Operational Criteria and Reservoir Elevations Report

June 2026

U.S. Army Corps of Engineers
Northwestern Division
Portland, OR

1 Introduction

This report is responsive to the U.S. District Court for the District of Oregon's (District Court) Preliminary Injunction Order issued February 25, 2026 and amended on March 2, 2026. The monthly Fish Operations Plan implementation reports identify circumstances when pool elevation lower limits exceed the planned operating ranges for each of the dams. Those reports are incorporated by reference herein. [1] We note that, in 2026, there have been no adjustments to pool elevation lower limits at the Lower Columbia River projects that exceed the required ranges per the 2026 court order. The Corps will likewise post this report to the website listed in footnote 1 in order to make it available to all regional fish managers. Detailed below are the authorized purposes and specific operational criteria dictating the normal minimum reservoir elevations at McNary, The Dalles, and Bonneville dams and what actions would be necessary to return to the original minimum operating elevations.

2 Background & System Interconnectivity

2.1 Run-of-River Projects

The eight Corps operated and maintained projects on the lower Columbia River (Bonneville, The Dalles, John Day, and McNary dams) and the lower Snake River (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams) are interconnected as a series of dams and reservoirs that pass flow from one project to the next. These dam and reservoir projects are operated in a coordinated manner with the six remaining Federally-operated Columbia River System (CRS) dam and reservoir projects (Dworshak, Chief Joseph, Grand Coulee, Albeni Falls, Libby and Hungry Horse). For the eight lower Columbia and lower Snake River dam and reservoir projects, changes in reservoir elevation at the dam, or forebay elevation, changes the water surface elevation at the base of the next upstream dam, called the tailwater elevation. Raising the forebay elevation at a downstream project raises the tailwater elevation at the project immediately upstream. The tailwater elevation at a project is also affected by the amount of flow

[1] FOP implementation reports are posted monthly at https://public.crohms.org/tmt/documents/FOP_Implementation_Reports/

released from a dam (i.e., higher outflows result in higher tailwater elevations). Each project has a minimum and maximum forebay elevation as well as a minimum tailwater elevation requirement described below in Section 2.2. Maintaining forebay and tailwater elevations are important to ensure the projects operate as designed, and since forebay and tailwater elevations are interconnected, changes at one project can affect the project immediately upstream and downstream.

2.2 Normal Minimum Reservoir Elevations

Each dam and reservoir project has a normal forebay operating range and minimum tailwater requirement to ensure that all authorized project purposes are maintained (Table 1). Forebay operating ranges and tailwater minimum requirements are established during the design of the project to meet project authorized purposes and documented in the project's Water Control Manual (WCM).[2] Normal forebay operating ranges are adjusted periodically (but generally very infrequently) to accommodate development in the basin (e.g., Bonneville's range was modified in 1971 to accommodate the Second Powerhouse and The Dalles Dam construction). Generally, the normal operating ranges have been in place for decades and provide a safe and reliable reservoir level for river users including irrigators, municipal and industrial water supply providers, boaters, marina owners, port operators, barge operators, etc. Communities and businesses have developed along the Snake and Columbia Rivers around these reliable and well-established reservoir ranges. Graphs showing the past 26 years of forebay operations for eight Lower Columbia and Lower Snake River dams are shown in Figures 1-8.

[2] The WCM documents pertinent project information for the operation of the projects and includes basin runoff characteristics, operating criteria for various dam components, and a Water Control Plan to guide real-time water management operations. WCMs are updated using guidance from ER 1110-2-240 and ER 1110-2-3600.

Table 1. Summary of Normal Reservoir Operating Ranges and Minimum Upstream Tailwater Elevations (elevations in feet above mean sea level)

Project	Normal Forebay Operating Range (2020 BA, ft, NGVD 29)	2026 Forebay Operating Range (ft, NGVD 29)	Upstream Dam minimum tailwater requirement (ft, NGVD 29)
Lower Granite	733-738	733-734.5 (3 Apr-31 Aug)	n/a
Little Goose	633-638	633-634.5 (3 Apr-14 Aug)	633
Lower Monumental	537-540	537-538.5 (3 Apr-14 Aug)	537
Ice Harbor	437-440	437-438.5 (3 Apr-14 Aug)	437
McNary	337-340[A]	337-340 (year-round)	337
John Day	262-266.5[B]	262-266.5 (16 Nov-14 Mar) 262.5-266.5 (15 Mar-9 Apr) 264.5-266.5 (10 Apr-1 Jun) 262.5-266.5 (2-14 Jun) 262.5-264.5 (15 Jun-31 Aug) 262.5-266.5 (1 Sep-15 Nov)	262
The Dalles	155-160[C]	157-160 (Mar-Nov)	158
Bonneville	71.5-76.5	71.5-76.5 (year-round)	70

[A] The McNary WCM specifies a minimum forebay elevation of 335 feet, however, for reasons discussed in the sections below, the normal minimum forebay elevation is 337 feet.

[B] The John Day WCM specifies that the reservoir may be drafted to 257 feet for flood risk management.

[C] The Dalles forebay is adjusted to maintain John Day tailwater above 158 feet. The Dalles reservoir generally operates from 157-160 feet to meet this criterion. Refer also to Figure 7.

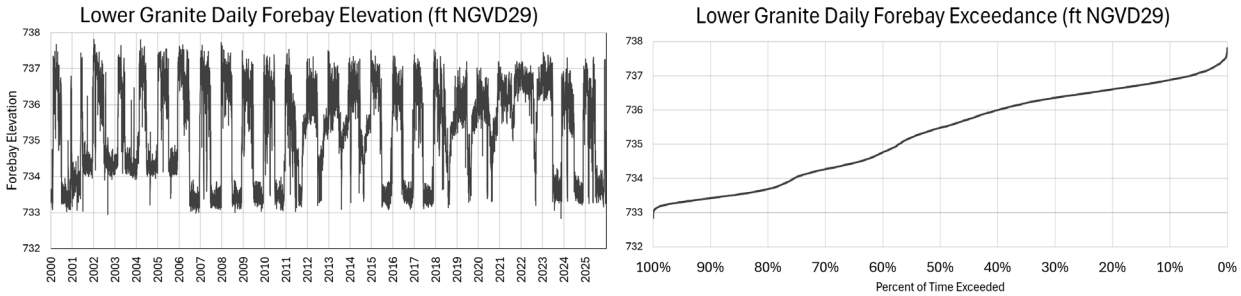

Figure 1. Lower Granite Dam Daily Forebay Elevation (left) and Exceedance Plots (right) from 2000-2025

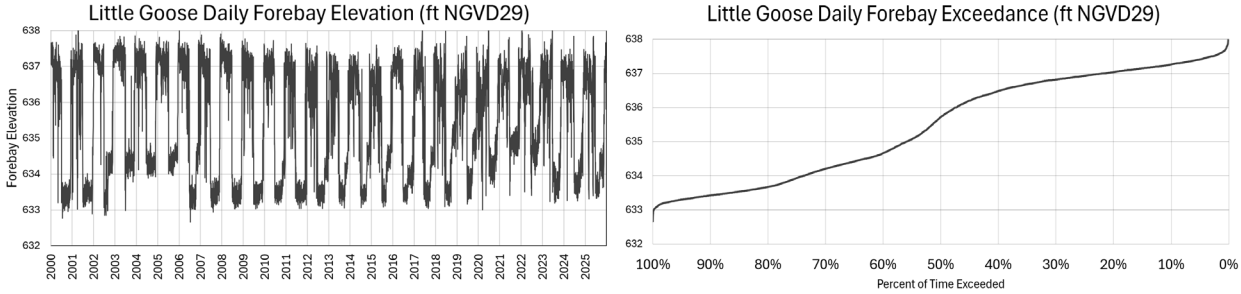

Figure 2. Little Goose Dam Daily Forebay Elevation (left) and Exceedance Plots (right) from 2000-2025

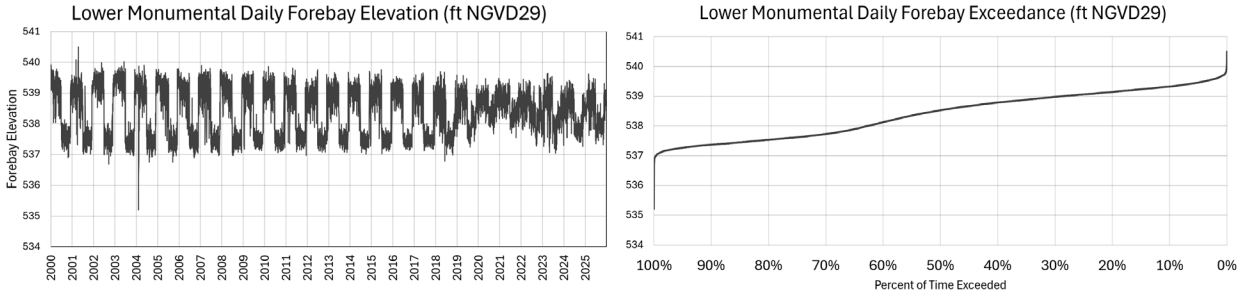

Figure 3. Lower Monumental Dam Daily Forebay Elevation (left) and Exceedance Plots (right) from 2000-2025

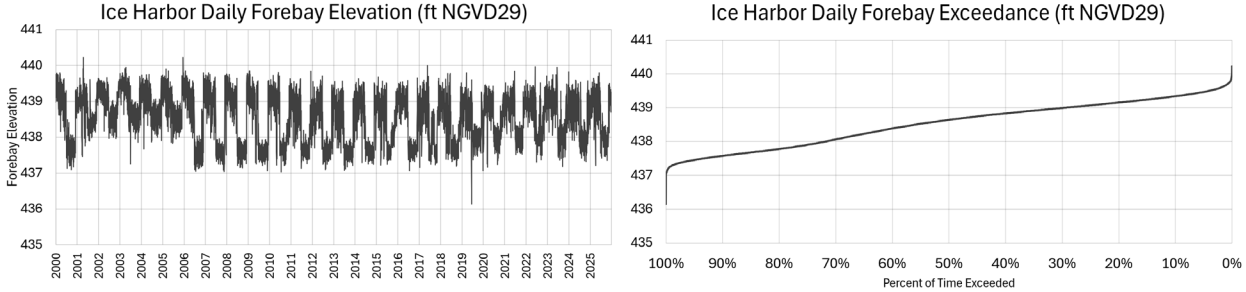

Figure 4. Ice Harbor Dam Daily Forebay Elevation (left) and Exceedance (right) Plots from 2000-2025

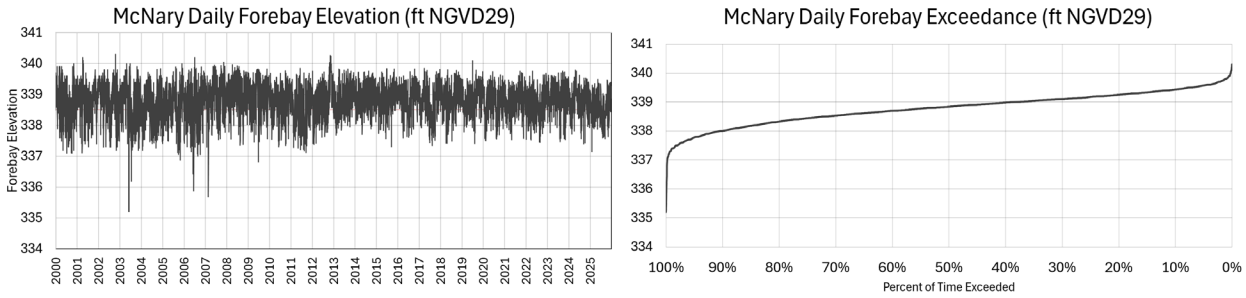

Figure 5. McNary Dam Daily Forebay Elevation (left) and Exceedance (right) Plots from 2000-2025

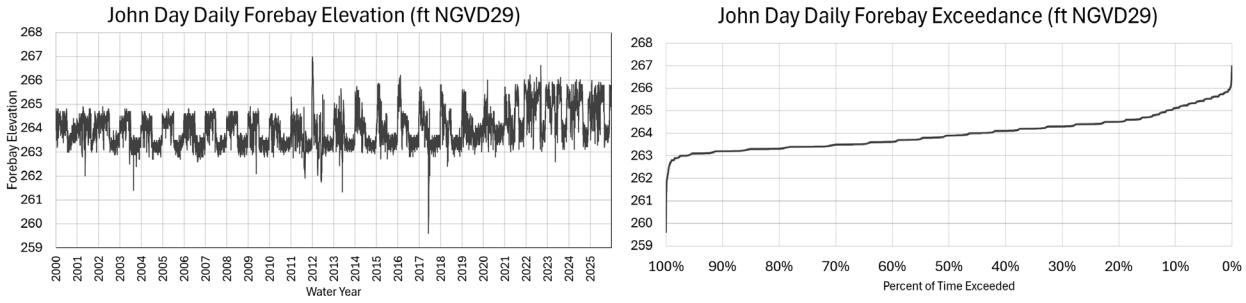

Figure 6. John Day Dam Daily Forebay Elevation (left) and Exceedance (right) Plots from 2000-2025

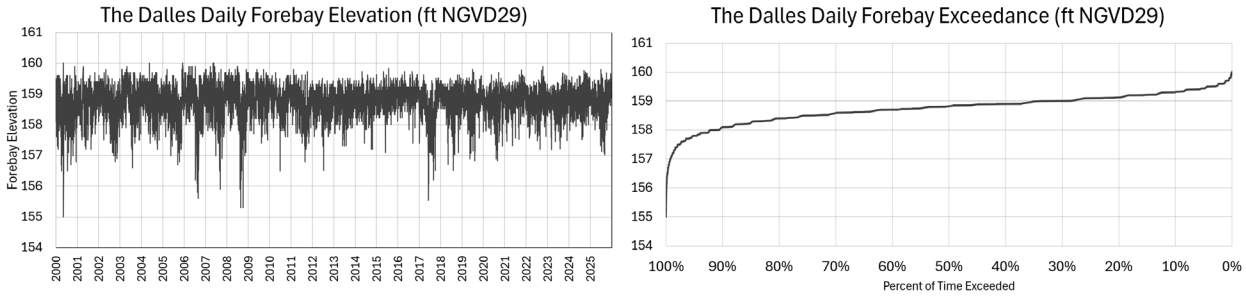

Figure 7. The Dalles Dam Daily Forebay Elevation (left) and Exceedance (right) Plots from 2000-2025

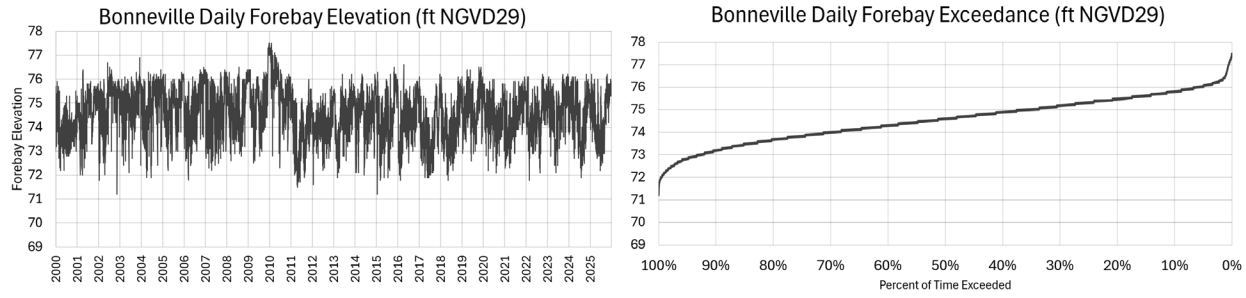

Figure 8. Bonneville Dam Daily Forebay Elevation (left) and Exceedance (right) Plots from 2000-2025

2.3 Hydraulic Modeling of Proposed Operations

Using hydraulic flow models[3], Corps staff simulated water surface profiles at McNary, Bonneville, and The Dalles reservoirs for the lower end of MOP ranges proposed by the Oregon and the NWF Plaintiffs in the 2021 and 2025 court filings. After the water surface profile analysis was completed, the resultant tailwater elevations for the upstream projects were then compared to existing tailwater criteria (Table 1). The water surface profiles were developed for a range of probable outflows that could occur from March 1 – August 31. Results of this modeling effort are presented below for individual projects.

2.4 General Description of Project Purposes Impacted by Project Forebay Levels

The sub-sections below describe, in general terms, the purposes of all eight CRS projects covered by the Court's Preliminary Injunction that are potentially impacted by operating the projects below the normal minimum forebay elevation as specified in the 2020 Biological Assessment. Consistent with the Amended Order, Sections 3 through 5 detail specific constraints for McNary, The Dalles, and Bonneville dams.

2.4.1 Fish and Wildlife

The Corps operates the lower Columbia and Snake River reservoirs to protect and enhance fish and wildlife, with a primary focus on supporting the migration and survival of ESA-listed salmon and steelhead among other ESA-listed species and non-listed species of concern (e.g, lamprey). Project operations must carefully balance hydraulic conditions required for adult fish ladders, juvenile bypass systems, and surface passage routes (such as spillway weirs and ice/trash sluiceways) to function effectively. In addition to fish passage, operations manage predator dynamics—such as preventing low-water shore exposure that aids predatory birds—and are compliant with the Migratory Bird Treaty Act.

Operating the lower Columbia and Snake River projects below the current normal minimum forebay elevation level would degrade operation of many of the fish passage systems at these projects and would have a negative impact on both adult and juvenile fish passage.

The Corps operates and maintains fish passage systems at each of the lower Columbia and lower Snake River dams to provide upstream and downstream passage routes for adult and juvenile fish. These critical passage systems include fish ladders that provide a safe route for adult fish to migrate upstream from a project's tailwater to the forebay, as well as bypass systems and surface

[3] The Corps used River Analysis Software ("HEC-RAS") developed at the Corps' Hydrologic Engineering Center. This software is an industry standard for hydraulic simulations for steady and unsteady flow computations, sediment transport/mobile bed computations, stormwater pipe network modeling, and water quality modeling (e.g., water temperature modeling).

passage structures that provide downstream passage through non-turbine routes for juvenile fish and downstream-migrating adults (e.g., steelhead kelts and bull trout). Criteria for maintaining and operating the adult and juvenile fish passage systems are documented in the Corps' Fish Passage Plan (FPP) [4], which is reviewed and updated annually, in coordination with the National Marine Fisheries Service (NMFS) and other federal, state, and tribal agencies through the Fish Passage Operations and Maintenance (FPOM) group[5] of the Regional Forum. Since 1996, the annual FPP provides criteria and guidance for protecting fish and fish passage throughout the year at the Corps projects on the lower Snake and lower Columbia rivers.

Adult fish traveling upstream enter a fish ladder below a dam and exit into the forebay. Entrances to fish ladders in the tailwater of each project require a minimum depth of water over the entrance sill to effectively attract and pass adult fish, per the FPP. This depth is largely dependent on the next downstream project's forebay elevation. The fish ladder entrances also have differential head criteria of 1-2 feet (1.5 feet optimum). Lower ladder entrance depths can reduce attraction flow which can make it more difficult for adult fish to locate the ladders.

Similarly, juvenile fish passage systems, including bypass systems and surface passage routes (e.g., spillway weirs, ice and trash sluiceways (ITS), and the Bonneville Dam corner collector) are more effective at attracting and passing juvenile salmon and steelhead at higher flow rates. Operating below the normal minimum forebay elevation reduces the total head, and thus flow and velocity, which degrades the operation of fish passage systems, rendering them less effective at attracting juvenile fish.

2.4.2 Hydropower

Operating forebay elevations are directly related to the Columbia River System's ability to provide reliable electricity generation for following demand, provide reserves for transmission reliability, and deploy present-day emergency protocols. The available energy that can be produced by each project is dependent upon both the ability to draft the reservoir to lower elevations and fill the reservoir to higher elevations as the demand for electricity fluctuates throughout the day, as well as accommodating the changes in hydraulic inflow and outflow that occur naturally and result from operations to meet the multiple congressionally authorized purposes. Operating the reservoirs below the normal minimum forebay elevation will negatively affect the generation of hydroelectric power and reserve carrying capabilities.

In order to deploy reserves or follow energy demand, there needs to be adequate storage of water for this purpose. Operating near the originally designated minimum forebay elevation would substantially reduce the ability to store water and decrease the amount of power that can be produced with the same level of water flow. It is this loss of flexibility that increases the risk of

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[4] *See* annual Fish Passage Plans (FPP) from 1996-2026 at https://public.crohms.org/tmt/documents/fpp/.
[5] See FPOM group of the Regional Forum website for meeting minutes and association meeting materials and records of coordination at https://public.crohms.org/tmt/documents/FPOM/2010/.

a transmission system emergency and, ultimately, the risk of a blackout. The risk is especially acute in circumstances where the transmission system requires relief from a specific project or projects.

Finally, reducing the minimum forebay operating level changes the 1% efficiency range of the turbines, potentially to untested ranges, threatening the effectiveness of this turbine operation. Operating the units in the most efficient range at established project forebay elevations lengthens the life of the moving parts of turbines, produces more power, reduces turbulence in the turbine environment, and moves water through the project more optimally for fish passage.

2.4.3 Navigation

Navigation is one of the Corps' primary missions, authorized by Congress in the River and Harbor Act of 1945, for the purpose of encouraging river-borne commerce and economic development in the Columbia and Snake River regions. The maintenance of the Federal Navigation Channels (FNCs) provides safe, reliable, efficient, effective waterborne transportation with most imports and exports from the country transported via water. The Corps is responsible for both improvement and maintenance of FNCs. These FNCs are maintained in accordance with the Congressional authorization while considering the needs of the users and are improved and maintained within the budgetary constraints of the agency in an environmentally protective manner. The FNC from Vancouver, Washington to the port terminal facility at The Dalles Dam is authorized to 300 feet wide and 27 feet deep; however, this channel is currently only maintained to 17 feet based on consideration of user needs (i.e., the authorized depth of 27 feet is not needed by the users). From the port terminal facility at The Dalles Dam to Lewiston, Idaho the FNC is 250 feet wide and 14 feet deep, which is the depth and width required for barge traffic to safely transit the lower Snake River based on user needs. The FNC upstream of Vancouver, Washington primarily supports barge traffic that transports grain, petroleum, wood, and fertilizer products. Depths in the FNC between Vancouver, Washington and Bonneville Dam are maintained through periodic dredging and a network of channel training structures.

In addition to navigation in the channel, the Corps requires a minimum depth of 15 to 16 feet over the upstream and downstream concrete sills at the navigation locks to protect the dam structures from impact, except at Bonneville Dam, which requires 18 feet of depth over the sill.[6] The additional depth beyond the depth of the navigation channel provides a factor of safety for the structure when wind and wave action become severe and cause localized changes to the reservoir elevations that cause loaded barges to pitch as they cross the lock sill. A severe impact to the navigation structure can have immediate and long-term negative consequences to fish, the environment, human health and safety, dam safety, and project operations. An impact to the lock sill can shut down navigation on the system for long periods of time while damage is repaired, with detrimental impacts to commerce and the possibility of environmental consequences due to

[6] The FNC is 17 feet up to The Dalles, Oregon so safe navigation sill depth at Bonneville Dam is 18 feet.

spillage. Forebay elevations at Corps projects are adjusted if needed to maintain appropriate depth over the navigation lock sills or to mitigate for shoaling upstream of the dam until dredging of accumulated sediments can be completed.

2.4.4 Irrigation and Water Supply

The lower Columbia and Snake River reservoirs provide reliable water levels to support regional agriculture, as well as municipal and industrial (M&I) water supply systems. Over decades, communities, irrigation districts, and industrial facilities have constructed extensive infrastructure—including pumping stations, potable water siphons, and cooling water intakes—specifically engineered to function within the Corps' historically established normal operating ranges. If forebay elevations fall below their established minimums, water levels can drop below the physical reach of the intake pipes. This "de-waters" the systems, causing pumps to suck air, effectively severing critical water supplies for crops, city drinking water, and wildlife refuges. Because the Corps does not own this external infrastructure, it lacks the authority and appropriations to modify or lower these private intakes, meaning any deviations from normal forebay elevations would place severe economic and operational burdens directly on the regional users.

2.4.5 Recreation

The reservoirs created by the lower Columbia and Snake River dams support a robust recreational economy and provide public access to the river. Authorized recreational uses include boating, fishing, swimming, and marina operations. The established normal reservoir operating ranges are essential to keep community boat ramps submerged and functional, keep marinas accessible, and ensure that shallow-water hazards, such as submerged mud bars, remain safely covered for recreational boaters. Furthermore, maintaining these forebay elevations is necessary to support regional events and to ensure safe, continuous river access for Treaty-protected Tribal fishing.

2.4.6 Water Quality

Managing water quality—specifically Total Dissolved Gas (TDG)—is a critical operational constraint at the lower Columbia River and lower Snake River dams. When large volumes of water are spilled over a dam, the plunging water entrains air deep into the stilling basin, supersaturating the water with TDG. High TDG levels can lead to Gas Bubble Trauma in fish, a condition analogous to "the bends" in human divers, which can be lethal. To mitigate this, the Corps installed spillway flow deflectors designed to create a "skimming" flow across the water's surface rather than “plunging” flow which entrains air into the water and increases TDG supersaturation. However, these deflectors only function correctly within their designed tailwater elevation ranges. Operating below the minimum tailwater elevation can cause plunging flows that exponentially increase TDG saturation and trap fish in highly gaseous turbulent eddies.

2.4.7 Cultural Resources

While not an authorized purpose of the system, the Corps has a responsibility to consider effects to cultural resources from operations. Maintaining normal reservoir elevation ranges is a primary method of protection of historic artifacts, ancient archaeological sites, and Tribal Traditional Cultural Places, including human burial locations; keeping the water levels within established historical ranges keeps many sensitive sites safely submerged or inaccessible. Reservoir elevations below the normal operating range would expose these resources to shoreline erosion, weathering, and a significantly heightened risk of vandalism and looting due to increased access to the exposed riverbed.

3 McNary Dam

The normal operating range at McNary Dam is 337.0 to 340.0 feet. The reservoir is rarely operated to the original minimum per the WCM of 335.0 feet. Figure 9 shows the Ice Harbor tailwater elevation as a function of Priest Rapids outflow and Ice Harbor outflow, assuming McNary forebay is at 335.0 feet. The minimum tailwater elevation at Ice Harbor Dam is shown as a dashed orange line.

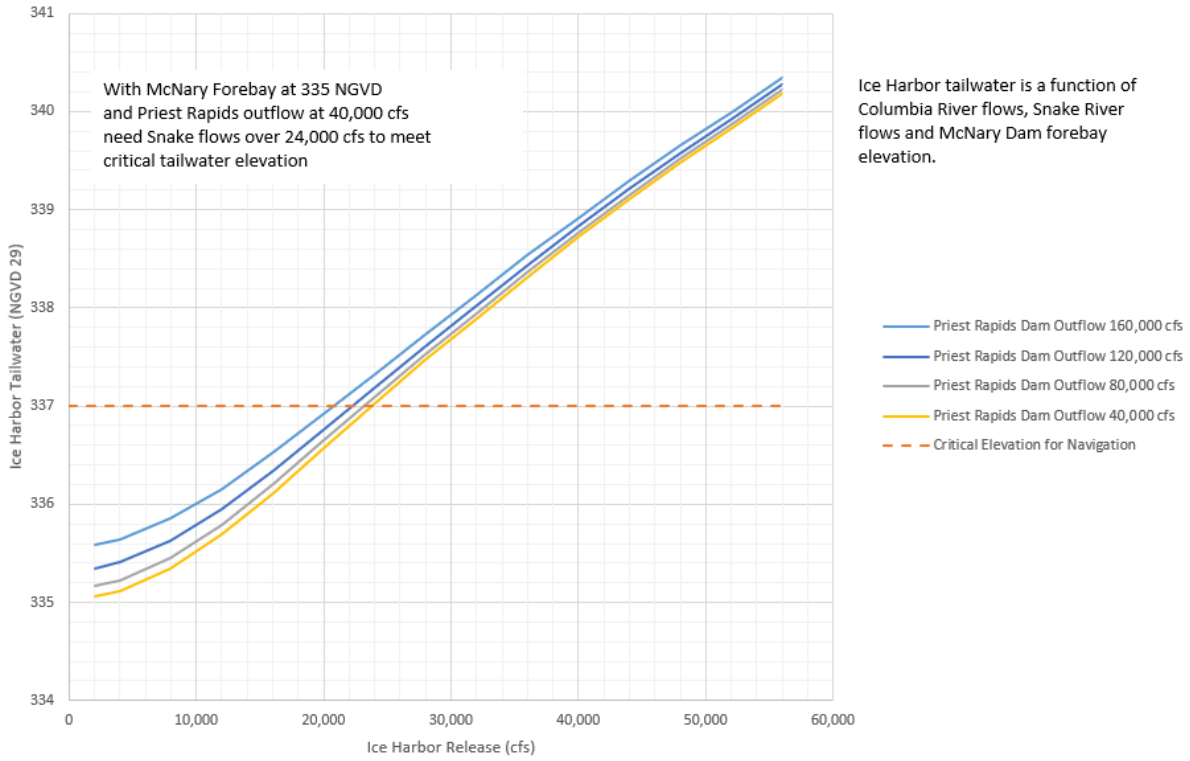

Figure 9: Ice Harbor Tailwater Elevation as a Function of Priest Rapids Flow and Ice Harbor Flow with McNary forebay at 335.0 Feet

Table 2 indicates the percent of time that flow would drop below the minimum required Priest Rapids/Ice Harbor outflow necessary to maintain the minimum tailwater at Ice Harbor. Outflows from Priest Rapids and Ice Harbor would fail to meet the minimum tailwater criteria during low flow periods with McNary forebay at 335.0 feet.

Table 2. Ice Harbor Tailwater Projections with McNary Forebay Elevation of 335.0 Feet

Tailwater (feet)[C]	**Percent of Time Hourly Flow is Below Flow Rate [A]**						
	Mar	Apr	May	Jun	Jul	Aug	Mar-Aug
336.0	6	0	0	0	0	0	1
337.0[B]	11	1	0	0	6	28	8
338.0	22	3	0	2	25	70	21

[A] Based on hourly observed flow data from 2006-2025

[B] Ice Harbor minimum tailwater elevation (row highlighted in yellow)

[C] Tailwater is a function of both Priest Rapids outflow and Ice Harbor outflow

3.1 Impacted Project Purposes & Associated Elevation Criteria

3.1.1 Fish and Wildlife

3.1.1.1 Fish Passage

3.1.1.1.1 Juvenile Fish

Operating the McNary forebay below 337.0 feet causes a low tailwater at Ice Harbor Dam and increases the potential risk of injury to fish. In conjunction with high spill levels, a low tailwater elevation at Ice Harbor Dam results in plunging flow through the spillway. Plunging flow jets at the deflector would impact the stilling basin baffle blocks, end sill, and the downstream channel bottom. Water from southern spillways (including the Removable Spillway Weir - RSW) is prone to re-entrainment beneath the deflected flow, which can repeatedly expose juvenile salmonids to extreme turbulence, baffle block strikes, and high TDG levels. These conditions could increase the risk of injury as well as disorientation to juvenile fish which may also increase their risk of predation.

Further, the centerline of juvenile collection channel orifices at McNary Dam are at elevation 330.0 feet. At a forebay elevation of 335.0 feet (PI request), the hydraulic head on the orifices would be reduced, which in turn would reduce flow to move fish through the system and could increase gatewell residence time as well as descaling and injury. A lower forebay elevation would also reduce gravity feed to the juvenile bypass channel, risking failure to maintain passage criteria.

Additionally, a lower forebay elevation at McNary Dam would also reduce flow over the two top spillway weirs (TSWs) from approximately 16 kcfs (at 337.0 feet) to 12 kcfs (at 335.0 feet). The TSWs are a highly efficient surface passage route for downstream-migrating fish with a high survival rate; thus, reducing flow over the TSWs would result in fewer fish using that route.

3.1.1.1.2 Adult Fish

Maintaining a minimum elevation of 337.0 feet in the McNary forebay elevation helps adult fish ladders at McNary Dam function as designed. The McNary WCM notes that the fishway entrances and the auxiliary water supply (AWS) pumps, which provide attraction flow to the ladders, are designed assuming 337.0 feet as a minimum operating level. Lowering the forebay would reduce the effectiveness of ladder attraction flows and could impede adult salmon and steelhead migration. In general, most of the McNary Dam adult fish passage structures were designed to operate down to 335.0 feet, however, the current condition of the fishway pumps, valves, tainter gate, tilting weirs, etc., would require significant and extensive upgrades.

3.1.1.1.3 Avian Predation Management

At McNary Dam, the normal forebay operating range allows regular fluctuations of the reservoir, minimizing habitat for piscivorous birds below established vegetation. Shoreline-nesting piscivorous birds are not likely to construct a nest in areas that are regularly inundated by the normal forebay fluctuations and typically establish nests at higher ground. Operating the McNary forebay below 337.0 feet would expose large areas of open mud, sand or rocky areas that are free of vegetation. These areas would provide more attractive nesting habitat for piscivorous birds for extended periods of time during the typical nest initiation period in the region, and nests are expected to be established at much lower elevations which would increase predation on ESA-listed salmonids.

3.1.2 Hydropower

Lowering the McNary forebay below 337.0 feet reduces the power output generated per unit of water flow through the turbines, thus decreasing the ability to carry reserves and meet power demand. Recovery of these lost capabilities requires full system changes to fill into the forebay over multiple hours.

3.1.3 Navigation

The navigation sill elevation at Ice Harbor is 321.0 feet and minimum depth required over sill is 16 feet per the Ice Harbor WCM which necessitates a minimum tailwater elevation at Ice Harbor of 337.0 feet. Maintaining the minimum depth over the concrete sill at the navigation lock entrance is critical to prevent a barge or other vessel from impacting the sill. If a barge or vessel contacts the concrete sill, the lock would need to be taken out of service for inspection and repairs which could eliminate all passage through that lock for weeks or months.

Additionally, to provide the congressionally authorized 14-foot navigation channel depth and safe passage over the navigation lock sills at Ice Harbor, the Corps must maintain the Ice Harbor tailwater at a minimum of 337.0 feet. Operating the McNary forebay below 337.0 feet would create severe navigation hazards in the project forebay. A lower reservoir level would also severely restrict access to boat marinas, the Umatilla Fuel Terminal, and the Tidewater Fuel Dock (RM 2.2 on the lower Snake River).

3.1.4 Irrigation and Water Supply

Operating below 337.0 feet in the McNary forebay would impact water supply pumping withdrawals for irrigation and M&I purposes, including the pumping plants for the Umatilla Wildlife Refuge water supply system, Columbia Basin Irrigation District, and the City of Pasco, Washington.

3.1.5 Recreation

The Corps frequently receives requests from river users for higher reservoir elevations to facilitate safe recreation in the McNary reservoir (for example, the annual Tri-City Water Follies Hydroplane race). Operating to a lower forebay elevation would preclude operations to support recreation, including the Tri-Cities Water Follies, and assistance with stranded vessels.

3.1.6 Cultural Resources

Above McNary Dam on Lake Wallula, reducing the forebay elevation to 335.0 to 336.0 feet has the potential to expose and threaten at least 150 identified cultural resource properties.

3.2 Actions Required to Return to Original Minimum Reservoir Forebay Elevation

On a preliminary review, the Corps has identified the following actions that would, at a minimum, be required to operate the McNary Dam forebay below 337.0 feet:

a. The south adult fishway exit trash rack would need to be extended lower by at least two feet to handle debris at the lower water surface. The north shore exit trash rack may also need to be modified.
b. Bathymetric surveys in the forebay would be mandatory before forebay operation below the current minimum of 337.0 feet could be deemed safe for navigation.
c. An assessment of irrigators and municipal and industrial water supply users that would be affected in the McNary reservoir would need to be conducted.
d. Modeling of new spill patterns at McNary Dam with less water over the TSWs in conjunction with a lower tailwater would need to be completed.
e. The effectiveness of flow deflectors at lower Ice Harbor Dam tailwater elevations would need to be further evaluated.
f. At forebay elevation below 336.0 feet, the south fishway exit could theoretically be managed by removing the re-configuring the existing weirs, however, this configuration has not been recently tested, and the control system software would likely need to be updated to accommodate this operation condition.
g. Further analysis of the plunging flow impacts in the Ice Harbor Dam stilling basin would need to be completed. Plunging flows focus intense energy onto the stilling basin endsill and baffle blocks. Since little rock is available at Ice Harbor, the risk of ball milling

erosion is low. However, the high velocities near the baffle block create increased risk for juvenile fish injury.

h. A survey of cultural resources exposed by a lower operating elevation would need to be completed.
i. Notification to recreators and the public of lower water levels would need to occur.
j. McNary Dam forebay elevation would still need to be adjusted in real-time to provide sufficient depth in the Ice Harbor navigation lock.
k. Elevation content curves would need to be defined, and turbine operating ranges would need to be tested.
l. Biological studies to monitor impacts to ESA-listed species would be required.

4 The Dalles Dam

The normal forebay operating range at The Dalles Dam is 157.0 to 160.0 feet. Although the normal forebay elevation range specified in the WCM is 155.0 feet to 160.0 feet, The Dalles forebay is adjusted to maintain the John Day tailwater above 158.0 feet. The Dalles forebay generally operates from 157.0-160.0 feet to meet this criterion. Specific impacts resulting from operating the forebay below 157.0 feet are highlighted below. The minimum tailwater elevation at the upstream project, John Day, is 158.0 feet.

Figure 10 shows water surface profiles from John Day tailwater to The Dalles forebay with The Dalles forebay at 155.0 feet. The minimum tailwater elevation at John Day Dam is shown as a dashed red line.

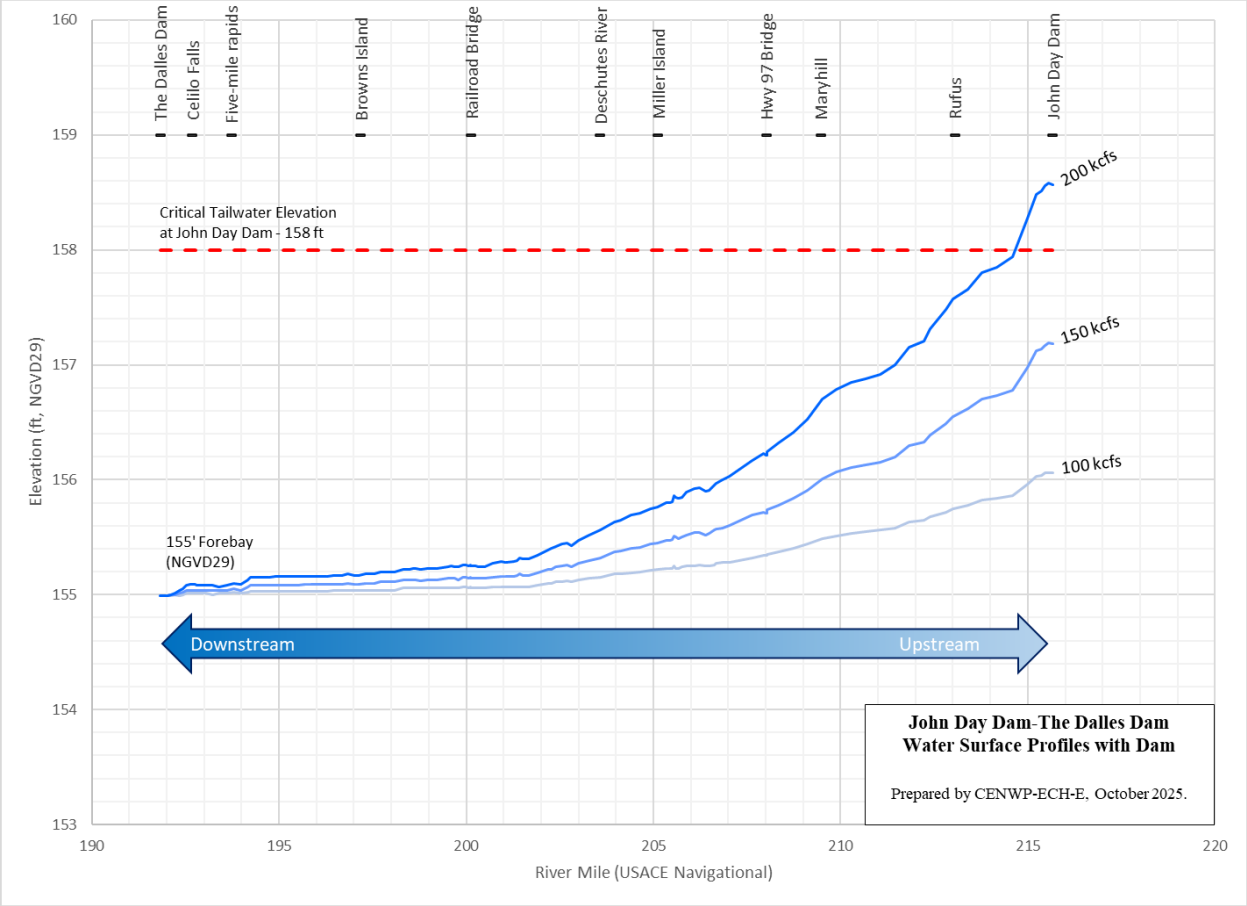

Figure 10. Water Surface Profiles from John Day Dam Tailwater to The Dalles Forebay at Different Flows with The Dalles Forebay at 155.0 feet

If The Dalles forebay elevation is restricted to 155.0 feet, a flow of 182 kcfs or greater is necessary to maintain John Day's minimum tailwater elevation of 158.0 feet (Table 3). Based on historical flow data, operating at a 155.0 feet forebay elevation would fail to meet the minimum John Day tailwater criterion 46% of the time between March and August.

Table 3. John Day Dam Tailwater Projections with The Dalles Forebay at 155.0 feet

		Percent of Time Hourly Flow is Below Flow Rate [A]						
Flow (kcfs)	Tailwater (feet)	Mar	Apr	May	Jun	Jul	Aug	Mar-Aug
100	156.0	13	4	0	0	2	12	5
150	157.2	48	24	2	6	34	68	31
182	158.0[B]	65	39	10	18	57	88	46
200	158.6	75	46	15	25	66	92	53

[A] *Based on hourly observed flow data from 2000-2025*

[B] *John Day Dam minimum tailwater elevation, March-August (row highlighted)*

4.1 Impacted Authorized Purposes & Associated Elevation Criteria:

4.1.1 Fish and Wildlife

4.1.1.1 Fish Passage

4.1.1.1.1 Juvenile Fish

At The Dalles Dam, juvenile fish tend to pass through the spillway and the ITS. The ITS provides a surface passage route at The Dalles Dam powerhouse for downstream-migrating fish. Flow through the ITS would be substantially decreased (by approximately half), if the project forebay was operated at 155.0 feet, thereby decreasing the attraction flow and effectiveness of passing juvenile salmon and steelhead and other downstream-migrating fish through this powerhouse, non-turbine surface passage route.

A lower forebay elevation at The Dalles will also impact juvenile passage at John Day Dam. Lower John Day tailwater elevations may result in more severe and unstable flows off the spillway deflectors during fish passage spill. Unstable flows from the spillway deflector results in alternating skimming and plunging flows. This condition risks increased juvenile fish injury, increased TDG, and increased stilling basin erosion.

4.1.1.1.2 Adult Fish

To meet adult fish ladder entrance criteria at John Day Dam per the FPP, The Dalles must maintain a reservoir elevation that keeps the John Day tailwater at 158.0 feet. Elevations below 158.0 feet (at John Day) will also increase the spillway entrainment flow, likely exacerbating eddies below the John Day powerhouse that can mask fishway attraction flows and impede adult passage.

4.1.2 Hydropower

Lowering The Dalles forebay below 155.0 feet reduces the power output generated per unit of water flow through the turbines. This decreases the ability to carry reserves and meet power demand. The energy storage behind The Dalles Dam is substantially reduced at reservoir elevation levels below 157.0 feet. The interplay with the John Day Dam tailwater would likely remove any hydropower flexibility at this project. Recovery of these lost capabilities requires full system changes to fill the reservoir over multiple hours.

4.2 Actions Required to Return to Original Minimum Reservoir Forebay Elevation

On a preliminary review, the Corps has identified the following actions that would, at a minimum, be required to operate The Dalles Dam forebay to a minimum reservoir elevation of 155.0 feet:

a. With more energy dissipation from higher spillway flows at lower tailwater elevations at John Day Dam, the potential for stilling basin erosion would increase. Routine

monitoring of the John Day stilling basin with detailed bathymetric surveys would be necessary to ensure the structural integrity of the stilling basin is not compromised.

b. A survey of cultural resources in The Dalles reservoir exposed by a lower forebay elevation would need to be completed.
c. An assessment of irrigators and municipal and industrial water supply users that would be affected in The Dalles reservoir would need to be conducted.
d. The resource agencies, specifically NMFS, would need to consider the implications of non-compliance with the fish ladder entrance criteria at the John Day fish ladder entrances. Achieving depth criteria with The Dalles forebay at 155.0 feet is practically infeasible; this would require lowering the entrance invert and associated features, including the diffusers and AWS conduit, collectively a significant structural modification. Alternatively, the reduced depth could be compensated by supplying more flow, but this would result in a violation of entrance head criteria.
e. An analysis of The Dalles ITS would need to be completed to determine whether it is feasible to open additional weirs to compensate for flow without reducing attraction flow rates. However, as the weir elevations are fixed at minimum elevation 151.0 feet, the reduced head on the weirs under the lower forebays will reduce attraction velocities over the weirs and fish passage effectiveness (i.e., more downstream-migrating fish are likely to pass through the turbines instead of the ITS).
f. Notification to recreators and the public of lower water levels would be required.
g. Elevation content curves would need to be defined, and turbine operating ranges would need to be tested.
h. Biological studies to monitor impacts to ESA-listed species would be required.

5 Bonneville Dam

The normal forebay operating range at Bonneville Dam is 71.5 to 76.5 feet. The Bonneville forebay has not operated as low as 70.0 feet (the original minimum specified in the WCM) since 1981. Specific impacts resulting from operating the forebay below 71.5 feet are highlighted below. The minimum tailwater elevation at the upstream project, The Dalles, is 70.0 feet.

Figure 11 shows water surface profiles from The Dalles tailwater to the Bonneville forebay. The Dalles minimum tailwater elevation would be met with a Bonneville forebay elevation as low as 70.0 feet.

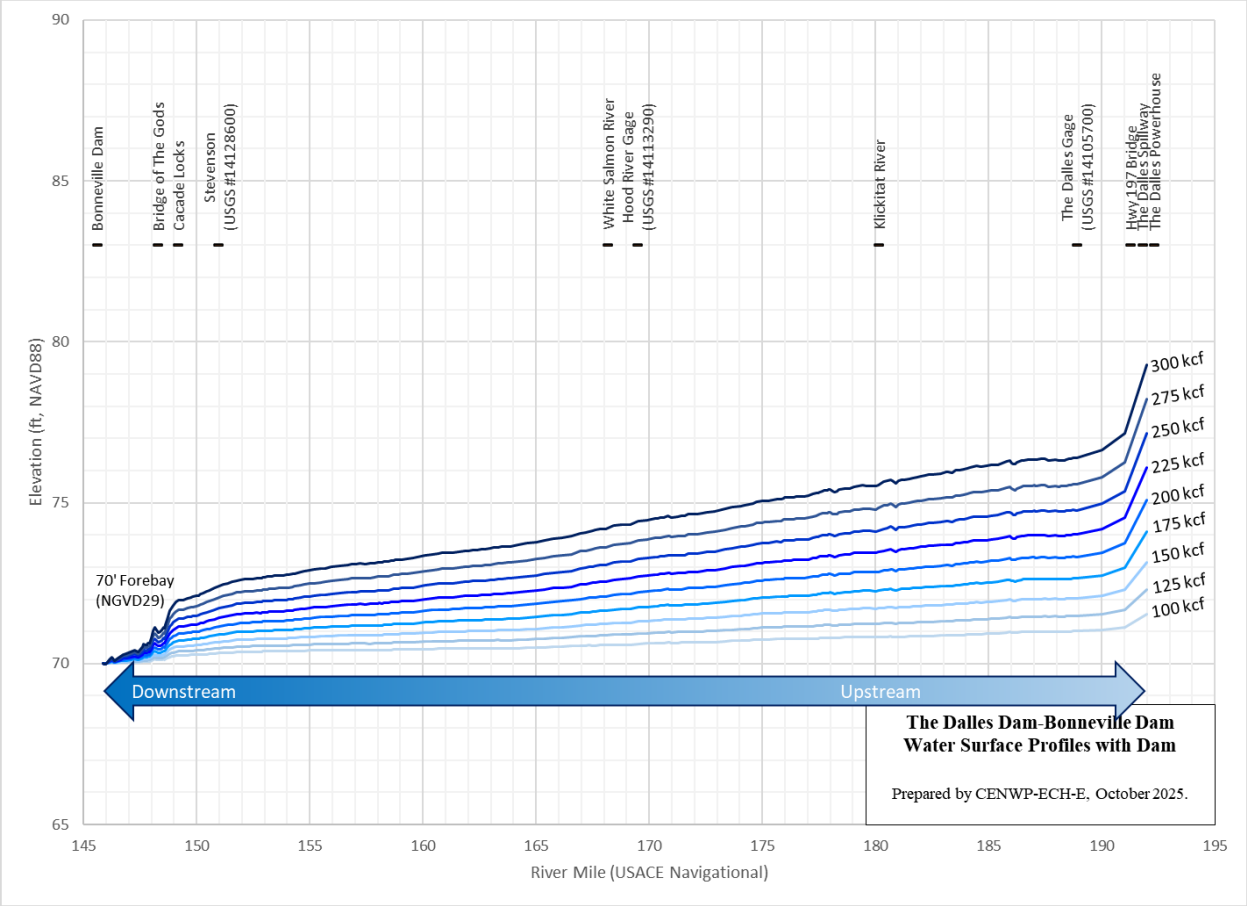

Figure 11. Water Surface Profiles from The Dalles Tailwater to Bonneville Reservoir at Different Flows with Bonneville Forebay at 70 Feet

5.1 Impacted Authorized Purposes & Associated Elevation Criteria

5.1.1 Fish and Wildlife

5.1.1.1 Fish Passage

5.1.1.1.1 Juvenile Fish

Operating the Bonneville forebay below 71.5 feet would result in operational loss of the Powerhouse One ITS, which provides a surface passage route for downstream-migrating fish on the south side of the river. The gates open to 71.0 feet and are designed for a minimum of 2.5 feet of depth. Thus, a forebay elevation under 71.5 feet reduces effectiveness and results in inadequate flow as a surface passage route for juvenile salmonids and other downstream-migrating fish. Additionally, operating the forebay below the normal minimum would reduce flow through the Powerhouse Two corner collector (B2CC), which provides a surface passage route on the north side of the river, from 5 kcfs down to about 3.5 kcfs; this reduction in flow results in minimized attraction flow as well as a larger range of tailwater elevations under which a hydraulic jump will form in the corner collector channel, which would negatively affect juvenile egress.

The Powerhouse Two juvenile bypass system (JBS) fails to provide adequate downstream migrant channel water levels at forebay elevations below 71.5 feet. The decreased flow due to reduced head could increase travel times through the JBS to the smolt monitoring facility two miles downstream, where fish are returned to the river. Any delay in the JBS has the potential to increase injury and death.

At forebay elevations of less than 71.5 feet at Bonneville Dam, there would also be adverse impacts at The Dalles Dam spillwall, which was constructed in 2010 to provide better egress conditions for juvenile fish in the tailrace. Prior to the spillwall construction, juveniles that passed through the spillway could be pushed into shallow areas where they were subject to eddy currents, longer retention times, and increased predation. The spillwall directs juveniles into the main river channel, speeding their downstream migration and reducing predation. Therefore, to achieve optimum egress conditions and higher survival, spill for juvenile fish passage at The Dalles Dam is generally limited to bays 1–8 north of the spillwall. The spillwall structure was designed assuming normal forebay and tailwater levels. Bonneville Dam forebay levels below the normal operating range would create high velocities in The Dalles Dam tailrace, over 20 feet per second, that are outside the design criteria for the facility and could lead to erosion of the spillway stilling basin and structural failure of the spillwall under high flow conditions. Corps staff estimates that even with the Bonneville Dam forebay at 71.5 feet, flow velocities would exceed the 20 feet per second threshold when total river flow exceeds 350 kcfs. During these high flow conditions, in order to meet the 40% spill requirement at The Dalles Dam and maintain safe velocities for the spillwall structure, a limited amount of spill would be released through the preferential bays 1–8 (north of the spillwall) and the remainder of spill would be released outside the spillwall (i.e., spillbays 9-23) to protect the project from erosional forces. When this occurs, fish that pass south of the spillwall would be directed into shallow islands immediately downstream of the spillway where they are heavily preyed on by piscivorous fish and birds. At lower forebay elevations, the proportion of spill outside of the wall would increase substantially.

5.1.1.1.2 Adult Fish

The established minimum reservoir elevation of 71.5 feet is required to ensure adequate depth at the exits of the Bradford Island and Washington Shore fish ladders at Bonneville Dam. Additionally, forebay elevations below 71.5 feet would reduce flow to the Adult Fish Facility as well as the AWS. As systems fail to keep up with required flows for fishways and entrance differentials cannot be maintained, migratory fish are less likely to find the entrance of a ladder and their migration could be delayed. Delayed migration below Bonneville Dam leaves fish in the tailrace susceptible to sea lion predation.

5.1.1.1.3 Lamprey

Lamprey utilizing the Bradford and Cascades Island systems would drop into dangerously shallow water (1-2 feet) with the Bonneville forebay operated below 71.5 feet, and the

Washington Shore lamprey passage system would force lamprey to drop an additional 4 feet, increasing the risk of fatal wall strikes.

5.1.2 Hydropower

Lowering the Bonneville forebay below 71.5 feet reduces the power output generated per unit of water flow through the turbines. This decreases the ability to carry reserves and meet power demand. Recovery of these lost capabilities requires full system changes to fill the reservoir over multiple hours.

5.1.3 Recreation

The Bonneville reservoir is used extensively for recreation. The Corps receives requests throughout the year to operate to a higher reservoir elevation to allow for access and safe conditions for recreators (for example, operating to a forebay elevation above 74.0 feet to support the Gorge Champs Canoe Paddling Event). The Bonneville reservoir is also occasionally raised to assist in boat removal and retrieval.

5.2 Actions Required to Return to Original Minimum Reservoir Forebay Elevation

The minimum forebay elevation at Bonneville has been modified several times since its original construction in the 1930s due to development in the Columbia Basin upstream, around the Bonneville reservoir, and at the dam (e.g., construction of the Second Powerhouse). The normal forebay operating range at Bonneville Dam has evolved over time with significant changes in 1963 (72.0-74.0 feet) to the current range established in 1971 (71.5-76.5 feet). On a preliminary review, the Corps has identified the following actions that would, at a minimum, be required to return to a minimum forebay elevation of 70.0 feet:

a. A survey of cultural resources exposed by a lower forebay elevation would need to be completed.
b. An assessment of irrigators and municipal and industrial water supply users that would be affected in the Bonneville reservoir would need to be conducted.
c. Long term effects of operating the juvenile bypass system downstream migrant channel below 71.0 feet would need to be evaluated.
d. Effects on water levels through the AWS intakes at a lower forebay elevation would need to be evaluated.
e. Flow rates into the adult fish facility (AFF) would need to be evaluated.
f. Further evaluation of the fish impacts related to spill at The Dalles Dam north of the spillwall during high flow levels would be required.
g. An evaluation of the lamprey passage system under low head conditions would be required.
h. Modifications to the ITS and B2CC would be required.

i. Modifications to the Bradford Island and Washington Shore fish ladder exits would be required; note that the Washington Shore fish ladder exit section was modified in 2025; preliminary reports indicate that modifications have substantially improved passage of lamprey.
j. Notification to recreators and the public of lower water levels would be required.
k. Elevation content curves would need to be defined, and turbine operating ranges would need to be tested.
l. Biological studies to monitor impacts to ESA-listed species would be required.