U.S. Army Corps of Engineers
Seattle District

Flow Plan Implementation Protocol Technical Team

SUMMARY
of
2022 Sturgeon Operations at Libby Dam

March 31, 2023

U.S. Army Corps of Engineers
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WY2022 Libby Dam FPIP Sturgeon Flow Augmentation Operations

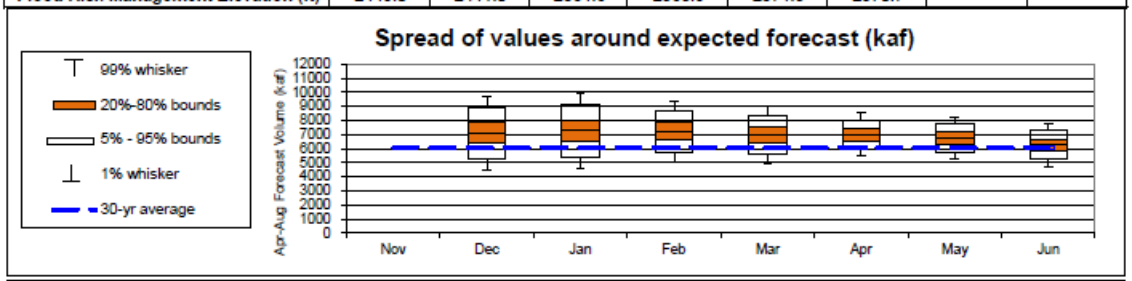
Monthly precipitation in the Kootenai basin through the fall, winter, and spring (October – June) of Water Year 2022 varied from below normal to above normal. The monthly April through August Water Supply Forecasts (WSF) for Koocanusa Reservoir remained above normal December through May, slowly decreasing to normal by June (Figure 1).

Libby : June Runoff Forecast & Flood Risk Management Calculation — WY 2022

Runoff Forecast	June	1991-2020 Average	1991 - 2020 Percent of Average	1929-2020 Average	1929 - 2020 Percent of Average
Most Probable Runoff Volume: Apr-Aug (kaf)	6276	6080	103%	6259	100%
Most Probable Runoff Volume: Apr-Jul (kaf)	5634	5570	101%	5708	99%
Most Probable Runoff Volume: May-Jul (kaf)	5288	5014	105%	5183	102%

Forecast/Reservoir Data	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Apr-Aug Runoff Forecast (kaf)		7123	7273	7249	6972	6992	6740	6276
First-of-Month Elev (ft)	2450.2	2441.6	2414.4	2384.5	2363.5	2365.3	2369.0	2372.0

Seasonal FRM Requirements	30-Nov	31-Dec	31-Jan	28-Feb	31-Mar	30-Apr		
Flood Risk Management Space (kaf)	500	2000	2851	3416	3208	3238		
Flood Risk Management Elevation (ft)	2448.0	2411.0	2384.6	2363.9	2371.8	2370.7		



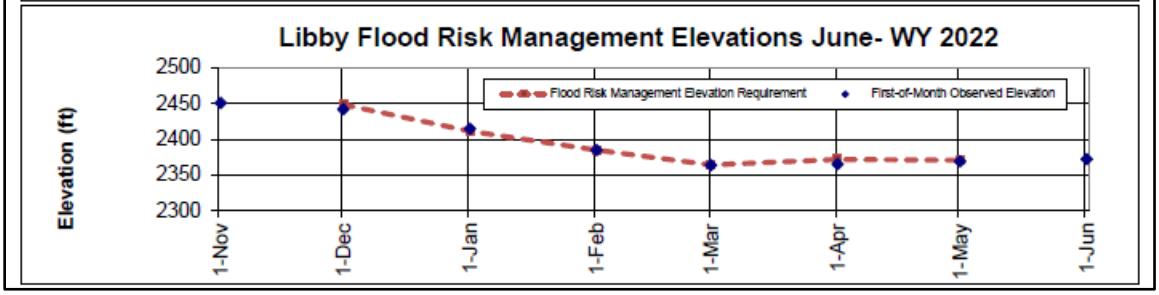


Figure 1. Final June 2022 Koocanusa Reservoir April through August WSF.

The initial controlled flow (ICF) for the Dalles, Oregon, was calculated as 298,000 cfs in the Declaration of Initiation of System Refill report issued by the Corps' Northwest Division Office on 26 April, which set the start of refill of Koocanusa Reservoir for 27 April. An initial VarQ flow of 16,100 cfs was calculated using the April 2022 WSF, which was greater than inflow of approximately 4,300 cfs. Therefore, that last few days of outflow were set to match inflow that increased to 6.2 kcfs on 30 April 2022. The May 2022 WSF was 6.7 MAF, or 111 percent of average. This forecast resulted in an updated VarQ flow of 12.3 kcfs and inflows increased enough to match to the VarQ flow.

The 2020 CRSO EIS and associated documents lay out several changes to the VarQ procedures at Libby Dam. A new storage reservation diagram (SRD) changes the end-of-month flood risk mitigation (FRM) target elevations from December through April. The new SRD requires a deeper draft of Koocanusa Reservoir during lower water supply forecast years. This deeper draft is offset by changes to the computation of VarQ FRM minimum flows during the refill period (generally starting on 1 May but could be earlier for May WSF >6.9 MAF). First, the new minimum flow procedure contains an updated chart for determining the initial flow, which is lower for lower WSF's. Second, the VarQ minimum flow now accounts for the known volume to be released during the sturgeon pulse, thus eliminating the double accounting of flow that previously existed; this change further lowers the minimum VarQ flow to be released. Third, the VarQ minimum flow now has a recalculation frequency of up to daily, changed from monthly under the pre-CRSO procedure. Typically, this recalculation is done to account for over-release resulting from following BiOp ramping rates to get to the specified VarQ minimum and will therefore lower the minimum flow to account for the increased volume released, particularly during declining WSF years. However, under-release due to inflows coming in lower than the VarQ minimum flow, or lower releases due to downstream flood concerns, could result in a higher release during a recalculation. The 2020 USFWS BiOp states: "The Proposed Action adjusts the refill equations for all years, which results in increased likelihood of reservoir refill in all but the lowest 5 percent of years."

The final May inflow forecast for April-August, which dictates sturgeon volume (Table 1), was 6.74 MAF (111% of normal), with an associated sturgeon volume of (1.15 MAF). The FPIP sturgeon volume augmentation operation began on 16 May, with Libby Dam discharge increasing from 12,300 cfs to powerhouse capacity of ~24,000 cfs (peak) following Biological Opinion ramping rates by 17 May. Peak discharge from Libby Dam was held through 07 June, followed by 6 days of discharge of 20,000 cfs prior to ramping flows down to 12,000 cfs by 16 June, at which time the sturgeon volume was expended.

Table 1. Kootenai River white sturgeon tiered volumes and minimum bull trout flows, based on the May final April-August WSF.

May Final April – August Forecast Runoff Volume at Libby (MAF)	**Sturgeon flow volume from Libby Dam (MAF)**
Less than 4.80	0.0
4.80 to 5.40	0.80
5.40 to 6.35	0.80 to 1.12
6.35 to 7.40	1.12 to 1.20
7.40 to 8.50	1.20
8.50 to 8.90	1.20 to 1.60
Greater than 8.90	1.60

Note: The sturgeon pulse volume is determined from the Corps' May final April through August water supply forecast. The volume released is a sliding scale volume and is interpolated between ranges, where applicable, based on the forecast runoff volume.

As per the Service's System Operation Request, which was based on the FPIP Technical Team Flow Plan, Libby Dam was operated in real time to achieve the following objectives:

1) Provide river stage at Bonners Ferry of ≥ 1,760'+ Mean Sea Level (MSL; flood stage is 1,764') for as many days as possible during the peak of the local tributary discharge downstream of Libby Dam;

2) Provide flows at Bonners Ferry of ≥30,000 cubic feet per second (cfs) for a duration concurrent with maximizing the duration of Kootenai River stage as per Objective 1; and

3) Provide a sharply receding hydrograph upon completion of the flow augmentation operation following Biological Opinion ramping rates from peak discharge to summer discharge (9,000 cfs in Tier 4).

Kootenai River flow at Bonners Ferry was ≥30,000 cfs for 33 days, and river stage at Bonners Ferry was ≥ 1,760' MSL for 13 days (Figure 2). River stage during the spring freshet is strongly influenced by local tributary discharge downstream of Libby Dam, as well as the elevation of Kootenay Lake (Figure 3), which is managed for flood risk reduction in compliance with the 1938 International Joint Commission (IJC) Rule curve (Figure 3, inset). The cool spring weather delayed local tributary discharge downstream of the dam and inflow into Koocanusa Reservoir by approximately 2 weeks, with peak inflow (~82,000 cfs) into the reservoir not occurring until 13 June; the reservoir drafted several feet during the peak sturgeon flow augmentation period (Figure 2), which is atypical.

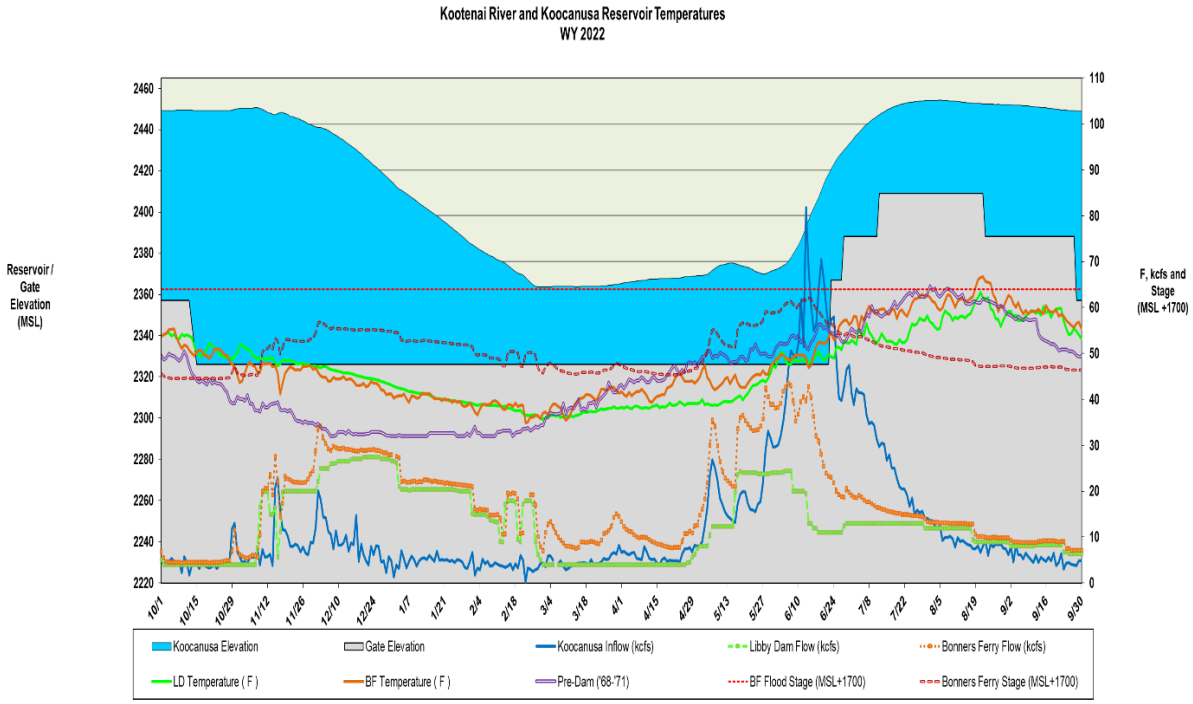


Figure 2. WY2022 Koocanusa Reservoir forebay elevation, selective withdrawal gate placement, Kootenai River flow and temperature at Libby Dam and Bonners Ferry, and stage and flood stage at Bonners Ferry.

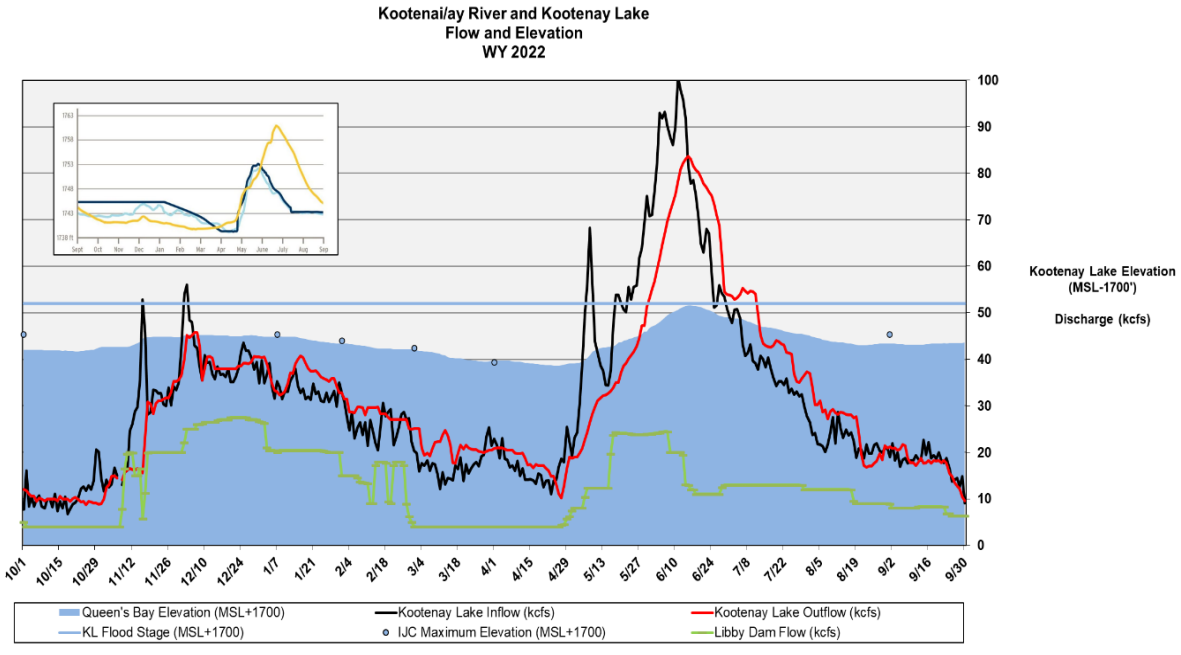


Figure 3. WY2022 Kootenay Lake elevation and discharge relative to Libby Dam discharge and 1938 International Joint Commission (IJC) Rule Curve.

WY2022 Libby Dam Temperature Operations

Though Koocanusa Reservoir remains largely isothermic during late winter and early spring, warming surface water in the forebay in late spring and early summer can be discharged via the Libby Dam's Selective Withdrawal System (SWS) to provide more normative discharge temperatures within the current operational constraints of the system. Similarly, the SWS can be utilized to cool discharge temperature through the warmer summer months, as necessary, again within current operational constraints of the system.

Normally, SWS gates at Libby Dam are stacked to within ~30-40 ft. of the forebay surface prior to the receding limb of sturgeon flow augmentation operation to enable discharge of the warmest water as flows are discharge is reduced, which allows for river warming between Libby Dam and Bonners Ferry commensurate with reduced volume. Gates are then stacked progressively higher through the early summer as the reservoir refills to target increasing "normative" river temperature via withdrawal of warmer surface water. The overall intent of this strategy is to provide a stable-to-warming thermograph throughout the operation, including optimal spawning temperature (~50° F at Bonners Ferry) and post-spawn egg incubation and larval development temperature; sturgeon spawning activity peaks as flow is receding and temperature is increasing.

The SWS crane was not functional during the 2022 FPIP Sturgeon Flow Augmentation Operation, but was back in service on 23 June, at which point SWS gates were installed incrementally to discharge warmer surface water from the forebay of the reservoir (Figure 2). Temperature in the Bonners Ferry reach during sturgeon flow augmentation ranged from ~ 42 to 50° F, though temperatures of 50°+ F at Bonners Ferry were not consistently observed until discharge from Libby Dam was reduced to 11-12,000 cfs in late June (Figure 2). Discharge temperature increased to the pre-dam mean target for a brief period as flows were reduced and SWS gates were installed, but then remained cool through the warm summer months until late August, at which time several rows of SWS gates were removed to provide discharge of cooler water from deeper and cooler strata in the forebay of the reservoir (Figure 4). Discharge temperature was warmer than the pre-dam mean through the fall (Figure 2).

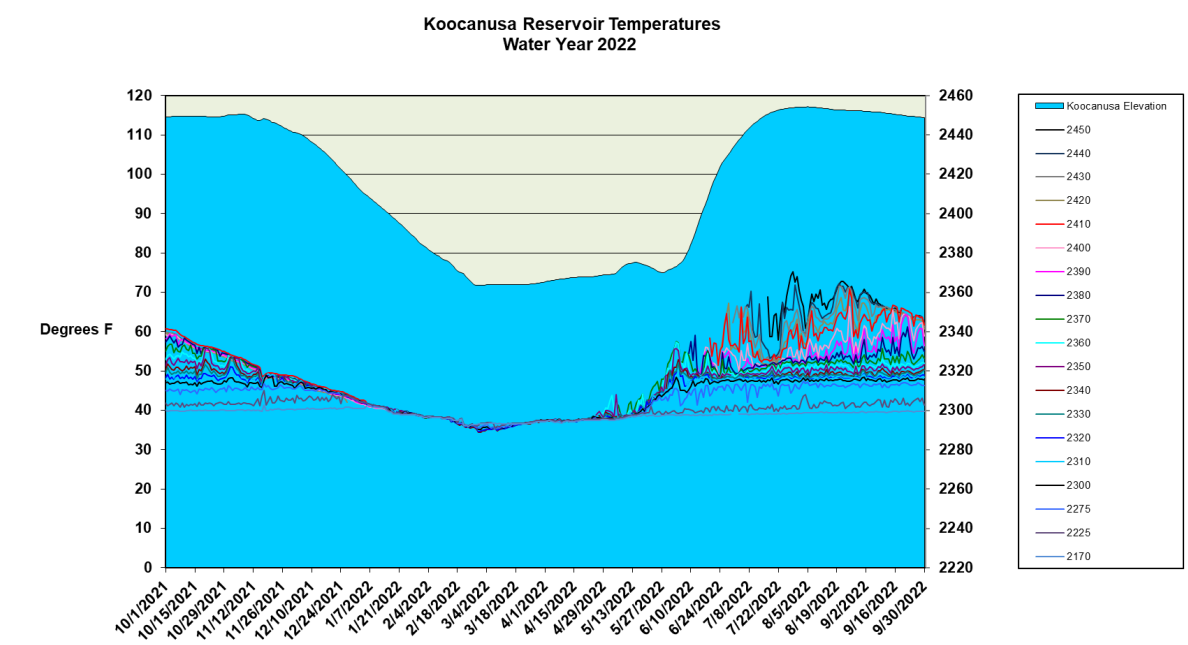


Figure 4. WY2022 Koocanusa Reservoir forebay elevation (MSL) and temperatures at elevation (MSL).