

REVIEW OF THE WATER YEAR AND MANAGEMENT ACTIONS

TMT Year End Review

Alexis Mills
Columbia Basin Reservoir Control Center
Northwestern Division
Corps of Engineers

December 6, 2023



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OUTLINE

1. 2023 Water Year Summary
 - a. Precipitation and Temperature
 - b. Snowpack
 - c. Water Supply
2. Storage Reservoir Operations
 - a. Libby
 - b. Albeni Falls
 - c. Dworshak
 - d. Grand Coulee
 - e. Flood Risk Management (FRM)
3. RCC Forecasting
4. 2023 Spill Operations



Columbia River Headwaters

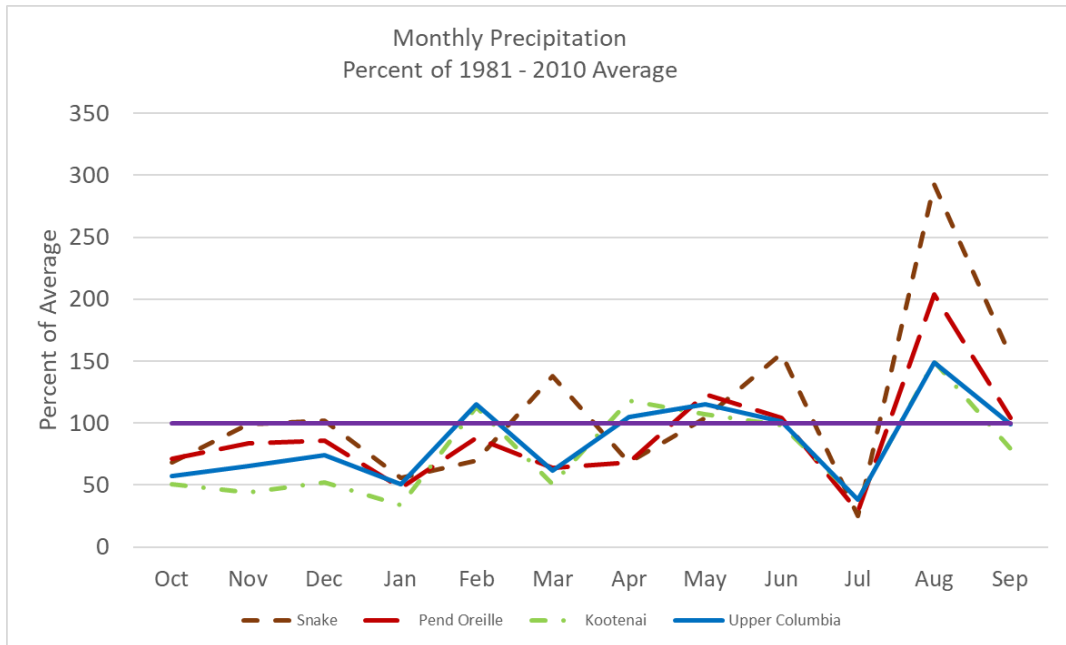
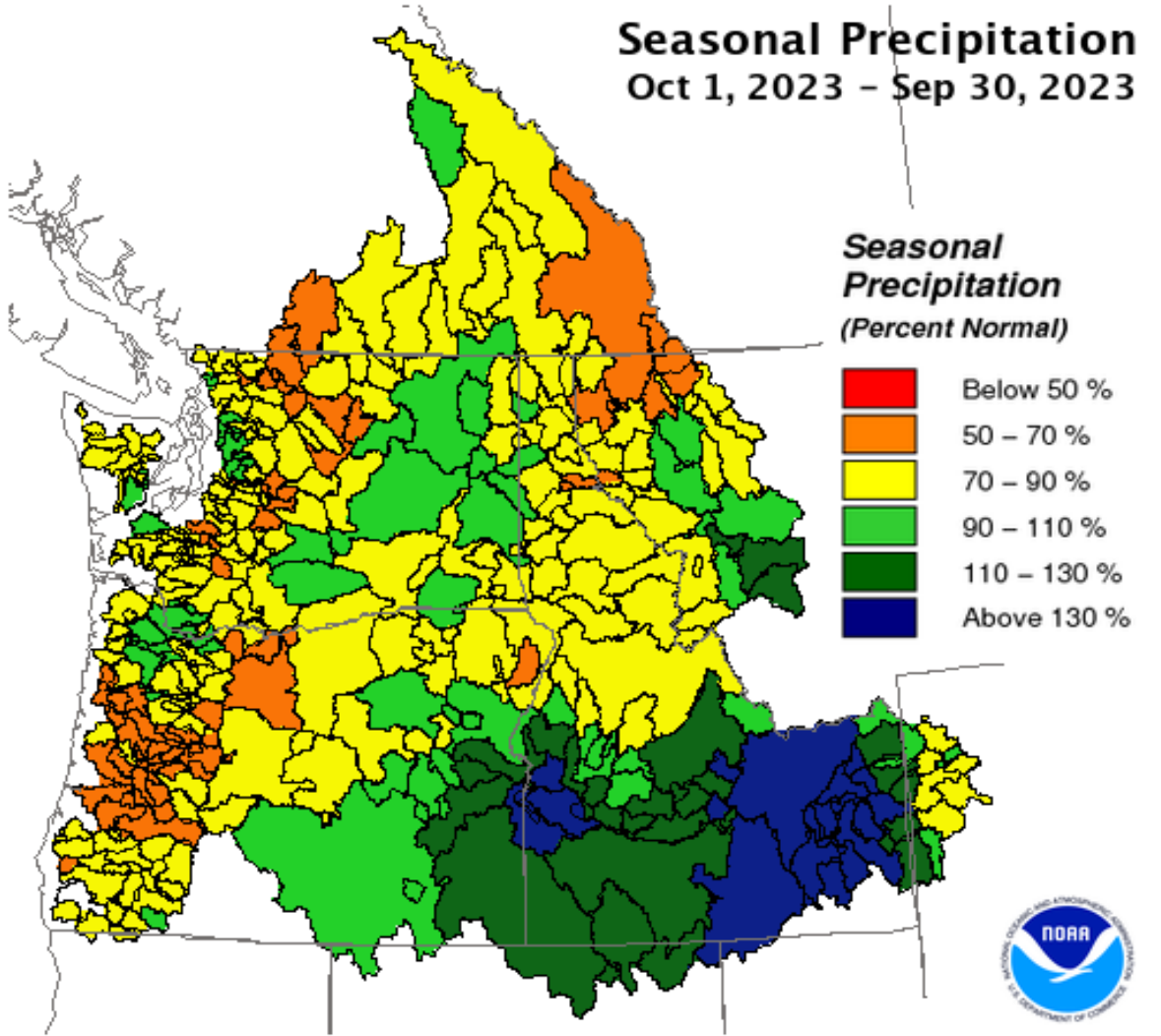
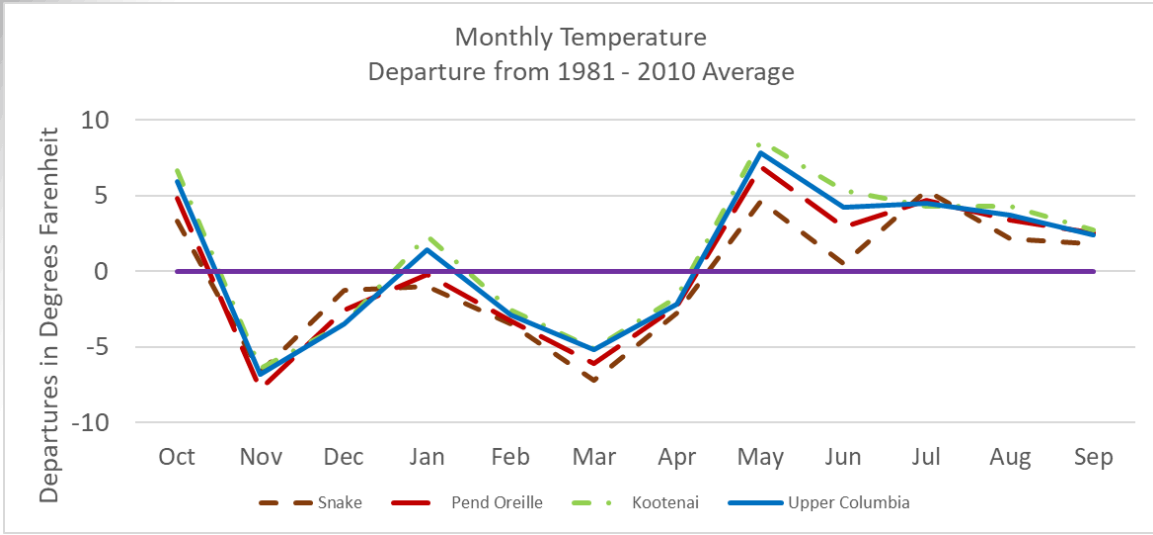


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PRECIPITATION AND TEMPERATURE SUMMARY



Creation Time: Sunday, Oct 1, 2023

Northwest River Forecast Center



Precipitation above The Dalles: 87% of Normal



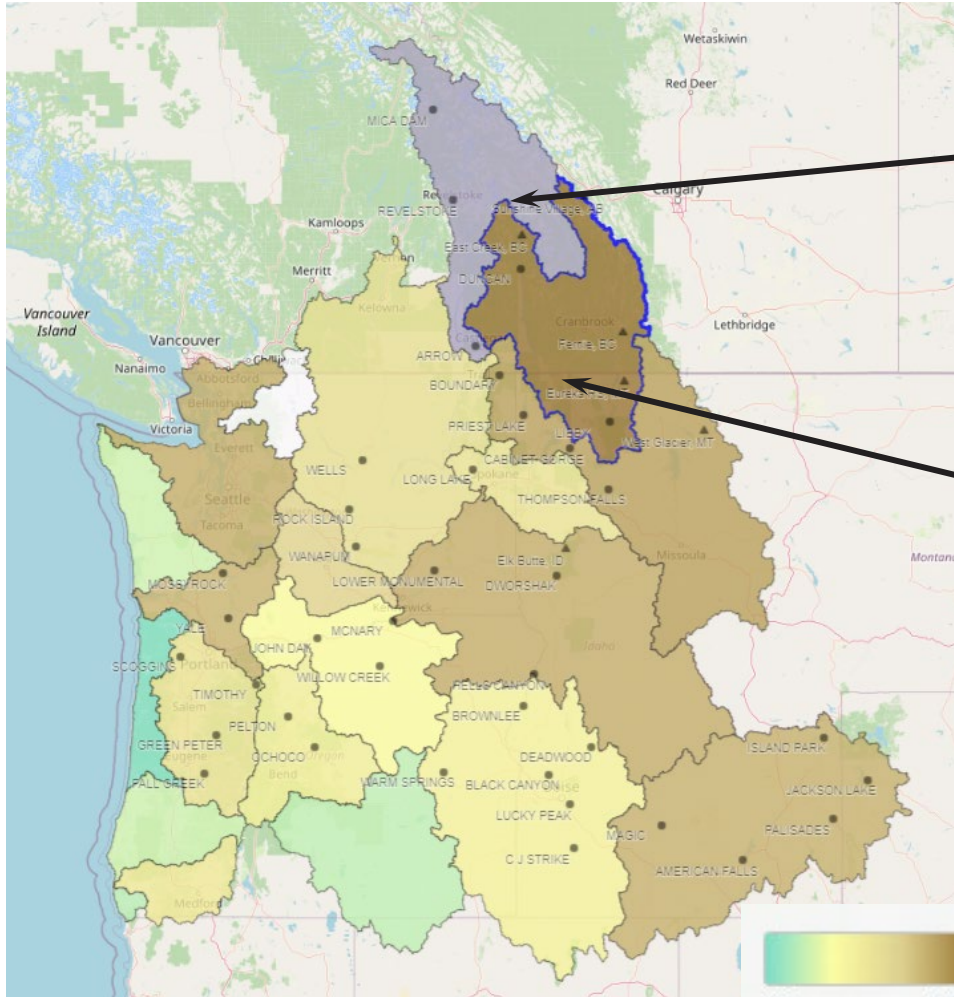
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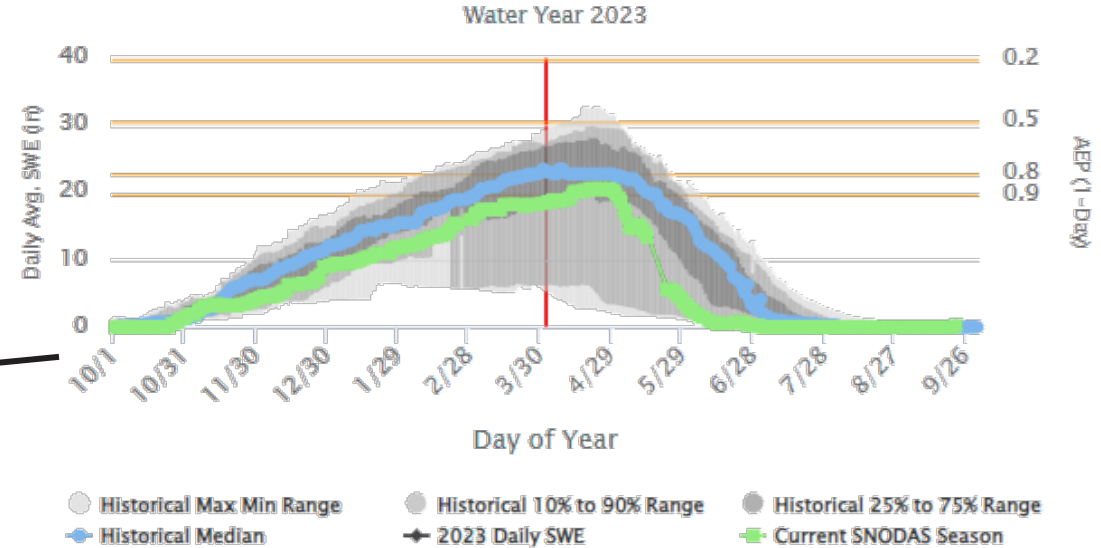
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SNOWPACK SUMMARY

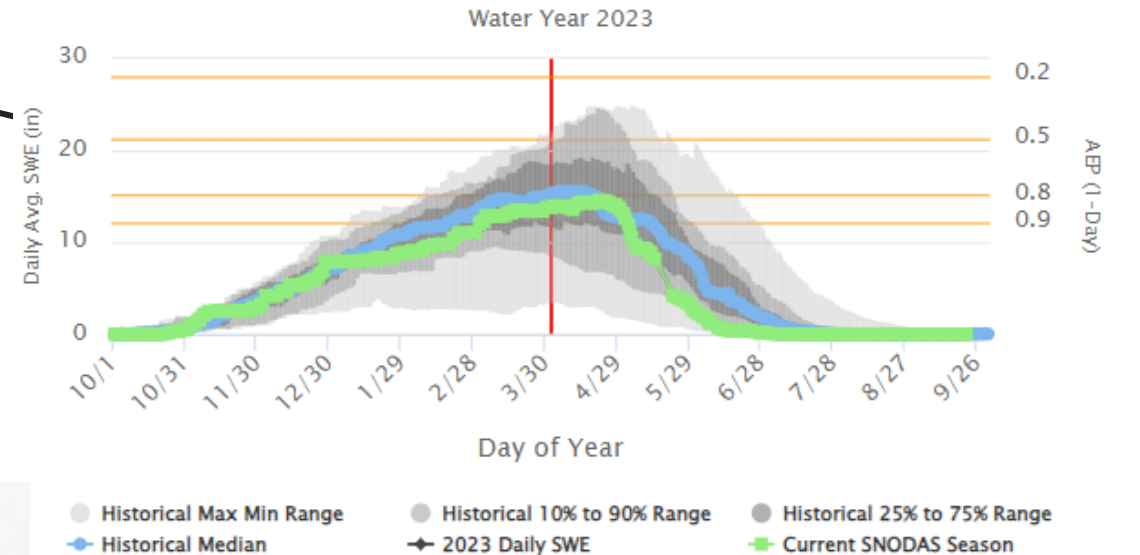
Columbia Basin Snowpack on 1 April 2023



SNODAS–Snow Water Equivalent–UpperColumbiaRiver



SNODAS–Snow Water Equivalent–Kootenai





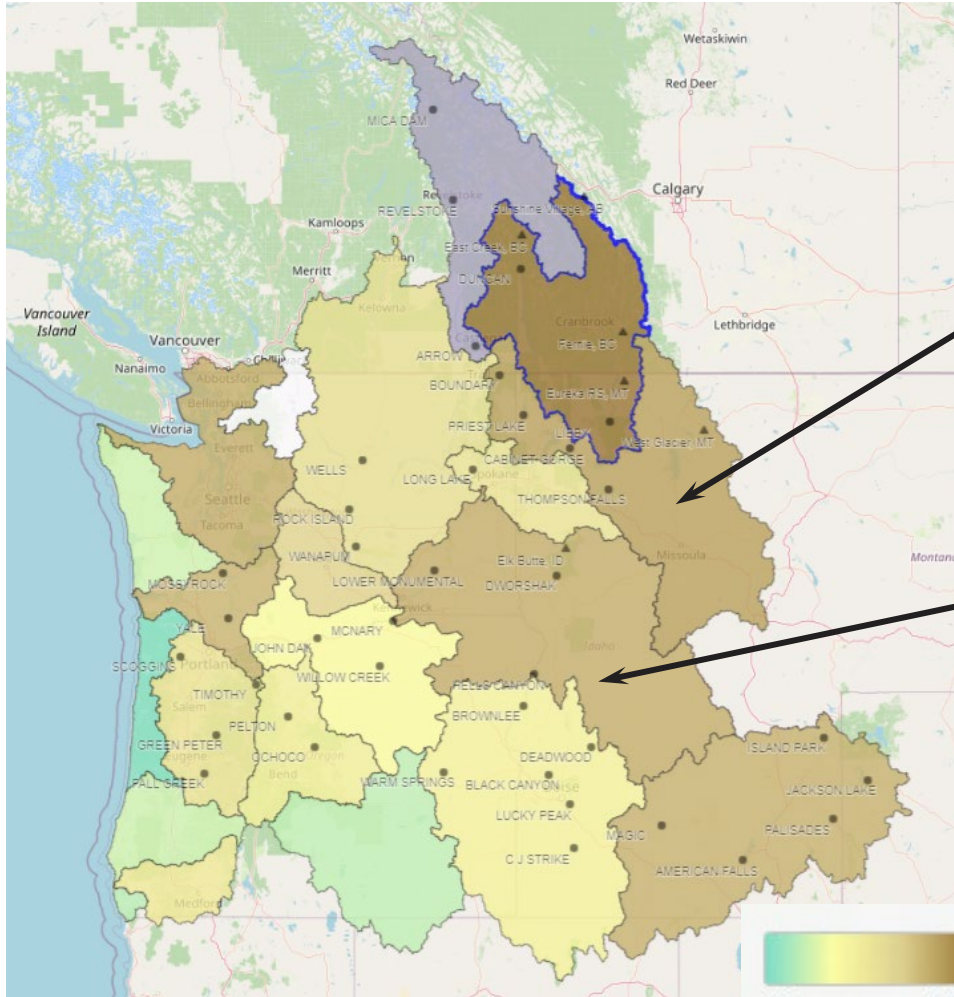
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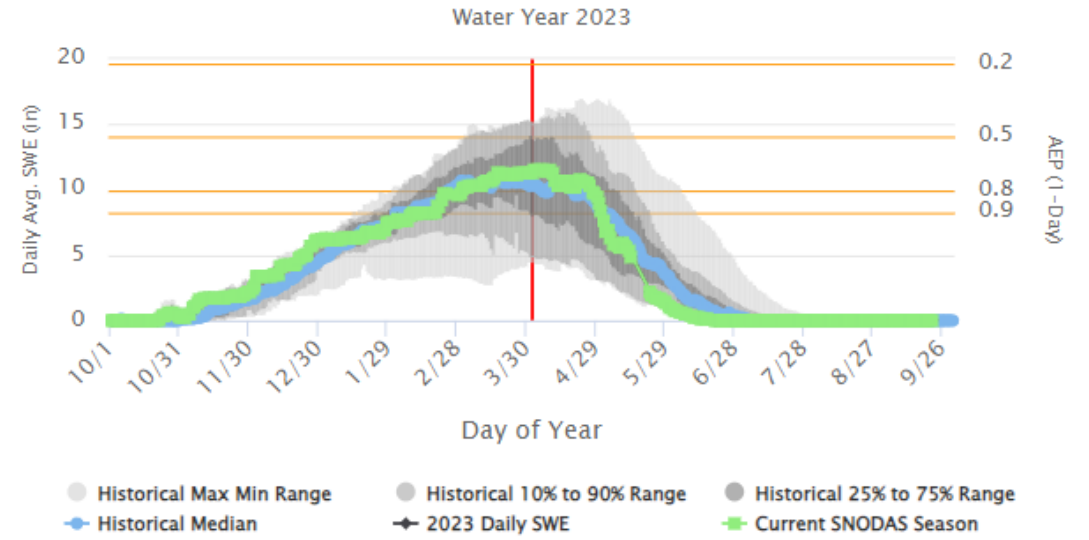
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SNOWPACK SUMMARY

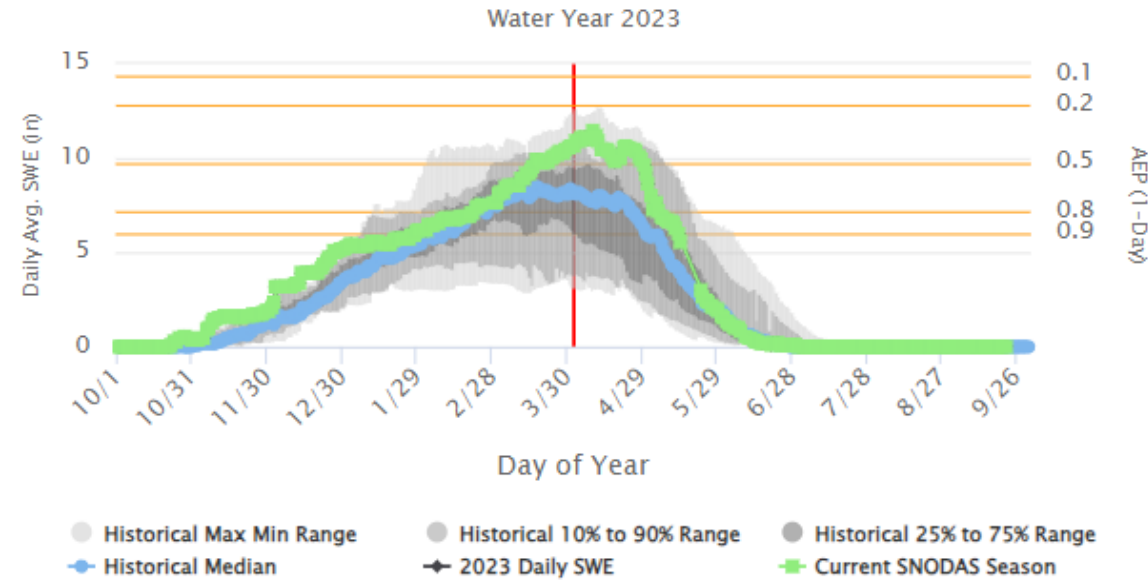
Columbia Basin Snowpack on 1 April 2023



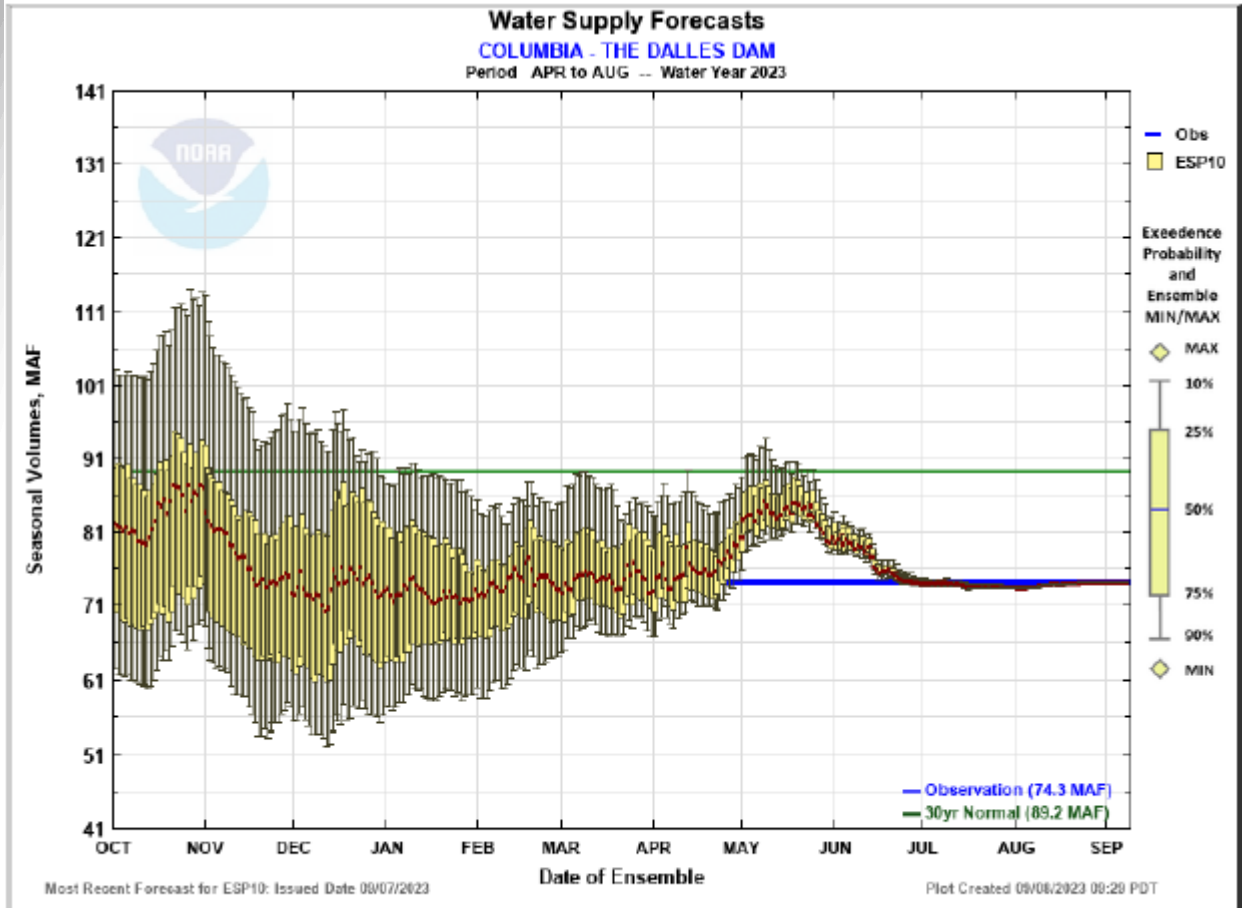
SNODAS–Snow Water Equivalent–PendOreille



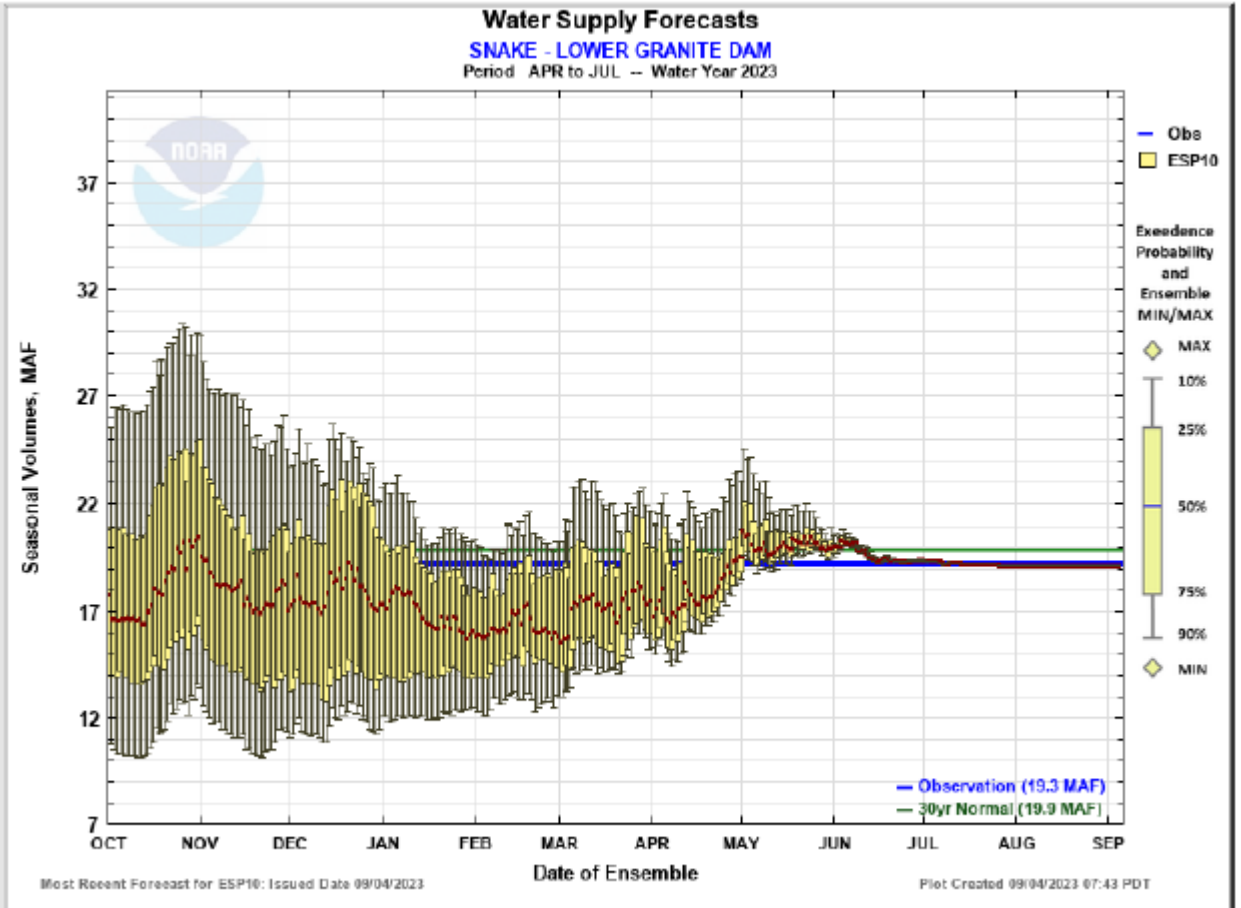
SNODAS–Snow Water Equivalent–LowerSnakeRiver



WATER SUPPLY FORECASTS- 2023 WY



The Dalles WSF, April-August 2023 (74.2 MAF, 83% of normal).



Lower Granite WSF, April-July 2023 (19.3 MAF, 97% of normal).

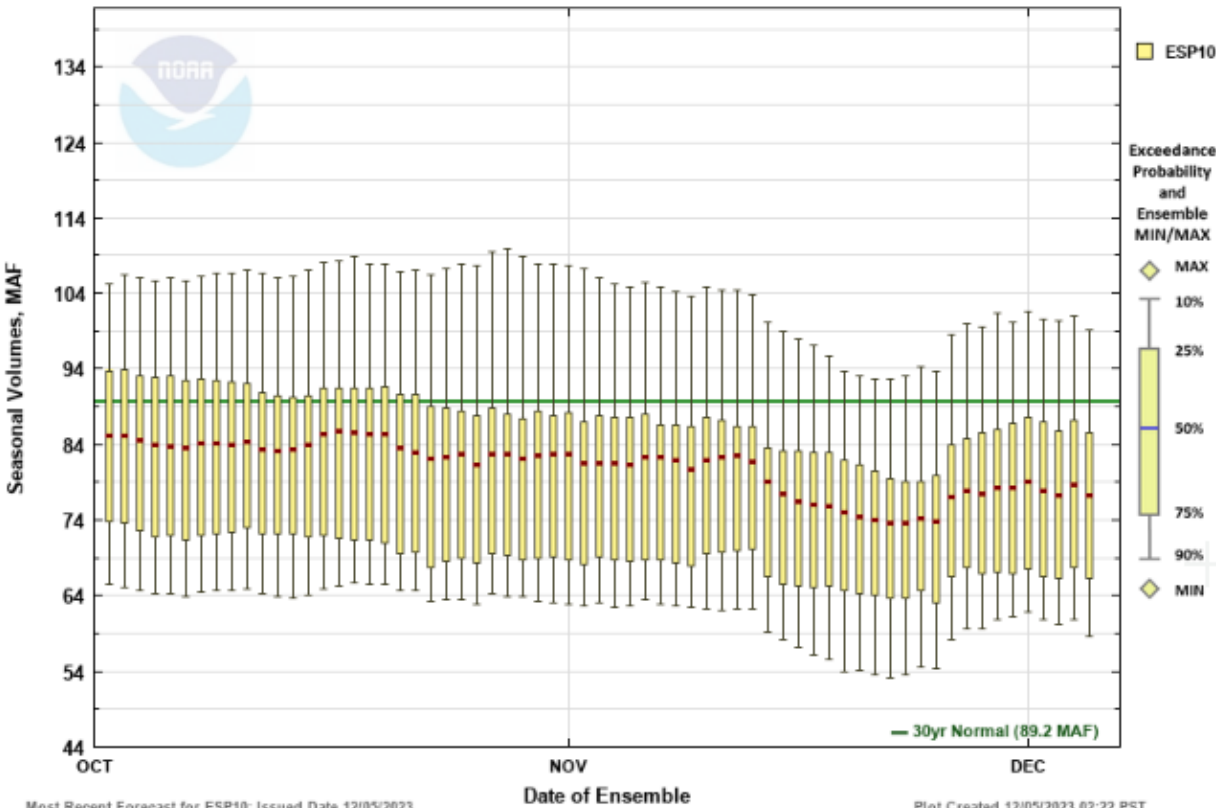


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WATER SUPPLY FORECASTS- 2024 WY

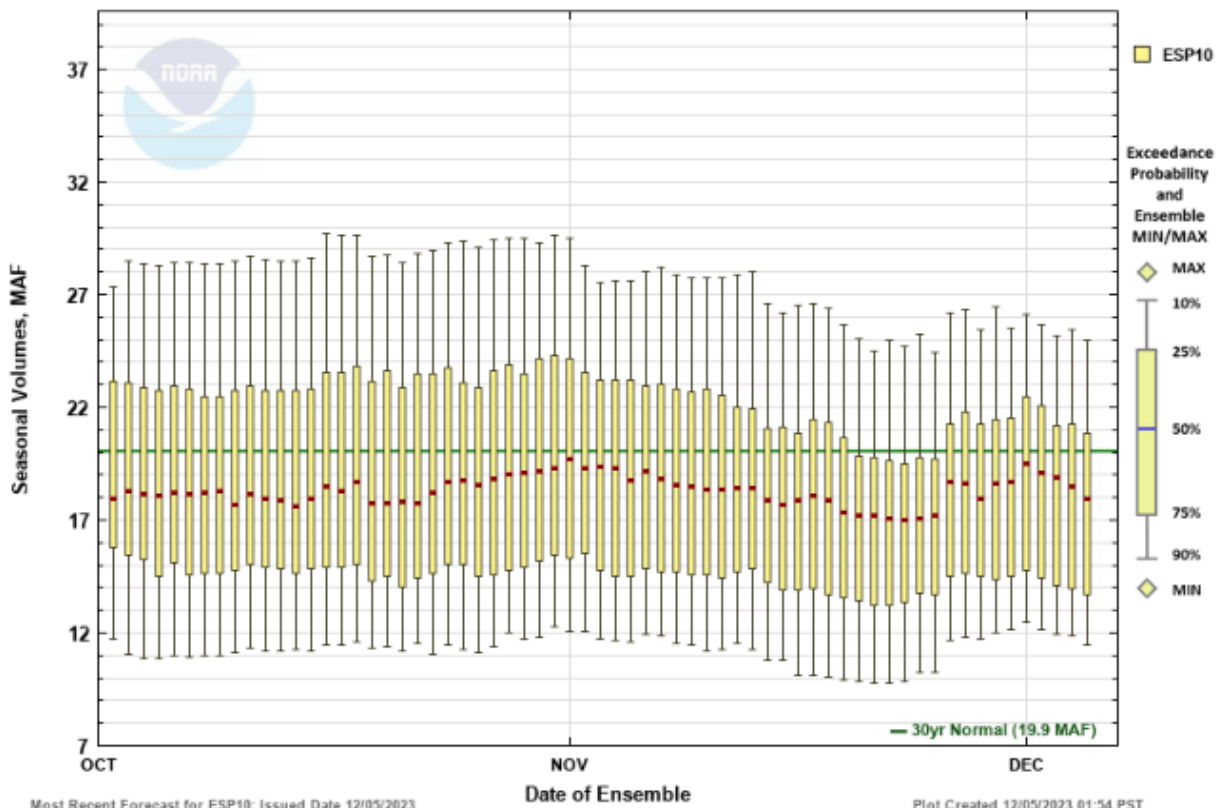
Water Supply Forecasts COLUMBIA - THE DALLES DAM Period APR to AUG -- Water Year 2024



Most Recent Forecast for ESP10: Issued Date 12/05/2023

Plot Created 12/05/2023 02:22 PST

Water Supply Forecasts SNAKE - LOWER GRANITE DAM Period APR to JUL -- Water Year 2024



Most Recent Forecast for ESP10: Issued Date 12/05/2023

Plot Created 12/05/2023 01:54 PST

2023: The Dalles WSF, April-August 2024 (77 MAF, 86% of normal)
2022 on December 5: 74 MAF, 83% of average

2023: Lower Granite WSF, April-July 2024 (18 MAF, 89% of normal)
2022 on December 5: 18 MAF, 90% of average



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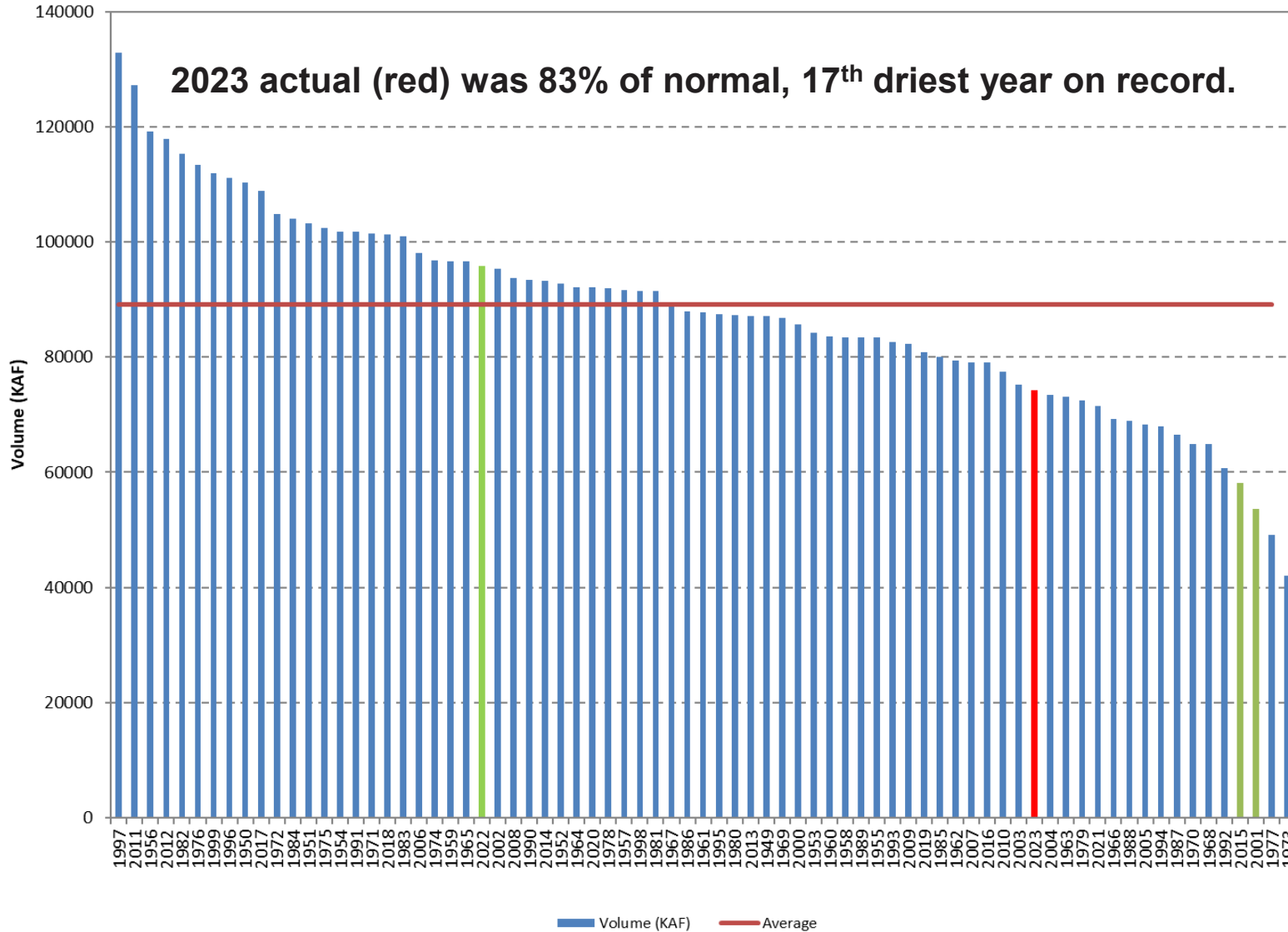


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WATER SUPPLY RANKINGS AT THE DALLES

COLUMBIA - THE DALLES (APR - SEP)

Actual 1949 - 2023





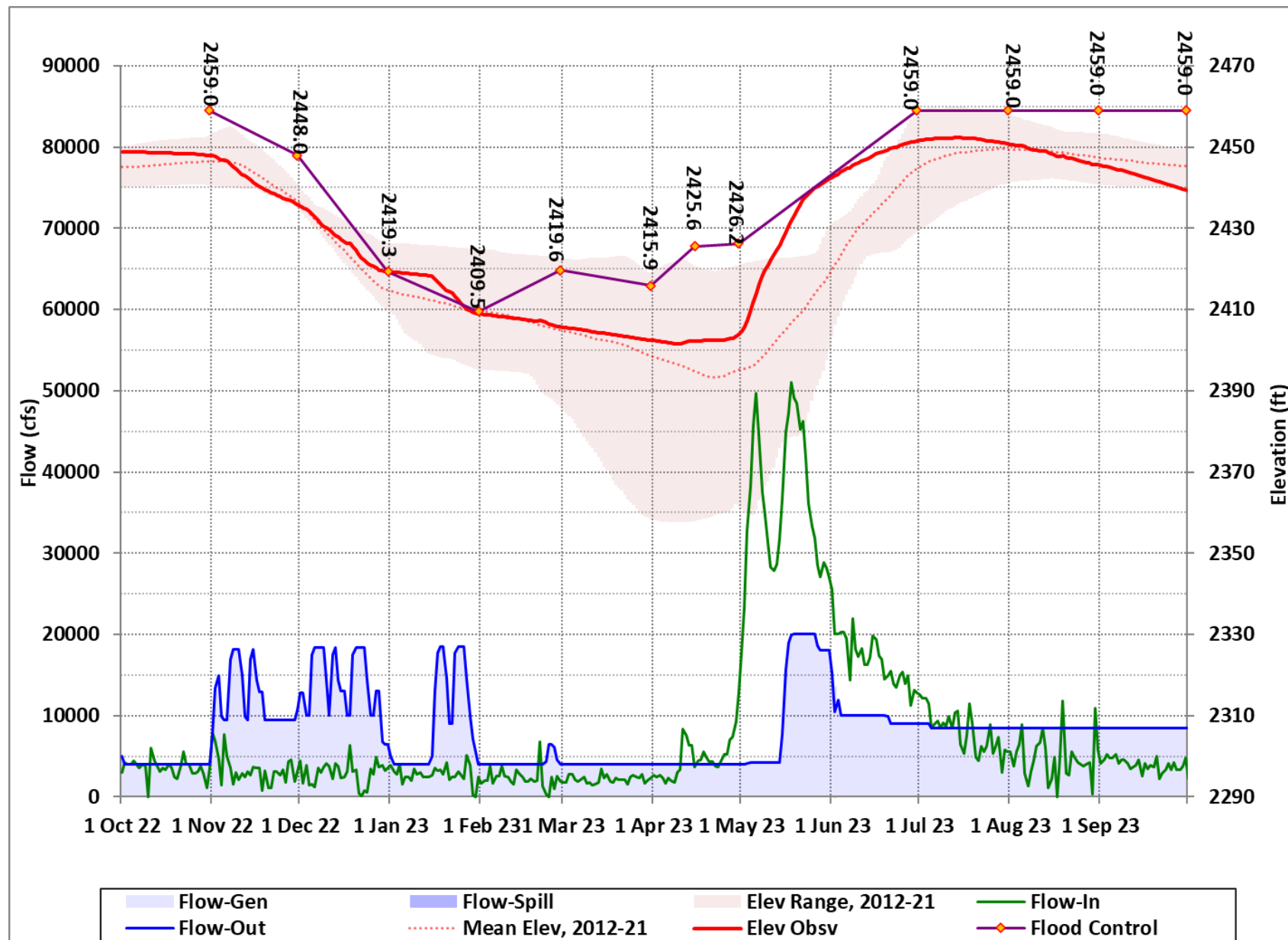
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LIBBY

- From November through April, Libby operated to meet Flood Risk Management (FRM) requirements and for hydropower with outflows ranging from the project minimum of 4 kcfs to a 4 unit flow near 19 kcfs
- Refill began on May 1 since the official April WSF was less than 6.9 MAF
- The May WSF for April-August was 4.4 MAF (72% of avg.) with no surgeon pulse since the WSF volume was less than 4.8 MAF.
- Outflows peaked at 20 kcfs in late May then ramped down in early June to manage refill
- Libby filled to a summer maximum level of 2452.4 ft on July 14, 6.6 ft below full pool
- Libby ended water year 2023 at elevation 2439.5 ft, 19.5 ft below full





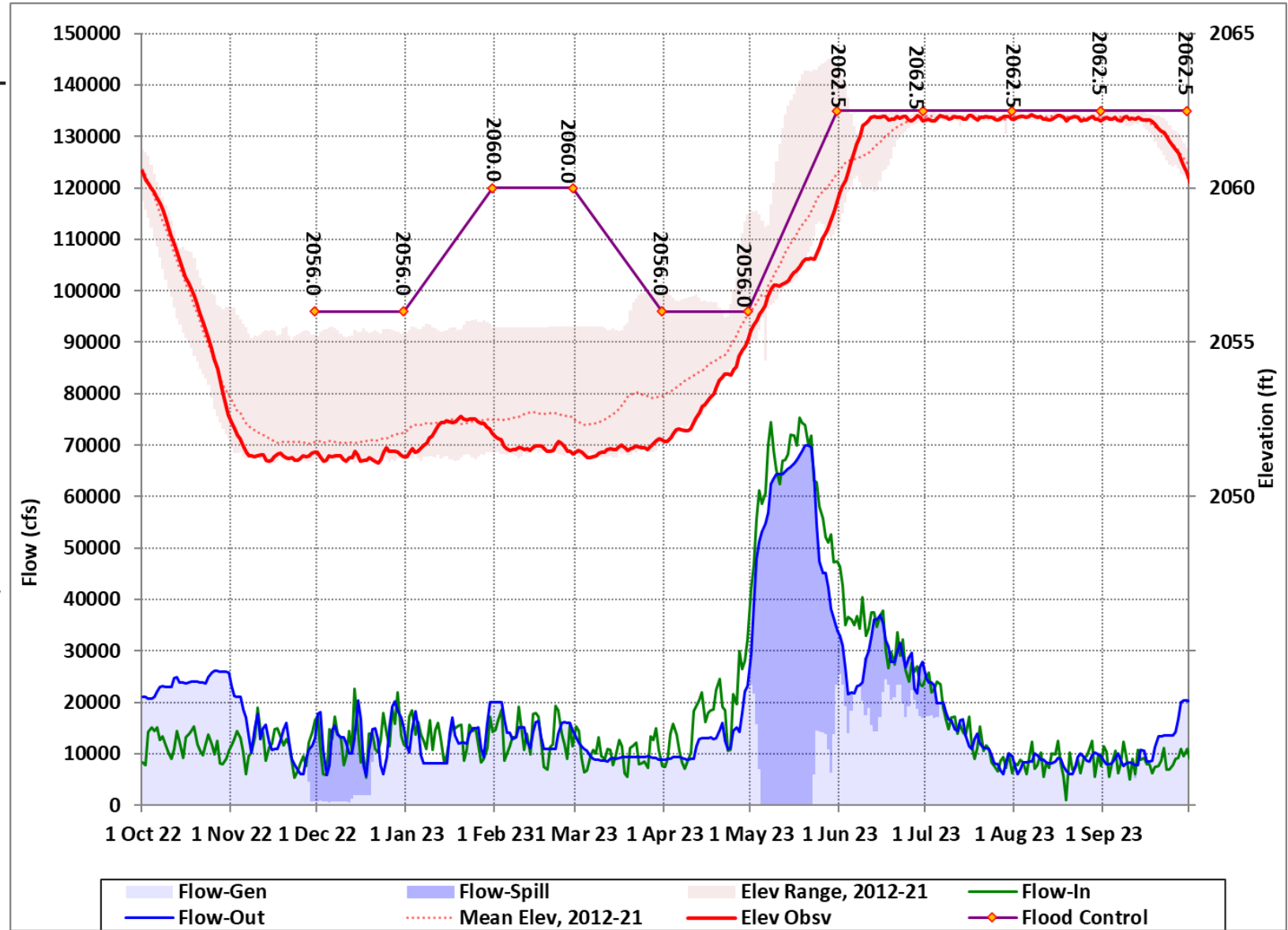
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ALBENI FALLS

- Drafted to winter operating band (2051-2051.5 ft) during winter kokanee spawning period
- In early January, BPA made a request for Flexible Winter Power Operations (FWPO), so the project began storing water to target a higher range from 2052.0-2053.0 feet
- Began filling during the first week of April and rose gradually across the month up to the target elevation of 2055 feet
- Began spilling in early May and switched to freeflow operations on May 4 to pass as much water as possible while the lake continued to fill
- Remained on freeflow until May 23
- Filled to the normal summer operating range (2062.0-2062.5 feet) on June 10 and continued operating within that range through mid-September





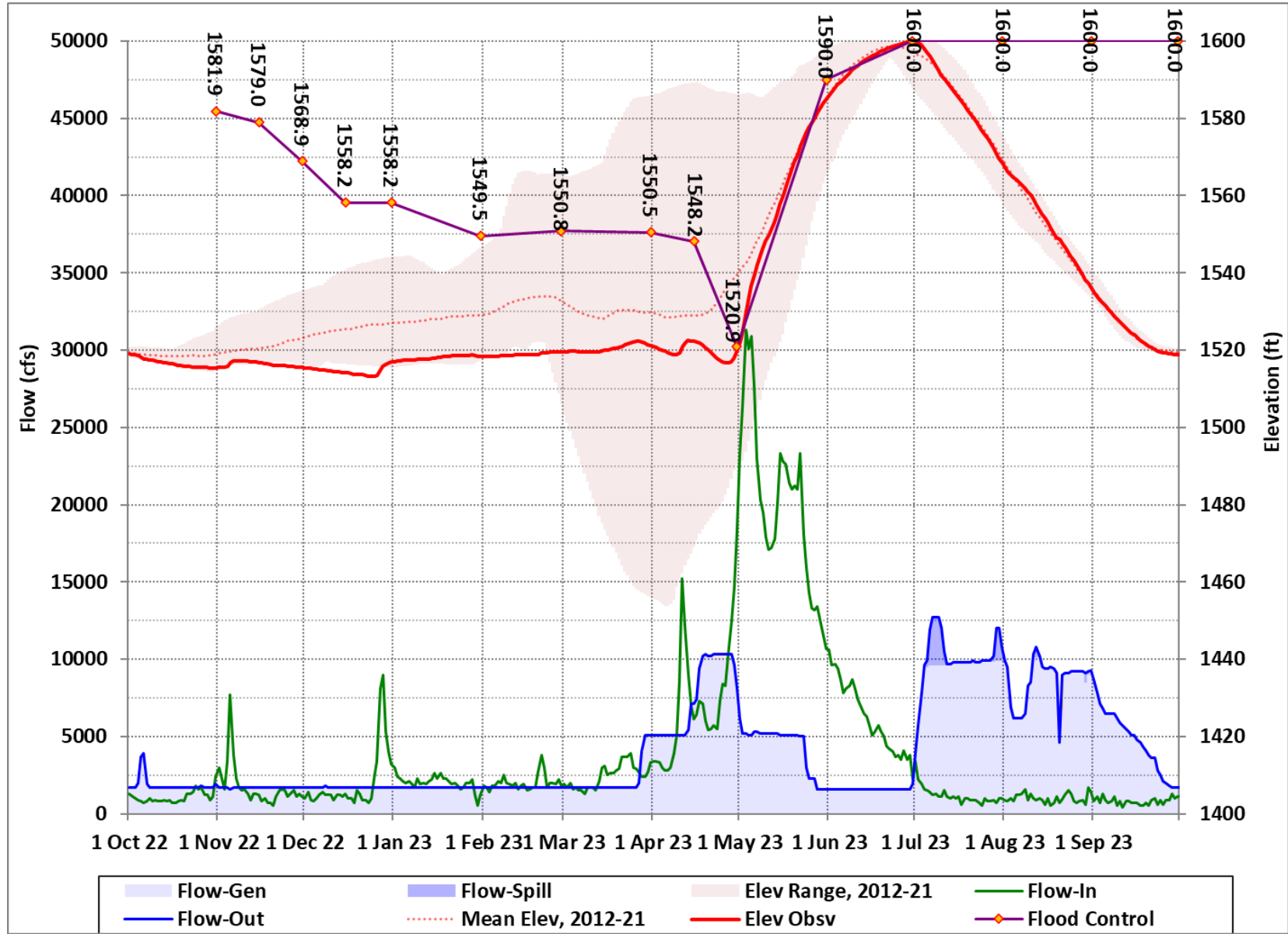
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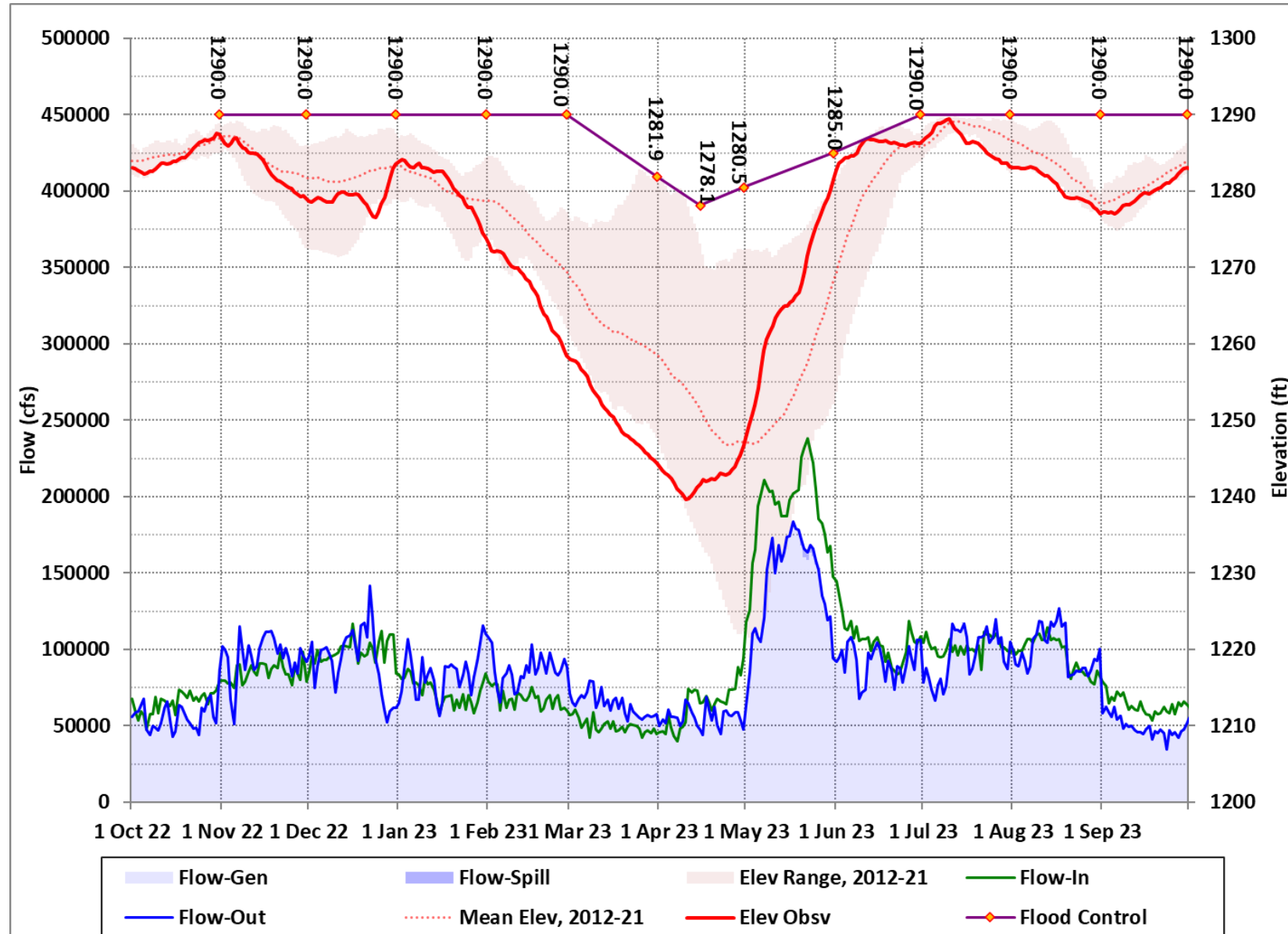
DWORSHAK

- On minimums through March 26
- FRM storage space shift to Grand Coulee
- Refilled to full pool (1600 feet) on June 30
- Relaxed temperature target not to exceed 69.5 °F in the Lower Granite tailrace from August 6-14 to achieve elevation 1535 ft on 31 August per SOR 2023-5
- Summer flow augmentation drafted the reservoir to 1536.1ft end of August
- Flows ramped down through September to meet 1520 ft



GRAND COULEE

- Filled to 1287.4 ft end of October prior to the start of chum spawning operations
- Chum operation November 1 through April 10
- Drum gate maintenance required in 2023
- FDR below 1255 ft from March 8 to May 5
- Drafted to minimum elevation 1240 ft
- Filled to 1289.6 ft on July 9
- Drafted to 1277 ft on August 31 to help downstream flow objectives
- Operated to meet minimum flows at Bonneville during September



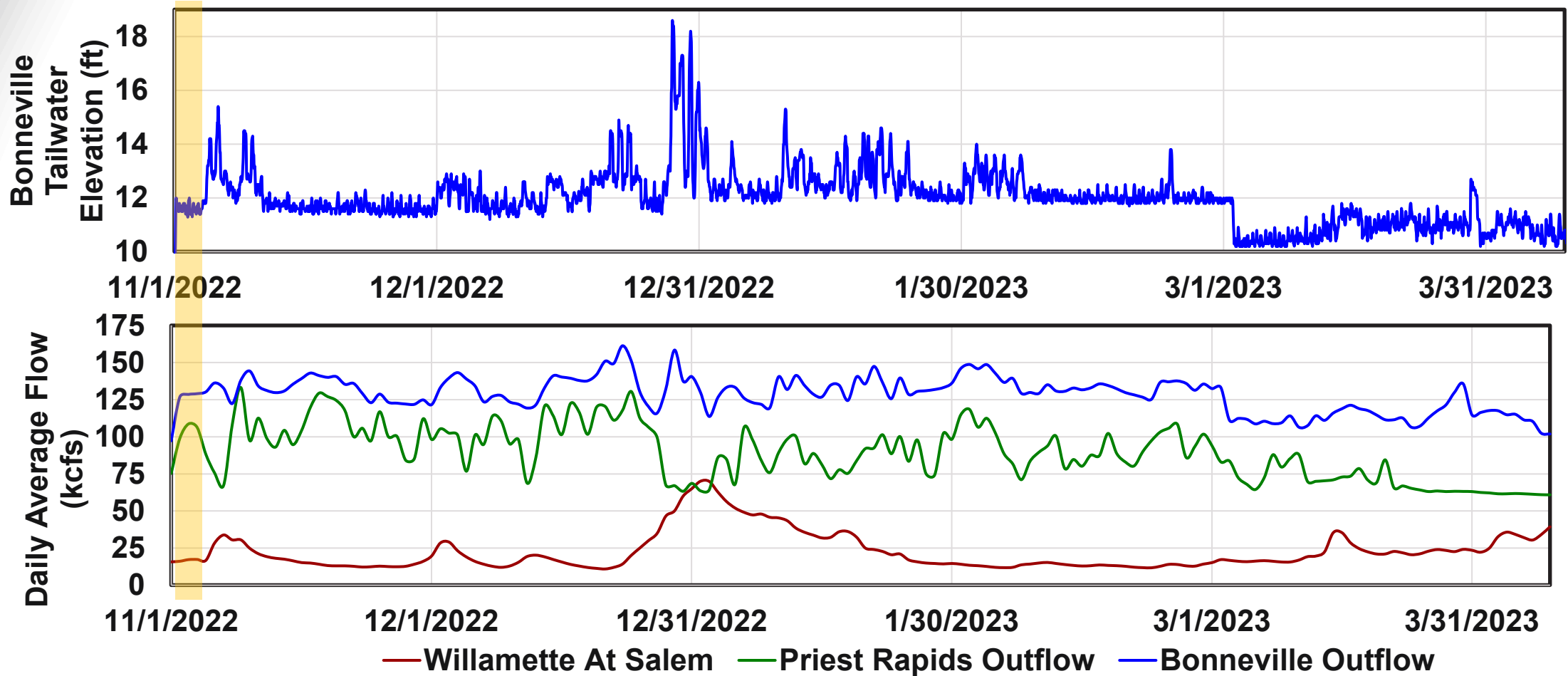


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CHUM OPERATION



November 1: Chum operation begins (11.3 – 13.0 ft Bonneville tailwater)

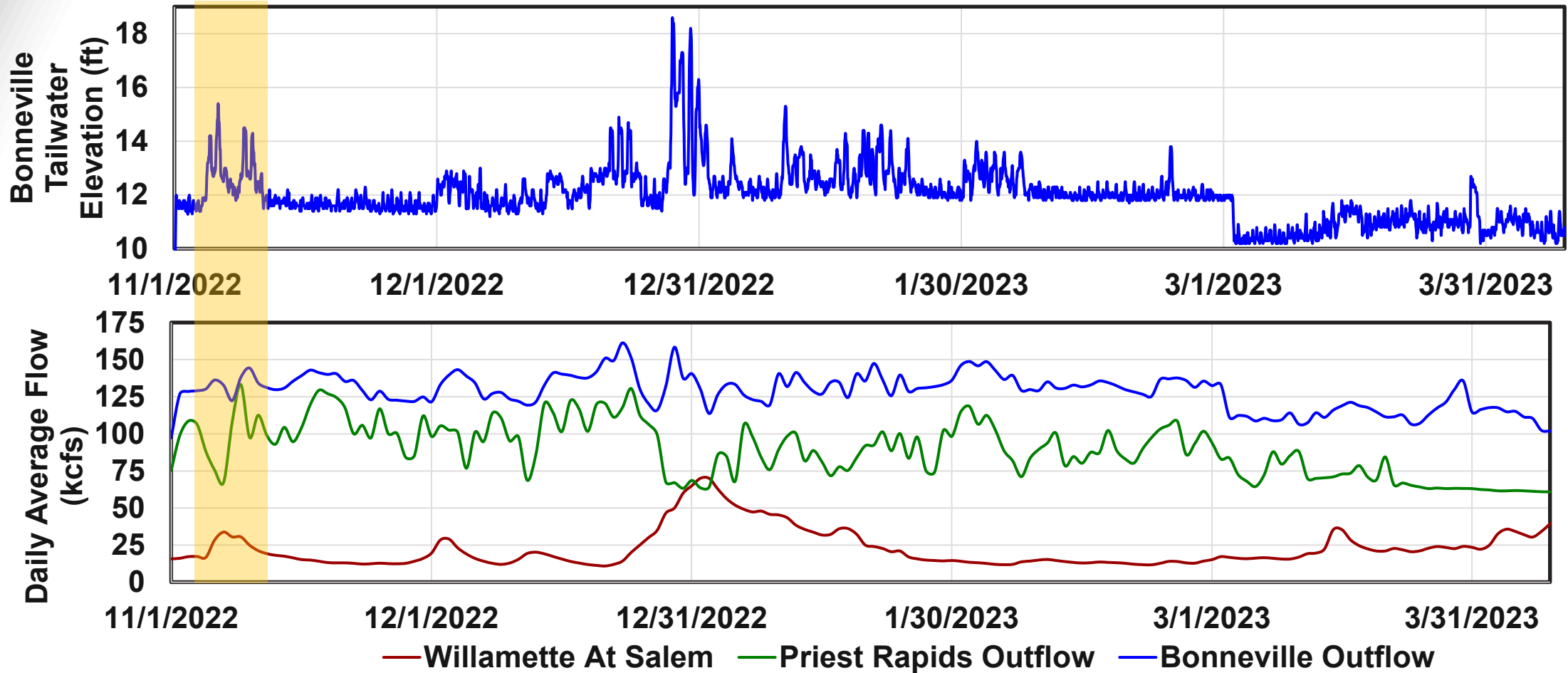


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CHUM OPERATION



Early November: Above average precipitation in late October led to a streamflow response and the need to manage for high tailwater at night. During this time, Grand Coulee filled to 1287 ft

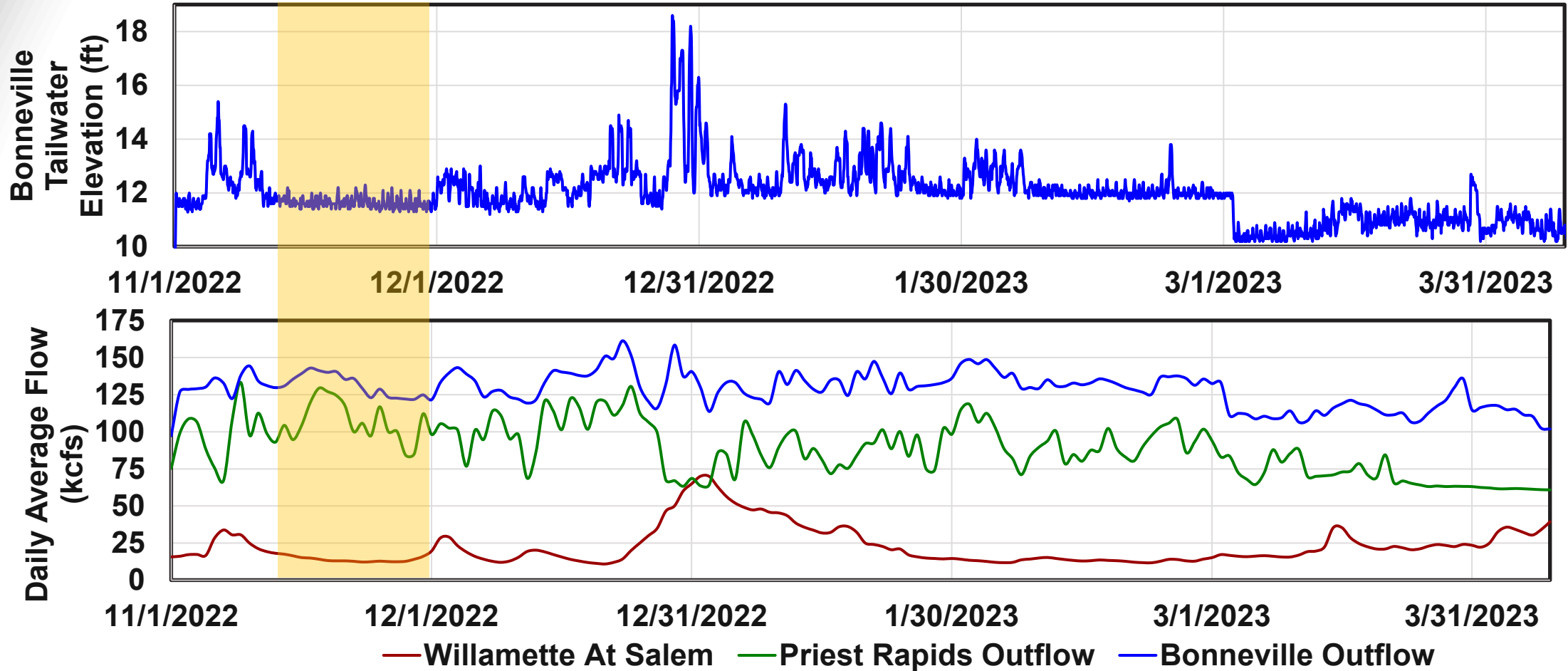


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CHUM OPERATION



November 12-30: The Snake and Willamette Rivers flowing <20 kcfs. The BON TW during this period ran very close to the bottom of the range. Grand Coulee drafted to elevation 1279 feet.

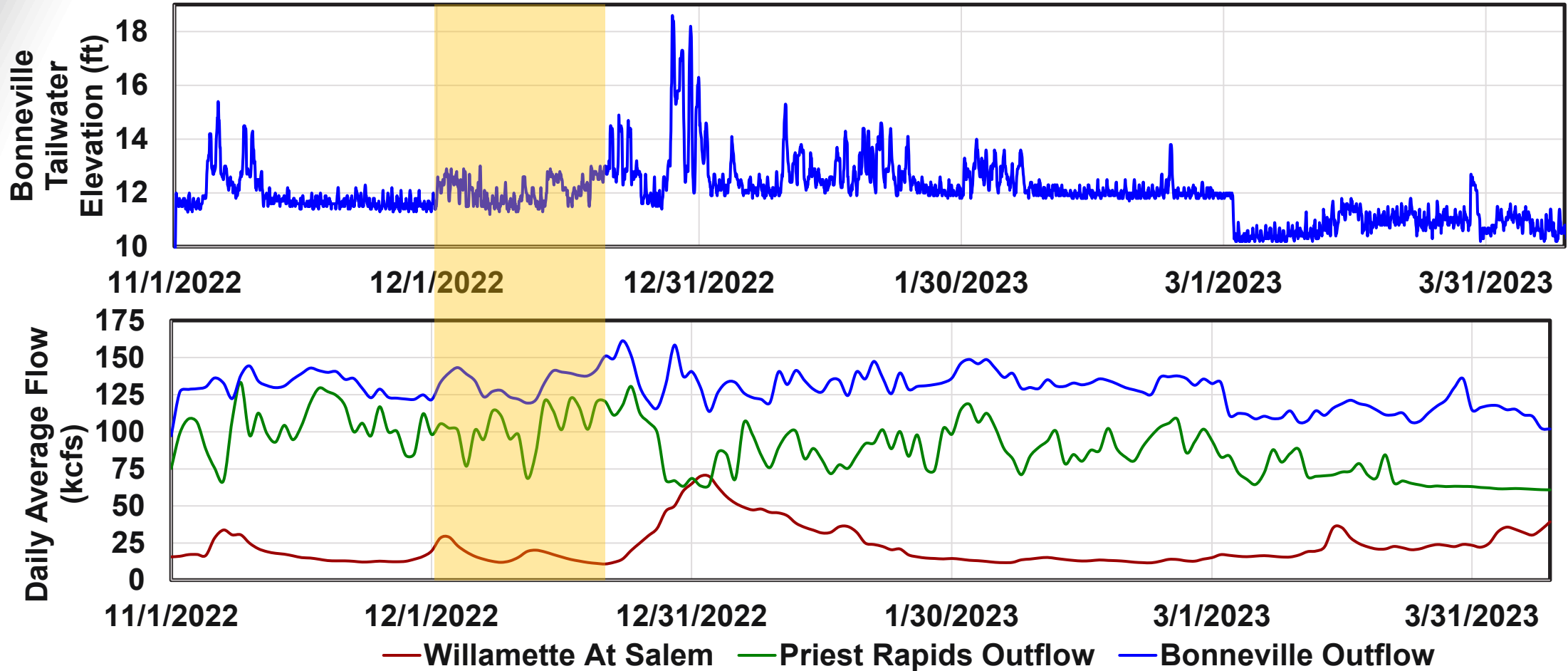


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CHUM OPERATION



December 1-20: Grand Coulee generally passing inflow, responding to cold snap

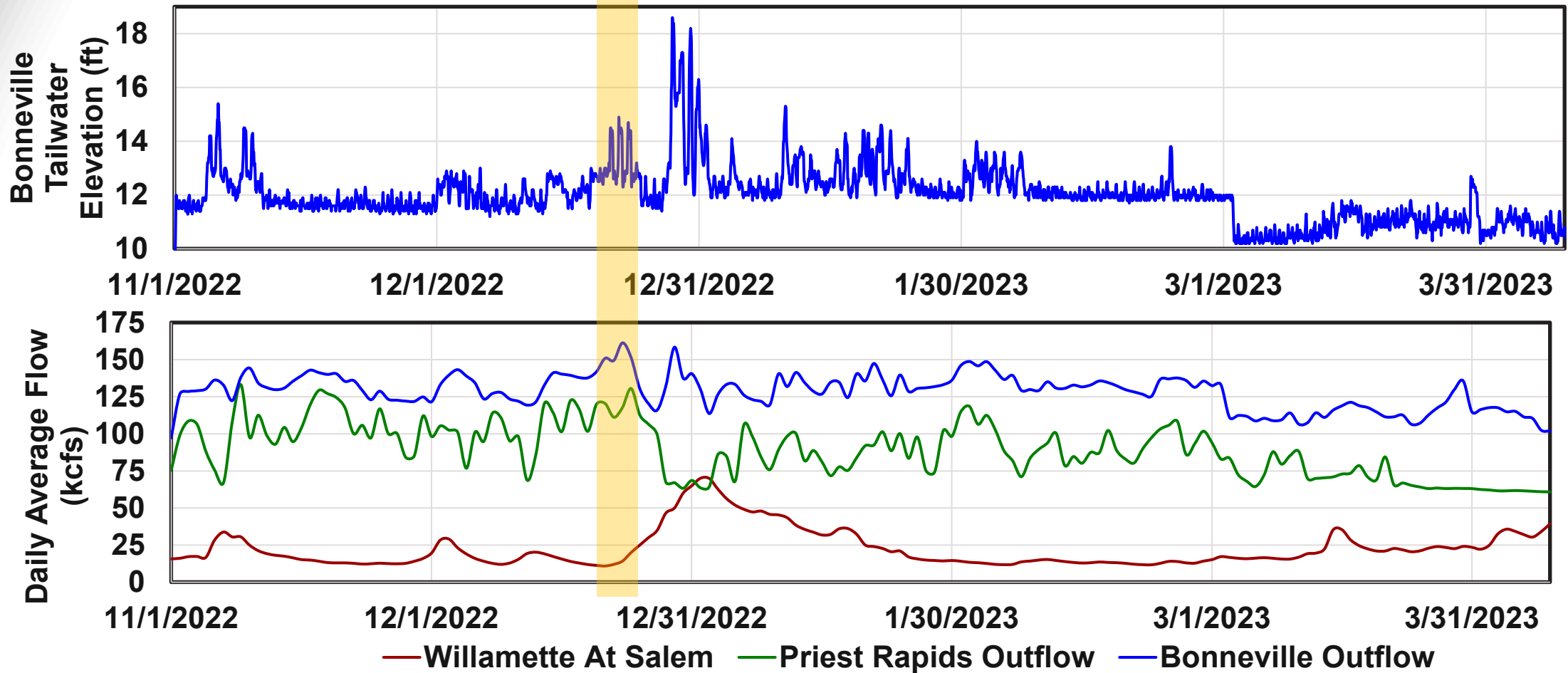


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CHUM OPERATION



December 21-24: A severe cold snap necessitated a 3 ft draft at Grand Coulee to help meet load. The Bonneville TW during this period was close to 13.0 feet during the day with TW exceeding 14 feet at night per the operational instructions



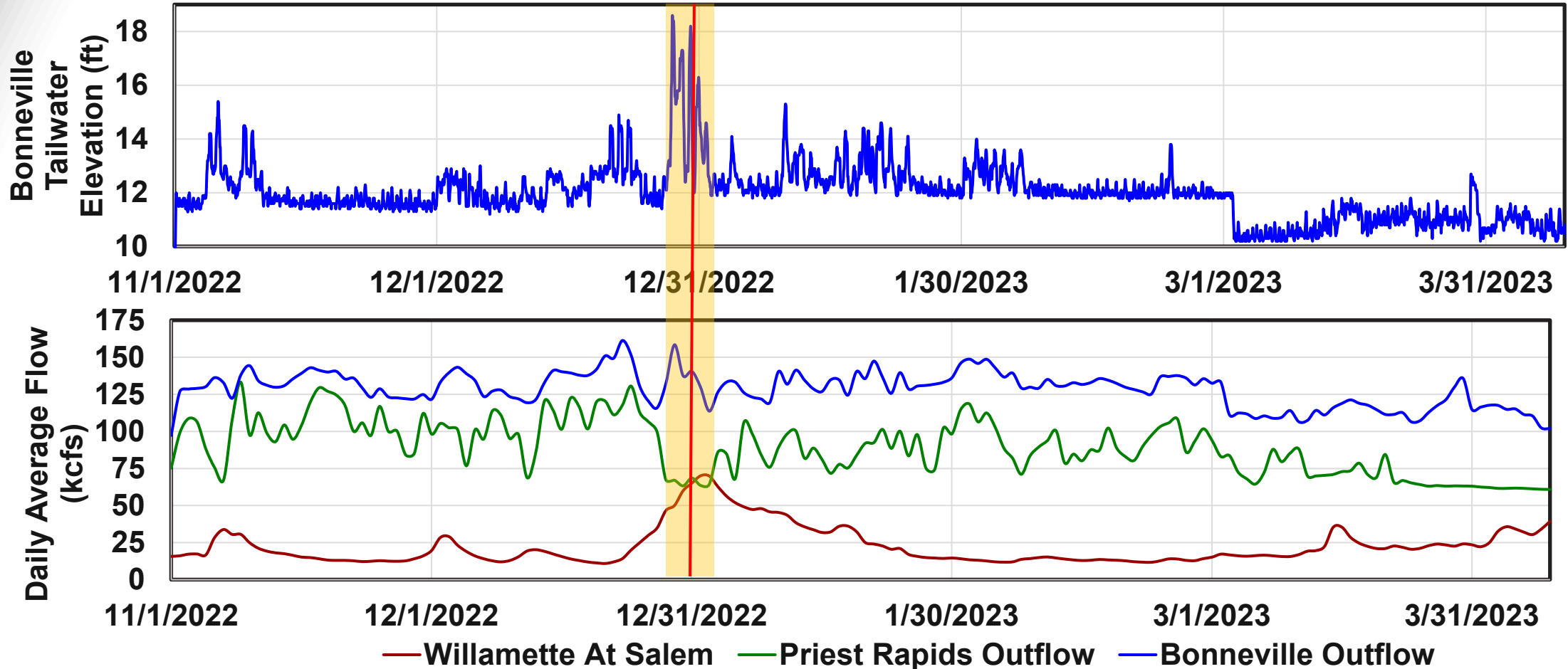
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CHUM OPERATION

December 31: Minimum elevation 11.8 ft for incubation period



December 25 - January 3: During a period of significant precipitation and warming, the Willamette River peaked at ~75 kcfs at Salem with the Snake River peaking at ~45 kcfs, resulting in the Bonneville tailwater significantly exceeding the daytime TW operating range. Grand Coulee reduced outflow to meet Vernita Bar minimums, filling to ~1284 ft.

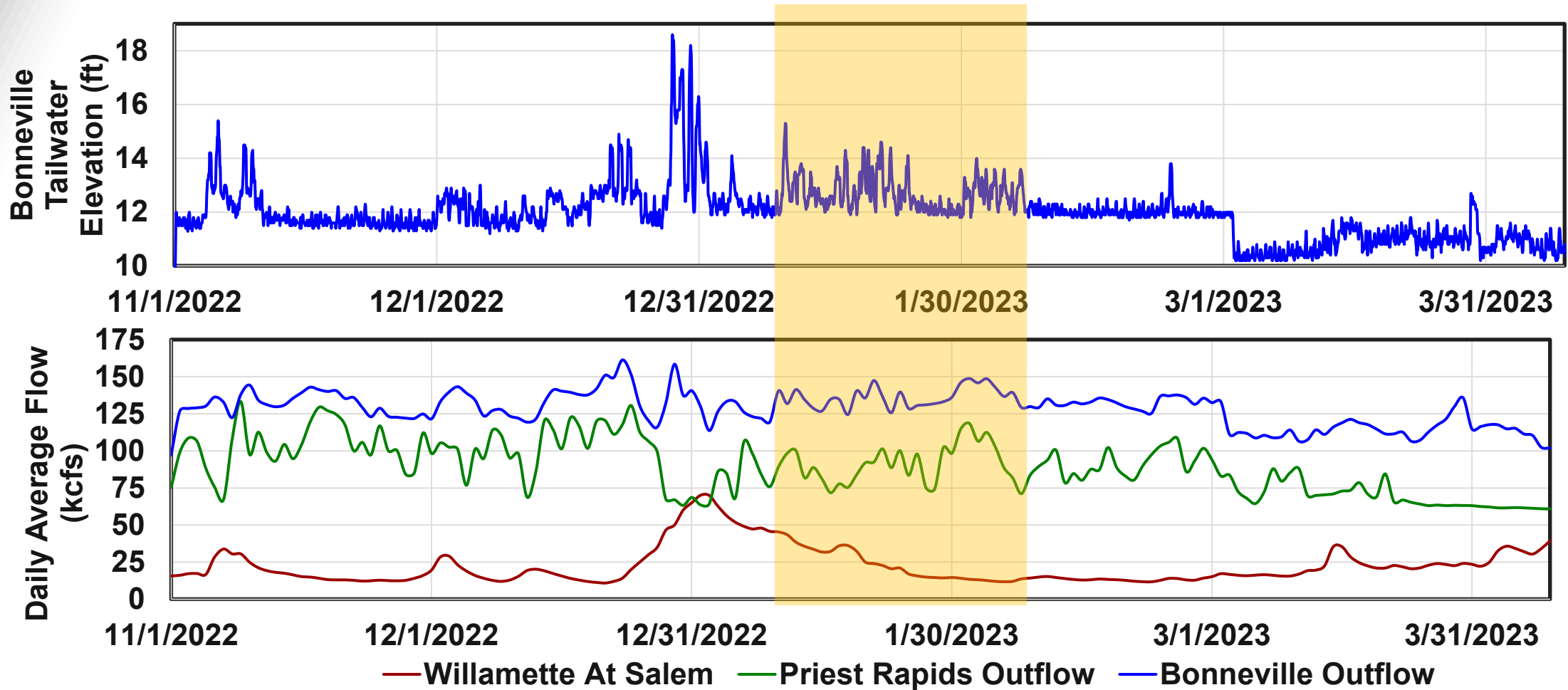


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CHUM OPERATION



January 4-March 1: Grand Coulee's forebay drafted for drum gate maintenance

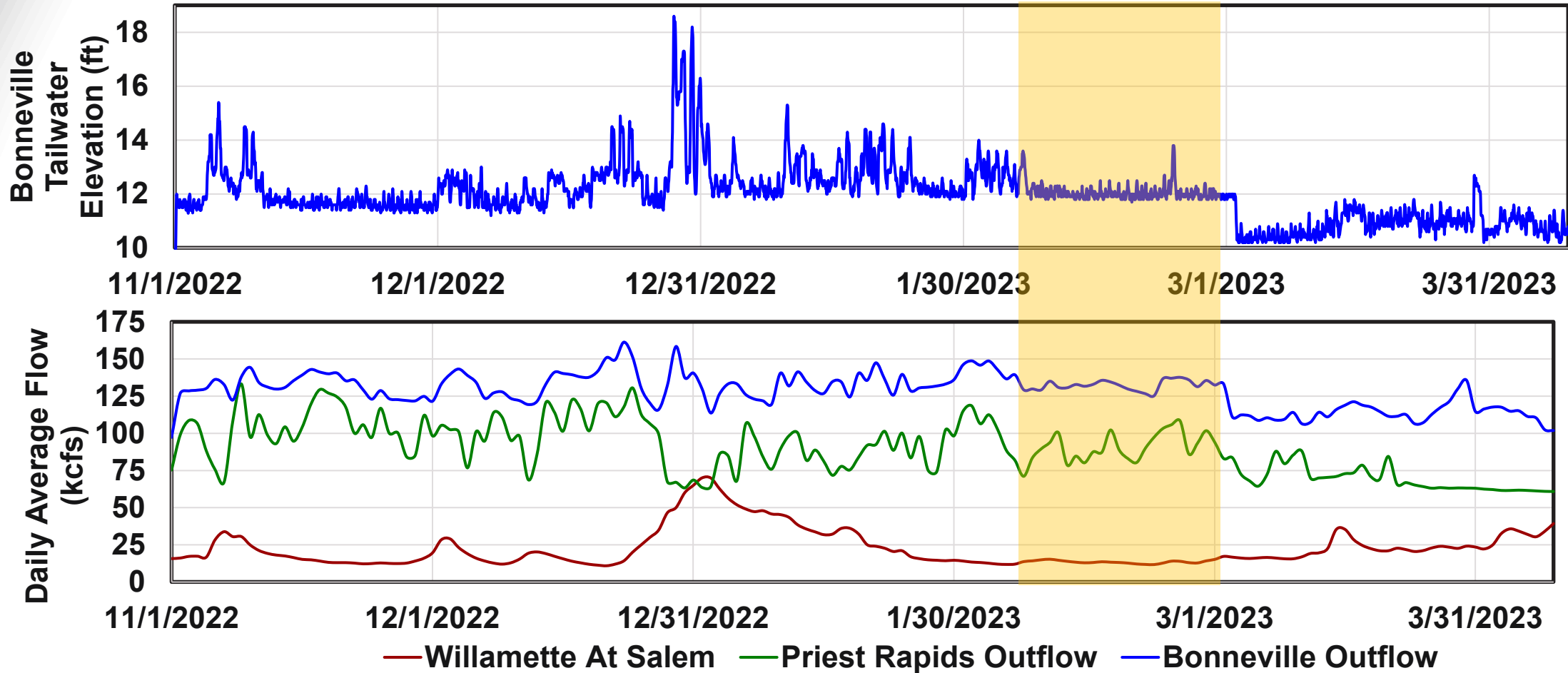


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CHUM OPERATION



February 6-March 1: The Snake and Willamette Rivers remained well below average and inflow to Grand Coulee average was ~66 kcfs. The outflow from BON required to maintain the chum protection TW ranged from 125 to 140 kcfs. Grand Coulee forebay on March 1 was at elevation 1258 ft

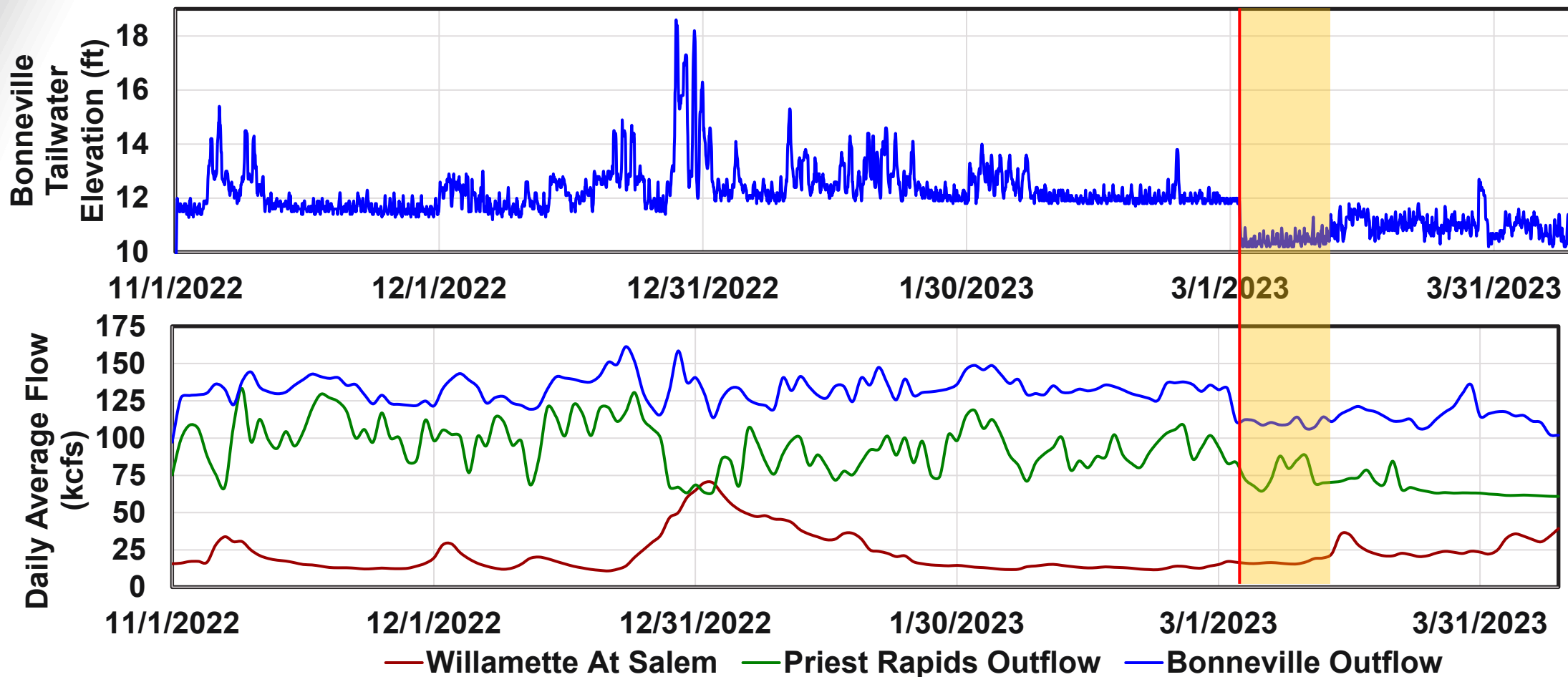


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CHUM OPERATION



March 2: The chum protection level was reduced to **10.2 ft**. Inflow to Grand Coulee during this period was insufficient to support the chum minimum TW of 11.8 at BON without exceeding the draft rate limit at Grand Coulee.

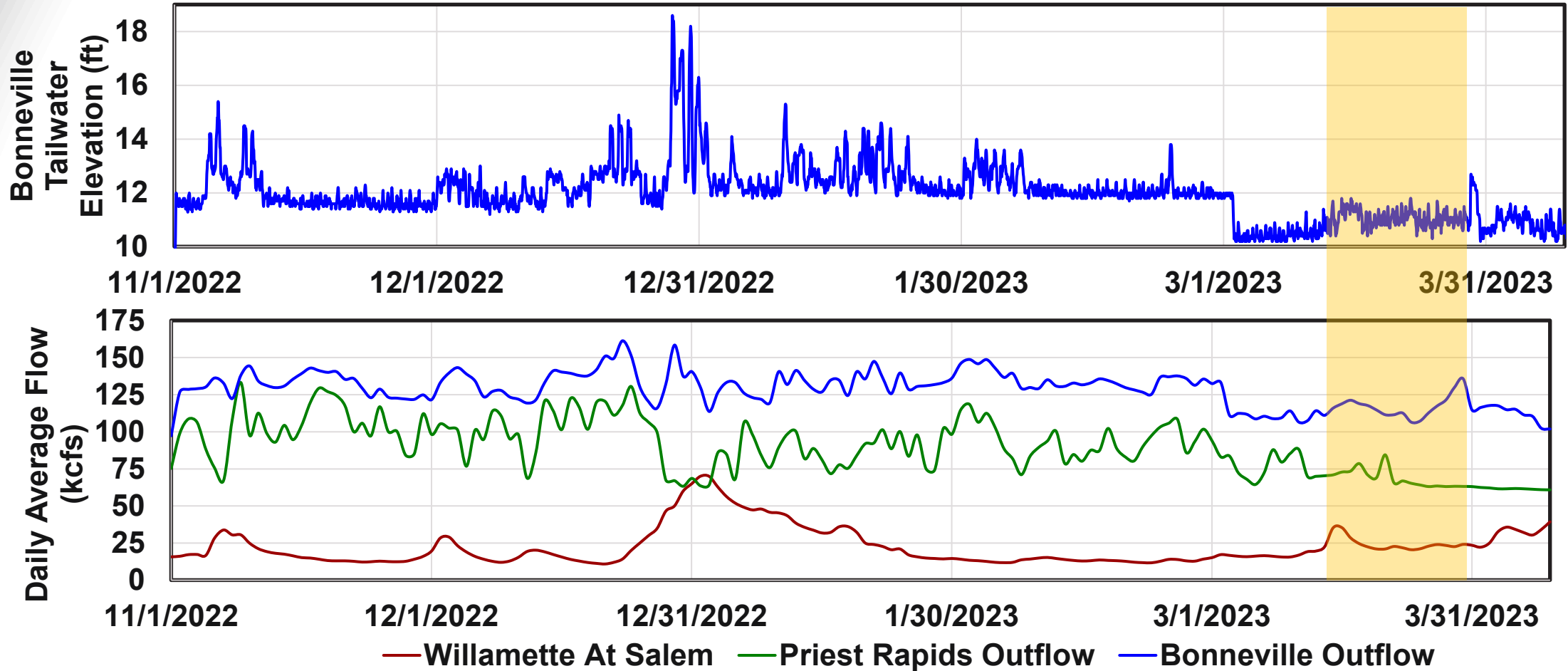


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CHUM OPERATION



March 13-21: Above average precipitation produced a streamflow response in the Willamette and Snake rivers which resulted in an average BON TW of 11.1 ft.

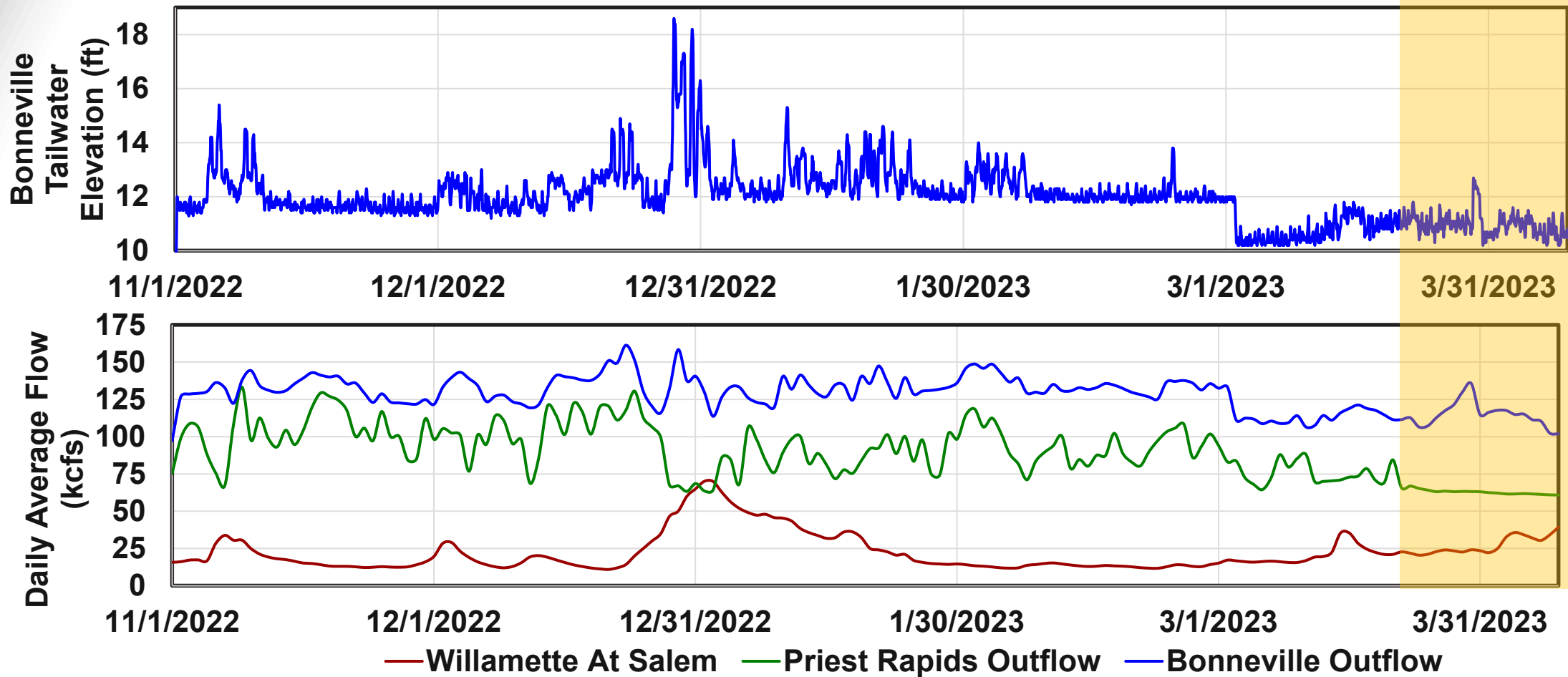


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CHUM OPERATION



March 22 – April 10: Grand Coulee operated to meet the Vernita Bar minimum of 63 kcfs. Increased streamflow from the Snake and Willamette Rivers produced a BON TW average of ~11 feet.



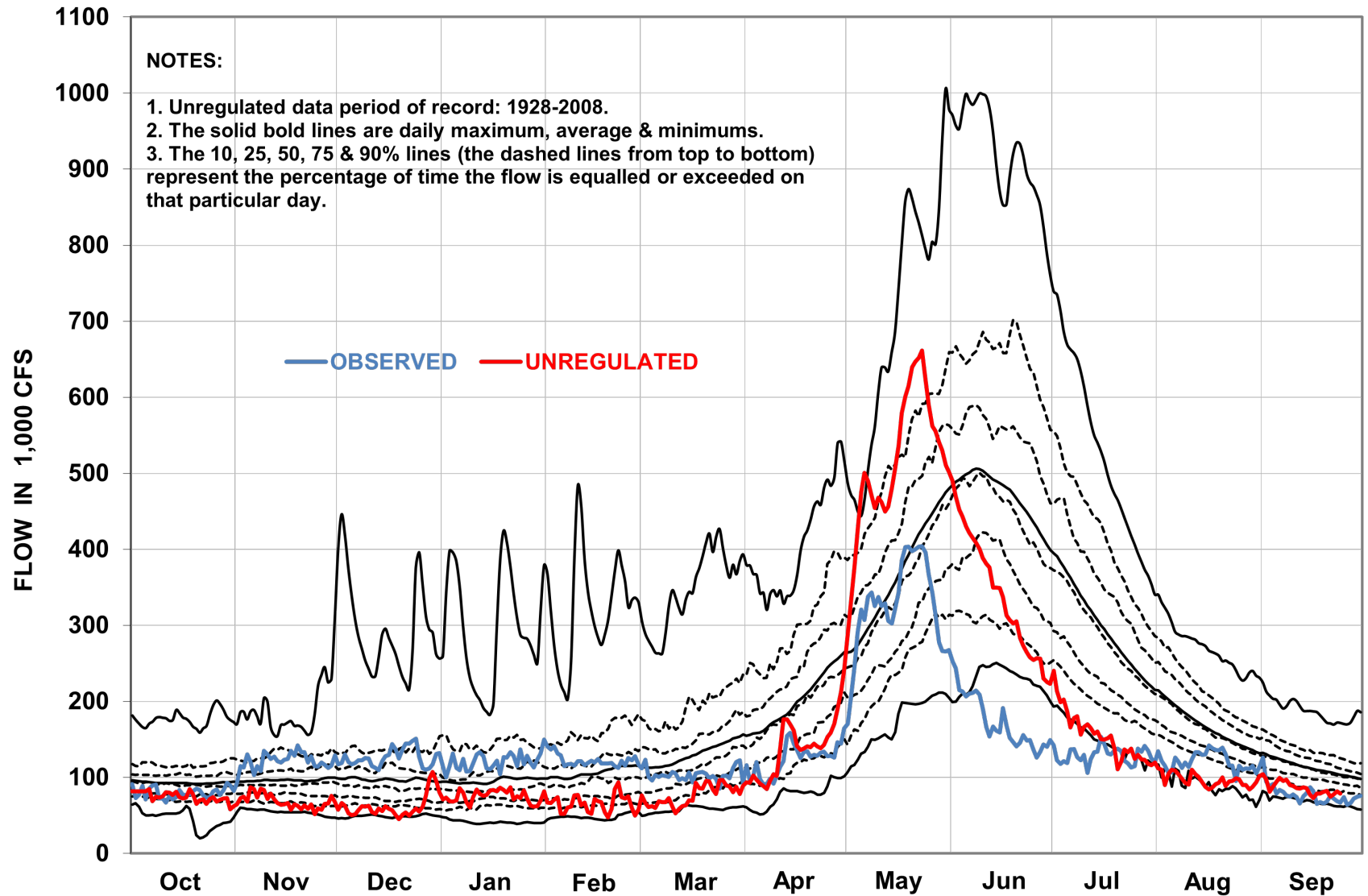
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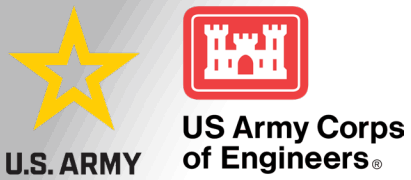


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2023 FLOOD RISK MANAGEMENT

- Unregulated flows at The Dalles would have peaked at 661 kcfs on May 23.
- TDA Regulated flows peaked at 404 kcfs on May 23.
- Vancouver stage peaked at 13.7 ft, 2.3 ft below flood stage, on May 20 during the freshet (Apr-Jul).





RESERVOIR REGULATION FORECASTING

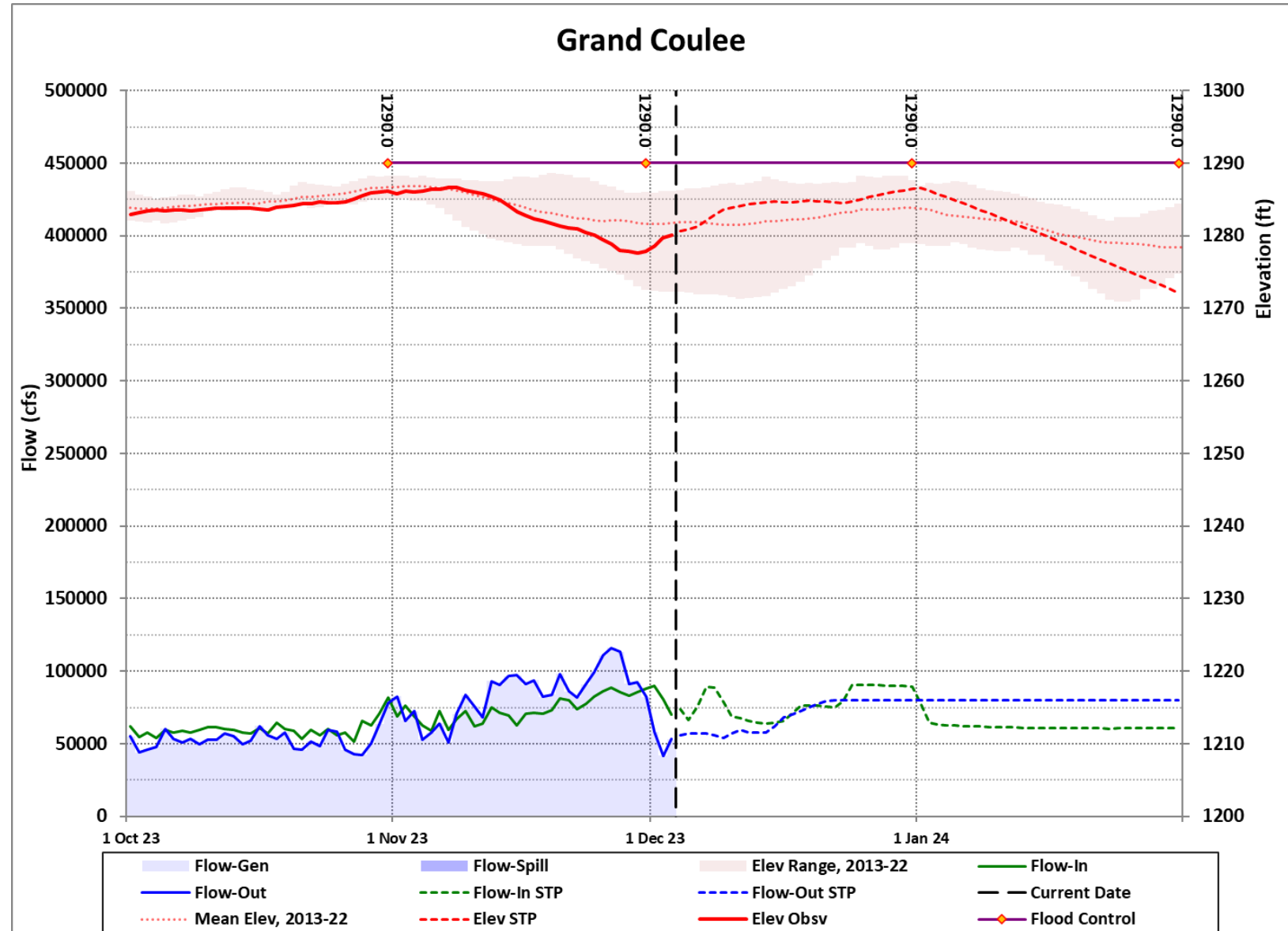
Single Trace Procedure (STP)

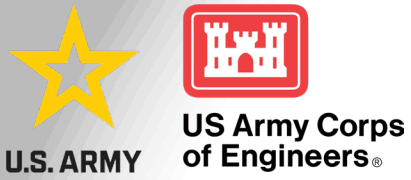
- Weekly on Mondays
- Regulation coordinated with district offices and BPA
- Assume storage project operation in accordance with WMP and FRM guidance
- Higher accuracy during deterministic 10-day window

Thursday updates

- Primarily focused on short term (10-day) outlook

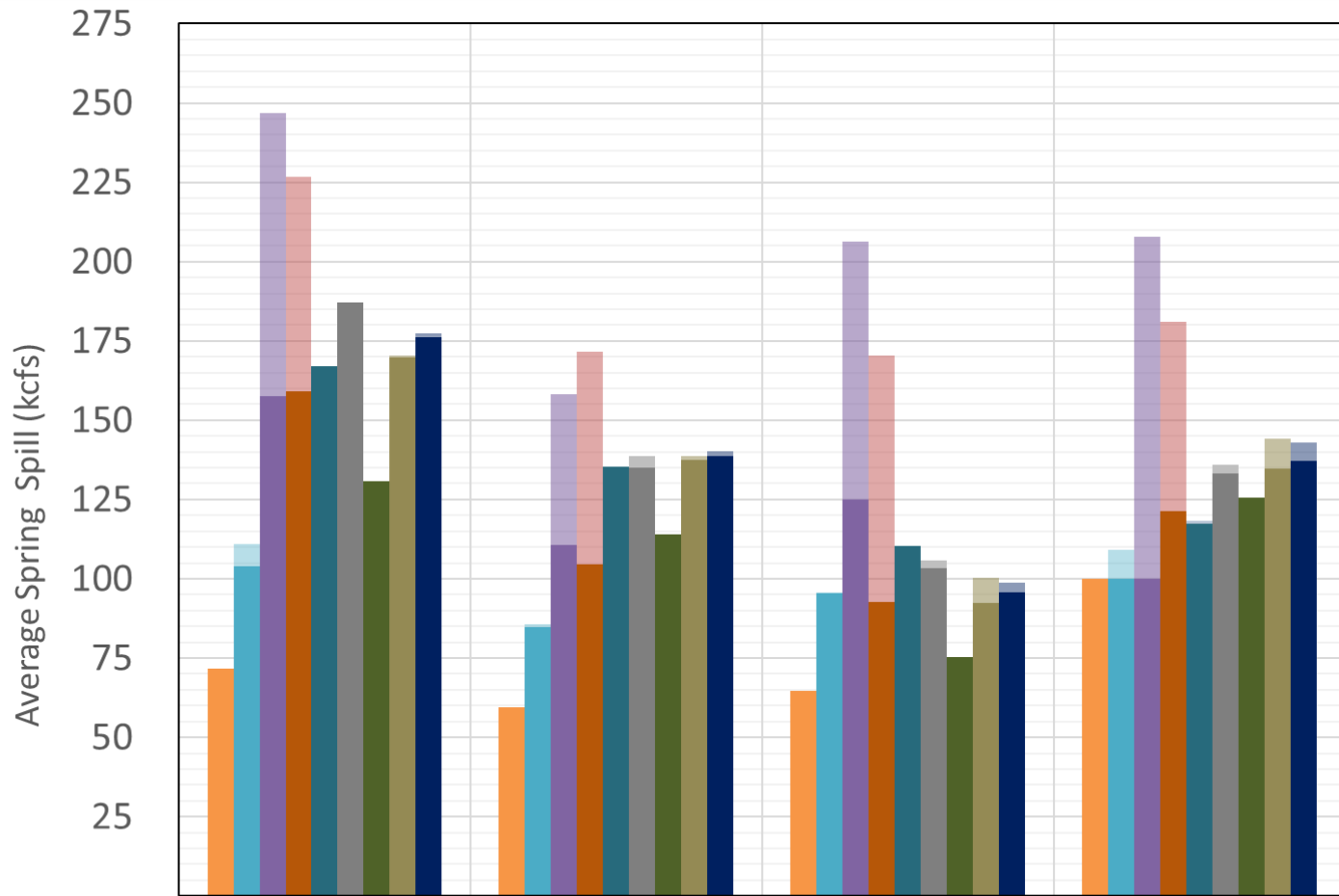
More frequent regulation inputs during flood fight





SPRING SPILL: LOWER COLUMBIA RIVER

Opaque bar: Fish Passage spill
Transparent bar: Forced spill



- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023

} 2008 BiOp levels

Court ordered operations:

- 120/115 = 120% TDG in tailrace and 115% TDG in next d/s forebay

Flexible Spill Agreement:

- 120% TDG in tailrace for 16 hrs and 8 hrs at Performance Level Spill
- 125% TDG in tailrace for 16 hrs and 8 hrs at Performance Level Spill (JDA at 120% TDG)

Stay Agreement operations:

- 125% TDG 24/7 at MCN and BON
- JDA at 125% TDG for 16 hrs and 8 hrs at PS
- TDA at 40%

Note: 2017 & 2018 were big runoff years; 2015 and 2021 were low runoff years



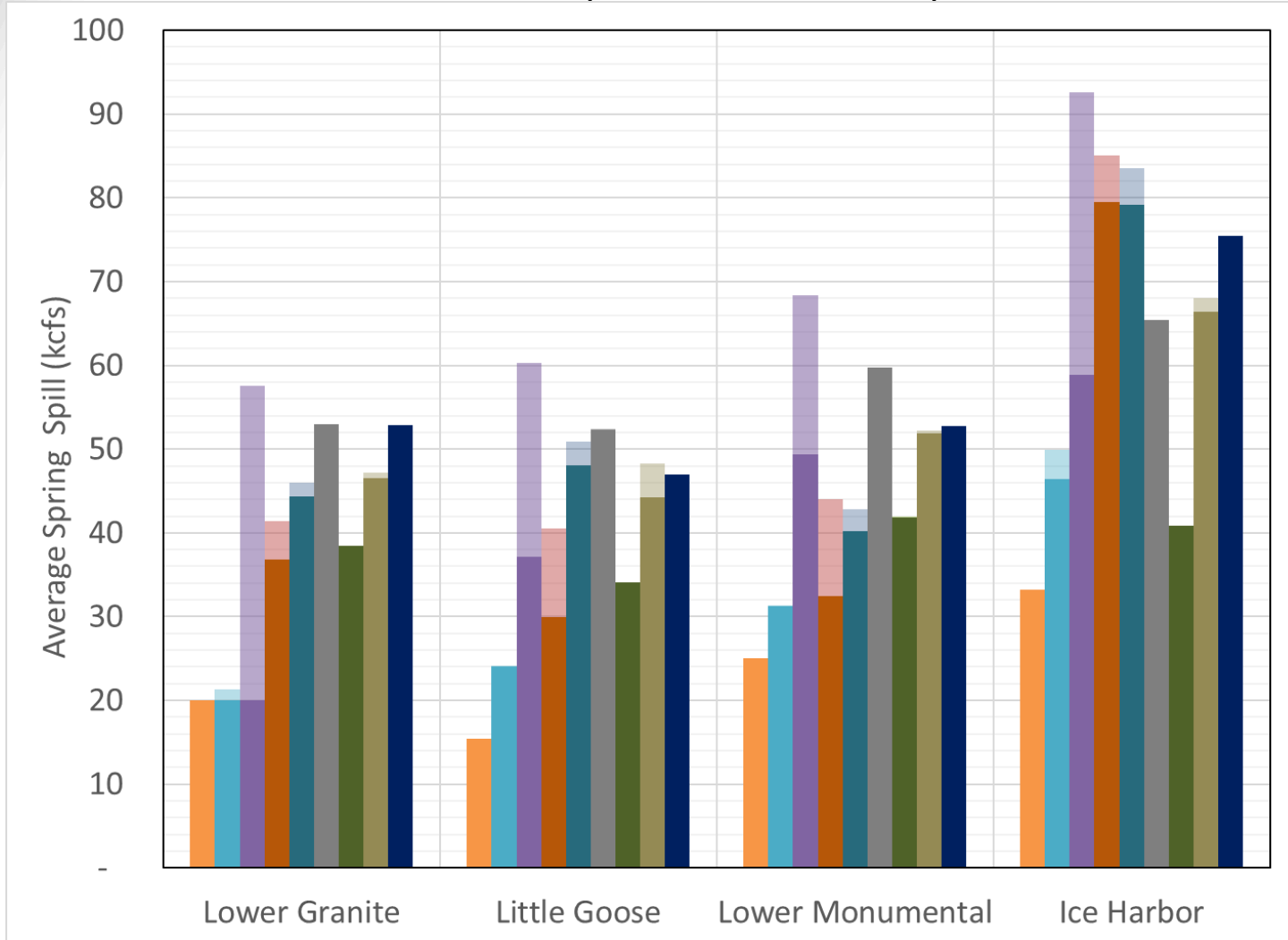
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SPRING SPILL: LOWER SNAKE RIVER

Opaque bar: Fish Passage spill
Transparent bar: Forced spill



- 2015
- 2016
- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023

2008 BiOp levels

Court ordered operations:
• 120/115 = 120% TDG in tailrace and 115% TDG in next d/s forebay

Flexible Spill Agreement:
• 120% TDG in tailrace for 16 hrs and 8 hrs at Performance Level Spill
• 125% TDG in tailrace for 16 hrs and 8 hrs at Performance Level Spill

Stay Agreement operations:
• 125% TDG in tailrace for 16 hrs and 8 hrs at Performance Level Spill except IHR at 125% TDG 24/7

Note: 2017 & 2018 were big runoff years; 2015 and 2021 were low runoff years

GAS BUBBLE TRAUMA MONITORING

Salmonid and non-salmonid monitoring

125% TDG criterion is conditional on monitoring:

- 15% GBT incidence rate in non-paired fins, or
- 5% severe GBT incidence rate in non-paired fins.
- Water quality standard reverts to 120% in the tailrace/115% TDG in the next downstream forebay if either condition is met (by zone)

As outlined in the 2023 GBT Biological Monitoring Plan, the following criteria were followed to guide reinstatement of spring spill operations up to 125 percent TDG:

- a. If gas bubble trauma exceeds any of the action criteria, additional GBT monitoring must demonstrate the incidence of GBT is below the applicable action criterion before spill up to 125 percent TDG can resume.
- b. GBT must be below the applicable action criterion over the next 7-day period before spill up to 125 percent TDG can be applied again.

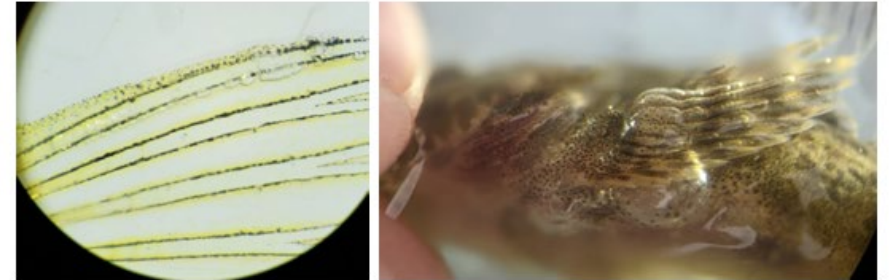


Figure 8. Some examples of external signs of gas bubble trauma in native nonsalmonids collected during field sampling in 2022. The top left panel shows gas bubbles in the caudal fin of a threespine stickleback and the remaining panels show gas bubbles in sculpins. Photos by Ken Tiffan and Joe Warren.

Figure from USGS, Monitoring Native Nonsalmonids for the Incidence of Gas Bubble Trauma Downstream of Snake and Columbia River Dams during the Spring Spill Season, 2022



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SPILL: GAS BUBBLE TRAUMA EXCEEDANCES

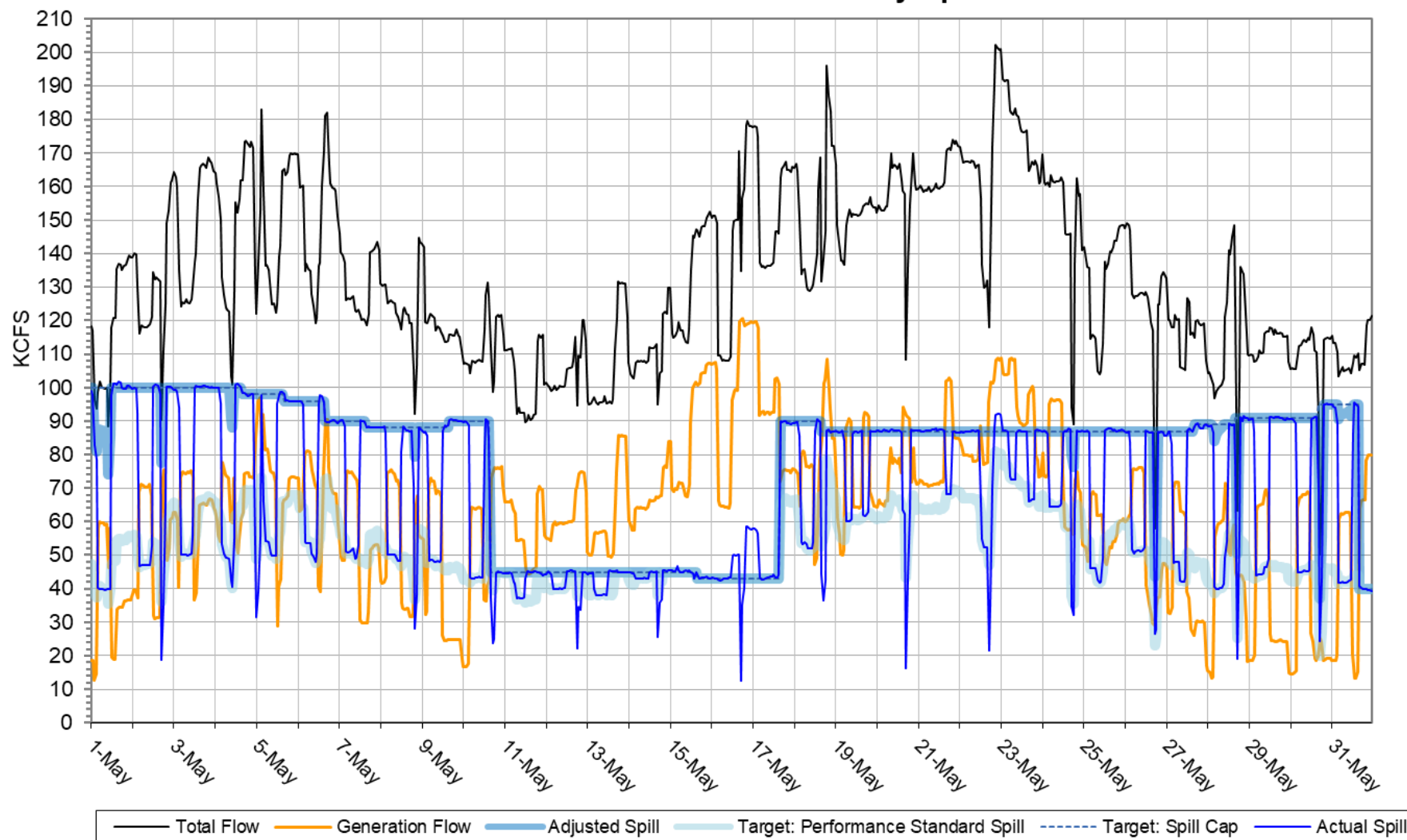
May 9: GBT exceedance of WDOE criteria (26% in native non-salmonids) below IHR.

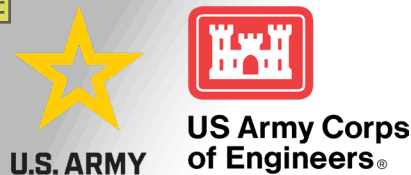
May 10: Spill reduction to 115/120% TDG at all four Lower Snake projects

May 11: After guidance from WDOE, LWG returned to 125% GC spill

May 17: Return to 125% GC at LGS, LMN, and IHR

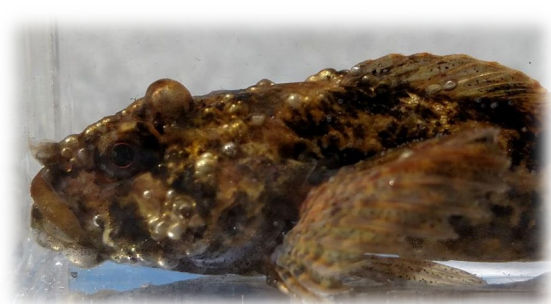
Lower Monumental Dam - Hourly Spill and Flow



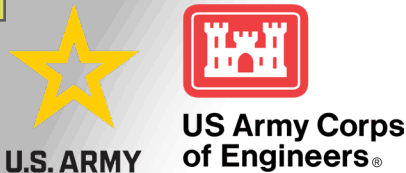


SPILL: GBT EXCEEDANCES

May 18: GBT exceedance in native non salmonids below Bonneville occurred during forced spill, no spill reduction



Station:	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
Gas Cap %:	N/A	125	N/A	125 or 120	N/A or 115	125 or 120	N/A or 115	125 or 120	N/A or 115	125	N/A	125	N/A	125	N/A	125
5/1/2023	104	125	119	125	123	123	119	125	115	120	111	119	114	115	113	121
5/2/2023	103	126	118	125	124	124	121	124	113	123	113	121	119	120	113	121
5/3/2023	104	126	120	125	127	126	123	125	115	125	114	122	122	123	116	122
5/4/2023	106	125	121	127	127	126	124	125	115	125	112	124	119	122	117	123
5/5/2023	105	124	118	126	124	127	120	125	113	124	111	125	121	122	114	123
5/6/2023	104	124	116	125	124	126	121	125	111	124	113	124	122	124	119	124
5/7/2023	104	125	118	125	124	125	121	125	113	124	111	124	122	123	120	124
5/8/2023	105	125	118	124	124	124	121	125	115	126	113	123	123	124	121	124
5/9/2023	104	113	118	124	125	123	121	125	115	125	115	124	122	123	120	124
5/10/2023	104	122	118	122 ¹⁴	125	122	121	123	115	125	118	124	124	125	122	124
5/11/2023	104	121	118	117	125	119	122	120	116	125	122	124	126	126	123	124
5/12/2023	104	124	118	117	120	119	120	120	116	124	123	125	126	126	124	123
5/13/2023	104	124	117	117	119	119	119	120	117	124	124	123	128	127	124	123
5/14/2023	105	125	119	118	119	119	118	120	116	125	124	124	128	128	126	123
5/15/2023	105	125	121	119	119	120	118	121	117	125	124	123	127	127	126	124 ¹⁵
5/16/2023	105	126	120	122	120	121	118	124	117	124	123	124	124	126	125	124
5/17/2023	105	126	120	125	122	124	119	125	119	125	126	125	125	127	127	125
5/18/2023	106	125	122	126	124	125	121	125	119	125	125	124	125	127	126	128
5/19/2023	106	124	120	126	127	124	122	125	120	125	125	124	124	126	124	125
5/20/2023	106	124	121	127	130	125	123	125	120	125	124	125	124	126	123	124
5/21/2023	107	125	121	127	130	125	124	124	119	124	122	125	120	123	120	124
5/22/2023	106	127	118	127	127	125	121	125	114	127	116	125	117	122	116	124
5/23/2023	107	126	117	128	130	125	122	129	114	127	113	125	119	124	119	124
5/24/2023	108	125	121	126	131	124	125	124	117	125	112	122	118	124	122	123
5/25/2023	107	123	121	124	130	124	126	125	119	125	118	122	122	125	123	125
5/26/2023	107	123	122	125	127	124	125	125	118	125	124	122	124	125	123	124
5/27/2023	106	124	121	125	126	123	124	125	119	125	123	122	121	123	121	122
5/28/2023	106	124	121	125	125	124	123	124	118	125	121	122	121	123	116	122
5/29/2023	105	124	121	125	126	122	123	125	117	125	121	122	122	123	115	122
5/30/2023	105	124	120	125	126	122	123	122	116	123	118	123	120	122	115	122
5/31/2023	105	125	118	122	123	121	122	122	114	122	115	123	117	120	112	121
Exceedances:		6		12	8	7	8	5	6	3				10		1



SPILL: GBT EXCEEDANCES

May 30: GBT exceedance below IHR. LGS, LMN, and IHR reduced to 115/120% TDG

June 7: LGS, LMN, and IHR returned to 125% TDG

Station:	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
Gas Cap %:	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
	115	120	115	120	115	120	115	120	115	120	115	120	115	120	115	120
6/1/2023	104	125	117	117 ¹⁸	122	119	121	121	111	121	113	121	120	121	112	121
6/2/2023	104	125	117	117	119	118	119	120	112	119	113	119	120	122	114	121
6/3/2023	105	125	119	117	118	116	119	120	113	120	113	119	119	120	116	121
6/4/2023	105	125	119	117	118	116	118	120	113	119	113	118	118	120	113	120
6/5/2023	105	124	120	117	119	116	118	119	114	119	116	119	119	120	114	120
6/6/2023	106	124	120	117	119	116	119	119	115	120	119	119	122	122	117	121
6/7/2023	105	123	121	122	119	119	119	118	115	119	120	120	122	122	120	121
6/8/2023	105	123	119	124	119	121	118	118	113	118	119	120	119	121	115	120
6/9/2023	104	123	118	124	122	121	118	117	113	118	118	119	117	120	112	120
6/10/2023	103	122	118	122	122	121	119	117	110	116	115	118	114	118	111	120
6/11/2023	103	121	118	122	123	120	120	116	111	116	114	117	115	118	112	120
6/12/2023	104	121	118	123	123	121	121	117	112	116	114	117	116	119	113	119
6/13/2023	105	121	118	122	123	120	121	117	113	116	113	117	114	117	112	121
6/14/2023	103	120	115	122	120	118	119	116	111	116	109	118	108	114	108	120
6/15/2023	102	120	112	122	116	120	114	117	108	117	107	118	111	115	106	120
6/16/2023	102	119	111	121	116	118	114	117	108	117	107	114	115	118	109	117
6/17/2023	102	118	112	119	119	117	116	115	110	117	107	113	109	115	109	117
6/18/2023	102	118	112	118	118	117	116	115	109	116	105	113	107	113	109	117
6/19/2023	102	119	111	120	116	118	114	114	107	116	104	114	106	112	107	117
6/20/2023	100	118	108	120	112	117	110	115	105	117	102	114	105	112	106	117
6/21/2023	99	109	108	113	112	118	110	113	104	118	104	114	108	114	109	117
6/22/2023	101	110	110	112	116	119	113	115	108	117	105	114	110	116	112	117
6/23/2023	103	110	112	113	118	119	115	114	109	116	105	114	110	115	113	117
6/24/2023	104	111	113	114	115	117	115	114	110	117	104	115	108	114	112	117
6/25/2023	105	111	114	114	113	117	115	113	111	117	104	115	108	114	110	117
6/26/2023	104	112	111	113	113	118	116	113	111	117	106	115	109	115	109	117
6/27/2023	103	112	110	113	114	117	116	115	111	116	109	116	109	115	108	117
6/28/2023	103	112	111	113	114	117	116	114	111	115	110	116	109	115	108	117
6/29/2023	103	111	112	114	113	115	115	113	110	115	111	116	111	116	109	117
6/30/2023	103	111	111	113	113	114	115	115	111	115	110	116	111	116	110	117
Exceedances:					8		9									



Questions?

