 cfs per hour when initial flows are higher than 18,000 cfs. Ramping operations at Foster Dam were modified in 2006 to reduce fishery impacts (Table B-1). Currently, the USACE attempts to maintain ramping rates of 0.1 foot/hour at night and 0.2 foot/hour during daylight hours, except during active flood damage reduction operations.

Table B-1. Flow Rates and Ramp Rate Requirements for Foster Dam

Time Period or Criterion	Target
High Flow Period (> 2,000 cfs)	
Minimum Flow	Up to 10,000 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	18,000 cfs
Normal Rate of Increase per hour	
100-1,000 cfs	500 cfs
1,000-3,000 cfs	1,000 cfs
3,000-17,000 cfs	1,500 cfs
Maximum Rate of Decrease per hour	20% of flow
Low Flow Period (< 2,000 cfs)	
Minimum Flow	
February 1 – March 15	800 cfs
March 16 – May 15 (winter steelhead spawning)	1,500 cfs
May 16 – June 30 (winter steelhead incubation)	1,100 cfs
July 1 – August 31 (rearing)	800 cfs
Sep 1 – Oct 15 (Chinook spawning)	1,500 cfs
Oct 16 – Jan 31 (Chinook incubation)	1,100 cfs
Rate of Change (increase)	300/hr
Rate of Change (decrease)	
Maximum Rate of Decrease	0.1 ft/hr nighttime hrs, 0.2 ft/hr daytime hrs
Maximum Daily Decrease	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

B.3.3. Downstream Fish Passage Operations

The USACE operates the Foster fish weir, located in spillway bay #1, from April 15th through May 15th annually, to provide downstream fish passage primarily for emigrating juvenile winter steelhead. The operation provides spill of 0.5 to 1.5 feet (~92-238 cfs) from 6:00 a.m. to 9:00 p.m. daily. The weir

provides a more focused surface passage route which may better facilitate efficiency and survival. Steelhead kelt may also use the weir if operations overlap with their emigration for ocean re-entry. Foster reservoir is drawn down to elevation 616 feet in order to operate the fish weir. The weir structure is located at 614 feet. Discharges during this operation average 300 cfs through the weir.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more details):

Green Peter Dam: None

Foster Dam: The annual operation will be extended throughout the year. During spring (~March 1-April 30) the Foster fish weir will be operated at a forebay elevation of 616 feet. Near the beginning of June to the end of September, the Foster fish weir will be operated at a reservoir elevation of 635 feet. A winter operation for the Foster fish weir is being proposed.

B.3.4. Operations to Limit Total Dissolved Gas

Both Green Peter and Foster dams generate TDG supersaturation when their spillways are operated. The extent of TDG saturation is dependent on the type and duration of operation and the number of spillways that are operated simultaneously. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms when reservoirs are near full or full.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

Green Peter Dam: None

Foster Dam: Spread spill across multiple spillway gates (#1-#4) during times when turbine capacity is exceeded or when off-line to limit TDG. Minimum gate openings may restrict this action depending on the desired outflow.

B.3.5. Operational Water Temperature Management

Currently, operational water temperature management is not implemented at Green Peter or Foster dams. During times of the year when reservoir operations typically impact water temperature (spring through fall), generation at Green Peter provides a substantial portion of the releases from Green Peter reservoir. This operation, combined with the unregulated flow of the South Santiam upstream of Foster, tends to provide adequate summer water temperatures in the South Santiam River. In the future, temperature management may be carried out to improve downstream conditions for ESA-listed fish. The USACE CE-QUAL W2 models are currently being used to inform future operations for successful downstream water temperature management.

Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation. This section of the WFOP will be changed in the event that temperature targets, operating period, or the compliance monitoring point are modified.

B.3.6. Recommended Turbine, Spillway Gate, and Regulating Outlet Operations

B.3.6.1. Foster Dam

The configuration and numbering of the spill gates are shown in Figure B-2. Use of turbines during adult fish passage from February 1st through October 31st should be prioritized and operate spillway bay #1 nearest the fish ladder during fish collection activities if turbine flows are exceeded or off line. Spread spill across multiple spillway gates (#1-#4) during times when turbine capacity is exceeded or when off-line to limit TDG (prioritize spillway bay #1 nearest fish ladder) between September 1st and July 31st for spring Chinook and winter steelhead incubation.

Figure B-2. Foster Dam Spillway Bays



B.3.6.1. Green Peter Dam

No recommendations at this time.

B.4. FISH FACILITIES AND OPERATIONS

B.4.1. Juvenile Fish

After spring Chinook broodstock are collected at the Foster Fish Facility and spawned, eggs are transferred to South Santiam Fish Hatchery upstream and reared until the fish reach smolt size. Smolts are then transferred back to the Minto Fish Facility and released. Summer steelhead are also released at the Foster Fish Facility. Broodstock for the summer steelhead program are collected at Foster Dam on the South Santiam River.

B.4.1.1. South Santiam Hatchery

The South Santiam Hatchery is located along the north shore of the South Santiam River at RM 37 at the base of Foster Dam, about 2 miles east of Sweet Home, OR and is operated by ODFW (Figure B-1). The incubation room is approximately 18 feet by 24 feet and contains thirty 16-tray vertical incubators and two 6-foot fiberglass picking troughs. All incubators and both troughs are plumbed with reservoir and well water. A 58-degree well water is available to mix with reservoir water for accelerating egg growth (but is currently used only for summer steelhead). A chemical treatment system is also plumbed to each incubator. Water from the incubation room discharges directly into the South Santiam River. Spring Chinook salmon eggs are incubated at the South Santiam Hatchery from the initial egg take through the “eyed” stage. The capacity of the hatchery can handle 3.8 million spring Chinook salmon eggs, but 2 million eggs are typically incubated annually.

Rearing facilities at the South Santiam Hatchery consist of ten 17 feet by 75 feet by 4 feet Burrows raceways and four 21 feet by 75 feet by 4 feet 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.

Maintenance of the hatchery is primarily done on an as-needed basis. Such maintenance as repairing/upgrading/cleaning/painting incubation and rearing infrastructure, public access sites, safety areas, alarms, roads, lawns, housing, and vehicles are all done by hatchery personnel or contractors. An example of maintenance that occurs can be found in Withalm and others (2011).

B.4.2. Adult Fish

Several species of fish arrive at the Foster Fish Facility throughout the year, including spring Chinook, winter steelhead, and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the Foster Fish Facility are determined by balancing goals for natural production, the Spring Chinook Reintroduction/Outplant Program, hatchery management and harvest opportunities, while ensuring that state tribal obligations are satisfied.

Other actions pertinent to this fish facility currently being pursued as stated in the 2008 BiOp is to complete the improvement of additional upstream release sites, as well as developing outplanting protocol (RPAs 4.7, 4.1, 4.3, 4.4). These actions should further reduce stress in fish and increase the chances of fish successfully reproducing.

B.4.2.1. Foster Fish Facility

Adult spring Chinook salmon and steelhead needed for ongoing fish management activities in the South Santiam subbasin are collected at the Foster Fish Facility located on the mainstem South Santiam River (Figure B-1). The facility is owned by the USACE and operated by ODFW. The Foster Fish Facility consists of a fish ladder, auxiliary water supply pump system, presort pool and crowder, sorting flume, four short-term post-sort and five long-term holding pools, and many other features that accommodates both holding adult salmon and steelhead as well as juveniles.

The Foster Fish Facility will be operated to collect summer steelhead , ESA-listed UWR winter steelhead, and spring Chinook (Table B-2). The Foster Fish Facility will be operated almost year-round with the exception of an annual shut-down period in for maintenance. Fish are attracted into the fish trap by a fish ladder with two entrances that provide attraction water from the pre sort pool and four AWS pumps. Adult spring Chinook salmon are collected at the trap between mid-May and October. The trap will be worked approximately 2-3 times per week depending on the level of fish movement. Chinook brood are collected throughout the run until September and held in the two of the long term post sort pools at the Foster Adult Collection Facility until spawning in September or October. Summer steelhead are also collected throughout the run and held in two long term post sort pools until spawning in late December thru early February.

Table B-2. Foster Fish Facility Operation and Fish Migration Timing

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Trap Operating													
Winter Steelhead													
Spring Chinook													
Summer Steelhead													

B.4.2.2. Foster Fish Facility Operations and Maintenance

The Foster Fish Facility is a complex system that must be operated carefully to maintain hydraulics for efficient fish passage and holding. Many features of the facility are automated but can also be operated manually. The facility O&M manual (see Appendix) contains specific information regarding startup, normal and manual operations, as facility shutdown as well as how to maintain hydraulic criteria.

The Foster Fish Facility will operate most of the year except during shutdown if necessary for maintenance or other activities.

All routine maintenance at the Foster Fish Facility will occur while the facility is closed, with the exception of emergency maintenance to maintain optimal operating conditions at the trap or if trapping activities are causing injury to fish.

In general, scheduled fish facility maintenance, to the extent practicable, will be conducted following the completion of passage, holding, or acclimation seasons when the facilities are closed. If not practical or when maintenance is needed during times when operating, maintenance will occur when impacts are

determined to be the lowest based on adult returns. This will minimize fisheries impacts during emergency maintenance during the adult fish passage season or during the holding of hatchery juveniles prior to release (see Section 2.3.3 of the main report).

The proposed maintenance period where a shutdown is required for the ladder will be from December 1 to January 31. The following will be performed during the maintenance period:

- a) All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.
- b) The fish ladder will be dewatered and inspected for debris, projections, or clogged orifices that could injure or impede fish. Necessary repairs will be completed at this time.

The proposed maintenance period where a shutdown is required for the post sort pools will be from March 1 to April 15. The following will be performed during the maintenance period:

- a) All staff gages and water level indicators will be inspected, cleaned, and repaired as necessary.
- b) The pools will be dewatered and inspected for damage, cracks, debris, or projections that could injure fish. Necessary repairs will be completed at this time.

Specific maintenance activities listed for monthly, quarterly, and annual actions will be appended to the WFOP.

B.4.3. Adult Collection

B.4.3.1. Broodstock Collection Guidelines

Broodstock collection guidelines were presented in the NMFS BiOp (NMFS 2008) for the South Santiam Basin spring Chinook salmon program. Broodstock collection will be detailed in the spring Chinook salmon HGMP for the North Santiam Basin.

B.4.3.2. Annual Adult Fish Disposition Guidelines

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team and published or attached in the WFOP upon finalization.

B.5. DISPOSITION OF FISH COLLECTED AT ADULT TRAPPING FACILITIES

B.5.1. Goals, Objectives, Strategies and Protocols for Outplanting Adults

The 2014 draft Hatchery and Genetic Management Plan (HGMP), *South Santiam Chinook HGMP for South Santiam River Spring Chinook (Stock 24)*, developed goals, objectives, strategies, and protocols for releasing adult spring Chinook salmon into historical habitat in the South Santiam subbasin.

The following information is modified from this HGMP.

B.5.1.1. Goals and Objectives

Overall Natural Production Goal

Manage the South Santiam spring Chinook salmon program and returns to fish collection facilities in the South Santiam subbasin to promote establishment and maintenance of a viable population of naturally reproducing spring Chinook salmon in the South Santiam subbasin.

Objective 1. Evaluate the potential to establish a naturally reproducing population of spring Chinook salmon in historic habitat upstream of dams in the South Santiam subbasin to increase natural production, to avoid jeopardy, and to aid in the recovery of UWR spring Chinook salmon.

- Release hatchery or a combination of hatchery/natural-origin fish into historical habitat upstream of USACE dams in South Santiam subbasin to evaluate potential for long-term reintroduction.
- Release hatchery or a combination of hatchery/natural-origin fish into inaccessible habitat, with the long-term intention of releasing only naturally produced fish should it provide a net benefit to South Santiam spring Chinook salmon population.
- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat in tributaries downstream of USACE dams that historically supported spring Chinook salmon.

Objective 2. Meet legal and policy standards, including those under the ESA, established by the Technical Recovery Team, and viability criteria identified in *Oregon Native Fish Status Report* (ODFW 2005) or other recovery planning efforts.

Objective 3. Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.

Objective 4. In the long-term, reduce mitigation production of hatchery fish in the South Santiam Basin if natural production increases as a result of the outplanting program. Ultimately, provide a sustainable harvest on naturally produced spring Chinook salmon.

B.5.1.2. Strategies

Upstream of Foster Dam and Reservoir

Proposed Releases. Continue to release natural-origin adult Chinook salmon in the areas above Foster Dam while evaluating the success of preliminary reintroduction efforts.

Long-term Strategy. The long-term intent of the program is to release only natural-origin fish when above Foster reservoir. Information on the survival of outplanted adults and juvenile passage through the reservoirs and dams is necessary to evaluate the outplant program and determine the net benefit to releasing natural-origin adults upstream of the dams and if long-term reintroduction is feasible.

Since the hatchery program was originally founded from the historic population of spring Chinook salmon in the South Santiam River after the USACE dams were built, this stock of fish represents the best remaining source of fish for reintroduction efforts.

B.5.1.3. Protocols for Outplanting Adults

The protocols for planting fish in historical habitat for South Santiam spring Chinook salmon are essentially the same as for North Santiam spring Chinook salmon (see Appendix A). Specific information for the South Santiam that differs from the North Santiam is provided below.

Beidler and Knapp (2005) identified the following recommendations for outplanting spring Chinook salmon adults in the South Santiam River subbasin.

- Install smolt traps at the head of Foster Reservoir and below Green Peter Dam to monitor juvenile outmigration production.
- Give consideration to mark error rates to better distinguish between hatchery and natural-origin fish when outplanting.

The following information describes proposed and long-term protocols for the spring Chinook salmon reintroduction and outplanting program as well as for winter steelhead. A long-term strategy should identify the protocol that would likely result in maximum survival of supplemented fish over the long term, but are likely not achievable in the short-term without significant structural modifications or large-scale changes in monitoring. The transition from proposed operations to a long-term strategy will be overseen by the WATER group, informed by results of monitoring and evaluation and described in annual updates to the WFOP.

1. Target Number of Fish to Release

Proposed Operation. The current program involves releasing fish according to the targets identified in Table B-3. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Fish Passage and Hatchery Management Committee. When numerical adult abundance recovery goals are established for the South Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly. All unclipped winter steelhead are passed above Foster Fish Facility.

Table B-3. Proposed Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish	Origin	
		Hatchery	Natural
Above Foster ^a	All		X

^a Current release sites above Foster reservoir include the Calkins boat ramp, Riverbend County Park, and a private access area just upstream of the bridge at Gordon Road and Highway 20.

Long-term Strategy.

- Maximize adult survival to spawning and adjust target releases accordingly (based on reductions in pre-spawning mortality and improvements in survival at other life stages).
- Reduce the ratio of hatchery-origin fish released upstream of projects; eventually release only natural-origin fish in these areas.
- Eliminate the need to outplant hatchery-origin adults in areas upstream of dams. In the long term, collect and release only natural-origin adults collected into habitat upstream of each dam.

2. Sex and Age Composition of Outplanted Fish

Proposed Operation. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

Long-term Strategy. Explore the potential benefits of releasing adults according to the age and sex distribution that occurs naturally at Foster Fish Facility. Ensure that the minimum number of females are transported to achieve the desired target number of redds.

3. Run Representation of Outplanted Fish (seeding rate by run size by month)

Proposed Operation. Expand the operation of the Foster Fish Facility to include the July 15 to August 15 time frame, such that fish can be collected throughout the entire run. Some fish may be held at the Foster Fish Facility prior to outplanting. A new facility is currently being constructed to replace the current adult fish facility that will include better holding conditions and features to reduce stress to fish. The FPHM Team will develop the annual guidelines regarding when to outplant fish for each location. The group will need to carefully consider the impacts of water temperature on arrival time and holding capability in the South Santiam River.

Long-term Strategy. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of run strength. However, pre-spawning mortality of fish may be high and thus should be monitored to ensure effectiveness of this strategy. Fish could be held at the new the Foster Fish Facility. Fish will not be held longer than the agreed to time that will be developed through the WATER process.

4. Handling Protocols for Outplanted Fish

Proposed Operation. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplus (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date if not likely to survive. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur unless not likely to survive.¹
- Healthy fish will be used for both broodstock collection and outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

A more detailed protocol will be developed once the operations and maintenance manual is complete for the facility. The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for the Foster Fish Facility.

¹ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Foster Dam.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.
- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

Long-term Strategy. The Foster Fish Facility will be used for collection of broodstock and for reintroduction efforts above projects. Most outplanted fish should be in good physical conditions (i.e., no lesions, fungus, etc) to increase the likelihood of surviving to spawn. During initial processing/sorting, CO₂ may be used as anesthetic because summer steelhead are also present, which are recycled into the fishery. During secondary processing prior to outplanting, alternate anesthetics (MS-222 or Aqui-S, if approved) will be used if fish will not be subjected to a fishery. Fish will be moved out of the trap quickly and frequently. Fish in poor condition will be rendered or outplanted as carcasses (nutrient enrichment) at a later date. The facility was designed to minimize stress to fish, thus, all activities should complement this by minimizing any fish handling that may need to occur (e.g. multiple crowds). Handling protocols will be developed specific to the facility as it nears completion.²

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur.³
- Healthy fish will be used in both broodstock selection and outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for the Foster Fish Facility.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.

² Protocols will need to be refined that set specific timeframes for: how many times a day the trap is checked, how long fish will remain in the trap, and how long fish are in anesthetic.

³ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Foster Dam.

- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

5. Transport Protocols for Outplanted Fish

Proposed Operation. Elevated stress caused by high transport density has likely contributed to high incidence of pre-spawning mortality observed in fish outplanted above Foster reservoir. Beginning in 2006, fish have been loaded according to NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks with chillers will operate to prevent or reduce warming and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified.

All truck drivers will complete an adult salmonid outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish. In addition, fish handling will cease once temperatures reach 70°F.

Table B-4. Approximate Hauling Times and Distance from Foster Fish Facility to Release Sites

Release Site	Distance (miles)	Transport time (minutes)
Calapooia R	20-25	40-60
Above Foster Reservoir ^a	10-20	20-40
Thomas Creek	45-50	60-75
Crabtree Creek	30-40	50-80
Wiley Creek	7-15	20-45

^a Transport time does not include loading time. Source: Modified from Beidler and Knapp 2005.

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified in Section 2.2.1 of the main report. In addition, fish handling will cease once temperatures reach 70°F.

6. Release Protocols for Outplanted Fish

Proposed Operations

- Release sites. Continue to use the existing and new release sites, but identify potential new release sites that have adequate temperatures, are located near suitable holding areas, and are not located near areas with heavy human use to reduce harassment potential.
- Release methods. Have a minimum of a 12-inch opening on all release trucks. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck

to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. See Section 2.2.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release.

Long-term Strategy

- Release sites. Fish would be released at sites selected based on suitable habitat and temperature.
- Release methods. All fish would be released using smooth-walled pipe as described above.
- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior immediately after release.

B.6. SCHEDULED AND UNSCHEDULED MAINTENANCE

B.6.1. Scheduled Maintenance

The annual maintenance periods discussed below for Foster and Green Peter dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Foster Dam. Foster Dam has two turbine units and can impact flow during maintenance, so it is important that planned maintenance occur during the time frame shown below.

Value of Power to BPA

- Nov-Feb: High historical power demand (minimize outages if possible).
- Mid July-Aug: High historical power demand (minimize outages if possible).
- Sep-Oct: Power demand fluctuates year to year (secondary to March-June time frame).
- Mar-Jun: Low historical power demand (schedule outages during this period if possible).

Green Peter

Target outage periods:

- Mar 1-Jun 30: Primary scheduling period.
- Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.
- Sep 1-Oct 31: Secondary scheduling period.
- Nov 1-Feb 28: Limited outage scheduling due to power valuation considerations.

Considerations/Rationale for unit outage scheduling:

- No fish operations currently affect outage scheduling and therefore power valuations and historical stream flows will be the major factors affecting outage scheduling.

Foster

Target outage periods:

- Mar 1-Apr 30: Primary scheduling period.
- May 1-Oct 31: Attempt to schedule one unit at a time.
- **Nov 1-Feb 28: Restricted from outage scheduling.**

Considerations/Rationale for unit outage scheduling:

- Mar 1-Apr 30: Spring Chinook salmon have mostly emerged and few sac fry are present. There will be steelhead eggs present but are fairly hardy to impacts from excessive TDG.
- Apr 15-May 15: Fish weir in operation for downstream fish passage, minimize generating outages that would cause flow through other spillway gates.
- May 1- Oct 31: Minimize generation outages in order to maintain fish attraction water to fish ladder. Although, the few Foster Fish facility will have functioning AWS pumps.
- Nov 1-Feb 28: Generation outages restricted to maintain TDG below limit due to impacts on sac fry.

B.6.2. Unscheduled Operations and/or Maintenance

Atypical operations may occur due to either RM&E activities, natural hydrologic conditions, planned maintenance, or during unforeseen events such as outages or unplanned maintenance. During these events, operations may not be optimal for aquatic species and may disrupt, or impact fisheries and/or water quality based operations depending on the specific project or time of year.

Real-time management of reservoir operations may require atypical or emergency operations (including maintenance) and may be implemented immediately depending on the severity of the issue.

Instream flow reductions below the minimum targets identified in the 2008 BiOps and ramp rates exceeding current flow change targets may impact spring Chinook salmon and winter steelhead downstream of projects, and Oregon chub.

- December through July – Ramping from atypical operations may strand/isolate juvenile fish.
 - Period when spring Chinook fry, susceptible to ramping, may be present below the dams.
- May through November 15th – Ramping from atypical operations may impact spring Chinook salmon migration and spawning behavior.
 - Period of spring Chinook salmon migration, spawning and incubation.
 - Period of winter steelhead fry presence.
 - Period of adult trapping.

B.7. RECOMMENDATIONS TO REDUCE POTENTIAL EFFECTS OF UNSCHEDULED MAINTENANCE/OPERATIONS

As discussed above, various operations and maintenance actions have the potential to adversely affect fish survival. The following are recommendations to operations and or maintenance (both planned and unplanned) that are suggested to minimize potential negative effects. Provided below is a periodicity table for spring Chinook salmon indicating level of use by life stage by month (Table B-5). Red shading indicates key periods of use when impacts are considered to be greatest based on use and life stage sensitivity. This information will be used to guide maintenance planning and assess possible impacts that may result from atypical/emergency operations, including unscheduled outages.

B.7.1. Spill

Spill should be maintained to a level below the 110% TDG saturation below Foster during the following sensitive periods if possible:

- April through June
 - Protects spawning and incubating winter steelhead that are located immediately below Foster Dam and downstream mainstem reaches.
- September through December
 - Protects spawning and incubating spring Chinook in downstream mainstem reaches.
- Utilize generating unit at Foster and/or spread spill during sensitive periods.

B.7.2. Downstream Water Temperatures

The Green Peter and Foster projects are not operated for temperature control at this time. During times of the year when reservoir operations typically impact water temperature (spring through fall), generation at Green Peter provides a substantial portion of the releases from Green Peter reservoir. This operation, combined with the unregulated flow of the South Santiam upstream of Foster, tends to provide adequate summer water temperatures in the South Santiam River. During fall, when Green Peter is drafted using the rule curve for potential flood risk reduction operations, a water temperature increase can occur impacting downstream habitat conditions. Currently, not enough information is known regarding potential operations for temperature in the South Santiam River to modify operations for water temperature control. Planned and on-going efforts will assist the USACE in potential operations at either Green Peter and/or Foster dams.

Table B-5. Periodicity Table for Spring Chinook Salmon in the South Santiam River below Foster Dam

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Comments	
Upstream Adult Migration														
														based on Foster Dam counts
Adult Spawning														
Adult Holding														
Egg Incubation through Fry Emergence														
														incubation & emergence accelerated 2-3 mo. because of warm water dam releases
														Emergence based on field observations and TU calculations
Juvenile Rearing														
All life stages														
Fry														
Subyearling														peak period of rearing of fry based on trapping (1998) & field data (2011-2012);
Fall migrant														subyearling primary rearing period (May-Aug) based on seining data
Yearling														subyearlings that do not migrate in first summer
														fish that remain through first summer & winter
Downstream Juvenile Migration														
Dec-Mar = fry														Fry movement based on field data (2011-2012)
April-mid July = subyearling														
Mar-May = yearling smolts;														
mid-Oct-mid Dec = fall migrants														
														Migration data based on PIT tag data, except fry movement

Represents periods of peak use based on professional opinion.
 Represents lesser level of use based on professional opinion.
 shaded cells represent information based on field data & direct knowledge
 red cells represent critical periods when flow fluctuations should be avoided to prevent disruption of spawning,
 to minimize disturbance of eggs during early incubation, and to minimize stranding or displacing newly emerged fry

Based on professional opinion & field studies, 90% of the life-stage activity occurs during the time frame shown as the peak use period.

Based on professional opinion & field studies, 10% of the life-stage activity occurs during the time frame shown as the lesser use period.

Provided below are the recommendations to operations and maintenance (both planned and unplanned) that are suggested to minimize potential negative effects.

B.7.3. Instream Flows and Ramping

Provided below are suggested operations that should minimize potential negative effects from deviations to normal flows.

- April through June - Maintain adequate flows for winter steelhead incubation.
- September through December - Maintain target flows for spring Chinook salmon incubation.
- September through October - Maintain flows, as feasible, below 3,000 cfs to discourage margin spawning and avoid disrupting spawning behavior.
- June through September - Maintenance of target flows during this period may benefit ESA-listed Oregon chub in downstream off-channel areas.

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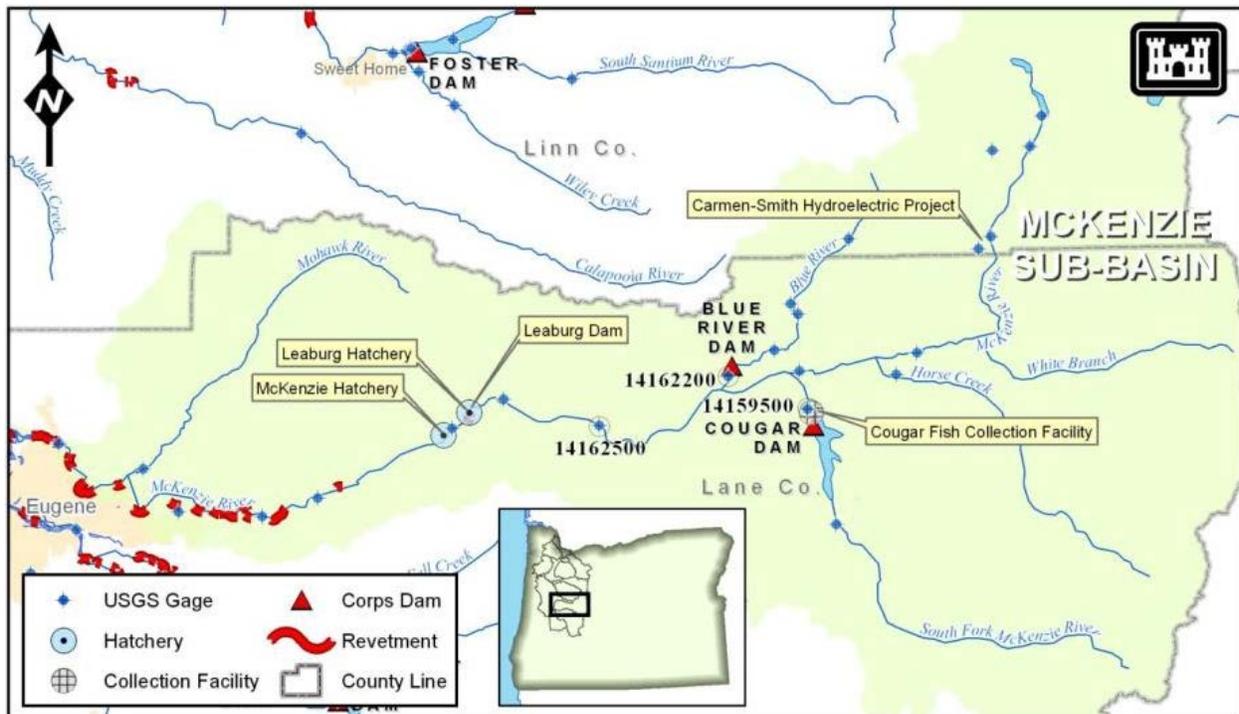
Appendix C. McKenzie Subbasin Fish Operations Plan

C.1. OVERVIEW

The McKenzie River is about 90 miles long and drains an area of about 1,340 square miles (Figure C-1). Two U.S. Army Corps of Engineers (USACE) dams were constructed in the McKenzie subbasin – Cougar Dam at river mile (RM) 4.4 on the South Fork McKenzie River was completed in 1963 and Blue River Dam at RM 1.8 on the Blue River was completed in 1968. Multiple smaller diversions/canals and some higher dams are located on the McKenzie River including Leaburg Dam (RM 29) and the Carmen-Smith Hydroelectric Project (RM 82), both owned by the Eugene Water and Electric Board (EWEB). Leaburg Dam was outfitted with new ladders and a screened diversion intake in 2005-2006.

Cougar Dam blocks access to most of the South Fork watershed and Blue River Dam and the Carmen-Smith hydroelectric project block smaller amounts of habitat. For Carmen-Smith Dam, an artificial spawning channel was built alongside the main McKenzie River just below Trail Bridge Dam to mitigate for lost habitat. The EWEB is also proposing to install a new ladder and screen at Trail Bridge Dam, the lowermost dam of the Carmen-Smith complex, to enable reestablishment of Chinook salmon into historical habitat. High quality habitats remain accessible in significant portions of the subbasin not blocked by dams, but habitat degradation in the Mohawk watershed from a century ago (Parkhurst et al. 1950) and historically significant rearing habitat in the upper Willamette River mainstem has been lost or damaged (NMFS 2008). The subbasin is inhabited by Upper Willamette River (UWR) spring Chinook salmon, Oregon chub and bull trout, all of which are listed on the Endangered Species Act (ESA).

Figure C-1. McKenzie Subbasin



C.2. FACILITIES

Cougar and Blue River are the two Willamette Valley Project (WVP) dams located in the McKenzie subbasin. The USACE completed construction of Cougar Dam on the South Fork McKenzie River in 1964 and Blue River Dam on Blue River in 1968. These dams blocked access by spring Chinook salmon to more than 25 miles of quality historic spawning habitat. The McKenzie River remains the most productive area for naturally produced spring Chinook salmon upstream of Willamette Falls (Willis et al. 1995; Schroeder et al. 2006). Since the mid-1990s, ODFW has outplanted excess adult hatchery spring Chinook salmon into historic habitat upstream of dams (including those owned and operated by the USACE and EWEB) in the McKenzie Basin. Outplanting upstream of dams in the McKenzie River began in 1993 (Beidler and Knapp 2005).

Cougar and Blue River dams are operated remotely from the Lookout Point control room. The precision of the Supervisory Control and Data Acquisition (SCADA) system controls are not finely tuned enough to adjust the amount of water through the projects to meet small flow changes as required by the project schedule. Additionally, there can be a long lag time (30-60 minutes) from when an operational change is made at Cougar or Blue River dams and when the control room sees the change recorded at the nearest downstream U.S. Geological Survey (USGS) gages #14162200 (Blue River at Blue River) or #14159500 (South Fork McKenzie near Rainbow).

C.2.1. Cougar Dam

Cougar Dam is a multi-purpose storage project that operates to meet authorized purposes of flood damage reduction, irrigation, power generation, recreation, navigation, municipal and industrial water supply, and downstream water quality improvement. The dam is a rock-fill structure with a powerhouse, concrete spillway with two tainter gates, and two slide gate regulating outlets (ROs). The dam is about 1,600-feet long and 450-feet high from average tailwater to the dam crest. The RO and penstock tunnels have a common intake structure in the left abutment. The outlet capacity is 6,000 cubic feet per second (cfs) at minimum flood control pool (elevation 1,532 feet). The power plant has a capacity of 25 megawatts (MW) and is located at the toe of the rock-fill dam. A water temperature control (WTC) structure began operation in May 2005. A diversion tunnel used during construction of the WTC structure is an additional outlet but is not designed for routine use. All outflow is typically released through the powerhouse and ROs.

C.2.1.1. Turbines

The intake to the penstock from the WTC wet well is an 8-foot, 2-inch by 10-foot, 6-inch rectangular section with a transition between the intake and penstock. The 10-foot, 6-inch diameter main penstock is 1,030 feet long in rock. The penstock at the lower end branches into two 7-foot, 6-inch diameter conduits which lead to the turbines in the powerhouse. Cougar has two Francis turbines rated at 12.5 MW each. The hydraulic capacity through the turbines ranges from 650 to 1,100 cfs depending on head. The head of the turbines varies from a minimum of 266 feet, between normal tailwater and minimum power pool, and a maximum of 449 feet, between tailwater and maximum or full pool. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

C.2.1.2. Spillway Gates

The dual tainter gate ogee-type spillway has a net crest length of 80 feet and is located in the right abutment. The spillway has a discharge capacity of 76,140 cfs at maximum pool (elevation 1,699 feet), with the gates fully open. The spillway discharges into a 90-foot-long chute with no stilling basin. Interim risk reduction measures (IRRM) are being implemented at Cougar Dam to address concerns with tainter gate stability. The use of the spillway is reserved only for emergencies.

C.2.1.3. Regulating Outlets

Cougar Dam has two ROs that are controlled with vertically sliding gates from Lookout Point control room or locally. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limit fine-tuning RO flows. The dam's RO gate #2 currently has a set point of 1 foot in case the turbine wicket gate opening goes to zero indicating the turbine as tripped off. The set point is not adjustable when in use or through SCADA, so it requires an emergency stop. Turbine tripping offline at Cougar Dam can cause problems for juvenile fish or incubating eggs because the ROs are located on a different channel than the powerhouse. When the turbines shut off, even if the ROs are maintaining a consistent total project outflow, the powerhouse channel can still experience significant drops in water levels.

C.2.1.4. Water Temperature Control Tower

The 302-foot-high WTC tower was constructed adjoining the original intake tower and began operation in May 2005 to regulate downstream temperatures. The original intake tower includes a dry well (with operating equipment, stairs, and elevator), dual RO conduits, trash structure, and access bridge. The original intake tower was modified for construction of the WTC tower through addition of a wet well with three adjustable weir gates for selective withdrawal and lower RO and penstock bypass gates. The WTC wet well serves both the power generating facilities and the RO works. The selective withdrawal gates for temperature control consist of three 9-foot wide independently telescoping weirs, one located over each of the regulating outlets and one located over the penstock. The RO bypass gates consist of two 9-foot wide by 27-foot high gated openings at centerline (elevation 1,488.5 feet) that pass water into the lower portion of the WTC tower wet well. The penstock bypass gate is a 9-foot wide by 19-foot high gated opening that passes water into the lower portion of the WTC tower wet well.

Decisions on flow distribution are based on outflow and data from temperature instrumentation on the face of the structure. This instrumentation allows for effective remote operation of the tower through SCADA from Lookout Point. In addition to controlling the volume of flows, temperature data is required to determine thermal stratification in the reservoir and outflow water temperatures. Gates can be “throttled” at different levels to control the proportion of flow from different levels. In addition, the electrical generation system was upgraded to include replacement of turbine runners with minimum gap technology intended to improve fish passage survival.

C.2.2. Blue River Dam

Blue River Dam is a multi-purpose storage project that operates to meet the same authorized purposes as Cougar except there is no powerhouse (Figure C-1). The EWEB currently holds a Federal Energy Regulatory Commission license for the construction of generation facilities, although there are no current plans for adding hydropower to the project. The dam is a rock-fill structure with a gated concrete spillway with two tainter gates, two slide gate ROs, and two emergency slide gate ROs. All outflow is

typically released through the ROs. The dam is about 270 feet tall with top of dam at elevation 1,362 feet. Outflow is governed by the rule curve (a relationship between date and reservoir elevation to provide multipurpose use of the pool) and other project requirements.

Blue River Dam does not have a powerhouse and outflow is governed by the project rule curve and other streamflow requirements or special project requirements. Under all but emergency conditions, all outflow is released through the ROs. Blue River is one of the more “flashy” projects in the Willamette system. During significant winter storm events, it is not unusual for the project to fill 20 feet or more daily. During the lower flow summer season, the project can draw down quickly causing problems for recreational users.

C.2.2.1. Turbines

Blue River Dam has no turbines.

C.2.2.2. Spillway Gates

Blue River Dam has two radial tainter spillway gates and a spillway crest at elevation 1,321 feet. The Blue River Dam spillway gates are used relatively infrequently. The gates are controlled locally via a control panel with a mechanical dial detailing the spillway gate position, or through the SCADA system. The spillway gate can only be opened or closed at one speed (there is no variable frequency drive). The mechanical dial measures the amount of gate opening locally. The local dial is set to 0.5-foot increments. These settings limit the precision that flow changes can be made.

C.2.2.3. Regulating Outlets

Blue River has two ROs controlled with vertically sliding gates either locally or from the control room at Lookout Point. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA dial is set to 0.01-foot increments. The precision of the gate adjustments limits the fine-tuning of RO flows.

C.2.3. Cougar Adult Fish Facility

The Cougar Adult Fish Facility consists of a fish ladder, presort pool and crowder, three post-sort pools, and many other features that accommodates both holding adult salmonids, bull trout, and other resident fish.

C.3. OPERATIONS

C.3.1. Tributary Flow Targets

In recent years, the USACE has attempted to meet flow targets established in cooperation with ODFW for downstream fish protection. At Cougar Dam, these flows are 300 cfs year-round and at Blue River Dam, these flows are 50 cfs year-round. However, the USACE reduces flows to these targets when necessary to reduce downstream flood risks and during other emergencies. Cougar’s minimum outflow is 300 cfs, except during June 1-30 when it is 400 cfs (Table C-1). During high flow conditions, the typical maximum evacuation rate at Cougar Dam is 5,000 cfs and the maximum evacuation rate is 6,500 cfs. In cases of unusual and sustained storm events, Cougar Dam’s outflow may be increased gradually above

the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. Capacity of the outflow through the turbines ranges between 900 and 1,100 cfs; with total dissolved gas (TDG) issues, it is preferable to keep Cougar outflow below 2,000 cfs. During the summer flow augmentation season, project maximum outflow is usually capped in order to balance flow from the various Willamette projects. In 2009, the recommended maximum outflow cap was 500 cfs.

Table C-1. Flow Rates and Ramp Rate Requirements for Cougar Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water (> 1,200 cfs)	
Normal	5,000 cfs
Maximum*	6,500 cfs
Firm Power	750 cfs
High Flow Period	
Minimum Flow	100 cfs
Normal Maximum Flow* (for evacuation of stored flood water)	18,000 cfs
Rate of Increase per hour	
100-500 cfs	250 cfs
500-6,500 cfs	500 cfs
Maximum Rate of Increase per hour	750 cfs
Rate of Decrease per hour	
Maximum	20% of flow
Low Flow Period (< 1,200 cfs)	
Minimum Flow	
July 1-May 31	300 cfs
June 1-30	400 cfs
Maximum Rate of Change (increase)	200 cfs/hr
Rate of Change (decrease during nighttime)	
30-2,400 cfs	150 cfs/hr
> 2,400 cfs	0.1 ft/hr
Daytime of Decrease	0.2 ft/hr
Maximum Daily Decrease	1.0 ft/day or 50%

* Project outflows during major flood events may exceed these levels.

During high flow conditions at Blue River, the typical maximum evacuation rate is 3,000 cfs and the maximum evacuation rate is 3,700 cfs (Table C-2). Similar to Cougar Dam, the project outflow may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. During the summer flow augmentation season, maximum outflow is usually capped in order to balance flow from the various Willamette projects. In 2009, the recommended maximum outflow cap was no greater than 1,000 cfs with a full pool, and is gradually reduced to 50 cfs based on the amount of stored water.

Table C-2. Flow Rates and Ramp Rate Requirements for Blue River Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water	
Normal	3,000 cfs
Maximum*	3,700 cfs
High Flow Period	
Minimum Flow	50 cfs
Rate of Increase per hour	
50-100 cfs	50 cfs
100-500 cfs	100 cfs
500-1,000 cfs	200 cfs
1,000-2,000 cfs	400 cfs
2,000-3,700 cfs	600 cfs
Rate of Decrease per hour	
Maximum	20% of flow
Low Flow Period	
Minimum Flow	
July-May	300 cfs
June 1-30	400 cfs
Maximum Rate of Change (increase)	
Rate of Change (decrease during nighttime)	
50-2,300 cfs	100 cfs/hr
> 2,300 cfs	0.1 ft/hr
Daytime of Decrease	
Maximum Daily Decrease	
	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

C.3.2. Rates of Flow Change (24 hour, day and night)

Historically, ramping rates at Cougar Dam were limited to 500 cfs per hour during high flow and 200 cfs per hour during low flow (USACE 2000). Changes in river stage corresponding to these discharge ramping rates have not been defined. Up-ramping limits at Blue River Dam range from 50 cfs per hour at total project flows of 50-100 cfs to 600 cfs per hour at flows greater than 2,000 cfs (USACE 2000). The maximum down-ramping rate was 30% of total project discharge per hour. Ramping operations at Cougar and Blue River dams were modified in 2006 to reduce fishery impacts. Currently, the USACE attempts to maintain ramping rates of 0.1 foot/hour at night and 0.2 foot/hour during daylight hours except during active flood damage reduction operations (Tables C-1 and C-2).

During the winter high inflow period, Cougar Dam may decrease outflows at up to 500 cfs per hour. The allowance is for those cases where unanticipated conditions require flow reductions in order to control downstream control points for human health and safety considerations. At Blue River Dam, the project may decrease at rates up to 30% per hour with 20% per hour recommended. Whenever feasible, the project would attempt to adhere to the 0.1 foot/hour ramp down guideline. During the winter months when the reservoirs contain significant flood storage, water is evacuated pursuant to the water control manual requirements. This may require faster ramp up than 0.2 feet/hour. In these cases, flow ramp ups at Cougar and Blue River are prescribed according to a sliding scale. For example, Cougar flows will be increased at 250 cfs per hour when initial flows are between 100 cfs and 500 cfs, ranging up to 750 cfs per hour when the flow range is above 6,500 cfs (Table C-1). At Blue River, ramp ups are slightly more constrained with starting hourly increases at 50 cfs per hour when initial flows are between 50 and 100 cfs, ranging up to 600 cfs per hour when the flow range is above 3,700 cfs (Table C-2).

C.3.3. Downstream Fish Passage Operations

The USACE does not operate Cougar dam specifically for juvenile fish passage. However, past operations have been tested to facilitate downstream fish passage such as reservoir drawdown or using a regulating outlet.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more details):

Cougar Dam: Flow through a regulating outlet may be prioritized to facilitate downstream fish passage and implementation will be dependent on regional prioritization. The portable floating fish collector (PFFC) will be tested to assess fish collection.

Blue River Dam: None

C.3.4. Operations to Limit Total Dissolved Gas

If possible, flow will be capped during peak migration to minimize TDG levels during regulating outlet operations.

C.3.5. Operational Water Temperature Control

The Water Temperature Control tower is operated to meet temperature targets that are more the historical normative temperature range.

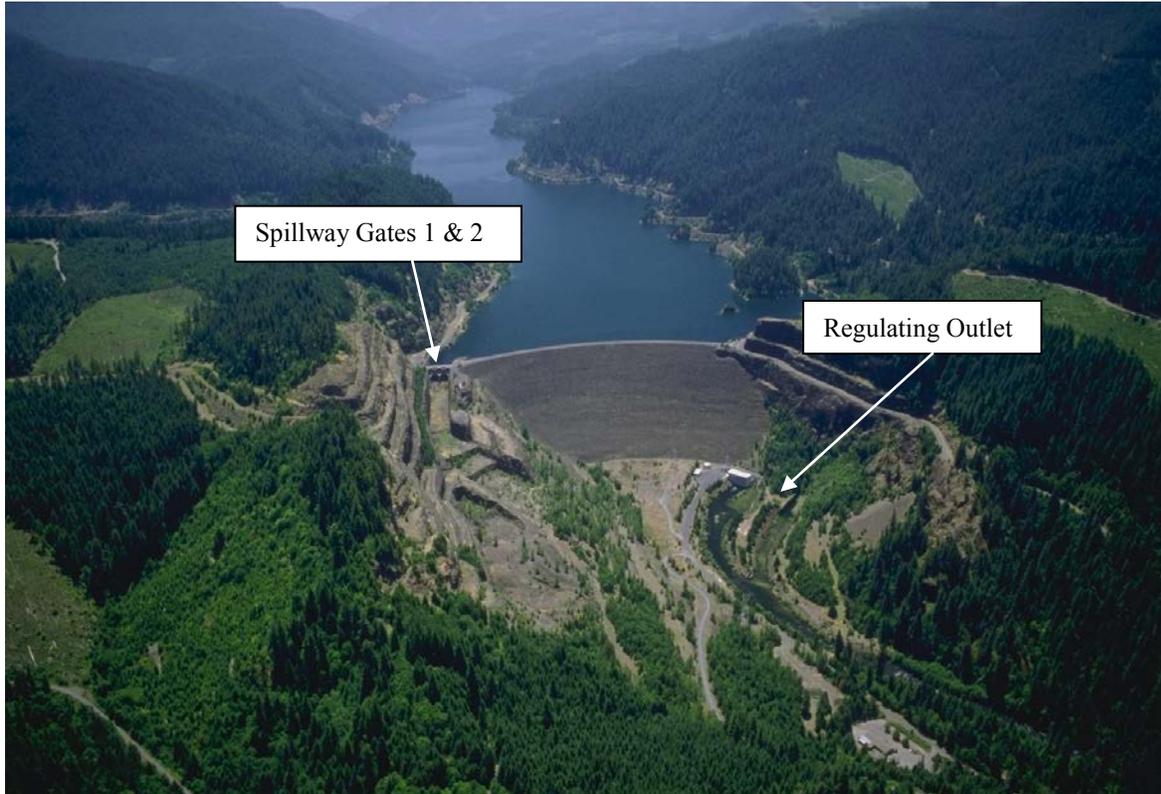
Annual results for operational temperature control are provided in the Willamette Basin Annual Water Quality Report. These annual reports detail periods of non-conformance from the temperature targets, providing the duration and cause of the deviation. This section of the WFOP will be changed in the event that temperature targets, operating period, or the compliance monitoring point are modified.

C.3.6. Recommended Spillway Gate and Regulating Outlet Operations

C.3.6.1. Cougar Dam

When a unit is off line, there is a need to be able to maintain the lowest instream flow requirement (300 cfs) through the RO (Figure C-2). The RO should be able to pass 300 cfs (min flow) at maximum pool. The minimum gate opening at maximum pool would provide an estimated flow of 677 cfs. Although, a release of 677 cfs solely through the RO may result in elevated TDG levels downstream of Cougar Dam. The RO may also be used for fish passage operations and may require a specific opening that will be based on results of RM&E studies. The turbine unit is the priority release point during operation of the adult trapping facility (May 1st through October 31st).

Figure C-2. Cougar Dam Spillway Gates and Regulating Outlet



C.3.6.2. Blue River Dam

No recommendations at this time.

C.4. FISH FACILITIES AND OPERATIONS

The McKenzie Fish Hatchery is the primary rearing facility for the McKenzie spring Chinook salmon program. The 2012 Cooperative Agreement with ODFW requires the USACE to fund production of a maximum of 80,800 pounds of juvenile spring Chinook to mitigate for the 4,060 lost Chinook salmon spawners that returned to the areas upstream of Cougar and Blue River dams.

An adult collection facility downstream of the powerhouse at Cougar Dam was completed (July 2010) and is currently in operation. The trap is used to collect returning adult UWR spring Chinook and bull trout for transportation upstream of the dam, in lieu of a volitional fish ladder.

C.4.1. Juvenile Fish

C.4.1.1. McKenzie Fish Hatchery

The McKenzie Fish Hatchery is located on the McKenzie River near RM 37, about 17 miles east of Springfield, Oregon and is operated by ODFW (Figure C-1). The hatchery is the primary rearing facility for the McKenzie spring Chinook program. Incubation facilities consist of 38 full stacks of vertical tray

incubators (640 trays). Dual water supplies are available from either the McKenzie River 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 at McKenzie Hatchery include 8 Canadian troughs with a volume of 89 cubic feet each, and 30 concrete raceways with a volume of 3,338 cubic feet each. Almost all production is reared at McKenzie Hatchery, with the exception of approximately 75,000 fry (in excess of production program needs), which are transferred to classrooms for educational purposes as part of the Salmon and Trout Enhancement Program. There are no off-site acclimation facilities. All fish are reared within hatchery raceways that drain into the fingerling release pipeline. This pipeline then flows directly into the McKenzie River via the fish ladder.

C.4.1.2. Leaburg Fish Hatchery

The Leaburg Fish Hatchery, located on the McKenzie River, was built in 1953 by the USACE for trout mitigation for the Upper Willamette dams. The hatchery primarily raises rainbow trout, cutthroat trout, and summer steelhead; these fish are stocked not only in the McKenzie subbasin, but in the Santiam, Middle Fork Willamette, and Coast Fork Willamette subbasins as well. In recent years the hatchery has outbreaks of the hematopoietic necrosis virus, and there are on-going efforts to address these issues through multi-agency collaboration.

C.4.1.3. Maintenance Schedule

Maintenance of the hatcheries is primarily done on an as-needed basis. Such maintenance as repairing/upgrading/cleaning/painting incubation and rearing infrastructure, public access sites, safety areas, alarms, roads, lawns, housing, and vehicles are all done by hatchery personnel or contractors. An example of what maintenance activities can be found in Withalm and others (2011).

C.4.2. Adult Fish

Several species of fish arrive at McKenzie Fish Hatchery and the Cougar adult fish trap throughout the year, including spring Chinook salmon and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the McKenzie Hatchery are determined by balancing goals for natural production, the spring Chinook salmon outplant program, hatchery management, and harvest opportunities; while ensuring that state tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel. In recent years, the majority of excess spring Chinook salmon broodstock have been collected and transported to unseeded, historical habitat in efforts to reestablish natural production. In the McKenzie subbasin, the Action Agencies and ODFW have transported fish collected at the McKenzie Hatchery into several locations throughout the subbasin, including the Mohawk River, the McKenzie River upstream of EWEB's Trailbridge Dam, and the South Fork McKenzie River upstream of Cougar Dam.

Adult collection occurs at the McKenzie Hatchery and the Cougar adult fish trap. In some years (1996-1997 and 2006-2008), adults are also collected for broodstock from the left bank fish ladder at Leaburg Dam. All spawning and rearing activities occur at the McKenzie Hatchery.

C.4.2.1. McKenzie Fish Hatchery

Adult fish enter the McKenzie Hatchery fish ladder from the river and negotiate 12 jump steps where they then advance 100 feet 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 here the fish are crowded into the spawning building using a power crowder. A lift brings the fish up to two anesthetic tanks where they can be anesthetized. The fish then can be handled for sorting, inoculation, transport, or placement into the holding ponds for broodstock.

Adults used for broodstock purposes are collected throughout the run from May to October (Table C-3). The hatchery trap is operated continuously; fish are incorporated into the broodstock in approximately the same distribution as they arrive at the trap, including late-arriving fish in September.

Table C-3. McKenzie Trap Operation and Fish Migration Timing

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Trap Operating												
Winter Steelhead												
Spring Chinook												
Summer Steelhead												

C.4.2.2. Leaburg Dam

From 2006 through 2008, natural-origin adult Chinook salmon were captured within the left bank fish ladder at Leaburg Dam to complement the natural-origin component of the broodstock. The ladder was not designed specifically for this purpose. A finger weir is inserted into the downstream end of one section of the ladder and a screen in the upstream end. This configuration is usually put in place in the evening. The following morning the water level in the ladder is lowered and fish trapped in the ladder section are captured by hand and manually slid into an inner tube sleeve, lifted out of the ladder, and placed into a liberation truck. No anesthetic or dip-nets are used in the process. The method has proven to be effective for supplementing the natural-origin component of the broodstock, but is labor intensive and has associated risks. These risks include handling stress and stress from trapping too many fish in the ladder section. In addition, this technique temporarily disrupts the upstream migration of fish using the ladder and results in some fish backing out of the ladder as the water is drained.

C.4.2.3. Cougar Adult Trap Operations and Maintenance

The Cougar Fish Facility will be operated from April 1 to October 15 unless there is a need to extend operations. All routine maintenance at the adult fish traps will occur while the facilities are closed, with the exception of emergency maintenance to maintain optimal operating conditions at the trap or if trapping activities are causing injury to fish encountering the temporary facility.

In general, scheduled fish facility maintenance, to the extent practicable, will be conducted following the completion of passage, holding, or acclimation seasons when the facilities are closed. If not practical or

when maintenance is needed during times when operating, maintenance will occur when impacts are determined to be the lowest based on adult returns. This will minimize fisheries impacts during emergency maintenance during the adult fish passage season or during the holding of hatchery juveniles prior to release. Refer to the Facility Operations and Maintenance Manual for more detailed information.

C.4.3. Adult Collection

C.4.3.1. Broodstock Collection Guidelines

Broodstock collection guidelines were presented in the NMFS BiOp (NMFS 2008) for McKenzie Basin spring Chinook salmon program. Broodstock collection will be detailed in the spring Chinook salmon HGMP for the McKenzie River Basin.

C.4.3.2. Annual Adult Fish Disposition Guidelines

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team and published or attached in the WFOP upon finalization.

C.5. DISPOSITION OF FISH COLLECTED AT ADULT TRAPPING FACILITIES

C.5.1. Goals, Objectives, Strategies and Protocols for Outplanting Adults

C.5.1.1. Goals and Objectives

The 2014 draft Hatchery and Genetic Management Plan (HGMP), *McKenzie Chinook HGMP for McKenzie River Spring Chinook (Stock 23)*, developed goals, objectives, strategies, and protocols for releasing adult spring Chinook salmon into historical habitat in the McKenzie subbasin. The following information is modified from this HGMP.

Overall Natural Production Goal

Manage returns to McKenzie Hatchery and other fish collection facilities in the McKenzie subbasin to promote establishment and maintenance of a viable population of naturally reproducing spring Chinook salmon in the subbasin.

Objective 1. Evaluate the potential to establish a naturally reproducing population of spring Chinook salmon in historic habitat upstream of dams in the McKenzie subbasin to increase natural production, avoid jeopardy, and aid in the recovery of UWR spring Chinook salmon.

- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat upstream of USACE and EWEB dams in the McKenzie subbasin to evaluate the potential for long-term reintroduction.
- Release hatchery or a combination of hatchery and natural-origin fish into inaccessible habitat, with the long-term intention of releasing only naturally produced fish should it provide a net benefit to the McKenzie River spring Chinook salmon population.
- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat in tributaries downstream of USACE or EWEB dams that historically supported spring Chinook salmon.

Objective 2. Meet legal and policy standards, including those under the ESA, established by the Technical Recovery Team, and viability criteria identified in *Oregon Native Fish Status Report* (ODFW 2005) or other recovery planning efforts.

Objective 3. Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.

Objective 4. Reduce mitigation production of hatchery fish in the McKenzie subbasin as natural production increases.

C.5.1.2. Strategies

Upstream of Cougar Dam and Reservoir

Proposed Releases. Continue to release natural and hatchery-origin adult Chinook salmon in the areas above Cougar Dam.

Long-term Strategy. The long-term intent of the program is to release only natural-origin fish when production and survival through Cougar Dam and reservoir are high enough to support a self-sustaining run. Information on the survival of outplanted adults and juvenile passage through the reservoir and dam is necessary to evaluate the outplant program, to determine the net benefit to releasing natural-origin adults upstream of Cougar Dam, and to determine if long-term reintroduction is feasible.

C.5.1.3. Protocols for Outplanting Adults

The protocols for planting fish in historical habitat for McKenzie spring Chinook salmon are essentially the same as for North Santiam spring Chinook salmon (see Appendix A). Specific information for the McKenzie that differs from the North Santiam is provided below.

Beidler and Knapp (2005) identified the following recommendations for outplanting spring Chinook salmon adults in the McKenzie subbasin.

The following sections describes proposed and long-term protocols for the spring Chinook salmon reintroduction and outplanting program.

1. Target Number of Fish to Release

Proposed Operation. The current program involves releasing fish according to the targets identified in Table C-4. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Fish Passage and Hatchery Management Committee. When numerical adult abundance recovery goals are established for the North Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table C-4. Proposed Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish	Origin	
		Hatchery	Natural
South Fork McKenzie River upstream of Cougar Dam	600 (400 females)	X	X

Long-term Strategy

- Maximize adult survival to spawning and adjust target releases accordingly, based on reductions in pre-spawning mortality and improvements in survival at other life stages. With increased survival, the reintroduction program may reach viability goals by releasing fewer fish.
- Reduce the ratio of hatchery-origin fish released above Cougar Dam. Eventually, release only natural-origin fish.
- Eliminate the need to outplant hatchery-origin adults in areas upstream of dams. In the long term, collect and release only natural-origin adults above Cougar Dam. Planned fish passage facilities will provide volitional fish passage at Trail Bridge Dam.

2. Sex and Age Composition of Outplanted Fish

Proposed Operation. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

Long-term Strategy. Explore the potential benefits of releasing adults according to the age and sex distribution that occurs in natural-origin fish within the McKenzie subbasin. Ensure that the minimum number of females are transported to achieve the desired target number of redds.

3. Run Representation of Outplanted Fish (seeding rate by run size by month)

Proposed Operation. Continue to outplant hatchery fish from McKenzie Hatchery as needed to supplement outplanting of unclipped spring Chinook from the Cougar Adult Fish Collection Facility. Operation of the fish trap in the left bank ladder at Leaburg Dam is not recommended under the current configuration, except for the purposes of collecting natural-origin adults to meet hatchery broodstock needs. The FPHM Team will develop the annual guidelines regarding when to outplant fish from each location.

Long-term Strategy. The long-term goal is to outplant only natural-origin fish from Cougar Adult Fish Trap.

4. Handling Protocols for Outplanted Fish

Proposed Operation. Continue to use of both the Cougar Adult Fish Collection Facility and McKenzie Hatchery trap to collect fish for release upstream of Cougar Dam. All transport tanks will be treated with Nov-Aqua, per manufacturer's instructions, to reduce stress during transport.

Loading Density. Transport adult spring Chinook at density ≤ 25 gallons of water per fish (60 fish/1,500 gallon tank).

Oxygen

Oxygen levels in the transport truck water should remain between 7-12 parts per million (7-12 mg/L).

Temperature

Fish will not be released into receiving waters with a seven day average maximum temperature

> 65°F or weekly mean temperature > 60°F. Drivers will measure the temperature of the water in the transport tank and the receiving water prior to releasing the fish. If the temperature difference between the receiving water and tank water is > 7°F, the water will be tempered to a difference of < 5°F at a rate of 1F°/6 minutes.

Hauling Frequency

Transport Period	Hauling Frequency
March 15 - October 15	2 times per week (more frequent if needed on returns to facility)

Long-term Strategy. The Cougar adult fish facility will be used for collection and passage above Cougar Dam for reintroduction efforts. Most outplanted fish should be in good physical conditions (i.e., no lesions, fungus, etc) to increase the likelihood of surviving to spawn. Aqui-S or clove oil will be used as an anesthetic. Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date if not likely to survive. The facility was designed to minimize stress to fish; thus, all activities should complement this by minimizing any fish handling that may need to occur (e.g., multiple crowds).

In addition, the following guidelines will be followed:

- Sorting of adult spring Chinook for outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur unless fish not likely to survive.¹
- Sorting shall be completed to ensure an adequate sex ratio for outplanting.

The fish disposition table developed by the WATER Fish Passage and Hatchery Management Committee will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps.

5. Transport Protocols for Outplanted Fish

Proposed Operation. Elevated stress caused by high transport density has likely contributed to the higher incidence of pre-spawning mortality observed in fish outplanted above Cougar and Trail Bridge reservoirs. Beginning in 2006, fish were loaded according to NMFS recommended loading density of approximately 25 gallons per fish (e.g. 40 fish/1000 gal; 50 fish/1200 gal). Densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate them to prevent or reduce warming during transport and minimize temperature differential between the transport tank and the release stream, to the extent possible. If the receiving water is warmer, then attempt to acclimate fish prior to release.

All truck drivers will complete the adult Chinook salmon outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

¹ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Detroit Dam.

Table C-5. Approximate Hauling Times and Distances from McKenzie Hatchery to Release Sites

Release Site	Distance (miles)	Transport time (minutes)
South Fork McKenzie Upstream of Cougar Dam	35	120
McKenzie River Upstream of Trail Bridge Dam	45	120
Mohawk River	35	100

^a Transport time does not include loading time. Source: Modified from Beidler and Knapp 2005.

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified in Section 2.2.1 of the main report. In addition, fish handling will cease once temperatures reach 70°F.

6. Release Protocols for Outplanted Fish

Proposed Operations

- Release sites. Continue to use the existing and new release sites, but identify potential new release sites that have adequate temperatures, are located near suitable holding areas, and are not located near areas with heavy human use to reduce harassment potential. Work with private landowners or the Forest Service to develop these areas into suitable release sites.
- Release methods. Have a minimum of a 12-inch opening on all release trucks. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. See Section 2.3.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.
- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release.

Long-term Strategy

- Release sites. All fish would be released at sites that were selected based on suitable habitat and temperature.
- Release methods. All fish would be released using smooth-walled pipe as described above.
- Monitoring. Fish liberation truck driver and/or trained volunteer would observe released fish for mortality and unusual behavior immediately after release.

C.6. SCHEDULED AND UNSCHEDULED MAINTENANCE

C.6.1. Scheduled Maintenance

The annual maintenance periods discussed below for Cougar Dam is provided as applicable for the project and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts downstream of Cougar Dam. Cougar Dam has two turbines allowing for maintenance to be completed on individual units without impacting flow. Maintenance that requires both turbine units to be offline should be completed during the time frame shown below to avoid impacts to fish downstream of Cougar Dam.

Value of Power to BPA

- Nov-Feb: High historical power demand (minimize outages if possible).
- Mid July-Aug: High historical power demand (minimize outages if possible).
- Sep-Oct: Power demand fluctuates year to year (secondary to March-June time frame).
- Mar-Jun: Low historical power demand (schedule outages during this period if possible).

Cougar

Target outage periods:

- Apr 1-May 31: Primary target period.
- Jun 1-Oct 31: Restricted to one unit at a time in outage status.
- **Nov 1-Mar 31: Restricted from outage scheduling.**

Considerations/Rationale for unit outage scheduling:

- Apr 1-May 31: Spring Chinook salmon have mostly emerged and few sac fry are present.
- Jun 1-Oct 31: Minimize outage to one unit because unit flow is used for fish attraction to the adult fish collection facility.
- Nov 1-Mar 31: Generation outages are restricted in order to prevent high levels of TDG that has negative impacts on sac fry.

C.6.2. Unscheduled Operations and/or Maintenance

Atypical operations may occur due to either RM&E activities, natural hydrologic conditions, planned maintenance, or during unforeseen events such as outages or unplanned maintenance. During these events, operations may not be optimal for aquatic species and may disrupt, or impact fisheries and/or water quality based operations depending on the specific project or time of year.

Real-time management of reservoir operations may require atypical or emergency operations (including maintenance) and may be implemented immediately depending on the severity of the issue.

Instream flow reductions below the minimum targets identified in the 2008 BiOps and ramp rates exceeding current flow change targets may impact spring Chinook salmon downstream of projects and Oregon chub.

- December through July – Ramping from atypical operations may strand/isolate juvenile fish.
 - Period when spring Chinook fry, susceptible to ramping, may be present below the dams.
- May through November 15th – Ramping from atypical operations may impact spring Chinook salmon migration and spawning behavior.
 - Period of spring Chinook salmon migration, spawning and incubation.
 - Period of adult trapping.

C.7. RECOMMENDATIONS TO REDUCE POTENTIAL EFFECTS OF UNSCHEDULED MAINTENANCE/OPERATIONS

As discussed above, various operations and maintenance actions have the potential to adversely affect fish survival. Provided below is a periodicity table for spring Chinook salmon indicating level of use by life stage by month (Table C-6). Red shading indicates key periods of use when impacts are considered to be greatest based on use and life stage sensitivity. This information will be used to guide maintenance planning and assess possible impacts that may result from atypical/emergency operations, including unscheduled outages.

Table C-6. Periodicity Table for Spring Chinook Salmon in the McKenzie River below Cougar Dam

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Comments
Upstream Adult Migration				Peak	Peak	Peak	Peak	Peak	Peak	Peak			based on Cougar trapping
Adult Spawning								Peak	Critical	Critical			
Adult Holding				Lesser	Lesser	Lesser	Lesser	Lesser	Lesser	Lesser			
Egg Incubation through Fry Emergence	Critical	Critical	Peak					Lesser	Lesser	Critical	Critical	Critical	incubation & emergence based on South Fork McKenzie & downstream emergence based on field sampling for emergent fry and temperature unit calculations
Juvenile Rearing													
All life stages	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	Peak	
Fry	Critical	Critical	Critical		Peak	Peak						Critical	peak period of rearing based on trapping at Leaburg bypass (15-20 years) & field data (2011-2013)
Subyearling			Peak	Peak	Peak	Peak	Peak	Peak					subyearling primary rearing period (May-Aug) based on seining data
Fall migrant								Peak	Peak	Peak	Peak	Peak	subyearlings that do not migrate in first summer (some movement in Aug during high water years)
Yearling	Peak	Peak	Peak	Peak	Peak	Peak							fish that remain through first summer & winter
Downstream Juvenile Migration													
Dec-May = fry	Peak	Peak	Peak	Peak	Peak							Peak	Fry movement based on Leaburg bypass data (15-20 years) & seining (2011-2012)
April-mid July = subyearling				Peak	Peak	Peak	Peak						
mid-Oct-Dec = fall migrants										Peak	Peak	Peak	
mid Feb-mid Jun = yearling smolts		Peak	Peak	Peak	Peak	Peak							
													Migration data based on PIT tag data, except fry movement

<p> Represents periods of peak use based on professional opinion. Represents lesser level of use based on professional opinion. shaded cells represent information based on field data & direct knowledge red cells represent critical periods when flow fluctuations should be avoided to prevent disruption of spawning, to minimize disturbance of eggs during early incubation, and to minimize stranding or displacing newly emerged fry </p>

Based on field data & professional opinion, 90% of the life-stage activity occurs during the time frame shown as the peak use period.
 Based on field data & professional opinion, 10% of the life-stage activity occurs during the time frame shown as the lesser use period.

Provided below are the recommendations to operations and or maintenance (both planned and unplanned) that are suggested to minimize potential negative effects.

C.7.1. Spill

Spill should be maintained to a level below the 110% TDG saturation below Cougar during the following sensitive periods if possible:

- September through February
 - Protects spawning and incubating spring Chinook in downstream reaches.
- Utilize generating unit at Cougar during sensitive periods.
- Limit RO release to < 550 cfs when feasible during September through February period.

C.7.2. Downstream Water Temperatures

Cougar Dam provides water temperature control to meet specific temperature targets through the use of the Cougar WTC tower. This operation is performed annually starting in June and continues through September, or until the elevation of the reservoir compromises the ability to provide control.

Temperature targets should be followed as closely as operationally feasible during the following periods:

- June through November (*general consideration*) - maintain temperature targets:
 - Period within current operational control that protects ESA-listed salmon adult, migration, holding, spawning, and incubation life stages;
 - Protects all fish maintained at the Cougar Adult Trapping Facility; and
 - May afford benefits to ESA-listed bull trout in downstream areas.

C.7.3. Instream Flows and Ramping

Instream flow reductions below the minimum targets identified in the 2008 Biological Opinion and ramp rates exceeding current flow change targets may impact spring Chinook migration, holding, spawning, and incubation downstream of Cougar Dam and efficient operations of the Cougar Adult Trapping Facility. Provided below are biologically sensitive periods when flow/ramp rate targets if not met, pending hydrologic conditions, may result in impacts to specific species and life stages.

- December through July – Ramping from atypical operations may strand/isolate juvenile fish.
 - Period when spring Chinook fry, susceptible to ramping, may be present below the dam.
- May through November 15th – Ramping from atypical operations may impact migratory and spawning behavior.
 - Period of spring Chinook migration, spawning and incubation.
 - Period of adult trapping at Cougar Facility.
- September through December – Maintain adequate flows for spring Chinook incubation.
- September through October– Maintain target spawning flows to discourage margin spawning and avoid disrupting spawning behavior.

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Appendix D. Middle Fork Willamette Subbasin Fish Operations Plan

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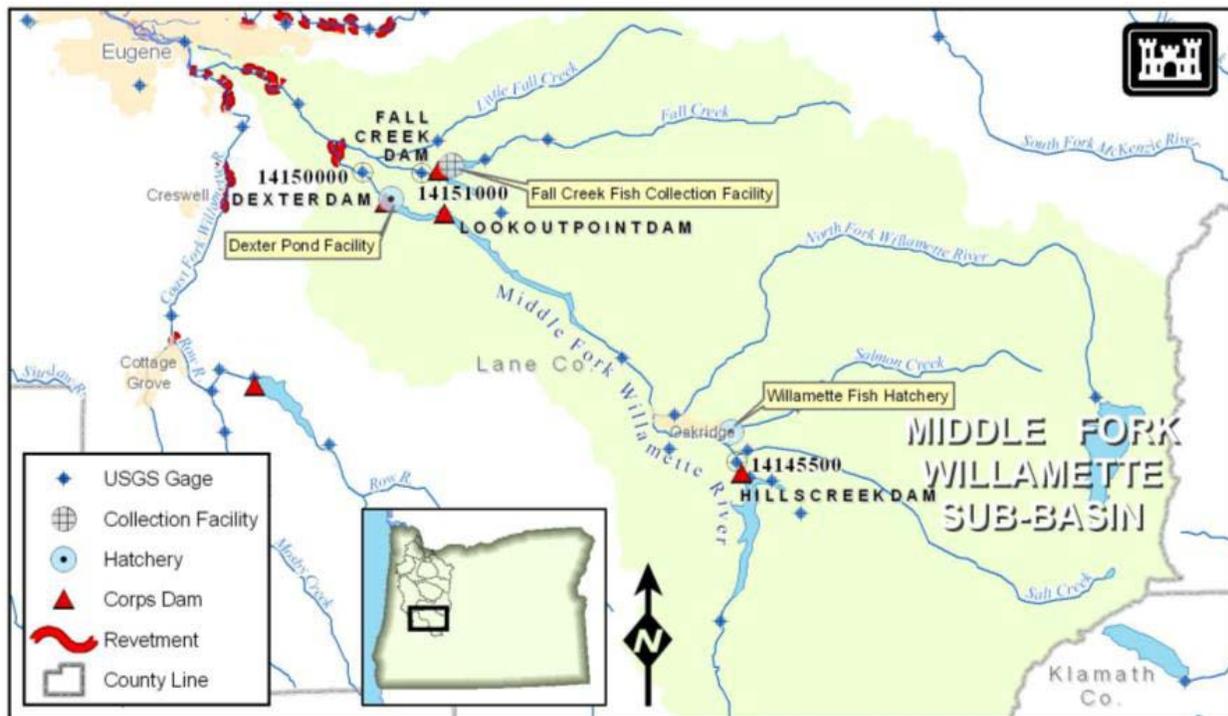
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Appendix D. Middle Fork Willamette Subbasin Fish Operations Plan

D.1. OVERVIEW

The Middle Fork Willamette subbasin drains about 1,370 square miles (Figure D-1). Four projects were constructed by the U.S. Army Corps of Engineers (USACE) in the subbasin. Hills Creek at river mile (RM) 47.8 on the Middle Fork Willamette River was completed in 1961. Lookout Point at RM 19.9 and Dexter at RM 16.8 on the Middle Fork Willamette River were completed together in 1955. Fall Creek Dam on Fall Creek (RM 7.9) was completed in 1965. The subbasin is inhabited by Upper Willamette River (UWR) spring Chinook salmon, Oregon chub, and bull trout, all of which are listed on the Endangered Species Act (ESA).

Figure D-1. Middle Fork Willamette Subbasin



D.2. FACILITIES

Fall Creek enters the Middle Fork Willamette River below Dexter Dam, while releases from Hills Creek and Lookout Point are reregulated by Dexter Dam on the Middle Fork Willamette. Current conditions below Dexter constrain potential Chinook salmon in-river production due to inadequate spawning and incubation temperatures, a result of water management operations in the subbasin. Outplanting of adult spring Chinook salmon is carried out upstream of Hills Creek, Lookout Point, and Fall Creek dams. Fall Creek is operated to assist with juvenile outmigration in the winter months through an enhanced reservoir draw-down. This provides juvenile fish access to the release outlet by reducing the overall distance fish

must sound to find an egress. No operations are performed at Dexter, Lookout Point, or Hills Creek to support juvenile downstream fish passage.

Hills Creek, Dexter, and Fall Creek are all operated remotely via the Supervisory Control and Data Acquisition (SCADA) system. Lookout Point does not use the SCADA system and all control is handled locally. The precision of the SCADA controls or equipment are not finely tuned enough to adjust the amount of water through Lookout Point to meet small flow changes as required by the project schedule. Additionally, there can be a long lag time (30-60 minutes) from when an operational change is made at and when the control can verify the change recorded at the nearest downstream U.S. Geological Survey (USGS) gages (Dexter gage #14150000, Fall Creek gage #14151000).

D.2.1. Hills Creek Dam

Hills Creek is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, hydropower generation, recreation, navigation, municipal and industrial water supply, and improved downstream water quality. The dam is an earthfill structure with gated concrete spillway containing three tainter gates. Maximum dam height is about 300 feet with the top of dam at elevation 1,548 feet. There are two slide regulating gates and two emergency regulating gates. The powerhouse has two turbines that can produce a total of 30 megawatts (MW). The project is operated using turbines and regulating outlets (RO), if needed. The spillway is only for emergencies. Hills Creek operates as a base load project, conforming to flow limits and ramping rates as described in table D1. Flow and power generation are primarily functions of reservoir levels and the amount of storage in Lookout Point, other streamflow requirements, and special project considerations.

D.2.1.1. Turbines

Hills Creek Dam has two Francis turbines rated at 15 MW each. The combined hydraulic capacity through the turbines at Hills Creek Dam ranges from 1,500 to 1,700 cubic feet per second (cfs) depending on head. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

D.2.1.2. Spillway Gates

Hills Creek Dam has two radial tainter spillway gates and a spillway crest at elevation 1,495.5 feet. The spillway is used only for emergencies.

D.2.1.3. Regulating Outlets

Hills Creek Dam has two ROs that are controlled with vertically sliding gates either locally or from the control room at Lookout Point. At Hills Creek, RO gate #2 currently has a set point of 1 foot in case the turbine wicket gate openings go to zero indicating the turbines have tripped off. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot and the SCADA system dial is set to 0.01-foot increments. The precision of the gate adjustments limits the fine-tuning of RO flows which increases the probability of missing a target flow.

D.2.2. Dexter Dam

Dexter Dam is a re-regulation project located downstream of Lookout Point (Figure D-1). Dexter is used to control water levels created by peak hydropower generation at Lookout Point. By holding back water released from Lookout Point then releasing it slowly, Dexter regulates downstream river fluctuations. Dexter Dam is earth and gravel-fill with one turbine and a concrete gated spillway that has seven tainter gate operated spillbays.

D.2.2.1. Turbines

Dexter Dam has one Kaplan turbine rated at 15 MW. Dexter pool maintains a relatively steady range; thus, the hydraulic capacity is typically 4,200 cfs. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

D.2.2.2. Spillway Gates

Dexter Dam has seven radial tainter spillway gates. The spillway crest is at elevation 702.5 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the spillway gate position, or through the SCADA system. Spillbay #1 currently has a set point of 1 foot in case the turbine wicket gate opening goes to zero indicating the turbine as tripped off. At Dexter Dam, there is only one speed that the spillway gate can be opened or closed, (there is no variable frequency drive). The mechanical dial measures the amount of gate opening locally at the projects. The mechanical dial for each gate indicates the opening of the respective gate. The dial is read in situ [at the top of the spillway]. They are inscribed only in 1-foot increments, which limits the precision with which flow changes can be set.

D.2.2.3. Regulating Outlets

Dexter Dam does not have ROs.

D.2.3. Lookout Point Dam

Lookout Point is a multi-purpose storage project that operates with Dexter to meet the same authorized purposes as Hills Creek Dam. The dam is earth and gravel-fill with a concrete-gated spillway. The spillway has five spillbays and four regulating outlets.

D.2.3.1. Turbines

Lookout Point has three Francis turbines rated at 40 MW each. The combined hydraulic capacity through the turbines ranges from 7,200 to 8,100 cfs depending on head. Turbines are adjusted by making changes to the wicket gate openings. Small flow changes can be difficult due to wicket gate limitations.

D.2.3.2. Spillway Gates

Lookout Point Dam has five radial tainter spillway gates. The spillway crest is at elevation 887.5 feet. The gates can be controlled locally via a control panel with a mechanical dial detailing the spillway gate position. Lookout Point has no set point for the spillway because it is staffed 24 hours a day so the operator on duty takes any necessary actions.

D.2.3.3. Regulating Outlets

Lookout Point Dam has four ROs. The ROs are not used when the pool level is above 915 ft. There is only one speed that the RO gates can be opened or closed. A staff gage is used to measure the opening locally. Readings on the staff gage are spaced at 0.1 foot. The precision of the gate adjustments limit the fine-tuning of RO flows. The dial used to make RO changes at Lookout Point is highly inaccurate.

D.2.4. Fall Creek Dam

Fall Creek Dam is a multi-purpose storage project that operates to meet the authorized purposes of flood damage reduction, irrigation, recreation, navigation, municipal and industrial water supply, and improved downstream water quality. Fall Creek Dam is a rockfill structure with a gated concrete spillway with two tainter gate operated spillbays. There is no power generation at Fall Creek Dam and no other dams immediately below Fall Creek Dam. There are two ROs and a special regulating outflow structure collectively called the fish horn.

D.2.4.1. Turbines

Fall Creek does not have turbines.

D.2.4.2. Spillway Gates

Fall Creek has two radial tainter spillway gates and a spillway crest at elevation 791.5 feet. The spillway is used only for emergencies.

D.2.4.3. Regulating Outlets

There are two ROs and a special regulating outflow structure collectively called the fish horn.

D.2.4.4. Fish Horns

Fall Creek has nine fish horns that allow water to be pulled from various elevations in the reservoir. They were originally put in place to pass fish, but it was later determined that survival was low. The fish horns are now used mainly to supply water for the adult fish collection facility at the base of the dam and for water temperature control operations since the openings are located at different elevations in the reservoir. Although survival is low, some fish still pass through the fish horns because they are attracted to the flow. The fish horns are controlled locally by the Lookout Point operators and are either open or closed.

D.2.5. Dexter Fish Facility

The Dexter Fish Facility consists of a fish ladder, adult holding pond, fish lock, and a sorting area. The facility also had 4 raceways and an asphalt pond used for rearing juvenile salmonids.

D.2.6. Fall Creek Fish Facility

The Fall Creek Fish Facility consists of a fish ladder, presort holding pond, fish crowder, and a hopper.

D.3. OPERATIONS

D.3.1. Tributary Flow Targets

Hills Creek operates as a base load project, conforming to flow limits and ramping rates shown in Table D-1. Flow and power generation is primarily a function of reservoir levels and amount of storage in Lookout Point, other streamflow requirements, and any special project considerations. Minimum outflows are set at 400 cfs year-round. The normal high evacuation rate is 6,000 cfs and the maximum evacuation rate is 8,000 cfs (Table D-1). For unusual and sustained storm events, project outflow may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the storm peak due to a full reservoir. Outflow above about 12,000 cfs (assuming both turbines and ROs are available) would require use of the spillway, which could impact the powerhouse.

Table D-1. Flow Rates and Ramp Rate Requirements for Hills Creek Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water	
Normal	6,000 cfs
Maximum*	8,000 cfs
High Flow Period (> 1,500 cfs)	
Minimum Flow	400 cfs
Rate of Increase per hour	
50-1,000 cfs	300 cfs
1,000-5,000 cfs	500 cfs
5,000-8,000 cfs	800
Maximum Rate of Increase per hour	1,500 cfs
Rate of Decrease per hour	
Maximum	4,000 cfs
Low Flow Period (< 1,500 cfs)	
Minimum Flow	400
Rate of Increase	
Normal	200 cfs/hr
Maximum	200 cfs/hr
Maximum Tailwater Change in 24 hours	200 cfs/hr
Maximum Rate of Decrease	
Nighttime Decrease	
400-1,700 cfs	100 cfs/hr
> 1,700 cfs	0.2 ft/hr
Daytime Decrease	0.2 ft/hr
Maximum Total Daily Decrease	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

Fall Creek has a variable seasonal minimum flow. From October to March, the minimum outflow is 50 cfs. It then increases to 80 cfs during April to August and is set at 200 cfs from September 1 through October 15 (Table D-2). The normal evacuation rate during associated with high water events is 3,800 cfs with a maximum evacuation rate of 4,500 cfs. In cases of unusual and sustained storm events, the project outflow at Lookout Point may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. During the summer flow augmentation season, project maximum outflow is usually capped in order to balance flow from the various projects. For example, in 2009 the recommended cap was no greater than 1,000 cfs with a full pool and was gradually reduced to 50 cfs based on the amount in storage.

Lookout Point has three turbines that are used for power peaking that can result in rapid changes in discharge rates ranging from zero to 8,100 cfs. Dexter re-regulates the discharge fluctuations from load-following operations at Lookout Point. This re-regulating operation causes the elevation of Dexter Lake to fluctuate up to 5 feet daily, while keeping discharge rates to the Middle Fork Willamette much more constant with flow limits and ramping rates. Outflows from Lookout Point are referenced at the Dexter re-regulation dam. The minimum flow from Dexter year-round is 1,200 cfs. During flow augmentation, the maximum flow is set at 2,700 cfs. Under high water conditions, the maximum flow through Dexter is 12,000 cfs (normal evacuation conditions) and 15,000 cfs as a maximum evacuation rate (Table D-3). In cases of unusual and sustained storm events, the project outflow at Lookout Point may be increased gradually above the maximum evacuation rate using a prescribed formula to avoid passing inflow at the peak of the storm due to a full reservoir. This water is then passed through Dexter reservoir.

Table D-2. Flow Rates and Ramp Rate Requirements for Fall Creek Dam

Time Period or Criterion	Target
Evacuation of Stored Flood Water	
Normal	3,800 cfs
Maximum*	4,500 cfs
High Flow Period (> 700 cfs)	
Minimum Flow	50 cfs
Rate of Increase per hour	
Normal	
50-1,000 cfs	300 cfs
1,000-4,000 cfs	500 cfs
Maximum Rate of Increase per hour	800 cfs
Rate of Decrease per hour	20% of flow
Low Flow Period (< 700 cfs)	
February 1-March 31	50
April 1-August 31	80
September 1-October 15	200
October 16-January 31	50
Rate of Increase	
Normal	200 cfs/hr
Maximum	200 cfs/ ½ hr
Rate of Decrease	
Nighttime Decrease	
50-500 cfs	50 cfs/hr
> 500 cfs	0.1 ft/hr
Daytime Decrease	
50-300 cfs	50 cfs/hr
> 300 cfs	0.2 ft/hr
Maximum Total Daily Decrease	1.0 ft/day or 50% of flow

* Project outflows during major flood events may exceed these levels.

Table D-3. Flow Rates and Ramp Rate Requirements for Dexter Dam

Time Period or Criterion	Target
High Flow Period (> 3,000 cfs)	
Minimum Flow	500 cfs
Maximum Flow*	15,000
Rate of Increase per hour	
500-1,000 cfs	500 cfs
1,000-4,000 cfs	1,000 cfs
4,000-15,000 cfs	1,500 cfs
Maximum Rate of Increase per hour	2,500 cfs

Time Period or Criterion	Target
Rate of Decrease per hour	
Normal	
500-2,000 cfs	700 cfs
2,000-5,000 cfs	1,500 cfs
5,000-10,000 cfs	2,500 cfs
10,000-20,000 cfs	5,000 cfs
Low Flow Period (< 3,000 cfs)	
Minimum	1,200 cfs/hr
Rate of Change	
Increase	0.2 ft/hr and 0.5 ft/day
Daytime Decrease	0.2 ft/hr
Nighttime Decrease	0.1 ft/hr
Total daily Decrease	0.5 ft/day

* Project outflows during major flood events may exceed these levels.

D.3.2. Rates of Flow Change (24 hour, day and night)

Since 2006, the USACE has limited the maximum down-ramping at all three projects on the Middle Fork Willamette River to follow general ramping rate guidelines of 0.1 foot/hour during nighttime and to 0.2 foot/hour during daytime unless such restriction has been infeasible with existing equipment at the dam (Tables D-1 to D-3; USACE et al. 2007). The result has been adherence to these down-ramp rates at designated flow rates. During the winter high inflow period, the projects may ramp down at rates higher than the recommended 0.1- to 0.2-foot/hour guidance. The allowance is for those cases where unanticipated conditions require flow reductions in order to control downstream control points for human health and safety considerations.

Hills Creek Dam may ramp down at 4,000 cfs per half hour with a recommended reduction rate of 20% of the previous hours outflow. Dexter Dam maximum ramp downs are based on a sliding scale. With initial outflows between 1,200 and 2,000 cfs, the maximum ramp down is 700 cfs/hour. From 2,000 to 5,000 cfs, the ramp down is 1,500 cfs/hour, and at 5,000 to 10,000 cfs, the ramp down may be 2,500 cfs. Above 10,000 cfs with a limit to 20,000 cfs, the ramp down is 5,000 cfs/hour. At Fall Creek, there is no set ramp down limit but 20% per hour is the recommended ramp down rate during high flow periods.

Ramp up rates at the projects would generally follow the general ramping guidelines but during the wet season, higher ramp ups are allowed and needed to control reservoir storage for flood damage reduction operations.

D.3.3. Downstream Fish Passage Operations

Fall Creek Dam is operated to assist with juvenile outmigration in the winter months through an enhanced reservoir drawdown. This provides the juvenile fish access to the release outlet by reducing the overall distance fish must sound to find an egress. No specific operations are performed at Dexter, Lookout Point, or Hills Creek to support juvenile downstream fish passage. However, a surface spill operation was conducted in 2013 to govern temperatures that may have provided benefits to juvenile fish by providing passage.

Special, interim, and other operations to provide fish passage are listed below (see Fish Operations Appendix for more details):

Hills Creek Dam: None

Lookout Point Dam: Currently, there are no operations that specifically provide fish passage. However, the temperature management operation at Lookout Point Dam below may provide passage benefits.

Dexter Dam: None

Fall Creek Dam: Reservoir drawdown is implemented during winter months to facilitate downstream passage of juvenile salmonids.

D.3.4. Operations to Limit Total Dissolved Gas

Dams in the Middle Fork Willamette River generate TDG supersaturation when their spillways are operated. The extent of TDG saturation is dependent on the type and duration of operations. While spill primarily occurs involuntarily due to high-flow events during winter months, spill also occurs infrequently in other months during powerhouse outages or late spring rainstorms.

Special, interim, and other operations to minimize negative impacts from total dissolved gas levels are listed below:

Hills Creek Dam: Spill will be spread across bays or other outlets control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

Lookout Point Dam: Spill will be spread across bays or other outlets control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

Dexter Dam: Spill will be spread across bays or other outlets control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

Fall Creek Dam: Spill will be spread across bays or other outlets control TDG when not generating or when flows exceed turbine capacity. Minimum gate openings may restrict this action depending on the desired outflow.

D.3.5. Operational Water Temperature Control

D.3.5.1. Hills Creek Dam

Currently, Hills Creek Dam is not designed to be operated for downstream water temperature management, as there are no available surface outlets to discharge warm epilimnetic water from the reservoir. The spillway at the dam is only for emergency use; therefore, a structural solution would likely be needed to improve water temperatures below the dam.

D.3.5.2. Lookout Point/Dexter Dams

Water temperature management operations are conducted at Lookout Point from June through early September. Water temperature operations consist of using the existing outlet configurations at Lookout Point including the spillway and powerhouse penstock. The objective is to improve water temperatures

downstream of the project for anadromous fish species listed under the ESA, by providing temperatures that were slightly warmer in the summer and cooler in the fall than what is typical from normal project operations.

The water temperature operations include a 50/50 split blend of spillway and turbine discharge release to moderate downstream water temperatures. The reservoir elevation is held near 900 feet during the water temperature operations to ensure the ROs can be used safely and within specs in the event that the turbines became unavailable.

Table D-4. Monthly Temperature Targets for Middle Fork Willamette River below Dexter Dam

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

D.3.5.3. Fall Creek Dam

The WVP operates the fish horns combined with the deeper elevation ROs to provide some water temperature management downstream of the dam. Inflow temperatures measured upstream of the reservoir are used as the target temperatures, and operators adjust outflows from the varying outlets to try and achieve similar water temperatures downstream.

D.3.6. Recommended Spillway Gate and Regulating Outlet Operations

D.3.6.1. Fall Creek Dam

Currently, minimum flow is not provided by the ROs but by using the fish horns when the adult trapping facility is operating. The ROs are used in winter months for passing flows for the extended drawdown operation to pass juvenile Chinook from the reservoir (Figure D-2). Passing minimum flow through the RO (50 cfs) during the Fall Creek adult trap rebuild may need to be considered.

D.3.6.2. Hills Creek Dam

No recommendation at this time.

Figure D-2. Fall Creek Dam Spillway Gates and Regulating Outlets



D.3.6.3. Lookout Point Dam

When spilling at Lookout Point, TDG levels may be elevated and reach the hatchery intake located in the Dexter forebay. Data collected indicates that spill through spillway gates #1 and #2 and ROs #1 and #2 (Figure D-3) would limit the amount of TDG that is present during high spill events at Lookout Point, and limit exposure to fish being held at the Dexter Fish Facility below Dexter Dam.

Figure D-3. Lookout Point Dam Spillway Gates and Regulating Outlets



D.3.6.4. Dexter Dam

Spillway gate #1 (Figure D-4) should be prioritized when the unit is off-line or outflow exceeds unit capacity during operation of the Dexter adult fish trap (May 1st through October 31st). Releases provided through the powerhouse and spillway gates nearest the powerhouse provide attraction flow for adults to the collection facility. Spillway gates are used to spread spill during incubation period from September through March (prioritize unit and spillway gate #1 during Dexter adult fish trap operations).

Figure D-4. Dexter Dam Spillway Gates



D.4. FISH FACILITIES AND OPERATIONS

D.4.1. Juvenile Fish

D.4.1.1. Willamette Hatchery

The Willamette Hatchery is situated on 75 acres near the town of Oakridge, Oregon. The hatchery is composed of the original trout hatchery, situated near the entrance and the old salmon hatchery, which is immediately adjacent to the trout facility. All Willamette stock spring Chinook salmon are reared at Willamette Hatchery or Dexter Ponds. The Willamette Hatchery is also used for rearing South Santiam spring Chinook salmon, summer steelhead, and rainbow trout. The hatchery has a total of 1,005 incubators that allow for the incubation of 9 million eggs. There are 40 raceways (80-feet long by 20-feet wide by 3-feet high), 10 larger raceways (100-feet long by 20-feet wide by 6-feet high), four 20-foot circulars, 13 Canadian-style starter troughs, and 2 show ponds.

The holding facility at Willamette Hatchery was constructed in a former side channel of Salmon Creek. The earthen pond is 25-feet wide by 275-feet long, has a depth of approximately 2.5 feet, and is inadequate regarding size and structure. The flow rate is approximately 1,500 gpm. Adult broodstock are held in this pond and are injected with antibiotics on a monthly basis.

D.4.2. Adult Fish

Several species of fish arrive at Dexter Ponds throughout the year, including hatchery and wild UWR spring Chinook salmon and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the Dexter trap are determined by balancing goals for natural production, the spring Chinook salmon outplant program, hatchery management, and harvest opportunities; while ensuring that tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel.

In recent years, the majority of excess spring Chinook salmon broodstock have been collected and transported to unseeded, historical habitat in efforts to reestablish natural production. In the Middle Fork Willamette subbasin, adult spring Chinook have been released into the North Fork Middle Fork upstream of Lookout Point reservoir, into the Middle Fork Willamette upstream of Hills Creek reservoir, and into Salt Creek.

D.4.2.1. Dexter Ponds Fish Facility

Dexter Ponds Fish Facility, located at the base of Dexter Dam, is a satellite facility associated with Willamette Hatchery and is used to capture adult fish, provide juvenile rearing capacity, and serve as an acclimation facility for juvenile releases. All Middle Fork Willamette spring Chinook salmon broodstock are collected at Dexter Ponds and transported to a holding pond at Willamette Hatchery until spawning. Summer steelhead also are reared at Dexter Ponds for a short period of time. Dexter Ponds has four raceways (135-feet long by 18-feet wide by 8-feet high) and an asphalt pond (172-feet long by 64-feet wide by 8-feet high).

Broodstock is collected at the Dexter Ponds. The fish voluntarily swim up a fish ladder located at the base of Dexter Dam, then swim through a V-notch weir into the adult trap. Some steelhead are captured and released back into the river. There is a single adult collection pond at Dexter Ponds. The concrete pond has a volume of 3,848 cubic feet (74-feet long by 13-feet wide by 4-feet high). The pond can accommodate a flow rate of up to 18,000 gpm.

Adults used for broodstock purposes are collected from Dexter Ponds. Adults are collected in representative numbers throughout most of the run from mid-June to October (Table D-5). Fish returning to the trap prior to its opening in mid-June likely hold in the Middle Fork Willamette River downstream of Dexter Dam, and it is possible that sufficient mixing occurs to obtain a broodstock collection that is representative of the entire run. In some years, trap and temperature limitations may result in an overrepresentation of the middle of the run.

Table D-5. Dexter Dam Trap Operation and Fish Migration Timing (trap only operates from Jun-Oct).

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Hatchery Operating												
Spring Chinook												
Summer Steelhead												

D.4.2.2. Dexter Fish Facility Operations and Maintenance

All routine maintenance at the Dexter trap will occur while the facilities are closed, with the exception of emergency maintenance to maintain optimal operating conditions at the trap or if trapping activities are causing injury to fish encountering the facility.

In general, scheduled fish facility maintenance, to the extent practicable, will be conducted following the completion of passage, holding, or acclimation seasons when the facilities are closed. If not practical or when maintenance is needed during times when operating, maintenance will occur when impacts are determined to be the lowest based on adult returns. This will minimize fisheries impacts during emergency maintenance during the adult fish passage season or during the holding of hatchery juveniles prior to release.

D.4.2.3. Fall Creek Fish Facility

The Fall Creek Fish Facility consists of a fish ladder, presort holding pond, fish crowder, and a hopper.

D.4.2.4. Fall Creek Fish Facility Operations and Maintenance

The Fall Creek Fish Facility will be operated from April 1 to September 30 unless there is a need to extend operations. Only unclipped salmonids native resident fish species are placed above Fall Creek Dam. The exception is Northern Pikeminnow that are placed back into the tailrace. All routine maintenance at the Fall Creek Fish Facility will occur while the facilities are closed, with the exception of

emergency maintenance to maintain optimal operating conditions at the trap or if trapping activities are causing injury to fish encountering the facility.

In general, scheduled fish facility maintenance, to the extent practicable, will be conducted following the completion of passage, holding, or acclimation seasons when the facilities are closed. If not practical or when maintenance is needed during times when operating, maintenance will occur when impacts are determined to be the lowest based on adult returns. This will minimize fisheries impacts during emergency maintenance during the adult fish passage season.

D.4.3. Adult Collection

D.4.3.1. Broodstock Collection Guidelines

Broodstock collection guidelines were presented in the NMFS BiOp (NMFS 2008) for the Middle Fork Willamette Basin spring Chinook salmon program. Broodstock collection will be detailed in the spring Chinook salmon HGMP for the Middle Fork Willamette Basin.

D.4.3.2. Annual Adult Fish Disposition Guidelines

Disposition of adult fish will be determined annually at the WATER Hatchery Management Team and published or attached in the WFOP upon finalization.

D.5. DISPOSITION OF FISH COLLECTED AT ADULT TRAPPING FACILITIES

D.5.1. Goals, Objectives, Strategies and Protocols for Outplanting Adults

The 2014 draft Hatchery and Genetic Management Plan (HGMP), *Middle Fork Willamette Chinook HGMP for the Middle Fork Willamette River Spring Chinook*, developed goals, objectives, strategies, and protocols for releasing adult spring Chinook salmon into historical habitat in the Middle Fork Willamette subbasin.

The following information is modified from this HGMP.

D.5.1.1. Goals and Objectives

Overall Natural Production Goal

Manage the Middle Fork Willamette spring Chinook salmon program and returns to fish collection facilities in the Middle Fork Willamette subbasin, in order to promote establishment and maintenance of a viable population of naturally reproducing spring Chinook salmon in the subbasin.

Objective 1. Evaluate the potential to establish a naturally reproducing population of spring Chinook salmon in historic habitat upstream of dams in the Middle Fork Willamette subbasin to increase natural production, avoid jeopardy, and aid in the recovery of UWR spring Chinook salmon.

- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat upstream of USACE dams in the Middle Fork Willamette subbasin to evaluate the potential for long-term reintroduction.

- Release hatchery or a combination of hatchery and natural-origin fish into inaccessible habitat, with the long-term intention of releasing only naturally produced fish should it provide a net benefit to the Middle Fork Willamette spring Chinook salmon population.
- Release hatchery or a combination of hatchery and natural-origin fish into historical habitat in tributaries downstream of USACE dams that historically supported spring Chinook salmon.

Objective 2. Meet legal and policy standards, including those under the ESA, established by the Technical Recovery Team, and viability criteria identified in the *Oregon Native Fish Status Report* (ODFW 2005) or other recovery planning efforts.

Objective 3. Ensure that outplanted fish represent the life history characteristics of the natural population and promote successful production.

Objective 4. Reduce mitigation production of hatchery fish in the Middle Fork Willamette subbasin if natural production increases as a result of the outplanting program.

D.5.1.2. Strategies

Upstream of Hills Creek, Lookout Point, and Fall Creek Dams and Reservoirs

Proposed Releases. Continue to release hatchery-origin adult Chinook salmon in the areas above Hills Creek and Lookout Point dams, while evaluating the success of preliminary reintroduction efforts. Continue to release only wild or naturally produced spring Chinook and steelhead above Fall Creek Dam.

Long-term Strategy. The long-term intent of the program is to release only natural-origin fish when production and survival above Hills Creek and Lookout Point dams and reservoirs are high enough to support a self-sustaining run. Information on the survival of outplanted adults and juvenile passage through the reservoirs and dams is necessary to evaluate the outplant program, to determine the net benefit to releasing natural-origin adults upstream of the dams, and to determine if long-term reintroduction is feasible. Continue to release only wild or naturally produced spring Chinook and steelhead above Fall Creek Dam.

D.5.1.3. Protocols for Outplanting Adults

The protocols for planting fish in historical habitat for Middle Fork Willamette spring Chinook salmon are essentially the same as for North Santiam spring Chinook salmon (see Appendix A). Specific information for the Middle Fork Willamette that differs from the North Santiam is provided below.

The following sections describe the past, proposed, and long-term protocols for the spring Chinook salmon reintroduction and outplanting program. The past operations sections describe general operation of the outplanting and reintroduction program prior to 2006. These efforts focused on transporting the majority of excess hatchery fish using normal Integrated Hatchery Operations Team (IHOT) transportation guidelines and protocols for loading and transport. Adults transported using these techniques have suffered extremely high rates of pre-spawning mortality. Fish were transported at relatively high densities and released in sub-optimal locations using techniques that likely caused significant additional stress and/or physical injury.

1. Target Number of Fish to Release

Proposed Operation. The current program involves releasing fish according to the targets identified in Table D-6. Detailed protocols for the disposition of excess hatchery fish will be contained in the WFOP. These goals will be updated annually by the WATER Fish Passage and Hatchery Management Committee. When numerical adult abundance recovery goals are established for the South Santiam spring Chinook salmon population through the recovery planning process, these targets will be adjusted accordingly.

Table D-6. Proposed Number of Adult Spring Chinook to be Outplanted

Location	Target Number of Fish	Origin	
		Hatchery	Natural
Middle Fork Willamette, upstream of Hills Creek Reservoir	1,100	X	0
North Fork Middle Fork Willamette, upstream of Lookout Point Reservoir	1,350	X	0

Detailed protocols for the disposition of excess hatchery fish will be contained in the *Fish Disposition and Outplant Protocols* section of the *Willamette Fish Passage and Management Plan* (as described in USACE et al. 2007). These goals will be updated annually by the FPHM Team, based on predicted run size, results of RM&E, and the construction of new infrastructure affecting the ability to collect or release fish in the Middle Fork Willamette subbasin. Because returns may fluctuate annually, the plan for outplant releases also incorporates variability in outplanting numbers. In years when the returns to Dexter trap are low, then ODFW will release available fish according to the ratios described in the table. Likewise, if returns are high and the number of available fish exceeds these amounts, then fish will be released in excess of these targets in the same general ratios. The annual plan for releases in each location will be determined by expected returns to the Middle Fork Willamette River based on returns to Willamette Falls. Target outplanting releases are shown in Table D-6. When numerical adult abundance recovery goals are established for the Middle Fork Willamette population through the recovery planning process, these targets will be adjusted accordingly. However, the ability to implement targets may be limited by the availability of liberation trucks and hatchery staff.

Long-term Strategy

- Maximize adult survival to spawning and adjust target releases accordingly (based on reductions in pre-spawning mortality and improvements in survival at other life stages).
- Reduce the numbers or ratio of hatchery-origin fish released above Hills Creek and Lookout Point dams. Eventually, release only natural-origin fish in these areas.
- Eliminate the need to outplant hatchery-origin adults in areas upstream of dams. In the long term, collect and release only natural-origin adults collected at Dexter Ponds into habitat upstream of each dam.

2. Sex and Age Composition of Outplanted Fish

Proposed Operation. To the extent possible, adjust the sex ratio of releases based on known differences in pre-spawning mortality between males and females to maximize reproductive success. Ensure an adequate number of females are outplanted to seed available habitat.

Long-term Strategy. Explore the potential benefits of releasing adults according to the age and sex distribution that occurs naturally at Dexter Ponds. Ensure that the minimum number of females are transported to achieve the desired target number of redds.

3. Run Representation of Outplanted Fish (seeding rate by run size by month)

Proposed Operation. Continue to collect adult fish at the Dexter Ponds Fish Facility. The USACE is considering plans to rebuild Dexter Ponds to improve attraction flows and reduce adult handling via automated sorting (NMFS 2008). The FPHM Team will develop the annual guidelines regarding when to outplant fish to each location.

Long-term Strategy. Collect fish on a regular basis throughout the run and outplant when collected, ensuring temporal outplants are representative of run strength. However, pre-spawning mortality of early-released fish may be high and thus should be monitored to ensure effectiveness of this strategy.

4. Handling Protocols for Outplanted Fish

Proposed Operation. During processing/sorting, the anesthetic used will be dependent upon whether a fish will be: for brood, returned to the fishery, outplanted, sampled for RM&E, or surplus (e.g. sold, food bank). Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date if not likely to survive. Fish will be handled as gently as possible during processing and loading onto the truck, attempting to minimize stress and skin abrasions associated with handling.

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur unless not likely to survive.¹
- Healthy fish will be used for both broodstock collection and outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for Dexter after the rebuild.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.

¹ Past practice was to grade out fish that appeared to be unhealthy and plant those upstream of Foster Dam.

- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.
- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

Long-term Strategy. The new Dexter adult fish facility will be used for collection of broodstock, passage above Dexter Dam, and for reintroduction efforts above projects in the Middle Fork Willamette River. Most outplanted fish should be in good physical condition if available (i.e., no lesions, fungus, etc) to increase the likelihood of surviving to spawn. During initial processing/sorting, CO₂ may be used as anesthetic. During processing prior to outplanting, alternate anesthetics (MS-222 or Aqui-S, if approved) will be used if fish will not be subjected to a fishery. Fish will be moved out of the trap quickly and frequently. Poor condition fish will be rendered or outplanted as carcasses (nutrient enrichment) at a later date unless needed for other purposes. The facility was designed to minimize stress to fish, thus, all activities should complement this by minimizing any fish handling that may need to occur (e.g. multiple crowds).

In addition, the following protocols will be followed:

- Sorting of adult spring Chinook for brood production and outplanting shall be completed in manner that minimizes stress and injury.
- All efforts should be made to sort adult fish a single time.
- No grading of fish for outplanting or brood collection will occur.
- Healthy fish will be used in both broodstock selection and outplanting efforts.
- Sorting shall be completed to separate by species or origin (hatchery or wild) and to ensure an adequate sex ratio for outplanting and brood production.

The fish disposition table will be used to guide the management of anadromous and resident fish as they are encountered in the adult fish traps. To ensure captured fish are not overly stressed or injured, protocols are needed in regard to how long trapped fish are held prior to transport, broodstock collection, or recycling for fisheries. The following protocols will be followed by ODFW and incorporated into overall protocols for Dexter after the rebuild.

- Once fish are sorted, they will spend no longer than the allotted time that will be agreed to through the WATER process within holding tanks prior to being transported to their destination, which is determined by the fish disposition table.
- The fish trap will be checked at least twice a day, first in the morning, and then in the late afternoon to avoid having fish spend too much time in the trap and to assess the overall density of fish within the trap.
- Fish will be removed and placed in holding tanks with density ≤ 25 gallons of water per fish.
- Oxygen levels in the holding tank water should not exceed saturation (100%) or drop below 7 parts per million (7 mg/L).

5. Transport Protocols for Outplanted Fish

Proposed Operation. Elevated stress caused by high transport density may have contributed to the high incidence of pre-spawning mortality observed in fish outplanted above Hills Creek and Lookout Point dams. Beginning in 2006, fish will be loaded according to the NMFS recommended loading density of

approximately 25 gallons per fish (40 fish/1000 gallon; 50 fish/1200 gallon), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate them to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release.

All truck drivers will complete an adult Chinook salmon outplant form to document oxygen levels, temperatures in the tank and release stream, immediate mortalities, loading densities, and release method. These data will be used to enable better monitoring of outplanted fish.

Table D-7. Approximate Hauling Times and Distances from Dexter Ponds to Release Sites

Release Site	Distance (miles)	Transport time (minutes)
Middle Fork Willamette, upstream of Hills Creek reservoir	50	120
North Fork Middle Fork Willamette, upstream of Lookout Point reservoir	36	90
Salt Creek, upstream of Lookout Point reservoir	40	90

^a Transport time does not include loading time. Source: Modified from 2007 ODFW HGMP.

Long-term Strategy. Fish will be loaded according to the NMFS recommended loading density of approximately 25 gallons per fish (40 fish/1000 gal; 50 fish/1200 gal), although densities will be reduced if water temperatures are high. All transport tanks will be treated with Nov-Aqua to reduce stress during transport. Tanks will be aerated during transport, if possible. Trucks equipped with chillers will operate to prevent or reduce warming during transport and minimize change in temperature between the tank and in the release stream, to the extent possible. If the receiving water is warmer, fish are acclimated prior to release as specified in Section 2.3.1 of the main report. In addition, fish handling will cease once temperatures reach 70°F.

6. Release Protocols for Outplanted Fish

Proposed Operations

- Release sites. Continue to use the existing and new release sites, but identify potential new release sites that have adequate temperatures, are located near suitable holding areas, and are not located near areas with heavy human use to reduce harassment potential. Work with private landowners or the Forest Service to develop these areas into suitable release sites.
- Release methods. Have a minimum of a 12-inch opening on all release trucks. Discontinue use of collapsible tubes and use 16- to 20-inch smooth walled PVC pipe to convey fish from the truck to the stream. Set pipes at proper discharge angle and use discharge chutes. Use a water spout to flush fish from the truck. Avoid abrupt changes in temperature. Release fish early in the day whenever possible. If receiving waters are known to be too warm at certain times of year, release fish when or where waters are cooler. See Section 2.3.1 in the main report for more specific protocols. Investigate the options to improve survival such as holding fish in a hatchery pond and treating with antibiotics until they are ready to spawn, at which time they would be released. Releasing ripe fish may limit numbers outplanted and potentially reduce pre-spawning mortality.

- Monitoring. Fish liberation truck driver and/or trained volunteer will observe released fish and document any mortality and unusual behavior for 30 minutes after release.

Long-term Strategy

- Release sites. All fish would be released at sites that were selected based on suitable habitat and temperature.
- Release methods. All fish would be released using smooth-walled pipe as described above.
- Monitoring. Fish liberation truck driver and/or trained volunteer would observe released fish for mortality and unusual behavior immediately after release.

D.6. SCHEDULED AND UNSCHEDULED MAINTENANCE

D.6.1. Scheduled Maintenance

The annual maintenance periods discussed below for Hills Creek, Lookout Point, or Dexter dams are provided as applicable for the projects and will be adhered to during annual maintenance planning. Potential effects on ESA-listed fish include temperature, TDG, and flow-related impacts. No specified turbine unit maintenance period is needed for Fall Creek as there are no turbine units at the project.

Value of Power to BPA

- Nov-Feb: High historical power demand (minimize outages if possible).
- Mid July-Aug: High historical power demand (minimize outages if possible).
- Sep-Oct: Power demand fluctuates year to year (secondary to March-June time frame).
- Mar-Jun: Low historical power demand (schedule outages during this period if possible).

Hills Creek

Target outage periods:

- Mar 1-Jun 30: Primary scheduling period.
- Jul 1-Aug 31: Limited outage scheduling due to power valuation considerations.
- Sep 1-Oct 31: Secondary scheduling period.
- Nov 1-Feb 28: Limited outage scheduling due to power valuation considerations.

Considerations/Rationale for unit outage scheduling:

- No fish operations currently affect outage scheduling and therefore power valuations and historical stream flows will be the major factors affecting outage scheduling.

Lookout Point

Target outage periods:

- Mar 1-Apr 30: No limit on number of units simultaneously under outage.
- May 1-Sep 30: Limited to one unit at a time in outage status.
- Oct 1- Oct 31: No limit to number of units simultaneously under outage.
- Nov 1-Feb 28: Limit outages for power demand considerations.

Considerations/Rationale for unit outage scheduling:

- May 1-Sep 30: At least one unit is required for temperature control. If all units must be taken off line during this period, the month of May is preferred.
- Nov 1-Feb 28: Minimize spill in order to maintain low TDG for sac fry. Spillway gates 1 and 2 are preferred due to TDG concerns. Experience has shown that less TDG flows through Dexter reservoir when spillway gates 1 and 2 at Lookout Point are used.

Dexter

Target outage periods:

- Feb 1-Feb 28: Limit scheduled outages for power demand considerations.
- Mar 1-Apr 30: Primary target period.
- May 1-May 31: Secondary target period.
- **Jun 1-Jun 30: Restricted from outage scheduling.**
- Jul 1-Oct 31: Limit scheduled outages as much as possible in consideration for adult fish facility operations.
- **Nov 1-Jan 31: Restricted from outage scheduling.**

Considerations/Rationale for unit outage scheduling:

- Jun 1-Oct 31: Minimize generation outages as much as possible in order to maintain attraction flow to the Dexter fish facility provided by unit flow. If generation outage cannot be avoided, use closest available spillway gate to the unit as possible.
- Nov 1-Jan 31: Generation outages are restricted in order to prevent high levels of TDG that has negative impacts on sac fry.

D.6.2. Unscheduled Operations and/or Maintenance

Atypical operations may occur due to either RM&E activities, natural hydrologic conditions, planned maintenance, or during unforeseen events such as outages or unplanned maintenance. During these events, operations may not be optimal for aquatic species and may disrupt, or impact fisheries and/or water quality based operations depending on the specific project or time of year.

Real-time management of reservoir operations may require atypical or emergency operations (including maintenance) and may be implemented immediately depending on the severity of the issue.

Instream flow reductions below the minimum targets identified in the 2008 BiOps and ramp rates exceeding current flow change targets may impact spring Chinook salmon downstream of projects, and Oregon chub.

- December through July – Ramping from atypical operations may strand/isolate juvenile fish.
 - Period when spring Chinook salmon fry, susceptible to ramping, may be present below the dams.
- May through November 15th – Ramping from atypical operations may impact spring Chinook salmon migration and spawning behavior.
 - Period of spring Chinook salmon migration, spawning and incubation.
 - Period of adult trapping.

D.7. RECOMMENDATIONS TO REDUCE POTENTIAL EFFECTS OF UNSCHEDULED MAINTENANCE/OPERATIONS

Provided below are the recommendations to operations and or maintenance (both planned and unplanned) that are suggested to minimize potential negative effects.

D.7.1. Spill

Spill should be maintained to a level below the 110% saturation level below Dexter and Fall Creek dams during the following sensitive periods if possible:

- September through December
 - Protects spawning and incubating spring Chinook in downstream reaches.

D.7.2. Downstream Water Temperatures

The USACE will continue to implement and evaluate temperature control operations at Hills Creek and Lookout Point/Dexter Dams to further improve downstream water quality conditions for ESA-listed fish species. Currently, some improvements have been made below the Lookout Point/Dexter complex and water temperatures measured in 2012 were below lethal levels for the first time in recent history. Future modifications to water temperature management operations will continue to be documented in the WFOP.

At Fall Creek Dam, temperature control is limited to the use of the fish horns that provide flow to the Fall Creek adult trapping facility. During operation, the horns are used in a manner to discourage downstream passage yet provide some amount of temperature control to assist in efficient trapping operations and to benefit the downstream aquatic habitat. This operation is constrained due to the horn elevations, seasonally changing reservoir elevations, and limitations on flow that can be provided. Operations of the horns and modifications are determined by the USACE Project Operations Biologist who operates the fish trapping facility. Period of use is determined annually by meteorological conditions, reservoir elevations, timing in regards to spring Chinook salmon return, and other factors.

- June through October (as determined by Project Operations Biologist).
- All maintenance and construction activities that may impact temperature control operations should be completed between November and May.

Table D-8. Periodicity Table for Spring Chinook Salmon in the Middle Fork Willamette below Dexter Dam

Life Stage/Activity/Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Comments	
Upstream Adult Migration				[Peak Use]				[Lesser Use]					based on Dexter captures	
Adult Spawning									[Red]	[Red]	[Red]			
Adult Holding				[Lesser Use]									based on Dexter captures	
Egg Incubation through Fry Emergence	[Peak Use]	[Peak Use]							[Lesser Use]	[Red]	[Red]	[Red]	[Red]	incubation & emergence accelerated 2-3 mo. because of warm water dam releases Emergence based on field observations and TU calculations; often high egg mortality below Dexter
Juvenile Rearing														
All life stages	[Peak Use]													
Fry	[Peak Use]			[Peak Use]				[Lesser Use]						peak period of rearing of fry based on trapping field data (2011-2013)
Subyearling				[Peak Use]				[Lesser Use]						subyearling primary rearing period (May-Aug) based on seining data; however catch rates are low
Fall migrant											[Lesser Use]	[Lesser Use]	subyearlings that do not migrate in first summer; not documented	
Yearling	[Lesser Use]								fish that remain through first summer & winter; not documented					
Downstream Juvenile Migration														
Dec-Mar = fry	[Peak Use]			[Peak Use]								[Lesser Use]	Fry movement based on field data (2011-2013)	
April-mid July = subyearling				[Peak Use]									Juvenile migration data based on PIT tag data, limited for MF Willamette	
mid-Oct-mid Dec = fall migrants											[Lesser Use]	[Lesser Use]		
Mar-May = yearling smolts;			[Lesser Use]	[Lesser Use]	[Lesser Use]									

[Peak Use]	Represents periods of peak use based on professional opinion.
[Lesser Use]	Represents lesser level of use based on professional opinion.
[Shaded]	shaded cells represent information based on field data & direct knowledge
[Red]	red cells represent critical periods when flow fluctuations should be avoided to prevent disruption of spawning, to minimize disturbance of eggs during early incubation, and to minimize stranding or displacing newly emerged fry

Based on professional opinion & field studies, 90% of the life-stage activity occurs during the time frame shown as the peak use period.
 Based on professional opinion & field studies, 10% of the life-stage activity occurs during the time frame shown as the lesser use period.

D.7.3. Instream Flows and Ramping

Fall Creek reservoir is typically operated below the reservoir operating rule curve during the winter months at elevation 714.2 feet. This operation has been shown to lead to both a higher passage efficiency and survival of outmigrating juvenile spring Chinook salmon through Fall Creek Dam. This elevation is generally met in mid-November, but inflows and hydrology may cause minor differences in this date. Refill from elevation 690 feet begins as early as January, but would be governed by the rule curve.

- All maintenance and construction activities that may impact the enhanced drawdown (mid-November through January) should be completed between February and October.

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**Detroit Proposed Special Operation
Temperature Management
2014**

Implementation Timeframe

01 June - 14 November 2014

Purpose

The purpose of this proposed operation is to provide downstream water temperature management while enhancing downstream juvenile fish passage at Detroit and Big Cliff Dams through strategic use of the spillway, turbines and regulating outlets from 01 June through 14 November 2014. This operation meets Reasonable and Prudent Alternative (RPAs) measures 4.8 and 5.1 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream water quality and fish passage for ESA-listed fish.

Background

The construction and operation of Detroit Dam has altered the pre-dam seasonal thermal regimes in the North Santiam River and blocked access to the majority of historic spawning and rearing habitat. During pre-2007 project operations, all water was typically routed through the powerhouse of both Detroit and Big Cliff Dams when the project discharge did not exceed the hydraulic capacity of the powerhouses. During summer months, with Detroit Reservoir at maximum conservation pool, deep (hypolimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures 5.4° to 9.0°F cooler than inflow temperatures (June through September). During fall and winter as Detroit Reservoir was drawn down, surface (epilimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures up to 18°F warmer than inflow temperatures. It is likely that the increase in downstream water temperatures during fall and winter was exacerbated by the removal of Detroit Reservoir's cold hypolimnetic water throughout the summer, which increased the volume of warm epilimnetic waters for release from October through December (Gore and Petts 1989). This altered temperature regime negatively affected the productivity of ESA-listed spring Chinook salmon and winter steelhead in the lower North Santiam River, and has been identified as one of the most critical limiting factors for species recovery (NMFS 2008).

During temperature operations Research Monitoring and Evaluation (RM&E) studies have found also found high rates of dam passage and survival for juvenile Chinook salmon at Detroit Dam (Beeman et al. 2012, Friesen et. al 2012). Taken together, data indicate that temperature management operations may provide some connectivity to the majority of historic spawning and rearing habitat above the dam – through providing downstream passage benefits – while also improving the seasonal thermal regimes in the North Santiam River below Big Cliff Dam.

Biological Justification for Temperature Improvements

Restoring the natural thermal regimes in the river reach directly below Detroit Dam will provide a benefit to both ESA-listed spring Chinook salmon and winter steelhead. These benefits have been realized over the past six years that water temperature management operations have been performed. Recent RM&E studies also indicate that these temperature management operations promote downstream fish passage during summer spillway operations. Priority should be given to refilling Detroit Reservoir to full reservoir elevation in 2014 (i.e. maximum conservation pool elevation) so that both temperature management and fish passage operations can be accomplished to the fullest extent possible.

Proposed RM&E

Multiple RM&E studies are planned in 2014 to provide better estimates of direct and indirect survival of juvenile Chinook salmon passing Detroit Dam and migrating downstream during temperature management operations. The primary goal of these studies is to provide empirical information about the survival of juvenile Chinook salmon passing Detroit Dam to the Minto Facility. Secondary goals include estimating Minto Facility passage timing and probability of PIT detection of downstream migrating juvenile salmonids at Willamette Falls Dam. The third goal of the 2014 RM&E studies includes estimating the route-specific passage probabilities at the Bennett Dam complex.

Operational Details

On 01 June, water temperature management operations will commence. A blend of spillway and turbine releases (a 60%/40% split, respectively) from Detroit Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table 1) throughout the summer. This operation will be carried out until Detroit Reservoir is drawn down below spillway crest.

Once below spillway crest, water temperature management operations will shift to powerhouse-only discharges until mid-October or when outflow water temperatures reach 50°F. From approximately 22 October through 14 November, 2014, a blend of powerhouse and regulating outlet flow will be discharged to meet downstream water temperature goals (Table 1). It is estimated that a 30%/70% split in RO to powerhouse discharge will be needed during this time; however, adaptive management should be used to ensure water temperatures stay below 50°F. The RO/powerhouse operation for fall water temperature management is based on water quality modeling results and operations conducted in previous years. A discussion of this modeling effort and justification for RO use in the fall can be found in Section 4.2.2 of the *Willamette Basin Annual Water Quality Report, WY 2010*.

Big Cliff will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Detroit/Big Cliff Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would

result in temporary termination of the operation. Should any flow management of dam safety concerns arise during this study, these operations will be modified or suspended.

Table 1. Water Temperature Targets for the North Santiam River below Detroit and Big Cliff Dams.

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

Coordination

Appropriate environmental permitting has been completed for the proposed operation. Regional prioritization of the 2014 RM&E studies occurred via the Willamette Action Team for Ecosystem Restoration (WATER) process.

This SOR has been vetted internally and regionally and BPA concurrence will be [has been] established.

Foster Weir Fish Operation

Description/Intent

The goal of this RME is to provide information on juvenile salmonid passage at Foster Dam to support decisions on long-term measures and operations to improve passage conditions at the dam for fish listed under the Endangered Species Act (ESA).

This request is to operate the Foster fish weir at forebay pool elevation 613ft (normal winter pool) during October 13, 2014 through December 20, 2014. With a forebay pool of 613 ft, the weir will be at elevation 611 ft.

Data will be collected for juvenile fish passage over the fish weir at a reservoir elevation of 613ft during fall and winter (October 13, 2014 through December 20, 2014); a period when a majority of outmigrating steelhead and Chinook salmon are expected to pass the project. This RME is a second year study of juvenile fish passage at Foster Dam.

Winter data collection period:

October 13 – December 20, 2014: weir at 611ft el (forebay pool will be at 613 ft el).

Potential Impacts and Mitigation

Because the weir will be in spill bay 4, during the flood control season, an analysis of potential impacts to flood control operations is required. The project could remove the weir with a two (2) day or less notice, if required.

ResSim models were generated for the Foster Dam tainter gate repairs and it was determined that the same models could be used for this proposed operation, similar to the operation during winter 2013. The models show during flood control season, one or two spill gates would be adequate to pass excess water during flood control season.

As a precautionary method, a checklist was developed by Foster Operations in 2013 and will be used again as guidance of when or not to operate the weir during winter months.

After about mid-November, the Project would operate the weir only when no threat of heavy river flows is predicted. That is, if any single condition on the checklist is present, the weir will not be operated and bay 4 will be closed. If another spill bay is OOS, then the Project will remove the weir and stop logs and return the bay to regular service. If/when we put the weir back in will be determined by all of us after reviewing the circumstances.

Monitoring

Fish passage will be monitored by PNNL and ODFW using a variety of techniques, including radio telemetry and screw trapping. Specifically information will be collected on fish movement through the reservoir, fish behavior in the forebay, density of fish in the forebay, and daily, seasonal and diel fish passage and distribution at the dam. The key metric that this special operation will inform will help determine the effectiveness of this weir at passing fish. The weir was proven to have much higher survival than the units during the balloon tag tests.

Cougar Proposed Special Operation to Improve Downstream Passage & Survival

Implementation Date

This special operation should be implemented from 01 November 2014 (or whenever water temperature control tower operation has been completed) through 01 January 2015.

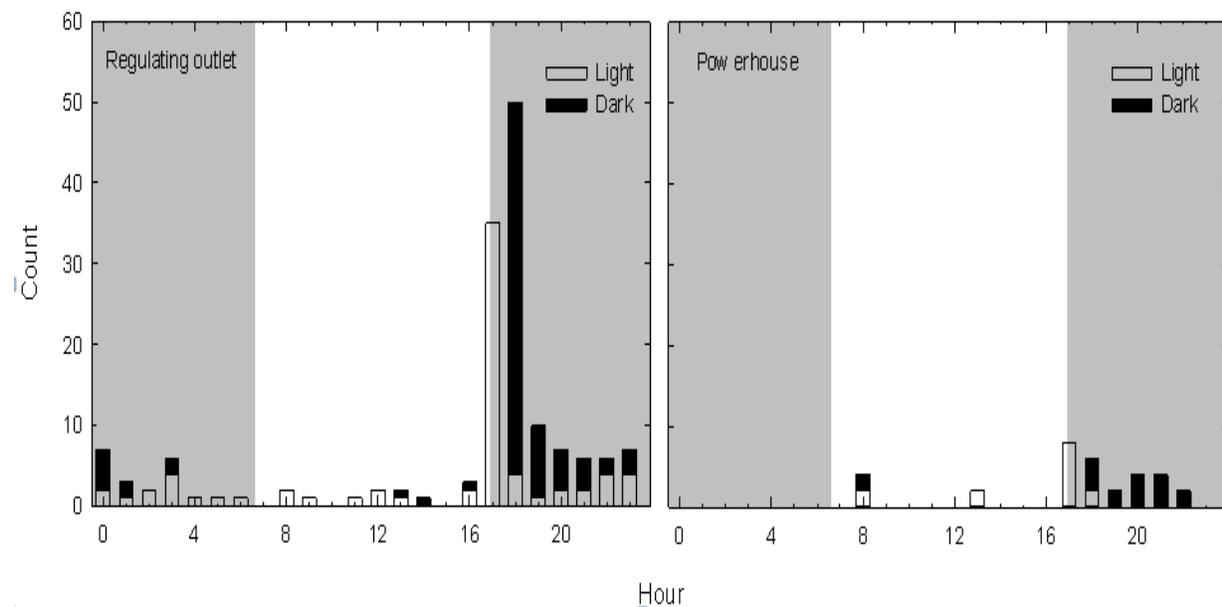
Purpose

The purpose of this proposed operation is to improve fish passage survival of juvenile ESA-listed spring Chinook salmon through Cougar Dam by prioritizing the operation of the regulating outlets (RO). Studies indicate that downstream passage through Cougar Dam is poor (ODFW 2008, Hiesey 2010, ODFW 2010, 2012, Beeman 2012, 2013). This is due to the inaccessibility of downstream passage routes during the conservation season (when the reservoir is full) combined with poor survival through these routes (turbine units) once they become available (shallower) during the flood season.

Biological Justification

Past biological studies have shown that the survival through the RO is about double that of the turbines (~70% for RO & ~35% for turbine). These studies also show that the majority (>87%) of fish pass Cougar Dam during the night (Figure 1.) rather than during the day. For this reason, priority should be given to the RO outlets as the reservoir is drawn down and held low for the winter flood control season. RO priority should be focused at night, from 1600 to 0400 hours, and should target flows of ~1000-1500 cfs through a single RO gate.

Figure 1. Diel passage timing for Radio Tagged Chinook juveniles (Beeman 2012).



Operational Details

This special operation should be implemented from approximately 01 November 2014 (or whenever WTC operation has been completed) through 01 January 2015. Exact outflows are uncertain and will depend on inflows and hydrologic conditions. Table 1 (below) shows some potential operations for different discharge levels. This table is presented as a concept only; the actual operations will need to be developed by regulators and managed on a real-time basis, especially during times of high flows. The actual discharge rates are subject to the reservoir level, minimum gate openings, and turbine operating range.

Table 1. Hypothetical operations for juvenile RO survival test.

Mean 24hr Discharge	NIGHT		DAY	
	RO Flow	Powerhouse Flow	RO Flow	Powerhouse Flow
500	500	0	0	500
1000	1000	0	0	1000
1500	1500	0	500	1000
2000	1500	500	1000	1000
2500	1500	1000	1500	1000
3000	2000	1000	2000	1000

Research, Monitoring and Evaluation

As in previous years, ODFW will monitor passage with screwtraps. Additionally, dam passage rates and timing can be inferred by the detection of PIT tagged fish at Leaburg and Walterville dams downstream.

Potential Impacts

This operation may cause elevated levels of total dissolved gas (TDG) below Cougar Dam. Real-time information will be measured and monitored during this operation, thus this operation may be suspended or ended all together if warranted.

Daily changes in dam operations may cause possible downstream ramp rate violations, however every effort will be made to minimize these.

During periods of critical power needs, project construction and maintenance, or high flow situations, the operation may be suspended or altered.

Fall Creek Proposed Special Operation Deep Drawdown to Facilitate Downstream Fish Passage

Background

The Corps' Willamette dams have blocked access to a majority of the historical habitat for ESA-listed fish. Many of these dams were built without downstream fish passage facilities and those facilities that were built have since been abandoned due to lack of functionality. Therefore, many fish are restricted to areas below the dams and subjected to altered flow and water quality conditions by dam operations. Those juvenile fish produced upstream of the dams (from adult salmon and steelhead outplanting) must pass through the dams via turbines, regulating outlets (ROs), or spillways.

Past studies indicate that downstream passage through the Willamette high-head dams is poor. This is likely due to the inaccessibility of downstream passage routes during the conservation season (when reservoirs are full) combined with poor survival through these routes once they become available during the flood season.

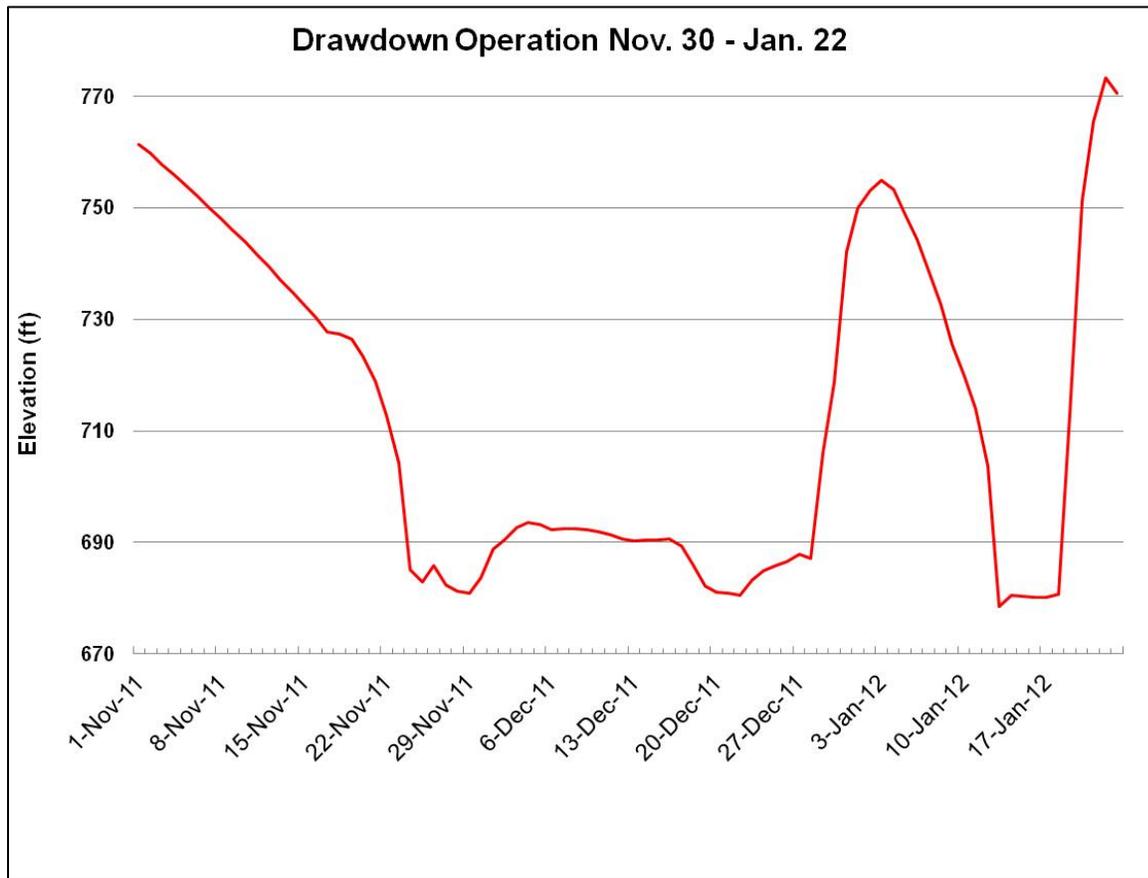
Purpose

The purpose of this proposed operation is to improve downstream volitional fish passage through a drawdown of Fall Creek Reservoir to an elevation ranged of 680 to 685 ft. This operation meets Reasonable and Prudent Alternative (RPA) 4.8 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream passage of migrants as safely and efficiently as possible.

Biological Justification

Reservoir drawdown has been shown to significantly increase the passage probability of Chinook salmon smolts at Fall Creek Dam (Taylor et al. 2012). In the winter of 2011, the Corps drew Fall Creek Reservoir down to near the target elevation of 680 ft to increase fish passage efficiency and survival of ESA-listed spring Chinook salmon. Due to varying inflows into Fall Creek Reservoir, forebay elevations ranged from 680 ft to 695 ft during the study timeframe (Figure 1). During drawdown, it was estimated that approximately 20,000 spring Chinook subyearlings were flushed from the reservoir, with the largest proportion outmigrating at the lowest reservoir elevations. Non-native fish species were also flushed from the reservoir, reducing predation and competition for food which should provide better rearing conditions for salmonids in future years.

Figure 1. Fall Creek Reservoir Elevation during Deep Drawdown Special Operation, Winter 2011.



Operational Details

Fall Creek Reservoir is typically operated at or below a water control diagram that provides guidance to the reservoir regulators on how to manage the storage in the reservoir to meet multi-purpose needs. The water control diagram for Fall Creek Dam is shown in Figure 2 below. Fall Creek Reservoir is typically drawn down (i.e., storage evacuated) in the fall to minimum conservation pool (elevation 728 ft) to provide space to store high runoff from winter rain events. In the early spring, the reservoir begins to capture some of the runoff to store water for use in the summer months. Refill back to maximum conservation pool (elevation 830 ft) typically occurs by mid-May.

Under this special operation, it is proposed that Fall Creek Reservoir be drawn down below minimum conservation pool to run-of-river-like conditions. Operations will target an elevation range of between 680 and 685 ft, or approximately 48 feet deeper than the minimum flood control pool elevation (Figure 2) for two weeks during the month of December. The goal is to hold the reservoir near elevation 680 ft. Per Hydraulic Design recommendations the RO gates should be operated between the minimum gate opening of 1 foot and the maximum gate opening is 8 feet when above elevation 682 ft. If the gate needs to be opened greater than 8 feet, it should be fully opened. Once below elevation 682 ft, the 0.65 maximum gate opening restriction should be applied. Table 1, below, gives specific gate openings that should be followed when the reservoir is drawn down below 682 ft elevation. Following

these guidelines will ensure that pressurized flow is maintained the regulating outlet conduit at all times.

Table 1. Maximum Gate Opening (ft) for Specific Low Reservoir Elevations, Fall Creek Reservoir.

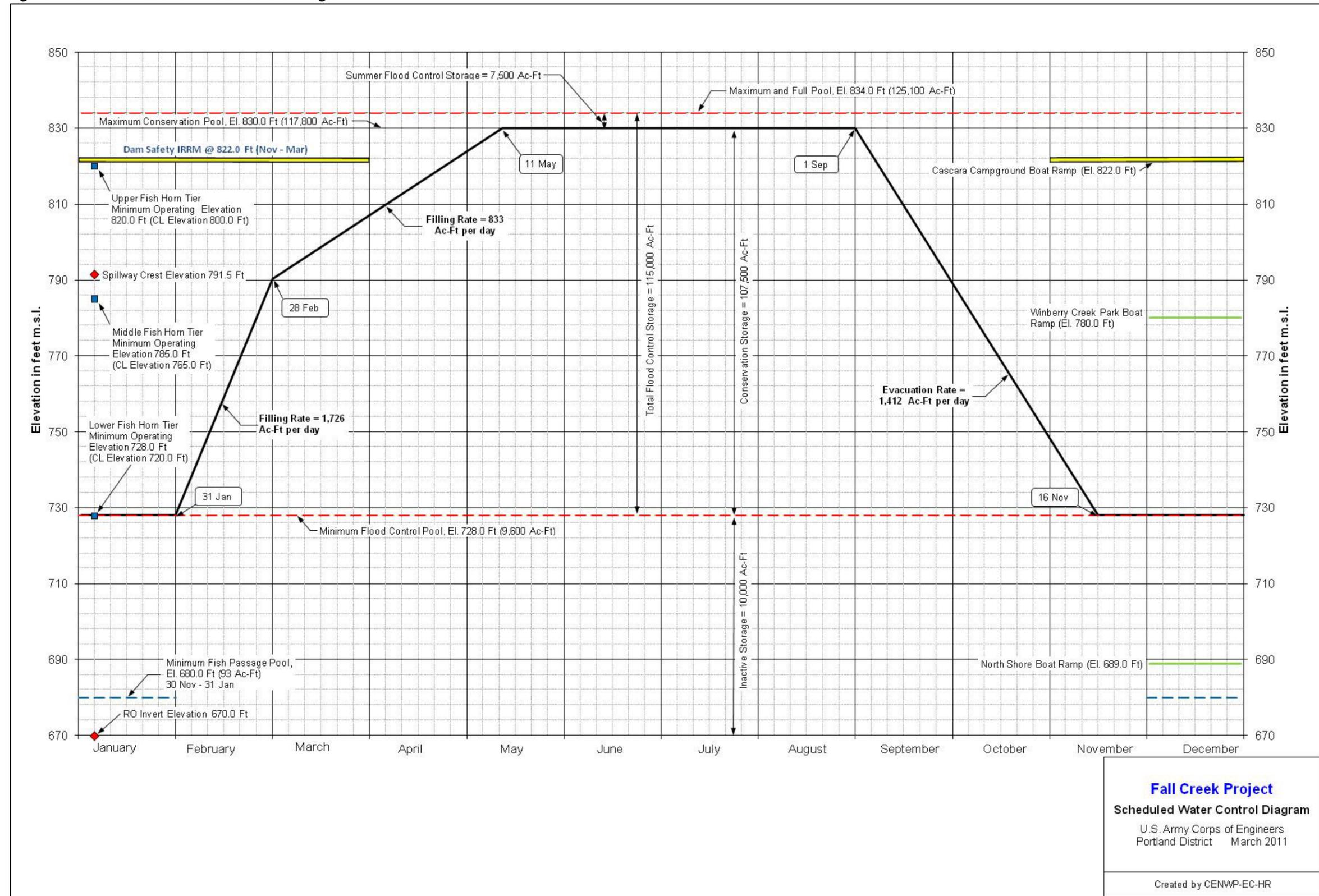
Pool Elevation (ft)	Maximum Gate Opening (ft)
682	7.8
681	7.1
680	6.5
679	5.8
678	5.2
677	4.5
676	3.9
675	3.2
674	2.6
673	1.9
672	1.3

Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the deviation operation.

The boat ramps to Fall Creek Reservoir are closed during the winter months by the Oregon Parks and Recreation Department so adverse impacts to recreation by implementing a deeper draft of the reservoir should not be an issue.

During drawdown and refill of Fall Creek Dam, draft and refill rates of 3ft and 5ft per/day, respectively, will be followed. All outlets will be operated within their limits to avoid cavitation and structural damage. Draft rates, ramp rates and downstream flow targets may be missed during this operation, especially if unforeseen meteorological conditions develop. The Corps will coordinate with the agencies throughout implementation of this operation to ensure good communication and transparency.

Figure 2. Fall Creek Reservoir Water Control Diagram



Fall Creek Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

Created by CENWP-EC-HR

Research, Monitoring and Evaluation

➤ *Biological Monitoring*

During implementation of the proposed operation, a telemetry study will be conducted to gain a better understanding of when spring Chinook salmon are available to pass, the dam passage efficiency under the drawdown operation, the seasonal distribution of fish in the forebay, and the size and abundance of fish. This information will help shape reservoir operations and ensure fish pass safely and effectively.

The following will be evaluated for juvenile Chinook relative to typical and alternative reservoir operations:

1. Cohort/Size specific information on seasonal and diel distribution in forebay near dam relative to typical and alternative operations
2. Cohort/Size specific information on seasonal and diel behavior and movements into and within forebay near dam relative to typical and alternative operations. If possible document and quantify different behaviors (i.e. milling).
3. Cohort/Size specific information on seasonal and diel passage metrics using existing passage routes for juvenile Chinook and other species of relatively high abundance relative to typical and alternative operations
 - a. Reservoir residency time (HOR → Forebay)
 - b. Forebay residency time (Forebay → Passage)
 - c. Dam Fish Passage Efficiency (total # of fish passed/ # of fish that entered forebay)
 - d. Reservoir survival (the probability of survival from the upstream boundary of the reservoir of a dam to the upstream boundary of the forebay for that dam)
 - e. Project Survival (the probability of survival from the upstream boundary of the reservoir of a dam to the downstream boundary of the tailrace of the dam. Includes survival through the reservoir, forebay, dam, and tailrace)
 - f. Dam survival (the probability of survival from the upstream boundary of the forebay to the downstream boundary of the tailrace; it includes the forebay, all routes of passage, and the tailrace)
 - g. Route specific survival (the probability of survival for fish passing through a given route of passage; measured from the upstream forebay boundary to the tailrace boundary.
4. Evaluate hydrodynamics in forebay relative to typical and alternative operations.

➤ *Bed Load and Suspended Sediment Transport Study*

The 2011 Fall Creek drawdown was considered a successful and effective fish passage operation, but also resulted in the release of large amounts of sediment downstream of Fall Creek Dam. The proposed operation is also likely to liberate large amounts of sediment, increasing turbidity and sediment transport in to Fall Creek and the Middle Fork Willamette River. Because of these expectations, in-depth monitoring and data collection is warranted. This data will inform future operations and aid in determining if annual drawdown operations at Fall Creek Dam are viable and sustainable.

The U.S. Geological Survey (USGS) will assist the Corps in monitoring conditions during the Fall Creek drawdown. The study objectives are to:

1. Collect data to estimate suspended sediment loads in and out of Fall Creek Lake, and bedload out of Fall Creek Reservoir for three months to capture pre-drawdown to post-drawdown conditions. Sampling will be designed to determine the spatial extent of sediment transport downstream of the reservoir on Fall Creek and the Middle Fork Willamette River. Data collection will include discrete samples of suspended sediment and bedload, and continuous turbidity.
2. Collect data to monitor changes to dissolved oxygen (DO) concentrations due to increased sediment loads.
3. Summarize data in a technical report.

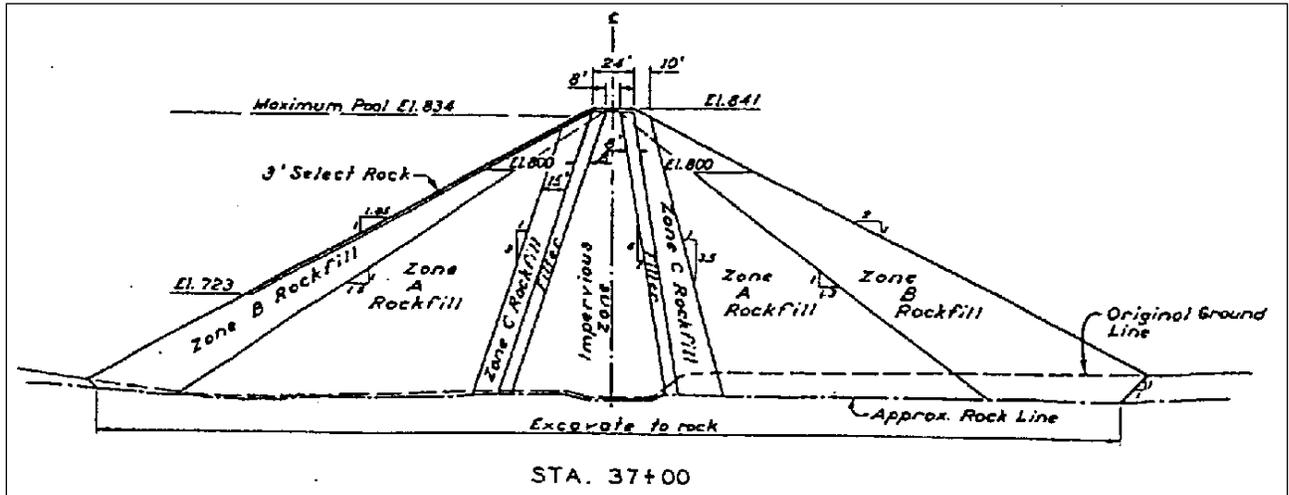
Suspended sediment, bedload and turbidity data will be collected for three months from mid-October 2012 through January 2013 to capture conditions pre, during and post-drawdown. Data will be collected at six sites including Fall Creek above North Fork, near Lowell, OR, Winberry Creek near Lowell, OR, Fall Creek below Winberry Creek, near Fall Creek, OR, the Middle Fork Willamette River near Dexter, OR, Fall Creek near Mouth near Hills, OR, and the Middle Fork Willamette River at Jasper, OR.

Data collected during the drawdown will be summarized in a technical report upon USGS approval of all laboratory and continuous data. Report efforts will include data analysis, interpretation, report writing and publication.

➤ ***Dam Safety and Geotechnical Monitoring***

Fall Creek was designed with 3 feet of select rock on the upstream face of the dam, from elevation 723 feet (5 feet below original minimum conservation pool) to the top of dam (Figure 3). This rock is added protection against scouring from wind action and the raising and lowering of the reservoir. Under the proposed drawdown operation, the reservoir will be below this armored area. Although no issues have been visually detected to date, it may be prudent to extend the armoring down to the dam heel in the future. During drawdown, visual inspections will be conducted to look for signs of erosion or rock movement. This information will inform appropriate protection measures to ensure structural soundness of Fall Creek Dam.

Figure 3. Fall Creek Embankment Cross Section



Coordination

Appropriate Environmental permitting has been completed for the proposed drawdown operation. A categorical exclusion has been completed and a Nationwide 401 water quality certification will be utilized.

This operation has been vetted with the region and BPA concurrence has been established.

**Lookout Point Proposed Special Operation
Temperature Management
2014**

Implementation Timeframe

01 June - 01 September 2014¹

Purpose

The purpose of this proposed operation is to provide downstream water temperature management while enhancing downstream juvenile fish passage at Lookout Point and Dexter Dams through strategic use of the spillway and turbines from 01 June through 01 September 2014. This operation meets Reasonable and Prudent Alternative (RPA) measures 4.8 and 5.1 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream water quality and fish passage for ESA-listed fish.

Background

The construction and operation of Lookout Point Dam has altered the pre-dam seasonal thermal regimes in the Middle Fork Willamette River (MFWR) and blocked access to the majority of historic spawning and rearing habitat. The typical operation of the dam is to route water through the powerhouse, generating hydropower for regional energy demand. During the summer months, when the reservoir is at full pool, the water released through the turbine outlets is deep (hypolimnetic) water which produces downstream water temperatures cooler than inflow temperatures. During fall as the reservoir is drawn down, the thermocline is pulled deeper and water released through the turbine outlets increases downstream water temperatures that are much warmer than inflow temperatures. It is likely that the increase in downstream water temperatures during fall and winter is a result of the removal of the reservoir's cold hypolimnetic water throughout the summer, which increases the volume of warm epilimnetic water for release from October through December (Gore and Petts 1989). The altered water temperatures below the dam has been identified as one of the primary limiting factors preventing the recovery of UWR Chinook salmon and winter steelhead (Corps 2000, Taylor and Garletts 2007, Angilletta et al. 2008, NMFS 2008).

Biological Justification for Temperature Improvements

Restoring the natural thermal regimes in the river reach directly below Lookout Point and Dexter dams will provide a benefit to both ESA-listed spring Chinook salmon and resident fish populations. In recent years, Lookout Point Dam has been operated to meet downstream water temperature goals (Table 1) as spelled out in the Biological Opinion. Although not as successful as Detroit operational temperature management, water temperatures have improved under such operations. Since the adoption of temperature management operations, water temperatures, once commonly exceeding the lethal limits for salmonids in late summer, have been moderated. In addition, RM&E studies indicate that

temperature management operations promote downstream fish passage during summer spillway operations.

Proposed RM&E

In 2013, hundreds of adult Chinook salmon were collected at the Dexter Dam trap and outplanted into areas above Lookout Point and Hills Creek dams. The primary goal of this study was to evaluate factors potentially associated with prespawn mortality (PSM) in adult Chinook salmon from the time they were collected at the traps through spawning. Factors evaluated included environmental stressors, maturation status, disease, parasites, and initial energetic condition. Beyond assessing PSM rates, this work is part of a larger effort related to informing reintroduction strategies into areas above the dams and evaluating juvenile life history and downstream passage using the progeny from these outplants (i.e., RM&E studies JPL-10-02-SYS and JPL-09-08-SYS)

An expansion of the timing and duration of outplant operations from Dexter Dam is planned in 2014 (i.e., RME study APH-09-01). The progeny from the 2014 outplants will also be used in a variety of 2015 RME studies related to head of reservoir run timing, feasibility of downstream trap & haul, reservoir survival, and dam passage (i.e., RM&E studies JPL-14-04_LOP, JPL-10-02-SYS, and JPL-09-08-SYS).

Further, in 2007, Taylor and Garletts conducted an experiment below Dexter Dam on the Middle Fork Willamette River in which a total of 3,200 eggs from 32 pairs of spring Chinook salmon were divided equally into two groups. One group was incubated with unregulated river water at the Willamette Hatchery, located above Lookout Point Reservoir. The other group was incubated in the river below Lookout Point and Dexter Dams in altered conditions. The group incubated in the unregulated river with natural water temperatures had a hatch rate of 81%, consistent with survival in studies reviewed by Healey (1991); while the corresponding survival rate for eggs incubated in the river below Dexter Dam, with altered temperatures, was zero.

This study will be replicated in 2014 to further understand the benefits realized from water temperature management operations conducted at Lookout Point Dam. This information will be used to determine future operations at Lookout Point.

Operational Details

On 01 June, water temperature management operations will commence. A blend of spillway and turbine releases (an approximate 50%/50% split, respectively) from Lookout Point Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table 1) throughout the summer. The intent is to meet the downstream water temperature targets, so adaptive management should be used. This operation will be carried out until Lookout Point Reservoir is drawn down below spillway crest (estimated 01 September).

Water temperature management operations will be reassessed prior to 01 September 2014. If warranted, temperature operations may be extended into the fall and include the use of the regulating outlets to further improve downstream temperatures.

Dexter Dam will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Lookout Point/Dexter Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the operation. Should any flow management of dam safety concerns arise during this study, these operations will be modified or suspended.

Table 1. Water Temperature Targets for the Middle Fork Willamette below Lookout Point and Dexter Dams.

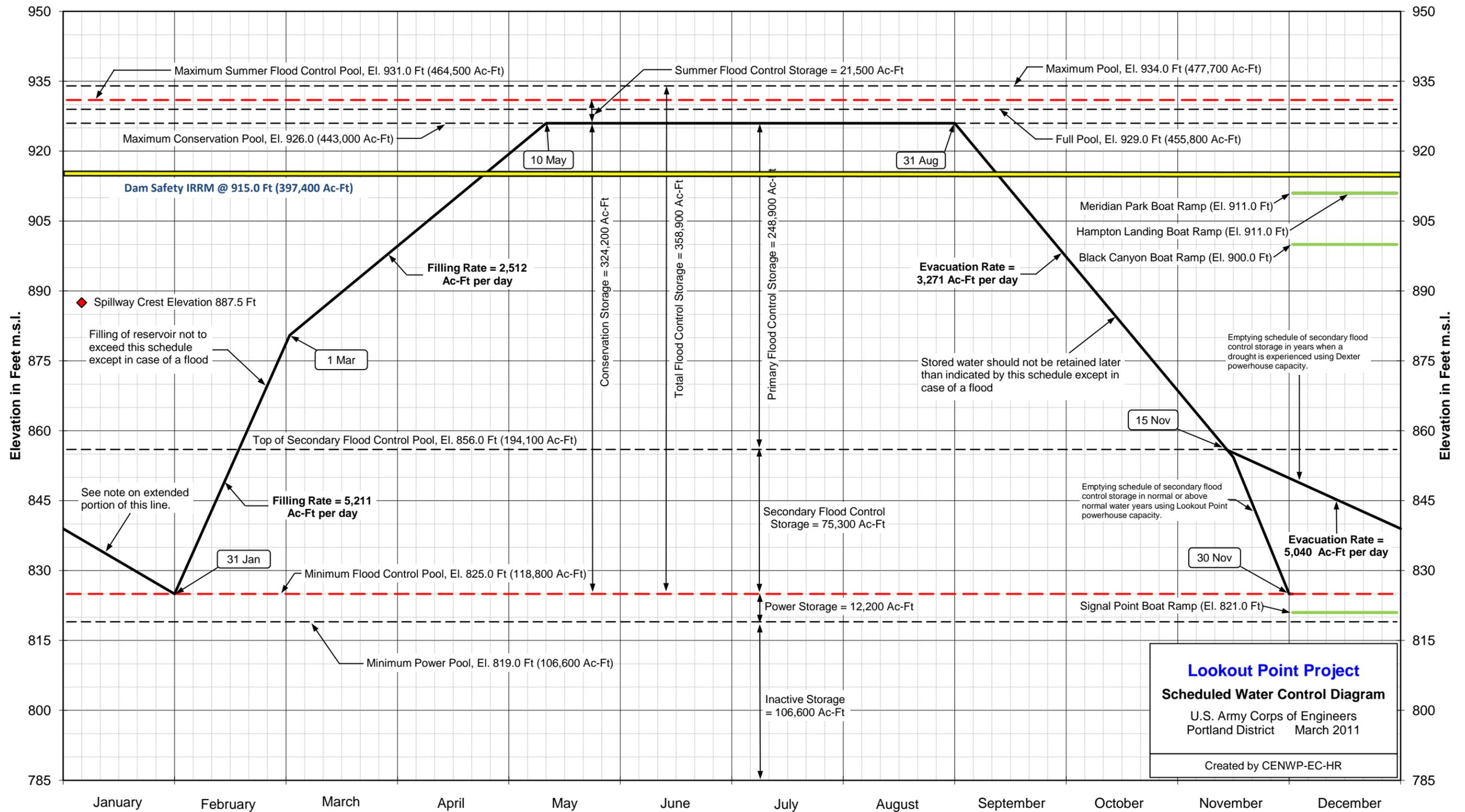
Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0
March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

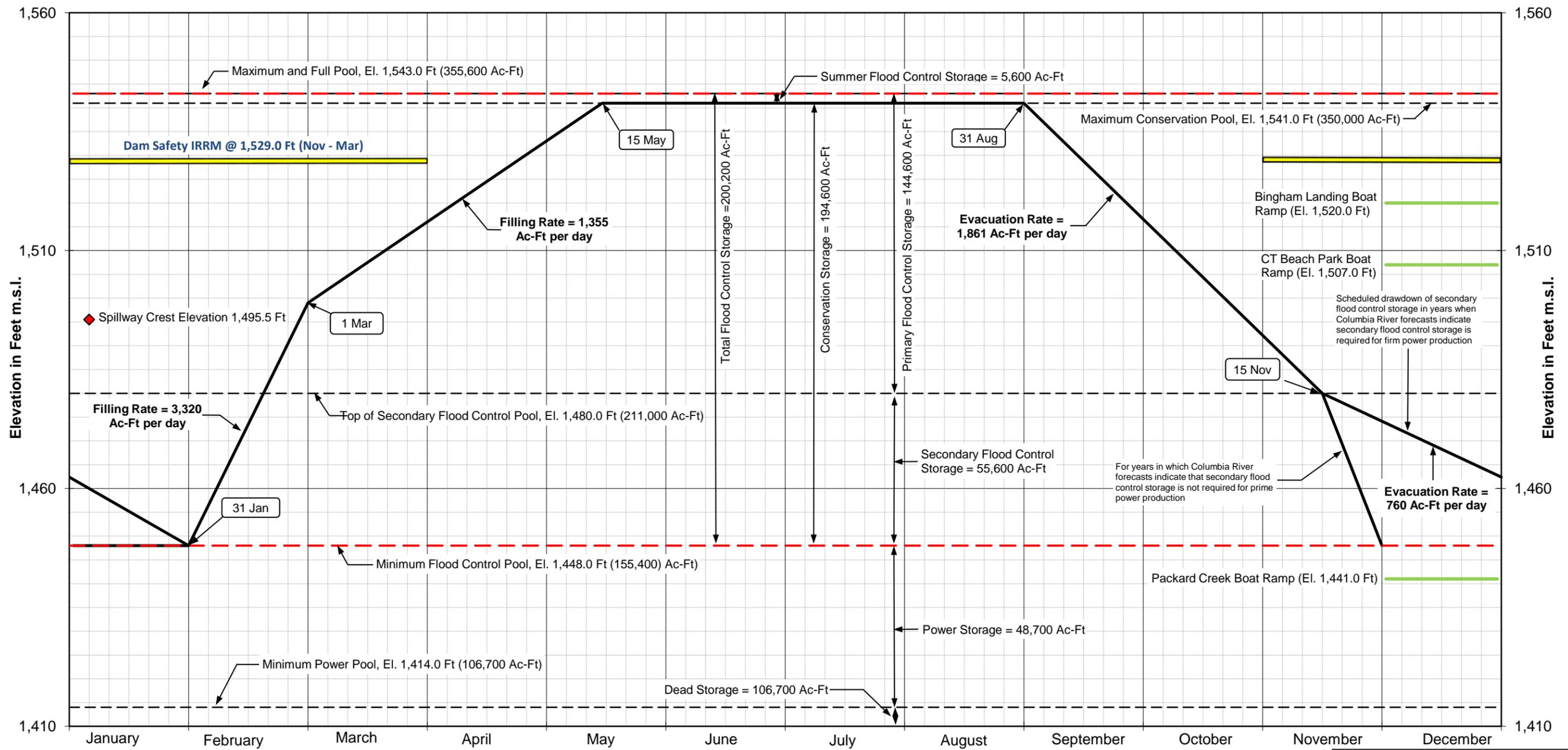
Coordination

Appropriate Environmental permitting has been completed for the proposed drawdown operation. Regional prioritization of the 2014 RM&E studies occurred via the Willamette Action Team for Ecosystem Restoration (WATER) process.

This operation has been vetted with the region and BPA concurrence will be [has been] established.

ⁱ Water temperature management operations will be reassessed prior to September 01, 2014. If warranted, these operations may be extended into the fall and include the use of the regulating outlets to manage downstream temperatures.

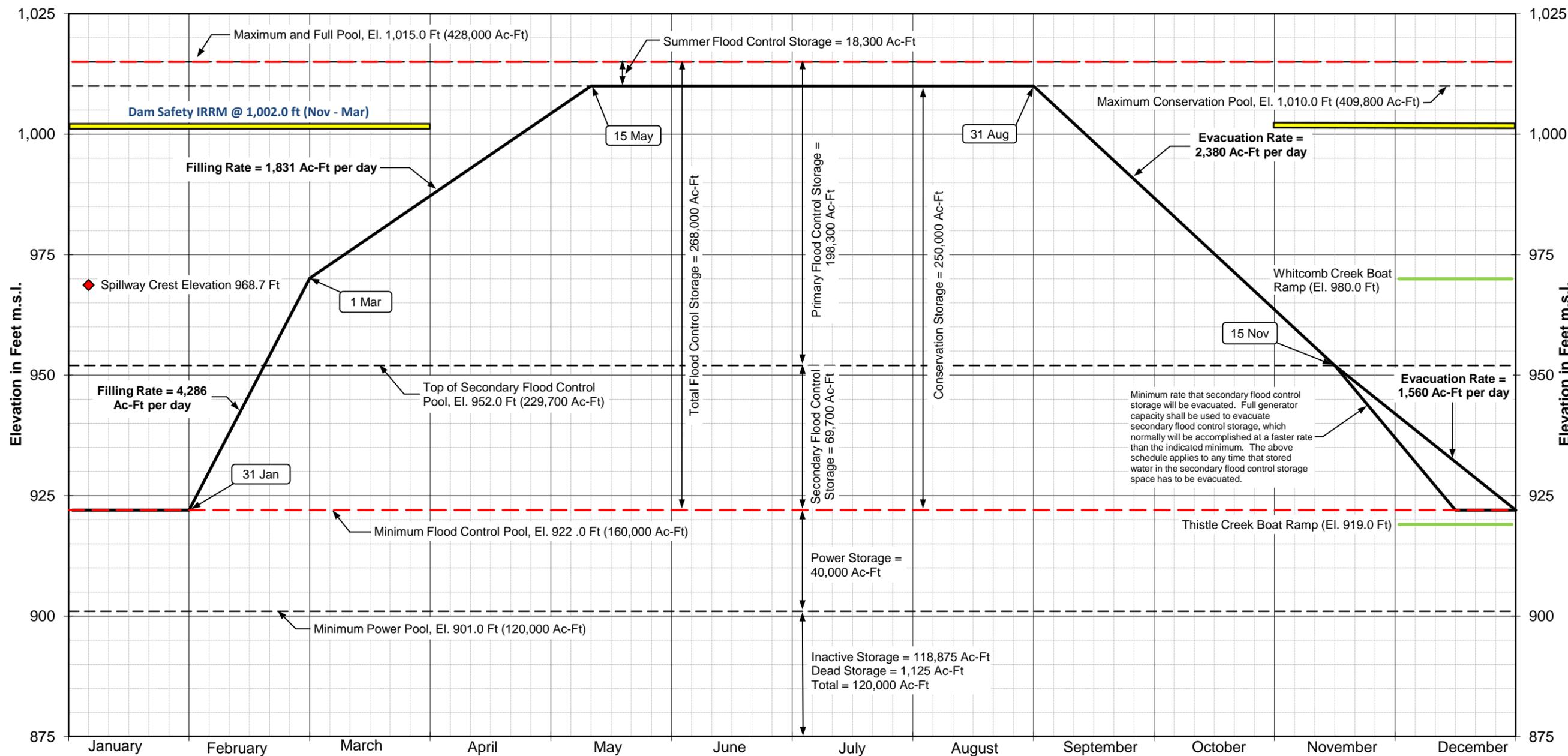




Notes:
Pool elevations and corresponding storage
applicable at 2400 hours.

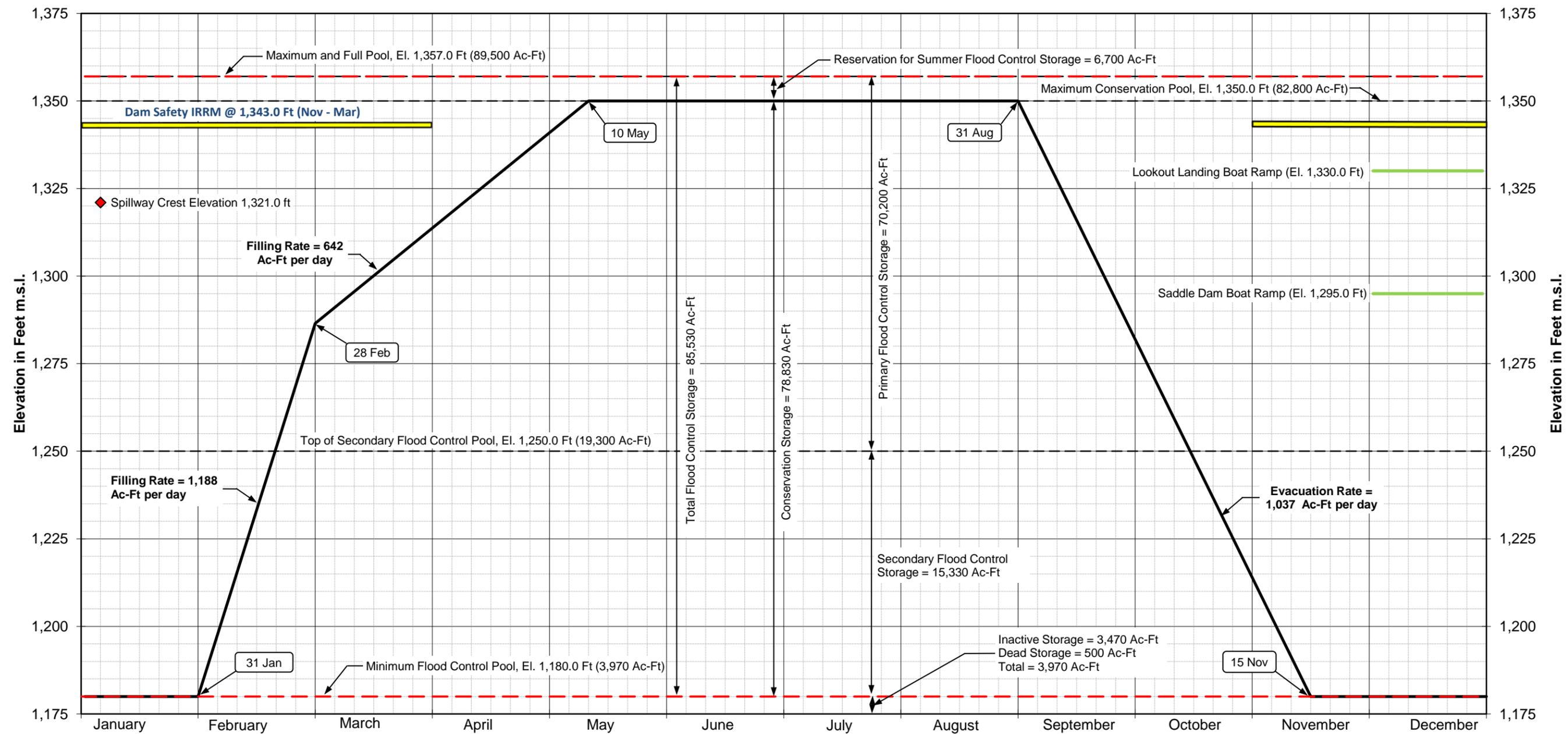
Hills Creek Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

Created by CENWP-EC-HR

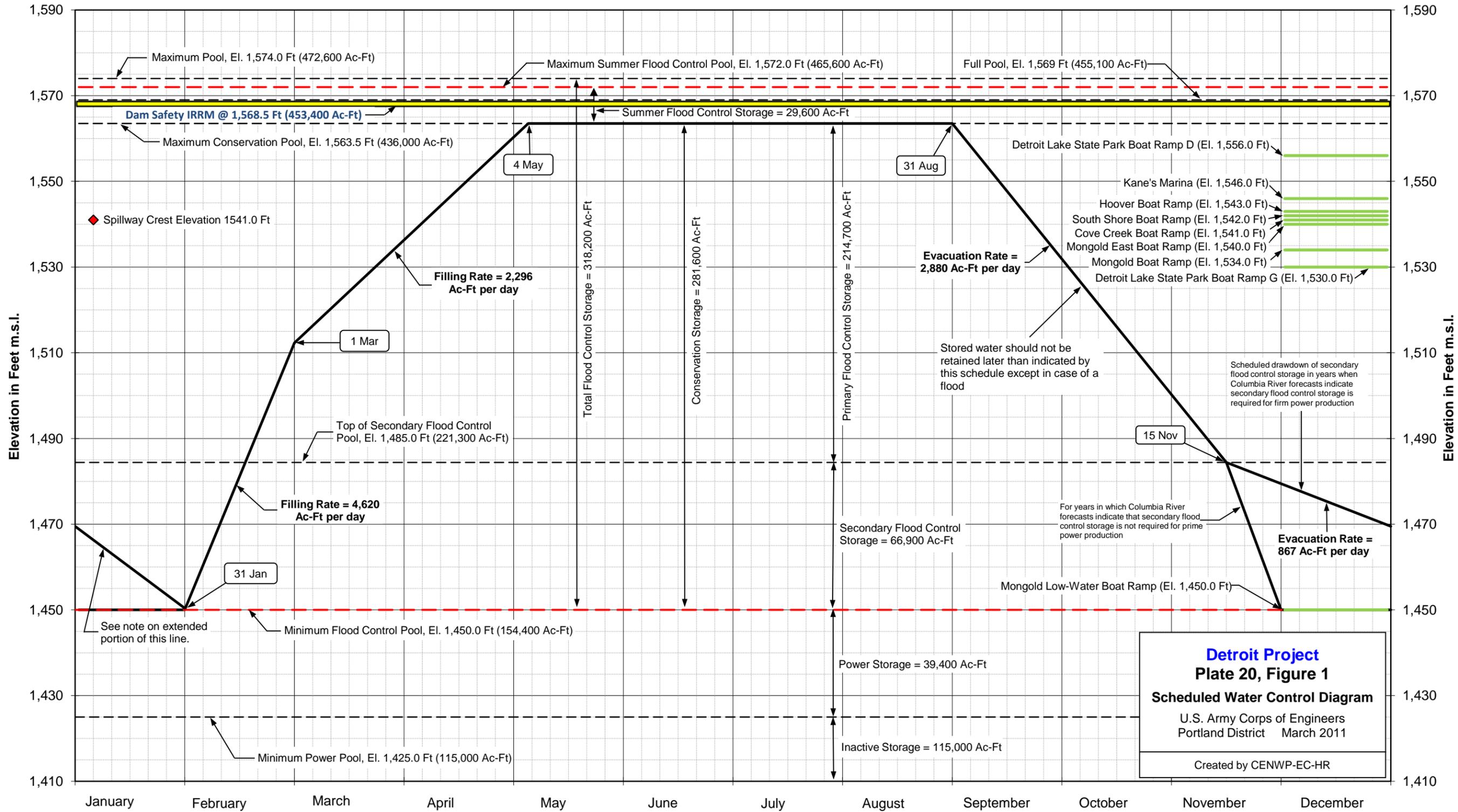


Green Peter Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

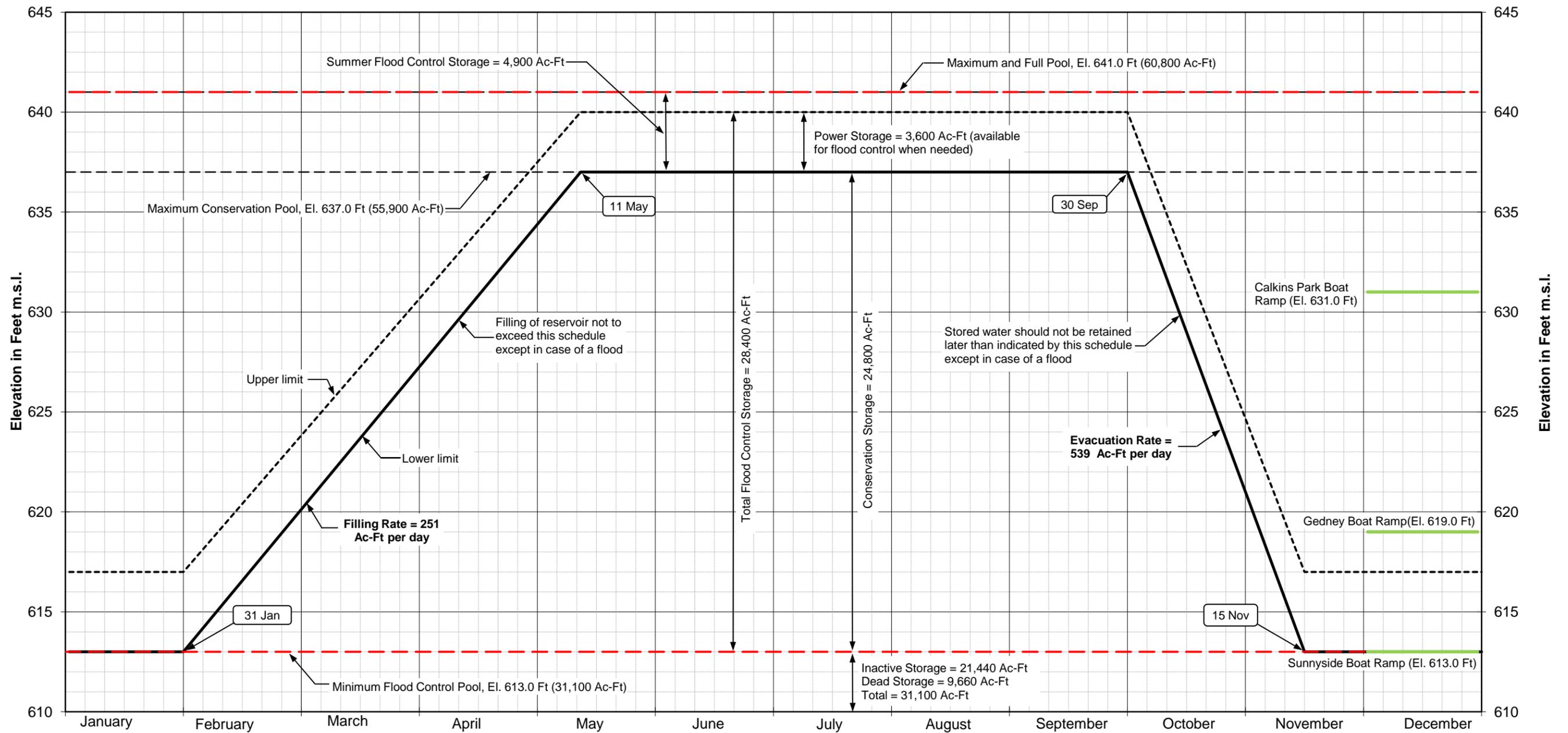
Created by CENWP-EC-HR



Blue River Project
Chart 8
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011
 Created by GENWP-EC-HR

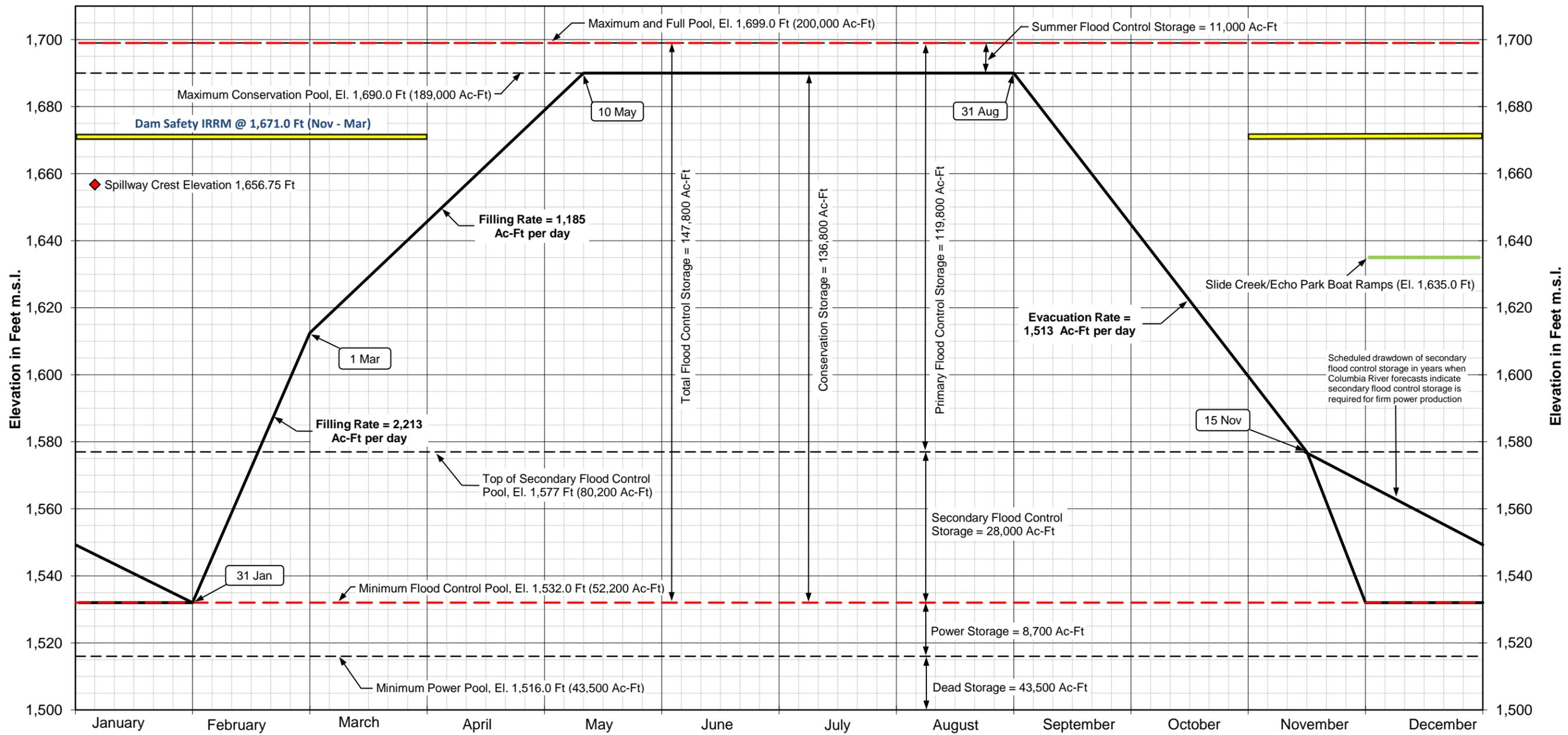


Detroit Project
Plate 20, Figure 1
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011
 Created by CENWP-EC-HR

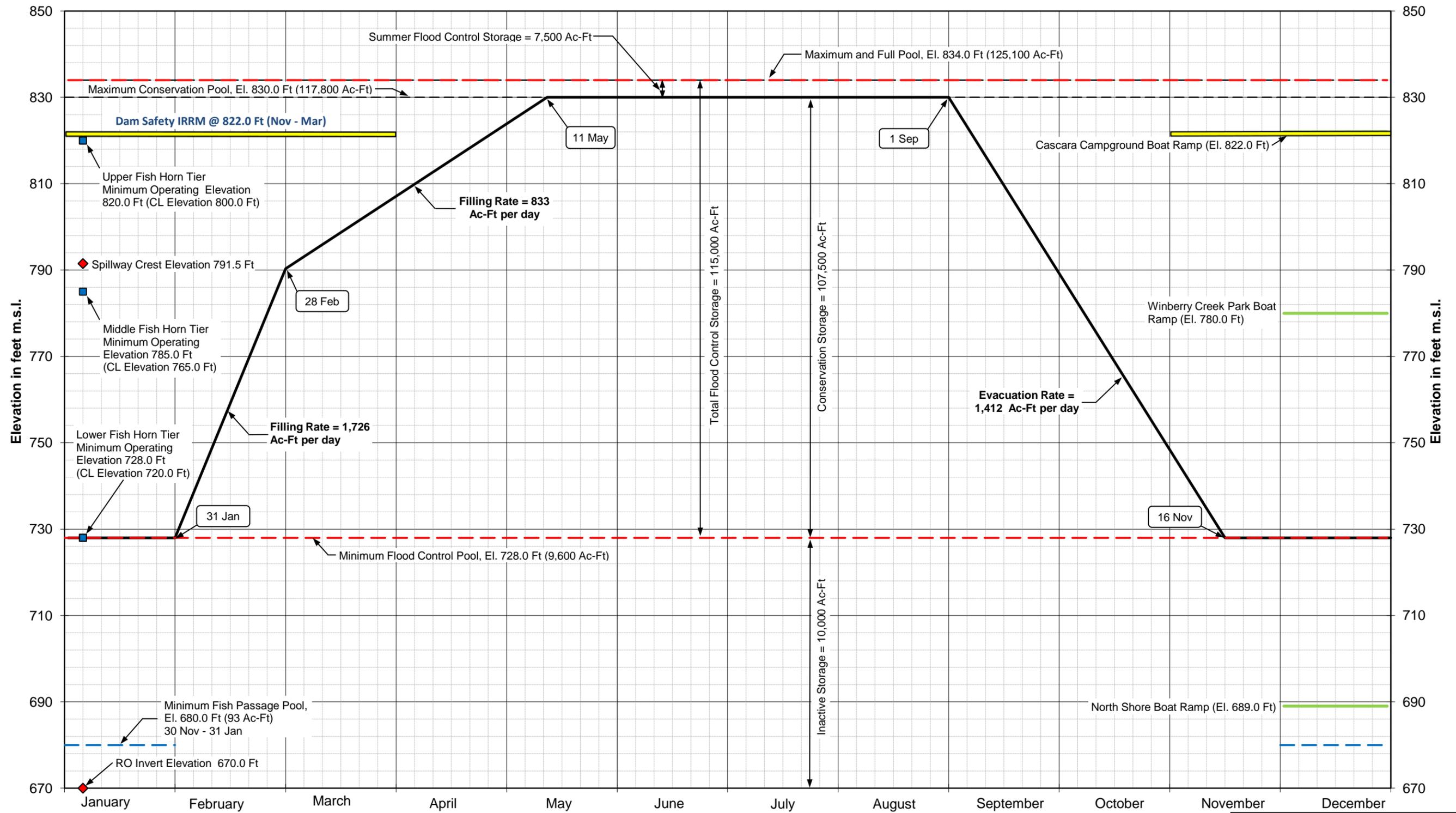


Foster Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portltna District March 2011

Created by CENWP-EC-HR

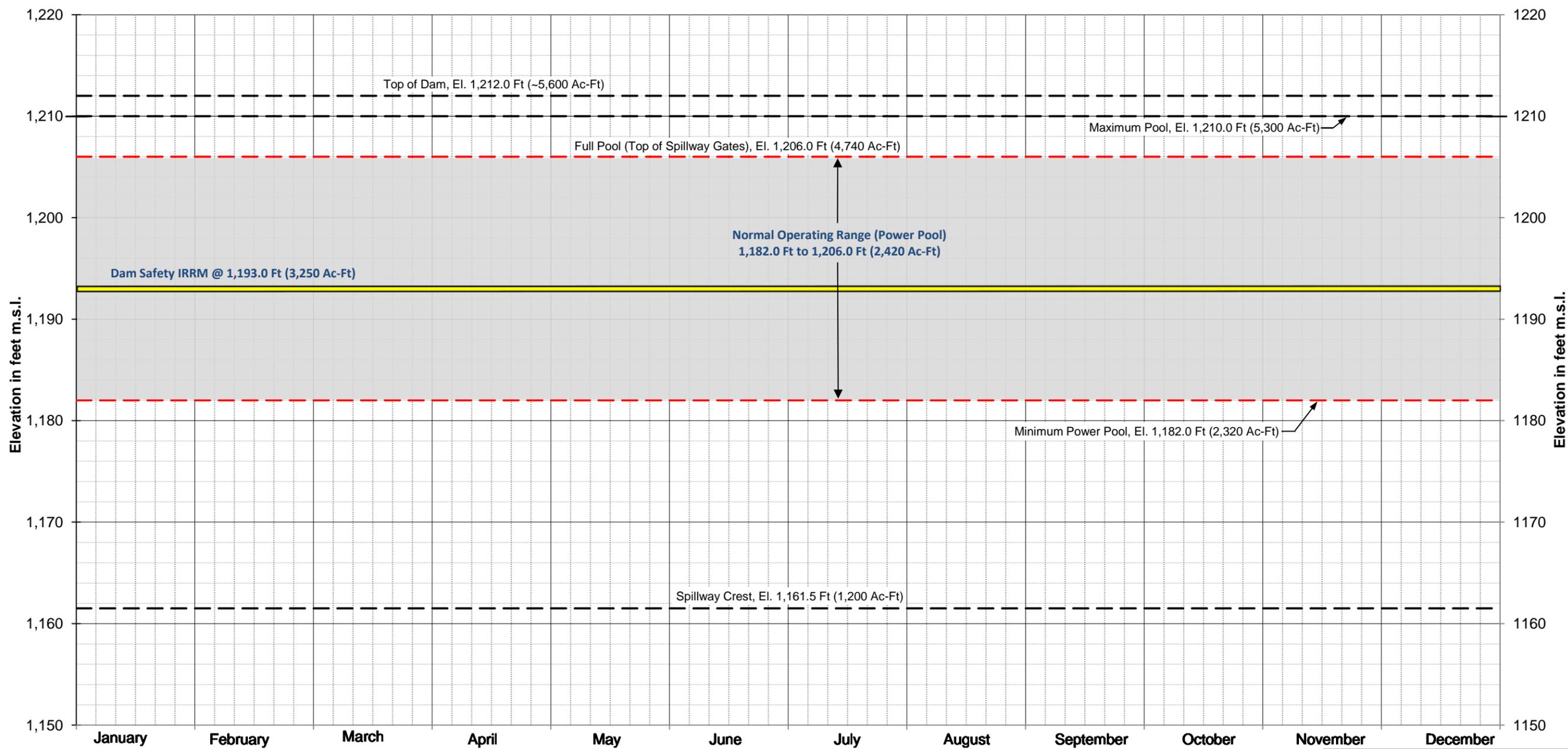


Cougar Project
Plate 11
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011
 Created by CENWP-EC-HR



Fall Creek Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

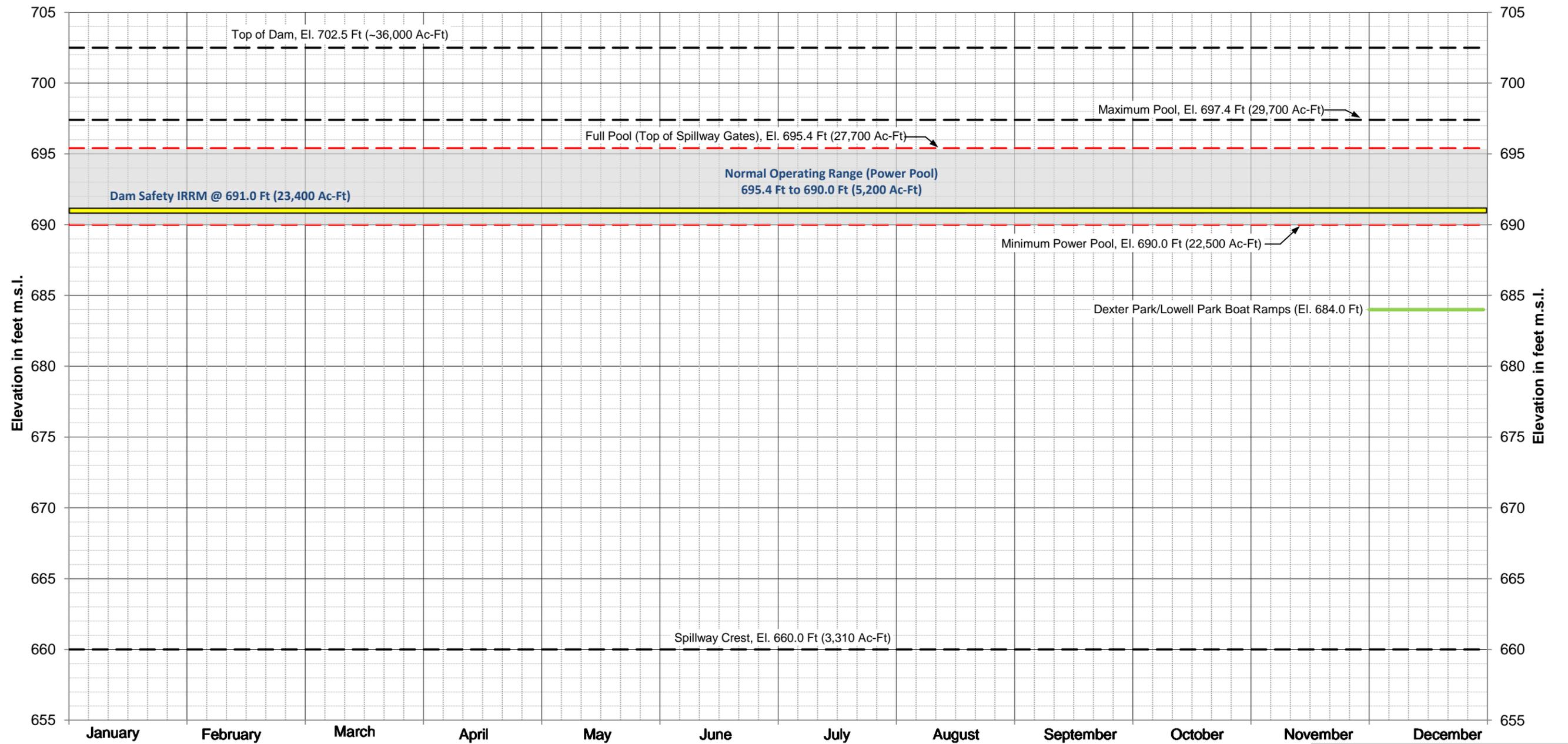
Created by CENWP-EC-HR



Notes:
Pool elevations and corresponding storage
applicable at 2400 hours.

Big Cliff Project
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

Created by CENWP-EC-HR



Notes:
Pool elevations and corresponding storage
applicable at 2400 hours.

Dexter Project
Plate 7-2.1, P103.1
Scheduled Water Control Diagram
 U.S. Army Corps of Engineers
 Portland District March 2011

Created by CENWP-EC-HR

Adult Chinook Outplant Form

Hatchery: _____ Date: _____

Driver: _____ Truck/unit number: _____

Water temp at collection site: _____ Anesthetic: _____

Tank Temperature - Start - _____ End - _____

Loading time-Start: _____ Loading time-End: _____

Antibiotic injections: Oxytetracycline: Erythromycin none

	Finclipped	Non Finclipped	Total
Male			
Female			
Jack			
Total			

Hauling time - Start: _____ Hauling Time - End: _____

Release Stream: _____

Release Site: _____

Water Temperature at release site: _____

Release Method: _____

Mortalities: _____ Likely mortalities: _____

Comments/Tags: _____

Adult Winter Steelhead Outplant Form

Hatchery: _____ Date: _____

Driver: _____ Truck/unit number: _____

Water temp at collection site: _____ Anesthetic: _____

Tank Temperature - Start - _____ End - _____

Loading time-Start: _____ Loading time-End: _____

Antibiotic injections: Oxytetracycline: Erythromycin none

	Non Finclipped
Male	
Female	
Total	

Hauling time - Start: _____ Hauling Time - End: _____

Release Stream: _____

Release Site: _____

Water Temperature at release site: _____

Release Method: _____

Mortalities: _____ Likely mortalities: _____

Comments/Tags: _____

**OFFICIAL COORDINATION REQUEST FOR
NON-ROUTINE OPERATIONS AND MAINTENANCE**

**COORDINATION TITLE-
COORDINATION DATE-
PROJECT-
RESPONSE DATE-**

Description of the problem

Type of outage/change required

Impact on facility operation

Dates of impacts/repairs

Length of time for repairs

Expected impacts on fish

Comments from agencies

Final results

Willamette Fish Operations Plan (WFOP) Change Request Form

Change Form # & Title: 15XXX### –

Date Submitted:

Project:

Requester Name, Agency:

Final Action:

WFOP Section:

Justification for Change:

Proposed Change:

Comments:

Record of Final Action: