

DWORSHAK OPERATIONS: MINIMIZING IMPACTS OF EXTREME TEMPERATURE

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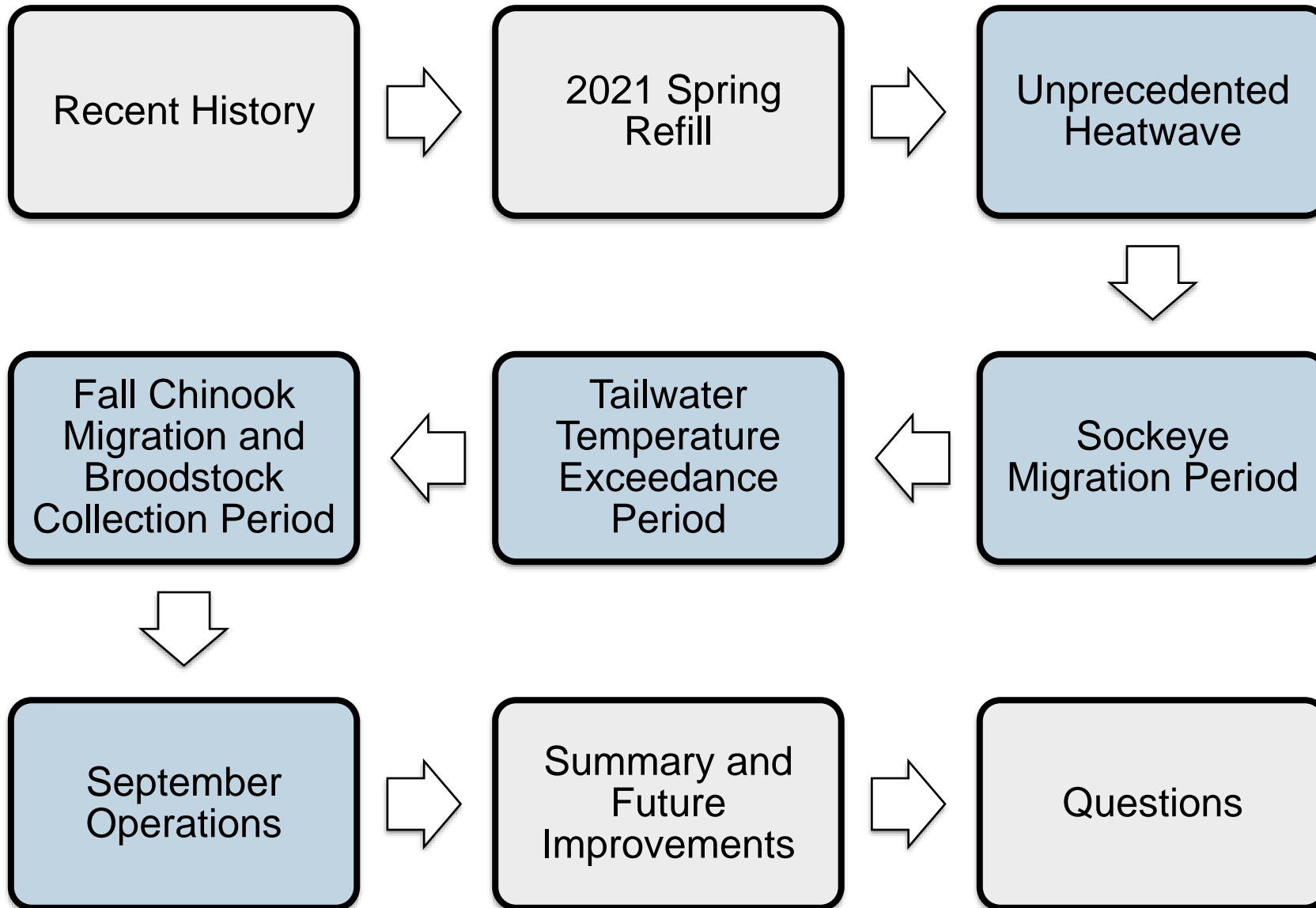
Lower Granite tailwater and juvenile return pipe (Willow Walker)



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OUTLINE





RECENT HISTORY - 2015

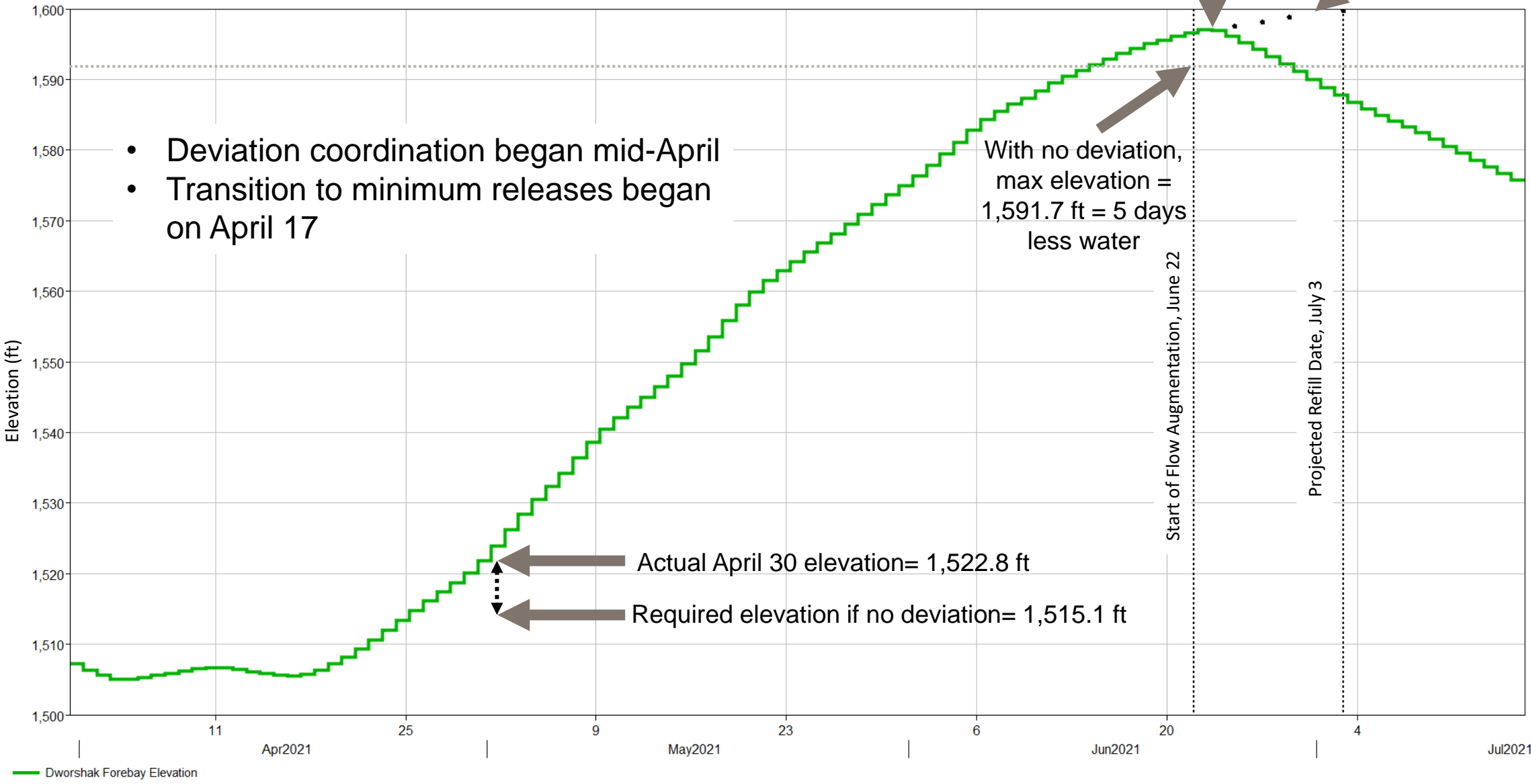


Lower Granite South fish ladder (Willow Walker)

- Hot and dry summer with low flow conditions
 - Lethal for fish, including sockeye
- NOAA published *2015 Adult Sockeye Salmon Passage Report*
 - Assessed effectiveness of actions taken by Snake River managers
 - Recommendations led to Walla Walla water management's 3-year plan
 - Enhanced short term modeling
 - New long term risk analysis approach
 - Advanced communication



SPRING REFILL





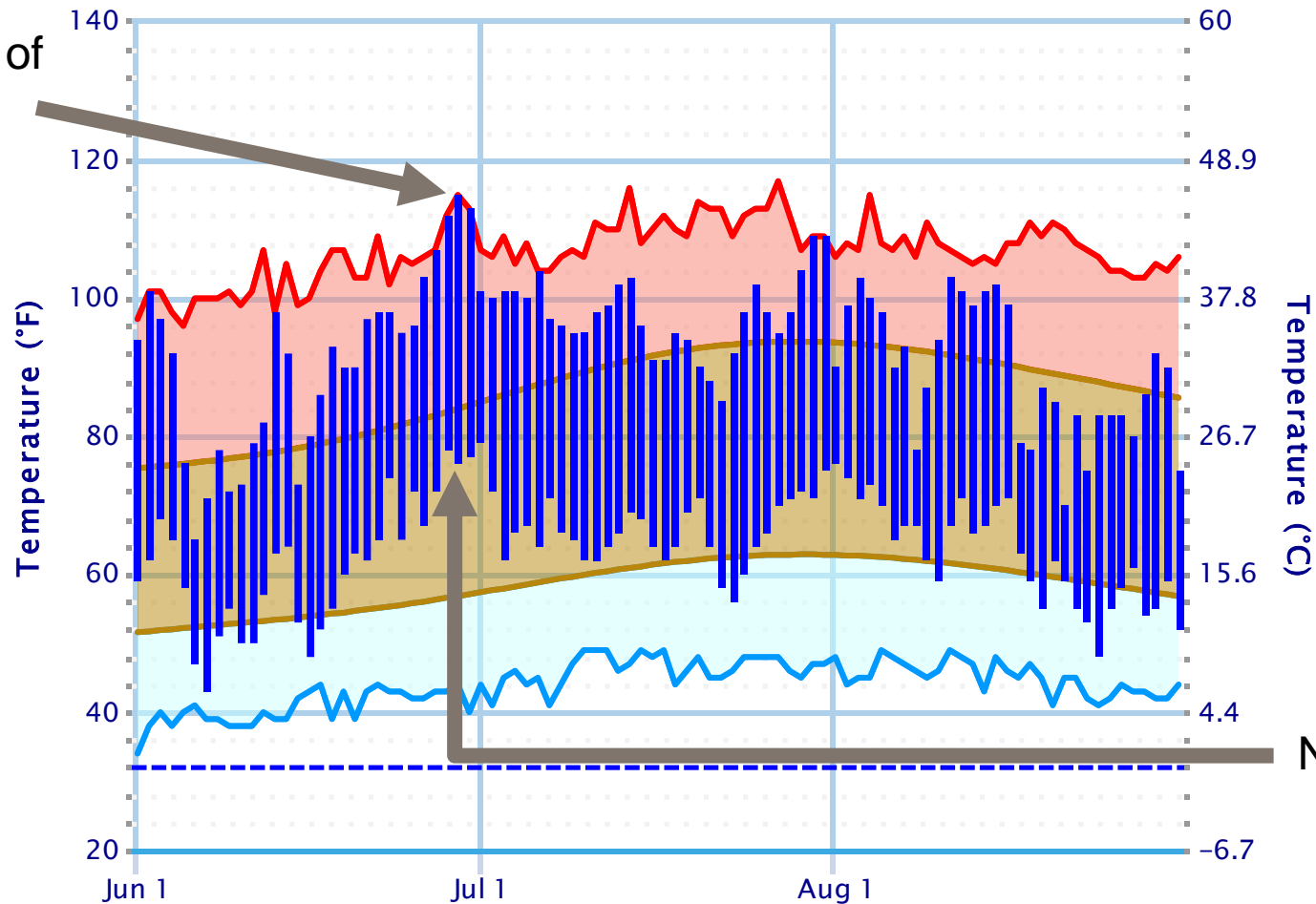
HISTORIC HEATWAVE

Daily Temperature Data – Lewiston Area, ID (ThreadEx)

Period of Record – 1881-09-01 to 2021-11-08. Normals period: 1991-2020.



Several consecutive days of record setting heat



No nighttime relief

- Observed temperature range (2021)
- Normal temperature range
- Record Max
- Record Min

Chart from National Weather Service: <https://www.weather.gov/wrh/Climate?wfo=otx>

Unprecedented Heatwave

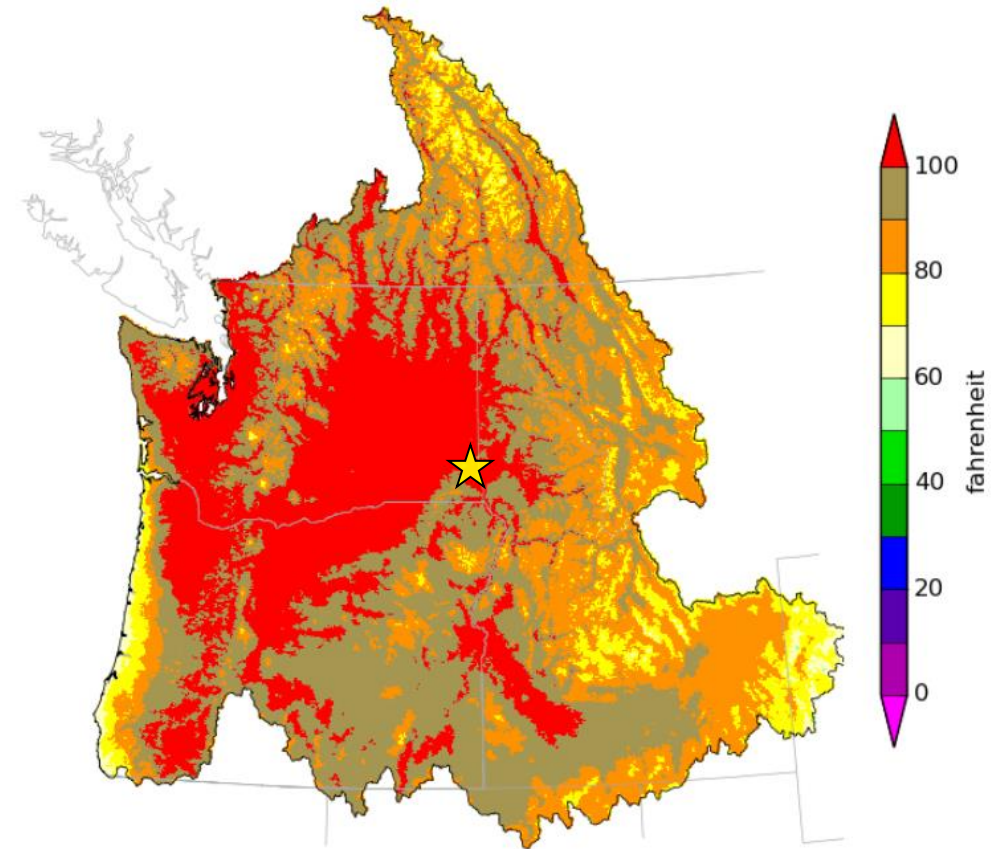


HISTORIC HEATWAVE (CONTINUED)



Northwest River Forecast Center
Forecast Max Temperature, Ending 12Z, 06/29/21

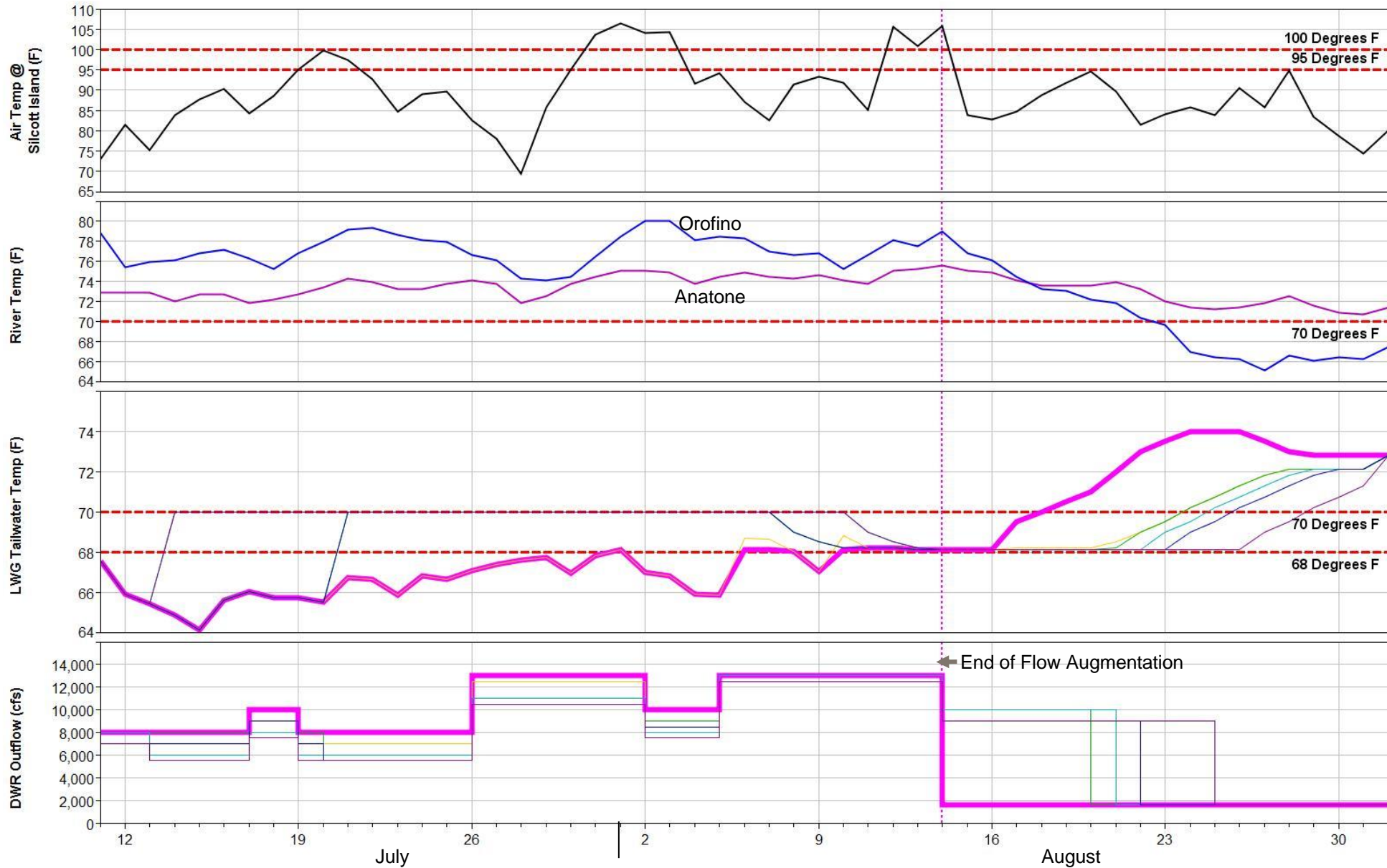
- Silcott Island air temperature $\geq 100^{\circ}$ F for 12 consecutive days
- 115° F on June 29
- $\geq 95^{\circ}$ F for 26 consecutive days (June 21 to July 16)
- Flow augmentation began June 22
 - Dworshak releases 12.5 kcfs to maintain Lower Granite tailwater at 68° F



Creation Time: Mon Jun 28 21:56:34 UTC 2021



INITIAL OUTLOOK



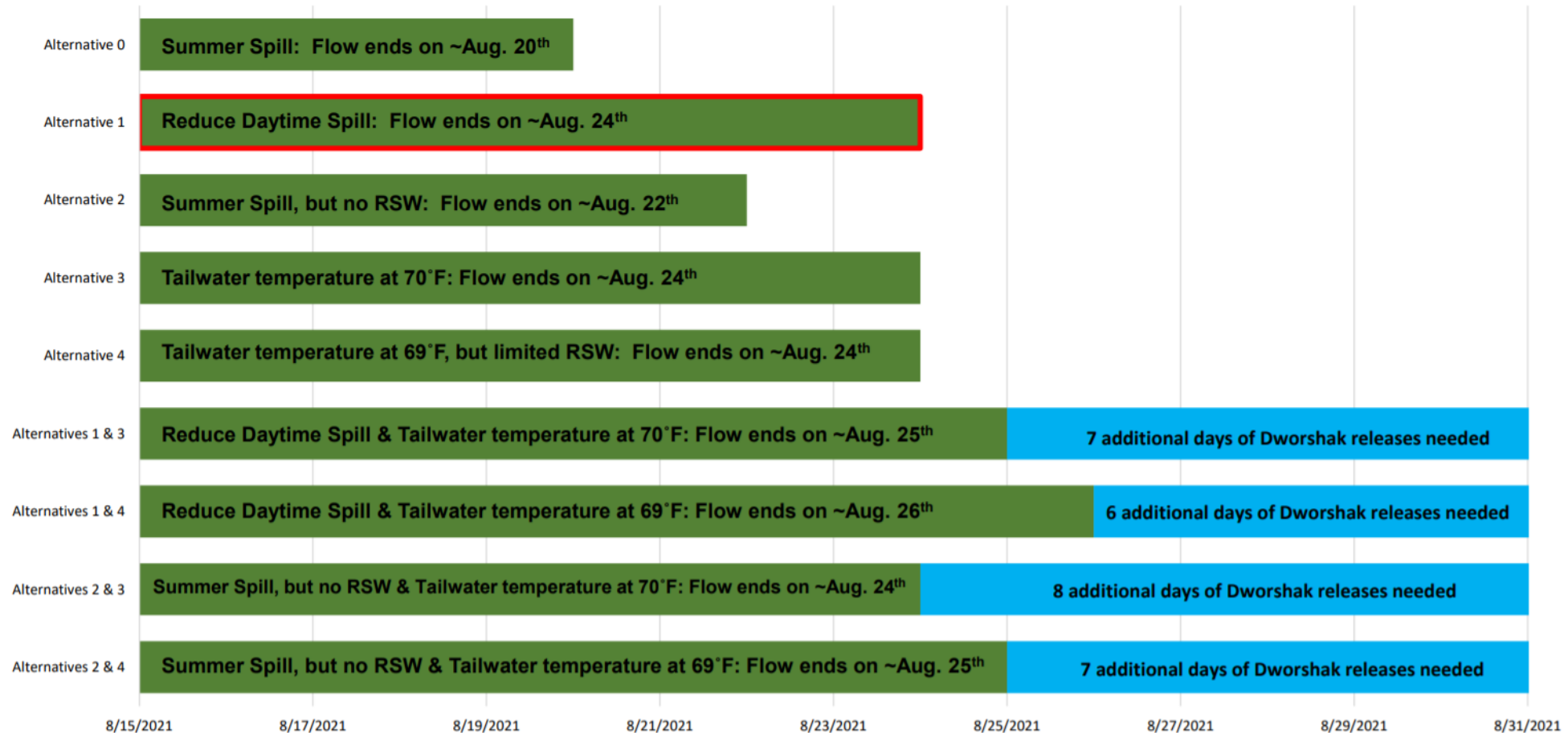
- Initial long-term risk analysis determined flow augmentation water likely to run out before August 15
- Region needed to avoid this outcome



PROACTIVE ANALYSIS FOR SUMMER OPERATIONS



- Regional co-managers came together to discuss alternative operational scenarios
 - Had to consider mitigation efforts never seen before
 - SOR's presented to TMT



Sockeye Migration Period



CONSIDERING NEW OPERATIONS



- SOR 2021-3
 - requested surface spill only from 0900-2300 hours; add traditional spill outlets back for all other hours (as described in 2020 BA)
 - Resulted in comparatively smaller volume of warmer water

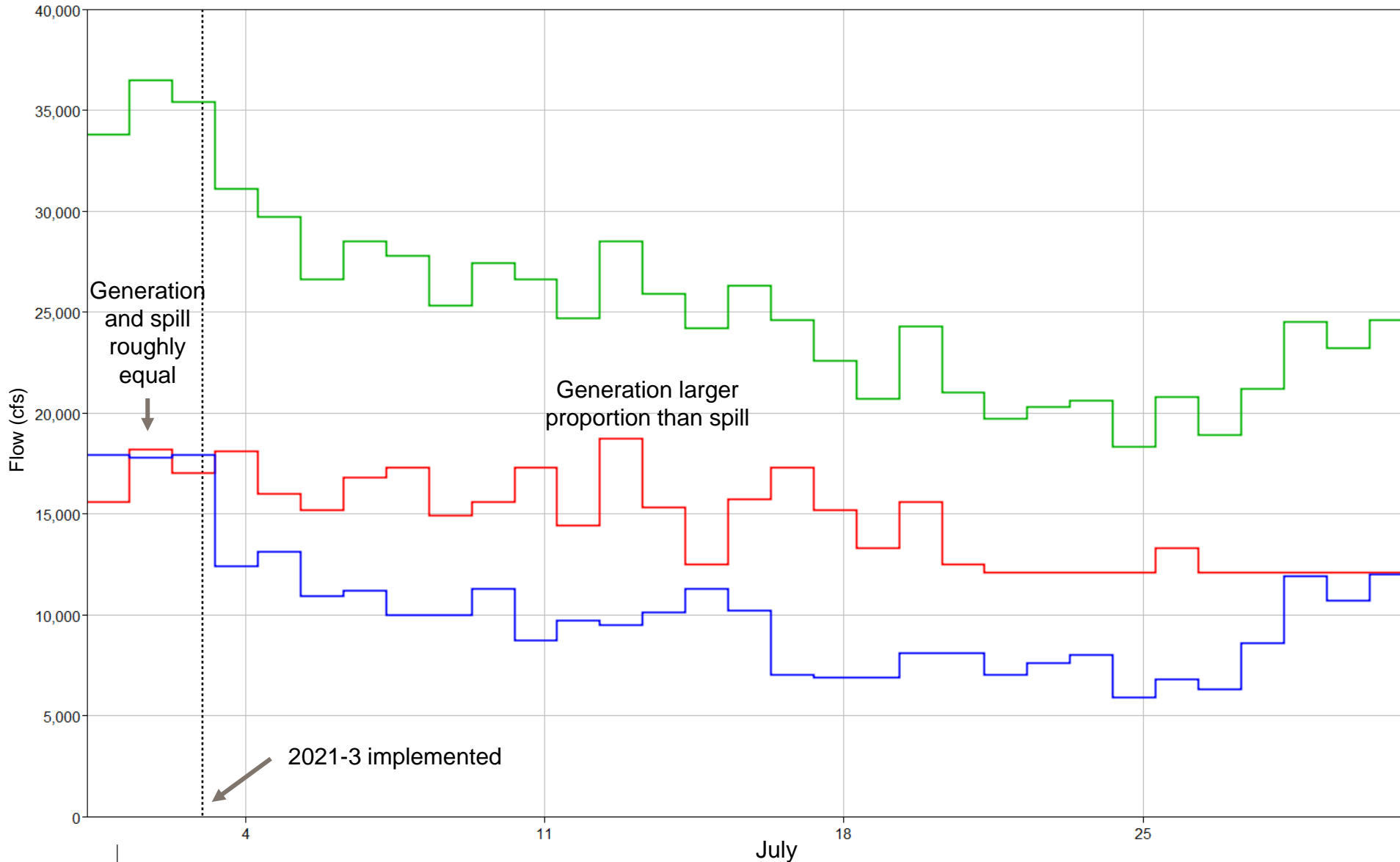
GENERALIZED EXAMPLE

	Surface Spill	Traditional Spill	Turbines	Mass Balance Temperature
Typical Operations	(72.2° F) (7 kcfs)	(66.6° F) (18 kcfs)	(64.2° F) (12 kcfs)	66.9° F
SOR 2021-3 Operations	(72.2° F) (7 kcfs)	(66.6° F) (0 kcfs)	(64.2° F) (30 kcfs)	65.7° F

Date	Time	Surface Spill		Traditional Spill				Turbines			
		0.5m	1.5m	3m	5m	10m	15m	20m	25m	30m	35m
07/03/2021	00:00	70.3	69.9	69.2	68.5	68.3	66.5	64.6	64.2	64.2	63.9
	01:00	70.5	69.7	69.0	68.8	68.4	67.0	64.6	64.2	64.2	64.0
	02:00	70.2	69.8	69.4	69.0	68.5	66.9	64.5	64.1	64.2	64.0
	03:00	70.1	69.9	69.5	68.8	68.4	66.6	64.7	64.1	64.1	64.0
	04:00	69.9	69.8	69.7	69.0	68.4	66.8	65.2	64.1	64.1	63.9
	05:00	70.5	70.4	69.9	69.5	68.5	66.8	65.0	64.1	64.1	63.9
	06:00	70.6	70.5	70.3	69.1	68.5	67.0	64.7	64.2	64.2	63.9
	07:00	70.9	70.8	70.5	69.5	68.9	67.1	64.8	64.3	64.2	63.9
	08:00	71.3	71.1	70.6	69.8	68.9	66.9	64.7	64.2	64.1	63.8
	09:00	71.9	71.4	70.8	70.2	68.9	66.9	65.1	64.3	64.2	63.8
	10:00	72.9	71.4	70.9	70.3	69.0	67.0	64.9	64.3	64.3	63.9
	11:00	72.8	71.9	71.0	70.6	69.2	67.2	65.0	64.4	64.3	64.0
	12:00	72.9	71.7	71.4	71.0	69.4	67.4	65.1	64.3	64.2	64.0
	13:00	73.5	72.0	71.7	71.1	69.3	68.0	65.3	64.3	64.2	64.1
	14:00	74.4	72.9	72.1	71.2	69.3	68.1	65.4	64.3	64.3	64.1
	15:00	76.9	73.9	72.8	71.6	69.3	67.5	65.1	64.2	64.2	64.1
	16:00	78.7	74.2	73.4	71.6	69.2	68.0	65.3	64.5	64.2	64.1
	17:00	77.8	74.9	73.1	71.5	69.1	68.0	65.3	64.5	64.2	64.1
	18:00	76.5	73.5	72.4	71.2	69.0	67.5	65.6	64.5	64.3	64.0
	19:00	76.2	73.4	72.4	70.7	69.1	67.1	65.8	64.5	64.3	64.0
	20:00	76.1	74.8	71.9	70.5	68.8	67.2	65.5	64.5	64.4	64.0
	21:00	75.8	74.2	71.9	70.6	68.8	67.1	65.4	64.4	64.4	64.1
	22:00	75.8	74.8	72.2	70.8	68.9	67.2	65.6	64.3	64.3	64.1
	23:00	75.5	74.1	72.4	70.9	68.6	67.2	65.6	64.3	64.3	64.1



TEMPERATURE IMPACTS OF SOR 2021-3



- Lower Granite Total Outflow
- Lower Granite Spill
- Lower Granite Generation Flow

- Reduced Dworshak releases from 12.5 to 9.7 kcfs
- Early consideration and implementation of SOR allowed for maximum benefit to Dworshak releases
- Saved ~8 days of water (~August 22)

Sockeye Migration Period



SOR 2021-4 & 5: EXCEEDING 68° F



- SOR 2021-4 and SOR 2021-5 changed Lower Granite tailwater temperature criteria from 68 to 69.5° F
 - Flexible time window with limits of July 23 and August 17
- Significant tradeoffs
 - Conserve flow augmentation water for later in summer
 - Critical for steelhead and fall Chinook migration and fall Chinook broodstock collection (scheduled for Aug 18)
 - Lower migration numbers for adult sockeye, adult summer steelhead, and juvenile and adult fall Chinook in flexible time window
 - Still impacts to migratory and resident fish



TEMPERATURE IMPACTS OF SOR 2021-4 & 5



- Tailwater temperature varies within a half of a degree of target during standard operations
- During SOR 2021-5 timeframe tailwater temperature did drift over 70° F
 - 12-hour moving average from August 3 to 5
 - Additional heatwave, longer and more intense than initially forecasted
 - July 30 and 31 were again record setting
- Daily average releases from Dworshak reduced to 7.1 kcfs
- Average daily maximum tailwater temperature was 68.9° F
- Saved ~4 days of water (~August 26) excluding natural return to average air temperatures in mid to late-August
 - ~9 days if return to average air temperatures is included



TRANSITIONING TO FALL CHINOOK RUN AND TRAP OPENING



- Flexible time window in SOR 2021-5 allowed NWW water management to capitalize on advantageous conditions to return to tailwater temperatures below 68°F
 - August 16
 - Adult trap opened as scheduled on August 18



Salmon from Lower Granite adult fish trap (Willow Walker)



IS DEEPER DWORSHAK DRAFT NEEDED?



- Early August analysis showed flow augmentation would still fall ~5 days short
 - Region considered drafting Dworshak deeper than 1,535 ft by August 31 to extend releases
- Some potential negative impacts to consider
 - Exposure of culturally significant areas during recreation season
 - Bull trout access to tributaries
 - Refill risk
- Deeper draft ultimately not needed
 - SORs 2021-3, 4, & 5 bought enough extension
 - Air temperatures returned to average in mid-August, not as extreme as previous weeks
- August 31 midnight elevation = 1,535.1 ft, flow augmentation lasted to target date



SEPTEMBER OPERATIONS



September releases from Dworshak are managed for the NPT 200 KAF water right and follow the Dworshak Operational Plan released by the Dworshak Board each year. The considerations, goals, and operational targets listed below are referenced from the 2021 Dworshak Operational Plan.

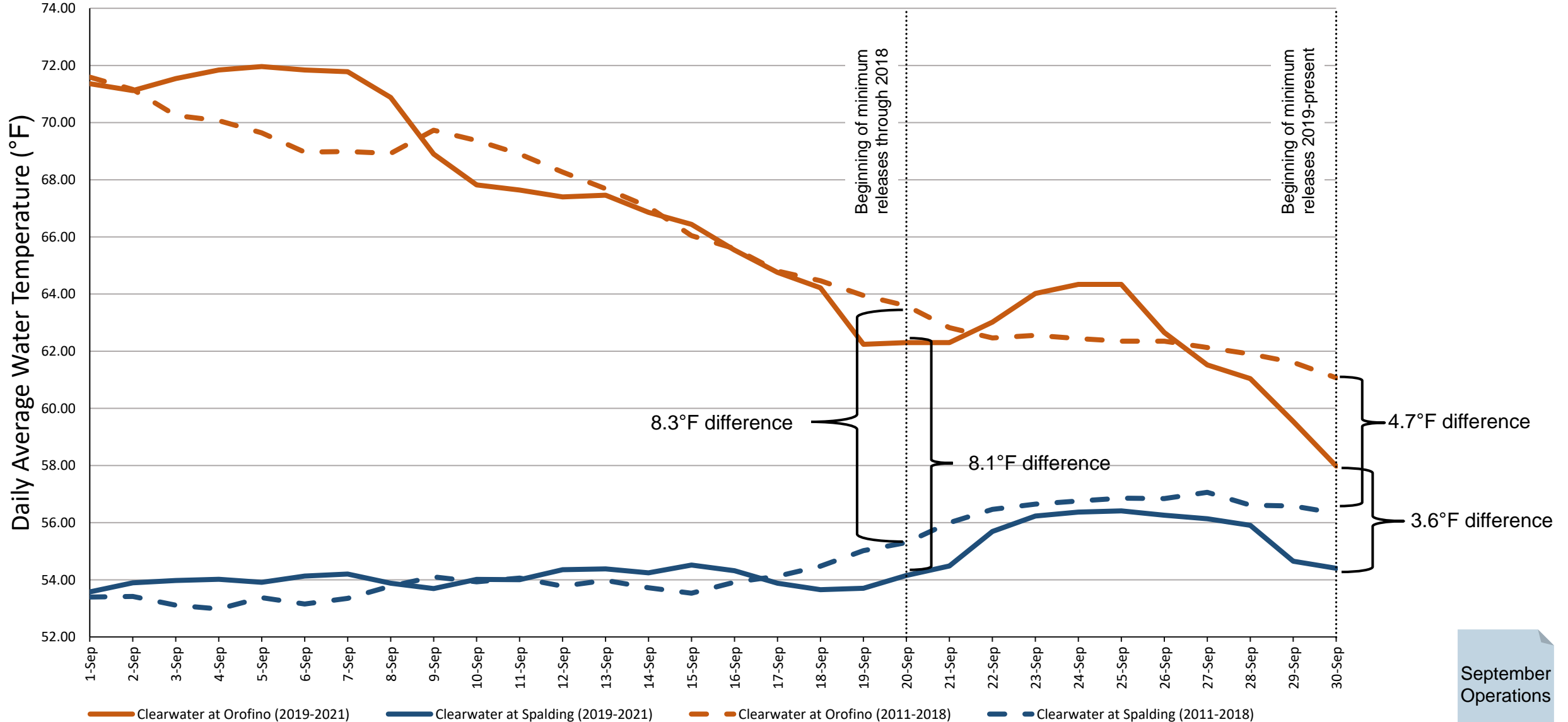
- Considerations
 - Juvenile fall Chinook and lamprey rearing
 - Migration of juvenile fall Chinook
 - Cultural resources
 - Recreation
 - Nez Perce Tribal Hatchery water supply
- Goals
 - Avoid rapid flow changes
 - Avoid rapid temperature changes
 - Provide thermal refuge
- Operational targets (all met during Sep.)
 - Lower Granite Dam tailwater temperature not to exceed 68° F
 - Adult trap temperature not to exceed 70° F
 - Clearwater River at Spalding daily average water temperature not to exceed 56° F
 - Clearwater River at Peck and Spalding daily average water temperatures change of no more than 1° F



SEPTEMBER OPERATION IMPROVEMENTS

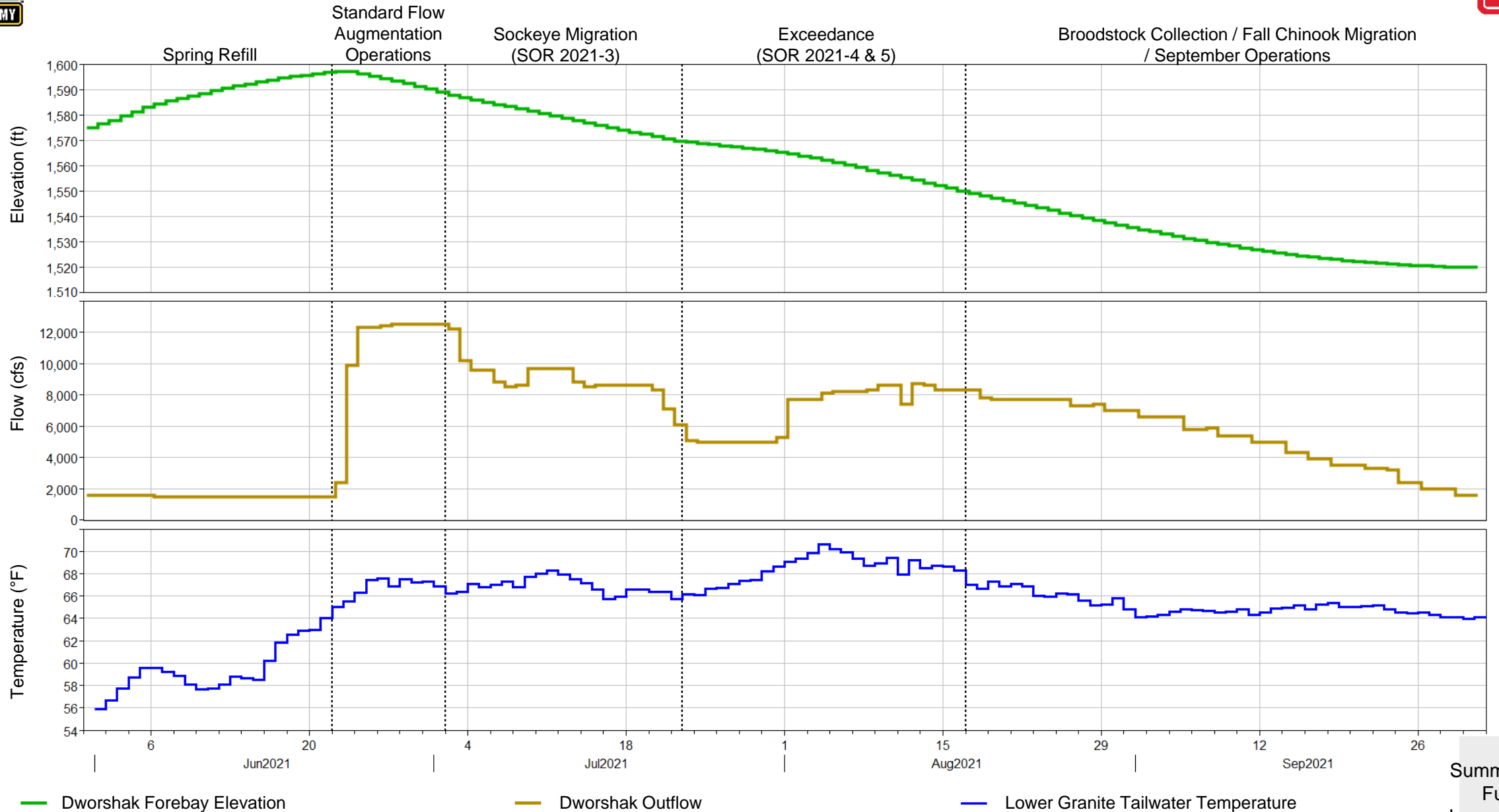


Comparison of Temperature Impacts: Old vs New Operations





SUMMER 2021 OPERATIONAL SUMMARY



CONCLUSION

- 2015 & 2021 were similarly difficult summers for temperature operations, but lessons-learned and targeted improvements made a difference this year
- Many alternative operations considered
- No “ideal” condition for fish
- Discussion and brainstorming is needed to best prepare for these conditions in the future

SUCCESSSES

- Dissemination of ideas from FPAC
- Looking 30 to 60 days ahead
- Coordination of flow augmentation above Brownlee, and Hells Canyon releases

THOUGHTS FOR THE FUTURE

- Account for earlier refill
- Continue to improve refill transition
- Improve Corps’ official forecast
 - Study began October 7, 2021, 2-year expected duration