LTEMP Flow Experiments

Technical Work Group Meeting

October 30, 2024

LTEMP Experiments

"The overall approach attempts to strike a balance between identifying specific experiments and providing flexibility to implement those experiments when resource conditions are appropriate."

"...rather than proposing a prescriptive approach to experimentation, an adaptive management-based approach that is responsive and flexible will be used to adapt to changing environmental and resource conditions..."

--2016 LTEMP ROD, p. B-9

Potential LTEMP Flow Experiments

- **Sediment** (High Flow Experiments)
  - Spring HFE
  - Proactive spring HFE
  - Fall HFE
  - Fall HFE extended duration (up to 250 hr)

- **Aquatic Resource**
  - Macroinvertebrate Flow
  - Trout Management Flows
  - Low summer flows (2nd ten years of LTEMP)

- **LTEMP SEIS**
  - Smallmouth Bass Flows
  - HFE protocol revision

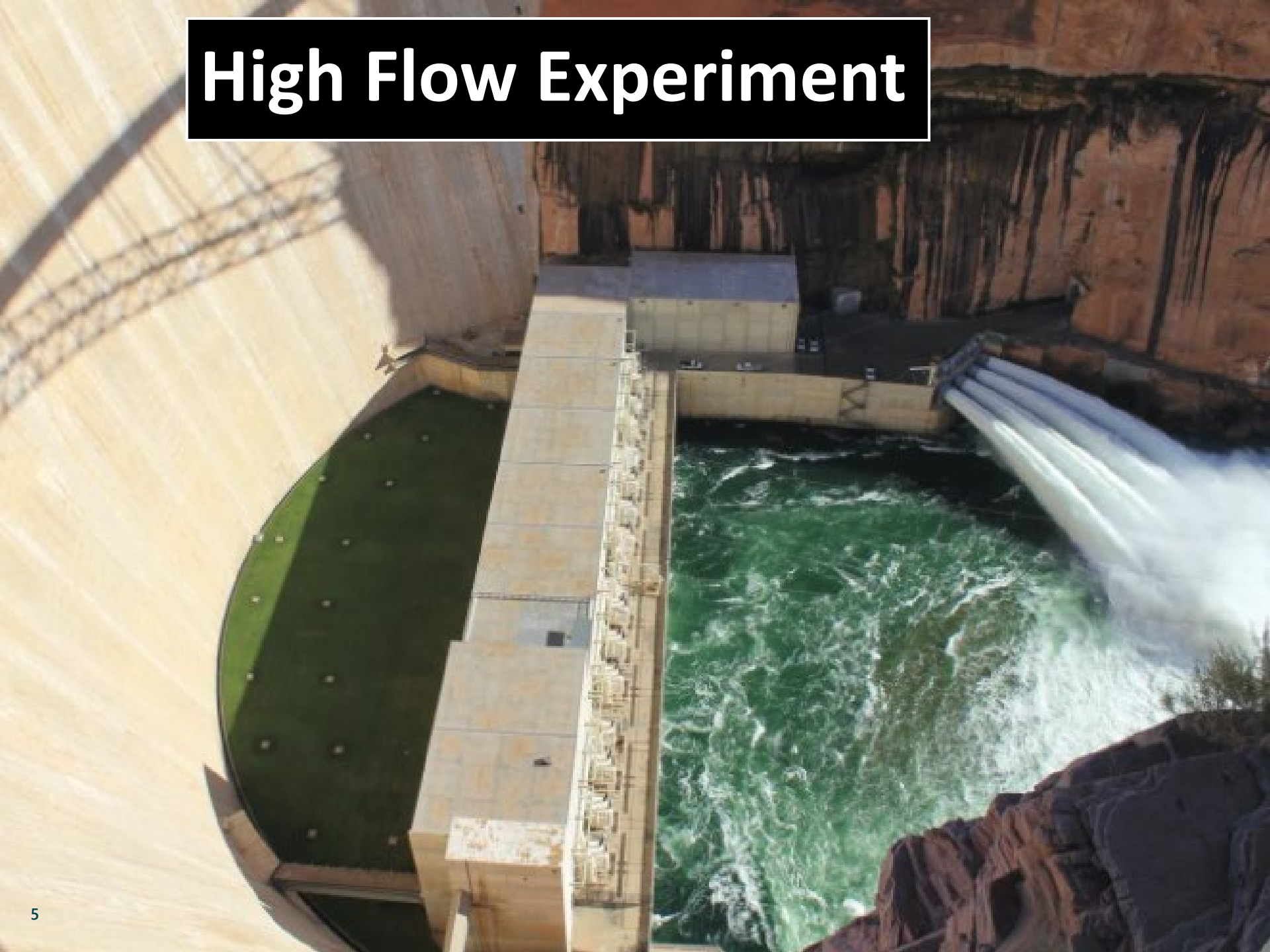
LTEMP Process for Experiments

- Annual Reporting and TWG meetings
- Notification and Consultation to Tribes & PA Parties
- Implementation / Planning Team Recommendation
- DOI decision

1.4 COMMUNICATION AND CONSULTATION PROCESS FOR ALTERNATIVE D

To determine whether conditions are suitable for implementing or discontinuing experimental treatments or management actions, the DOI will schedule implementation/planning meetings or calls with the DOI bureaus (USGS, NPS, FWS, BIA, and Reclamation), WAPA, AZGFD, and one liaison from each Basin State and from the UCRC, as needed or requested by the participants. The implementation/planning group will strive to develop a consensus recommendation to bring forth to the DOI regarding resource issues as detailed at the beginning of this section, as well as including WAPA's assessment of the status of the Basin Fund. The Secretary of the Interior will consider the consensus recommendations of the implementation/planning group, but retains sole discretion to decide how best to accomplish operations and experiments in any given year pursuant to the ROD and other binding obligations.

High Flow Experiment



LTEMP SEIS ROD Language

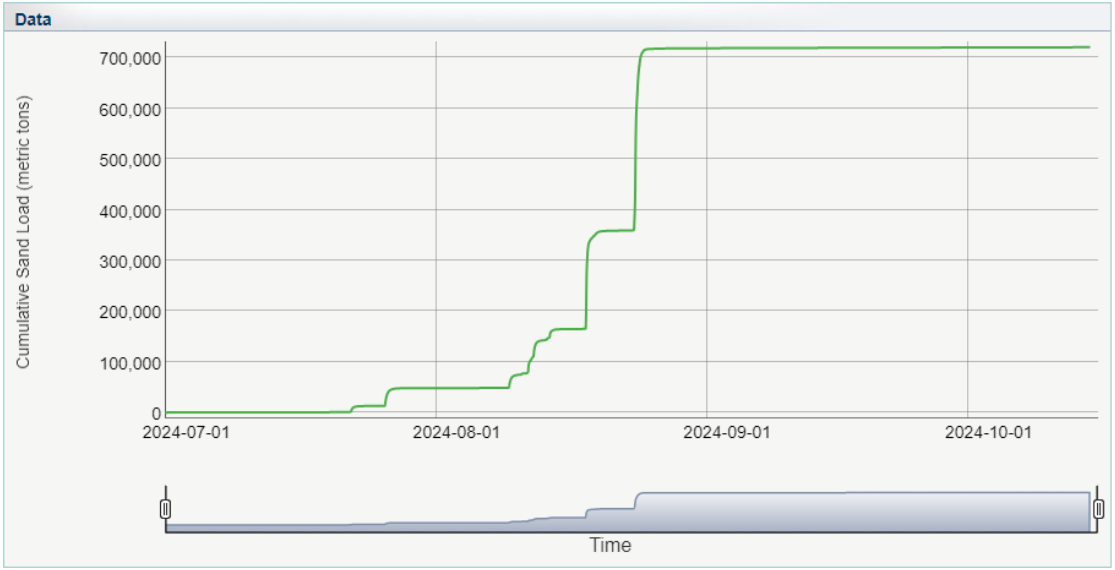
- "Planning for HFE releases will follow the planning and implementation process described in Section 7 of the 2016 LTEMP ROD, including close monitoring of all experimental treatments for unacceptable adverse impacts on important resources. Sand budget models will be run throughout the fall to determine whether sufficient sediment is available to conduct an HFE release. If sufficient sediment is available in the fall, the planning and implementation team may recommend conducting the fall HFE release or deferring implementation to the spring implementation window. Prior to the spring implementation window, the planning and implementation process will again be used to provide a recommendation on the duration, magnitude, and timing of the spring HFE release. If the HFE release is conducted, sediment accounting will restart on July 1. If, through the planning and implementation process, the recommendation is not to conduct an HFE release despite sufficient sediment, the remaining mass balance at the end of June will be carried into the new accounting period."

P&I Team Timeline

- August 27 – Reclamation/GCMRC initiated Modeling
  - GCMRC monitored forecasts and sediment inputs
  - Weekly meetings continued thru October
- September 6 – Initiated conversation with P&I Technical Team on early predictions
- September 24 – Updated the P&I Technical Team on Modeling.
  - Held discussion on a recommendation and assessment of resources.
- October 2 - Technical Team votes due
- October 9 – Tribal notification letters sent out.
- October 10 – Leadership Team notified of Technical Team recommendation and provided a brief Assessment of Resources Memo
- October 15 – Leadership Team Meeting – Consensus Recommendation

Paria River at Lees Ferry, AZ

- Date: 7/1 to 10/15
- Cumulative Sand Load: ~720k metric tons



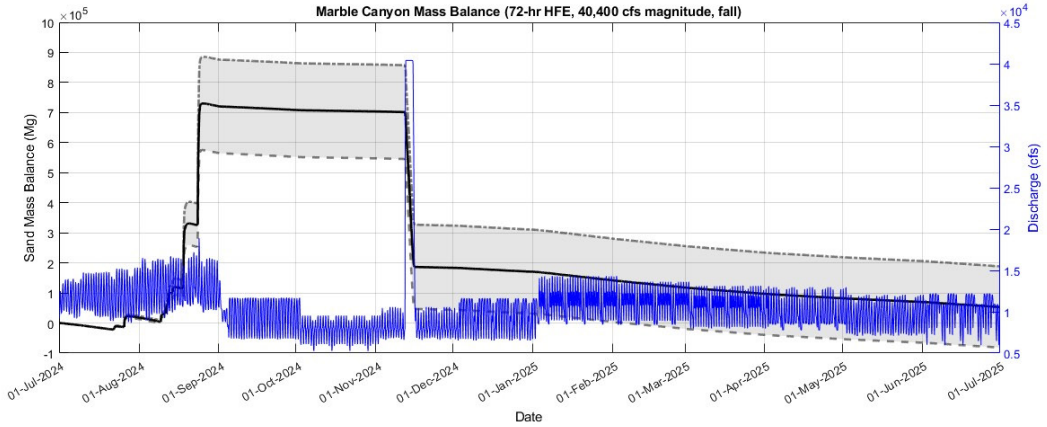
Fall Cumulative Sand Loads

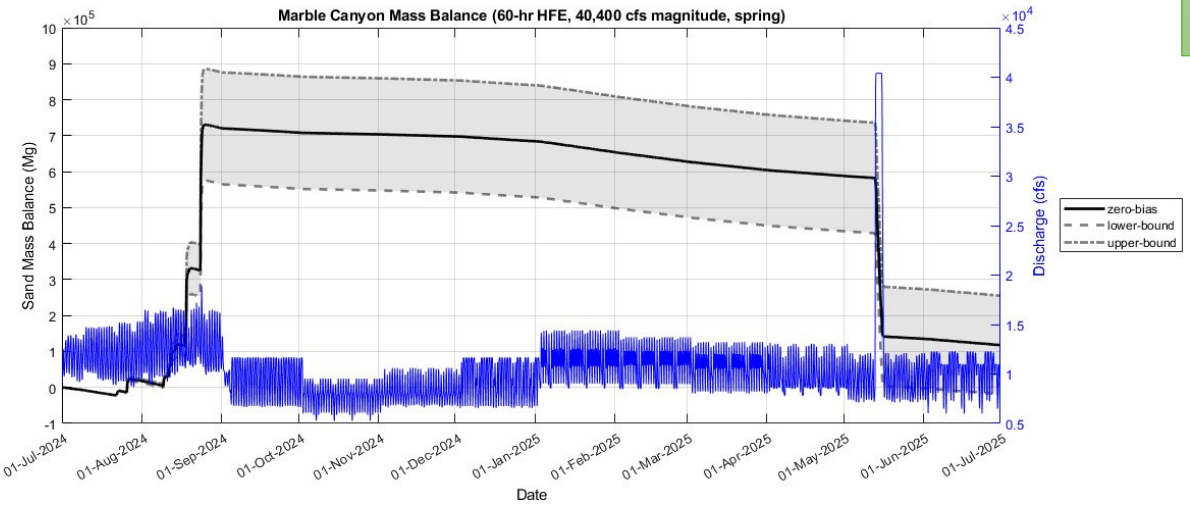
- 2024 (720,000 mt): As of Oct 15
- 2023 (32,000 mt): No (trigger not met)
- 2022 (1,600,000 mt): No (trigger met)
- 2021 (1,492,000 mt): No (trigger met)
- 2020 (6,385 mt): No (trigger not met)
- 2019 (52, 711 mt): No (trigger not met)
- 2018 (753,000 mt): Yes – 60 hrs. (Nov 5-8)
- 2017 (274,189 mt): No (trigger not met)
- 2016 (884,748 mt): Yes – 96 hrs. (Nov 7-12)
- 2015 (1,168,498 mt): No (trigger met)
- 2014 (1,213,000 mt): Yes – 96 hrs. (Nov 10-15)
- 2013 (1,849,192 mt): Yes – 96 hrs. (Nov 11-16)
- 2012 (690,000 mt): Yes – 96 hrs. (Nov 18-23)

* Credit to USGS for data

https://www.gcmrc.gov/discharge_qw_sediment/station/GCDAMP/09382000#

Modeling Fall HFE & Spring HFE



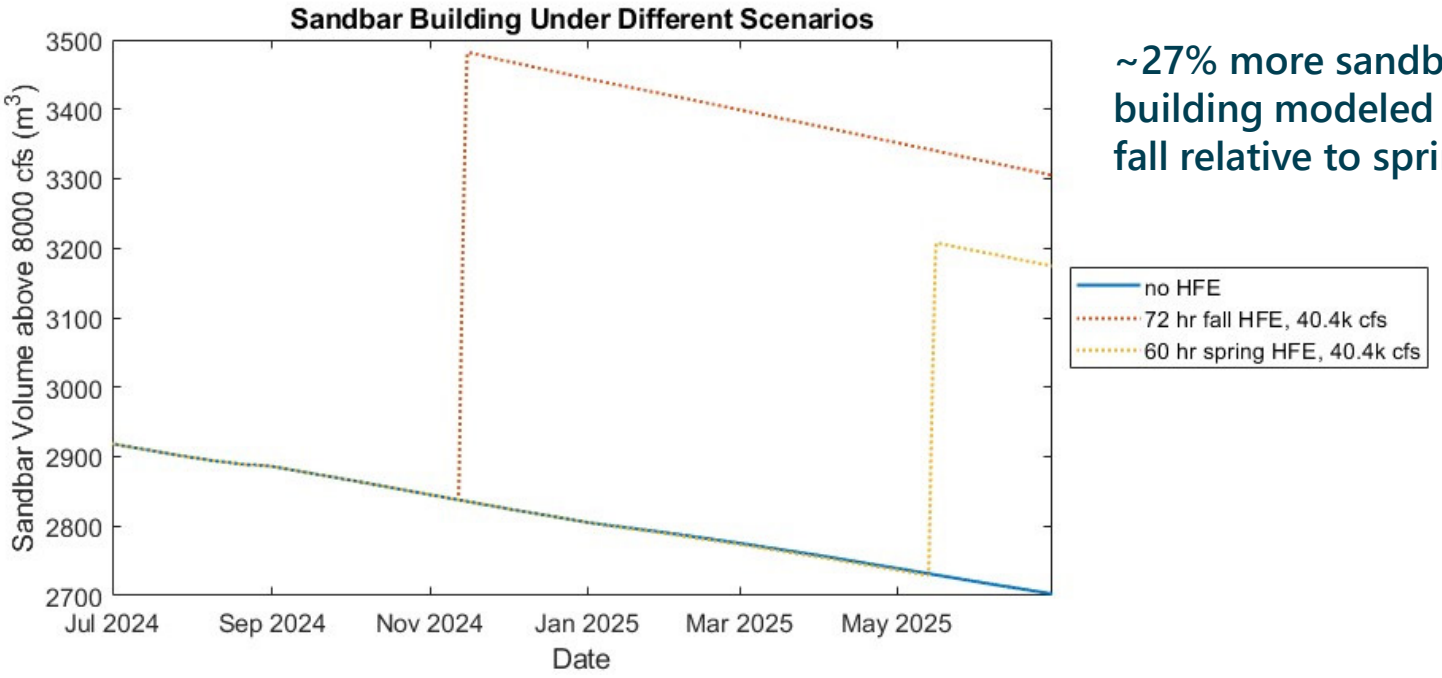


Modelling Assumptions

- HFE Magnitude (40,400 cfs)
  - Powerplant: 26,900 cfs (8 units)
  - Bypass: 13,500 cfs (4 ROW)
- No additional winter input
- HFE dates
  - Fall = Nov 5th
  - Spring = May 12th

Slides produced by A. Walker in coordination with USGS and are not to be cited.

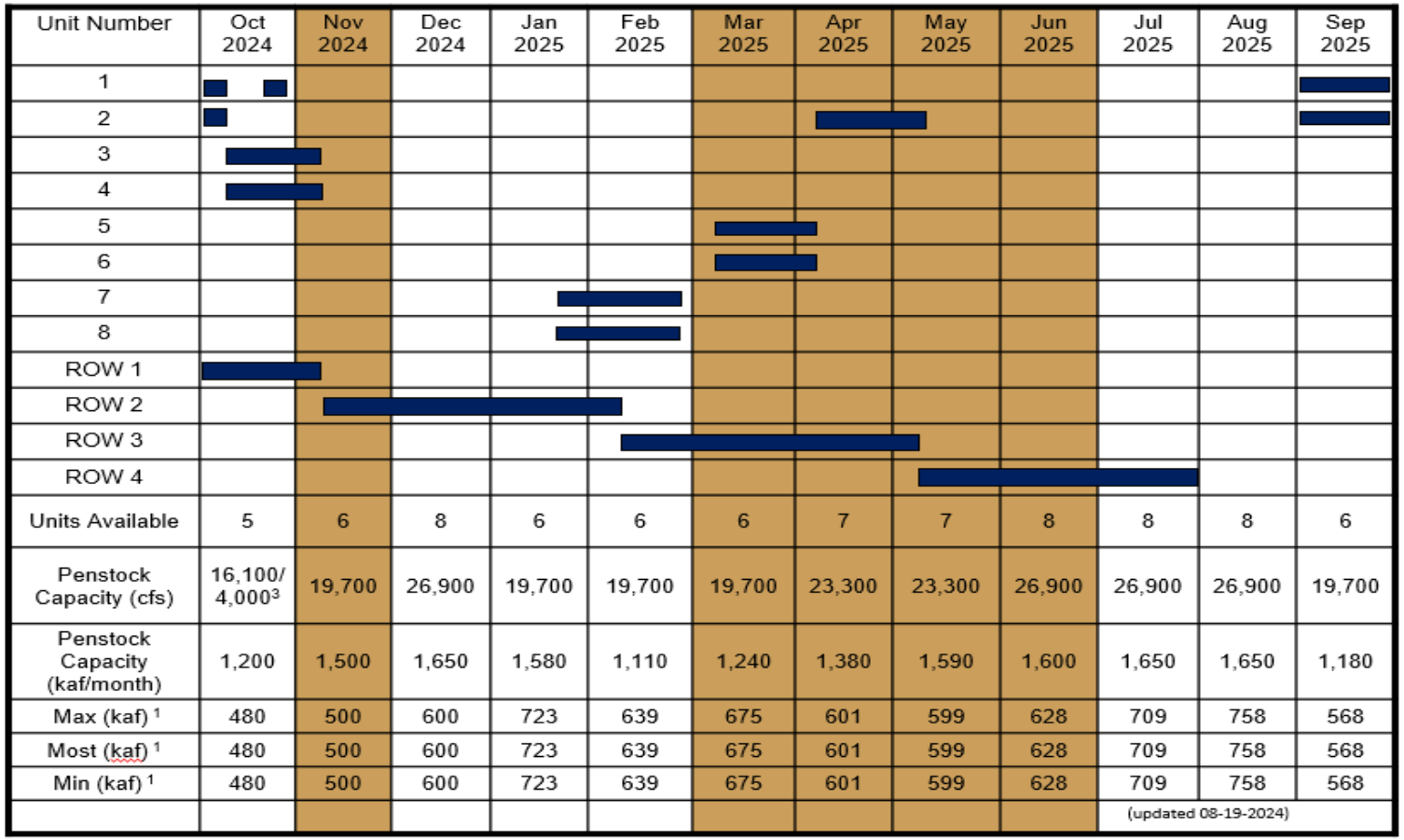
Start Date	Max Penstock Release (cfs)	Max ROW Release (cfs)	HFE Magnitude (cfs)	Duration (hrs)
11/4/2024	26,900	13,500	40,400	72
5/12/2025	26,900	13,500	40,400	60



~27% more sandbar building modeled in fall relative to spring

Slides produced by A. Walker in coordination with USGS and are not to be cited.

Glen Canyon Dam Power Plant Unit Outage Schedule for 2025



Unit Number	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025	
Units Available	5	6	8	6	6	6	7	7	8	8	8	6	
Penstock Capacity (cfs)	16,100/ 4,000[3]	19,700	26,900	19,700	19,700	19,700	23,300	23,300	26,900	26,900	26,900	19,700	AUG MOST[2]
Penstock Capacity (kaf/month)	1,200	1,500	1,650	1,580	1,110	1,240	1,380	1,590	1,600	1,650	1,650	1,180	AUG MOST
Max (kaf) [1]	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
Most (kaf) [1]	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
Min (kaf) [1]	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
										(updated 08-19-2024)			

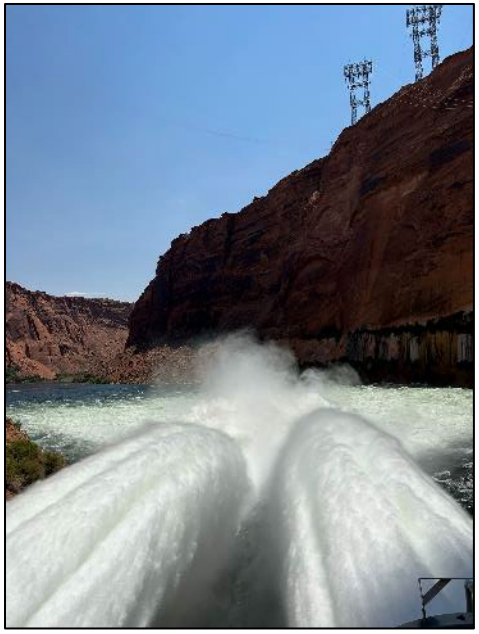
1 Projected release, based on August 2024 24MS for the minimum, most probable and the maximum probable 24-Month Study model runs.
2 Dependent upon availability to shift contingency regulation, which will increase capacity by 30-40MW (3%) at current efficiency.
3 Tailwater/Forebay inspection from October 21-24 will require one day at 4,000 cfs, and possibly two if necessary.

Assessment of Resources Fall vs. Spring

Archaeological and Cultural Resources	*Natural Processes (Flow Regime)*	*Natural Processes (Aquatic Food Base)*	*Humpback chub (Gila cypha) and Native Fish*	*Hydropower and Energy*
Recreational Experience	*Sediment*	*Rainbow Trout (Oncorhynchus mykiss) Fishery*	*Nonnative Invasive Species Green Sunfish (Lepomis cyanellus)*	*Nonnative Invasive Species Brown Trout (Salmo trutta)*
Nonnative Invasive Species Smallmouth Bass (Micropterus dolomieu)	*Nonnative Invasive Species Other Fishes*	*Riparian Vegetation*	*Water Delivery Monthly, Daily, and Hourly Releases*	*Water Quality*
Slough	*Dam Maintenance and Operations*	*Safety Considerations: Recreational Safety*	*Safety Considerations: Research and Monitoring*	

PI Tech Team Considerations

- Reasons for Fall HFE:
  - Greater potential for sandbar building
  - Potential for greater protection to Archaeological and Cultural Resources
  - Loss of fine sediment over the winter may have negative impacts on marsh/obligate wetland species



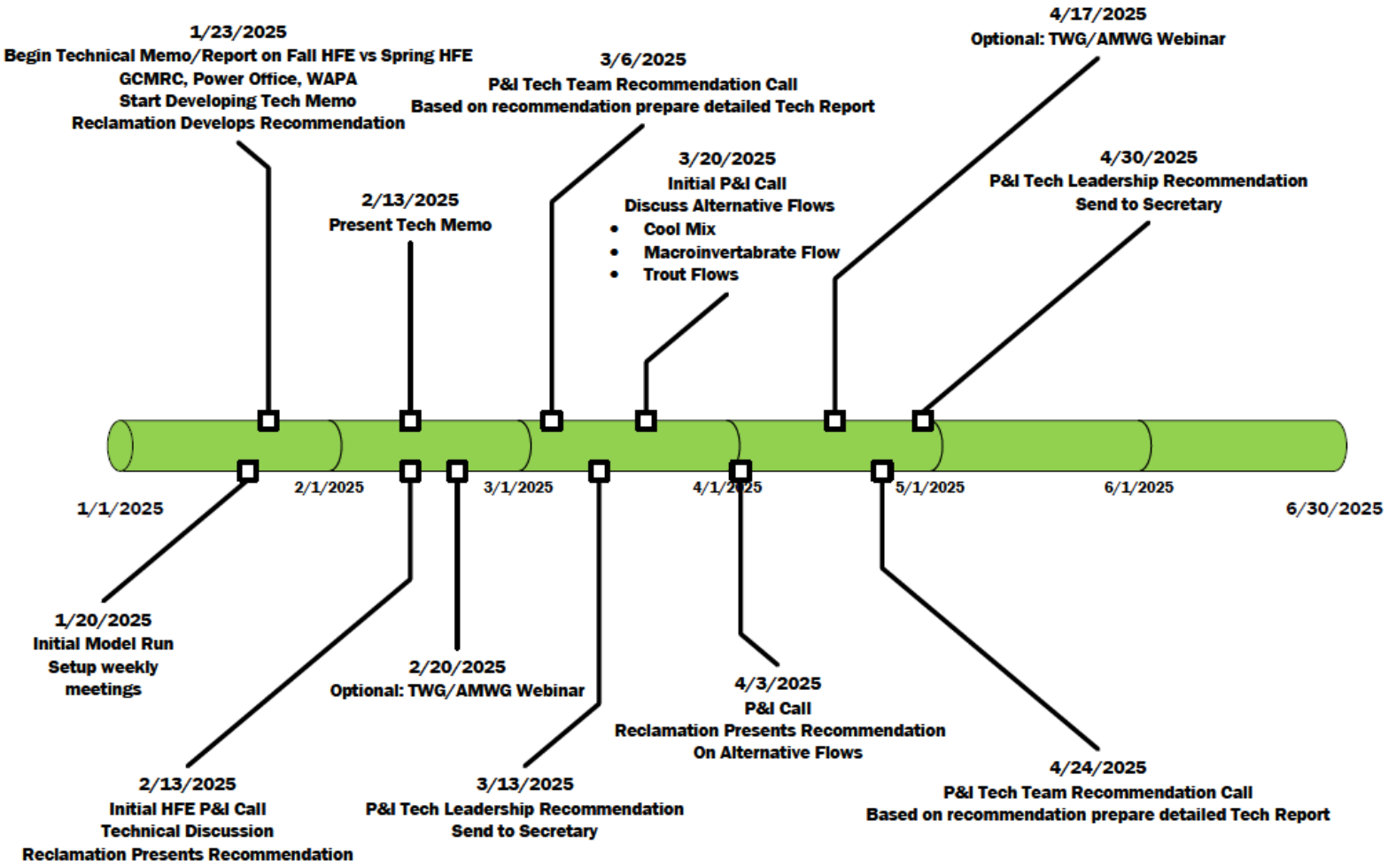
- Reasons for Spring HFE:
  - Spring HFE may mimic a more historically-timed peak flow
  - Interaction with Smallmouth Bass flows
    - Fall off-ramps have not yet been established and could overlap with a Fall HFE
    - It may make it harder to determine the effects of the Smallmouth Bass Flows
  - Dam Maintenance and Operations
    - Allows Reclamation to assess the river outlet works after running a summer of Smallmouth Bass flows
    - Allow more time to prepare for an HFE
  - Hydropower
    - Potential to reduce costs by “borrowing” water from earlier months (Ex. March and April)
  - Currently only one Spring HFE (2023) has been conducted since the 2016 LTEMP was implemented
    - Modeling predicted that a Spring HFE would be conducted 26% of the time
    - Increase our understanding of the effects of a Spring HFE on the River Resources

PI Leadership Team Consensus Recommendation (Oct 15, 2024)

"The Leadership Team recommends to not conduct a Fall HFE and that the Planning & Implementation Team reconvene in Spring 2025 to review and provide a recommendation for a Spring High-Flow Experiment using the sediment accounting window from July 1, 2024- June 30, 2025.

Because the trigger for an HFE was met in the Fall of 2024, and the Technical Team's preference is to defer a recommendation to the Spring, the Glen Canyon Dam Adaptive Management Program will plan as if a Spring HFE will occur to allow for any preparations to be made. This includes consideration of adjustments to monthly release volumes prior to the Spring HFE, allocation of monitoring resources, adjustments to maintenance schedules, and other resource considerations."

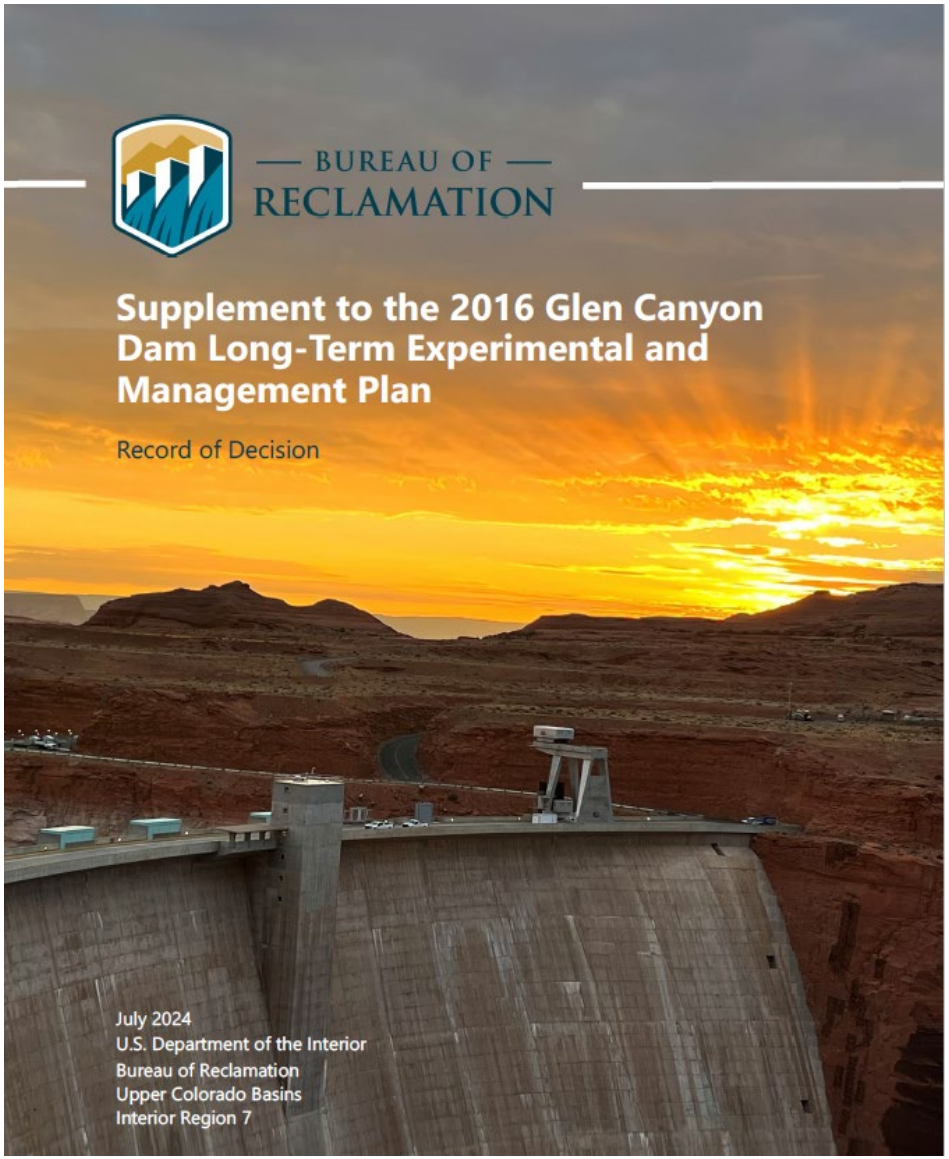
Spring P&I Tentative Timeline 2025



Smallmouth Bass Flows

Record of Decision

- Operational Flows (2024-2027)
  - Cool mix is the preferred alternative for 2024
  - Cool Mix Alternative and the other alternatives possible in 2025-2027 (if needed).



Smallmouth Bass Flows

2024

For 2024, based on the likelihood of needing to respond to increasing river temperatures, this ROD provides guidance for smallmouth bass flow operations. A cool mix would occur when the average daily temperature at river mile 61 exceeds 15.5°C (60°F) for 3 consecutive days. The temperature data would be determined using real-time stream gage data at the dam and at Lees Ferry and existing downstream models (such as Dibble et al. 2021). The Cool Mix Alternative would be implemented until the mean daily water temperature (without bypass) falls below 15.5°C (60°F) at river mile 61. Temperature and biological monitoring would occur throughout this process to assess effectiveness. Gage data near river mile 61 would be accessed monthly during implementation to confirm temperature targets are being met.

This ROD provides initial notice for the potential implementation of smallmouth bass flows in 2024 if the appropriate temperature triggers are met. As of the date of this ROD, data indicates that temperature thresholds cold be reached in July. As described in Section 1.3 of the 2024 LTEMP SEIS, there is a pressing need to address the ecological threat that smallmouth bass pose on the Colorado River downstream of Glen Canyon Dam. Potential smallmouth bass flows have been assessed in NEPA processes since May 2022, including participation by cooperating agencies. If implemented in 2024, the planning and implementation process will be used to assess monitoring results, including effectiveness of experimental flows and potential off-ramps. The planning and implementation process will be used for all aspects of smallmouth bass flow consideration in 2025-2027, as described in Section 2.3 of the 2024 LTEMP SEIS.

Smallmouth Bass Flows

B. Common Elements of Action Alternatives

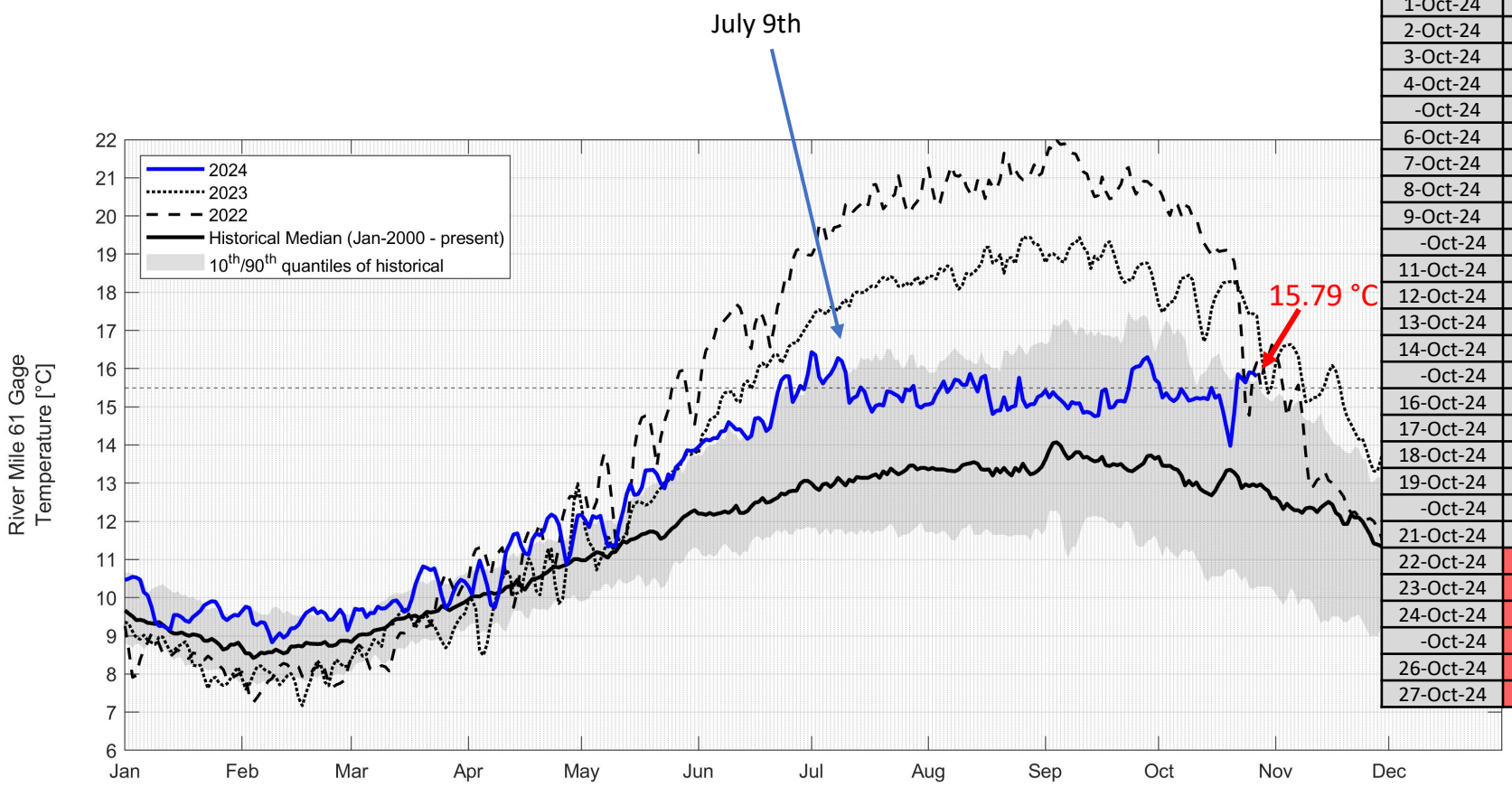
Changes in Release Volumes

All non-flow spike alternatives could result in minor changes to total daily release volumes, depending on the dam's operations as coordinated by Reclamation and WAPA. The flow spike alternatives could result in shifts in total daily release volumes, but they would not alter monthly release volumes.

Temperatures

The cold-water alternatives have been modeled for cooling effects at river miles 15 and 61. Modeling these locations provides a representation of potential effects on resources at different river reaches. The trigger for implementation would be when observed temperatures exceed 15.5°C (60°F) for 3 consecutive days. Currently real time temperature data exists below Glen Canyon Dam and at Lees Ferry (river mile 0). There are additional gauges at river mile 30 and river mile 61, however these gages do not provide real time data, but can be downloaded remotely. For locations that do not have real time temperature data, the best available models would be used to determine trigger timing. The trigger location for the 15.5°C (60°F) threshold could be anywhere upstream of river mile 61, depending on the smallmouth bass distribution and size class, frequency and efficacy of sampling, or other considerations as determined through the planning and implementation process. Smallmouth bass distribution upstream of river mile 61 would be assessed based on the best available information and considered in the planning and implementation process, with the understanding that smallmouth bass sampling is limited below Lees Ferry and can have limited efficacy in assessing the locations of smaller size fish and of fish located in certain riverine environments where sampling is difficult. Smallmouth bass distribution upstream of river mile 61 will be assessed based on the best available information and considered in the planning and implementation process, with the

RM61 Observations - Temperature



Date	RM61 Daily Avg. Temp
1-Oct-24	15.63
2-Oct-24	15.24
3-Oct-24	15.36
4-Oct-24	15.22
-Oct-24	15.15
6-Oct-24	15.23
7-Oct-24	15.47
8-Oct-24	15.32
9-Oct-24	15.16
-Oct-24	15.19
11-Oct-24	15.23
12-Oct-24	15.21
13-Oct-24	15.23
14-Oct-24	15.20
-Oct-24	15.50
16-Oct-24	15.24
17-Oct-24	15.30
18-Oct-24	14.91
19-Oct-24	14.44
-Oct-24	13.98
21-Oct-24	14.82
22-Oct-24	15.85
23-Oct-24	15.75
24-Oct-24	15.64
-Oct-24	15.90
26-Oct-24	15.89
27-Oct-24	15.79

* Credit to USGS for data

14-day weather forecast

Hydropower Optimization Model (WAPA)

Proposed Weekly Hydrograph(s)

Process Based River Temperature Model (USBR)

Forecasted River Temperatures

Operational Decision

Penstock & Bypass Release Temperatures

River Warming Lookup Table

Temperature Targets

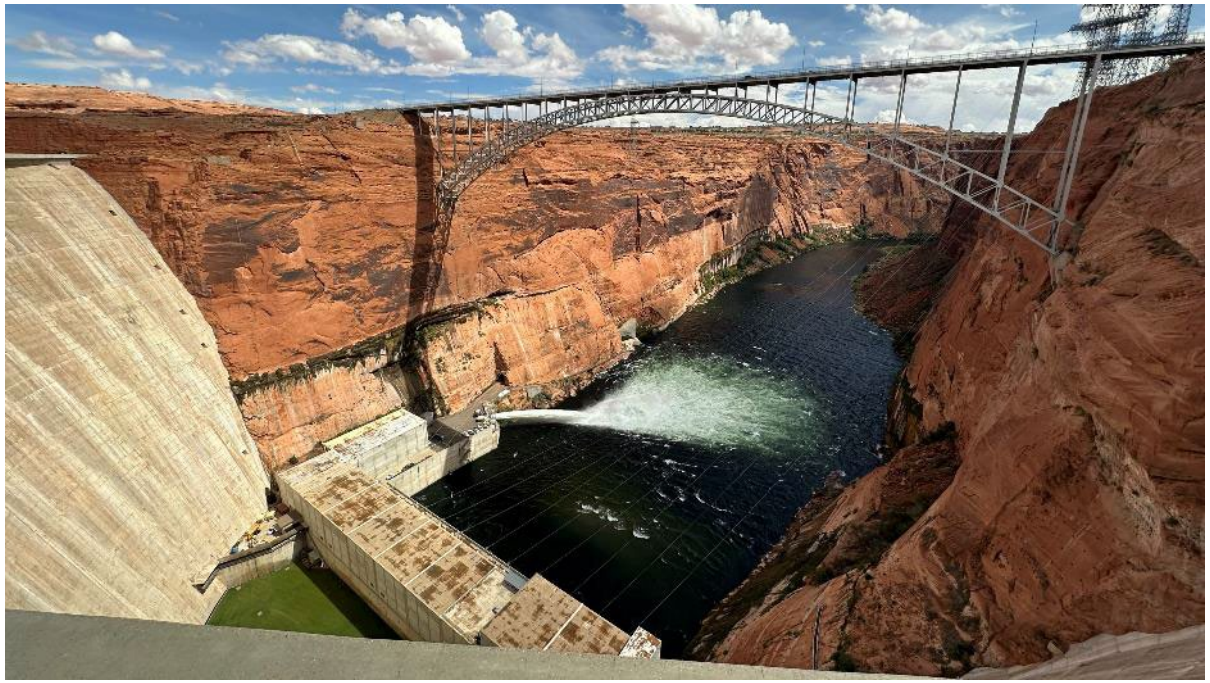
Monthly Release Volume

Logistical Considerations
(adjust flows up to 4 times per day)

Biological Considerations
(less than 4-degree swing in a day)

Release Restrictions
(must follow operating rules)

Implementation Results



Hour System Time (MST)	Bypass Release (cfs)	Penstock Release (cfs)	Total Release (cfs)
0:00	5,000	4,480	9,480
1:00	5,000	4,480	9,480
2:00	5,000	4,480	9,480
3:00	5,000	4,480	9,480
4:00	5,000	4,480	9,480
5:00	5,000	4,480	9,480
6:00	5,000	4,480	9,480
7:00	5,000	4,480	9,480
8:00	5,000	4,480	9,480
9:00	5,000	4,480	9,480
10:00	5,000	4,480	9,480
11:00	5,000	4,480	9,480
12:00	5,000	6,086	11,086
13:00	5,000	10,086	15,086
14:00	0	15,086	15,086
15:00	0	15,086	15,086
16:00	0	15,086	15,086
17:00	0	15,086	15,086
18:00	0	15,086	15,086
19:00	0	15,086	15,086
20:00	0	15,08	6
21:00	0	14,4	
22:00	5,000	6,9	
23:00	5,000	4,480	,480

Pre-Execution data from ByPass Solver, Dollar Value Comparison (ARGUS and MCG)

This is our estimate comparison for Optimized ByPass Purchased Power expense

				Optimized Bypass Estimated Costs		Post-hoc Analysis
"Week"	Dates	Number of Days	Purchased (MW)	Argus Forward Curve* ($)	Median of Price Vectors ($)	MCG Weighted Avg hourly# ($)
1	Tue Jul 9 - Sat Jul 13	5	13,701	1,031,806	624,550	794,926
2	Sun Jul 14 - Fri Jul 19	6	18,855	1,224,129	822,112	912,171
3	Sat Jul 20 - Fri Jul 26	7	20,698	1,325,943	899,064	1,033,776
4	Sat Jul 27 - Fri Aug 2	7	24,171	1,675,267	1,076,833	1,285,250
5	Sat Aug 3 - Fri Aug 9	7	21,038	1,584,859	971,140	1,097,984
6	Sat Aug 10 - Wed Aug 14	5	15,300	1,076,115	696,585	765,375
7	Thu Aug 15 - Fri Aug 23	9	35,329	2,522,482	1,613,214	1,647,206
8	Sat Aug 24 - Fri Aug 30	7	24,315	1,673,846	1,102,399	1,159,515
9	Sat Aug 31 - Fri Sep 6	7	28,707	1,377,465	1,048,576	1,520,643
10	Sat Sep 7 - Fri Sep 13	7	28,723	1,372,172	962,850	1,533,172
11	Sat Sep 14 - Fri Sep 20	7	22,788	1,069,233	744,588	1,219,986
12	Sat Sep 21 - Fri Sep 27	7	19,106	919,363	647,060	1,038,945
13	Sat Sep 28 - Fri Oct 4	7	22,616	857,479	689,586	1,205,027
14	Sat Oct 5 - Fri Oct 11	7	20,404	623,746	592,707	1,126,328
15	Sat Oct 12 - Fri Oct 18	7	18,298	557,152	527,643	974,869
16	Sat Oct 19 - Fri Oct 25	7	12,435	374,306	373,836	670,650
17	Sat Oct 26 - Fri Nov 1	7	7,557	231,015	229,095	
	Est. Total through week 16:		346,483	$ 19,265,363	$ 13,392,745	$ 17,985,823
	Est. Total through Week 17:		354,040	$ 19,496,377	$ 13,621,840	Pending

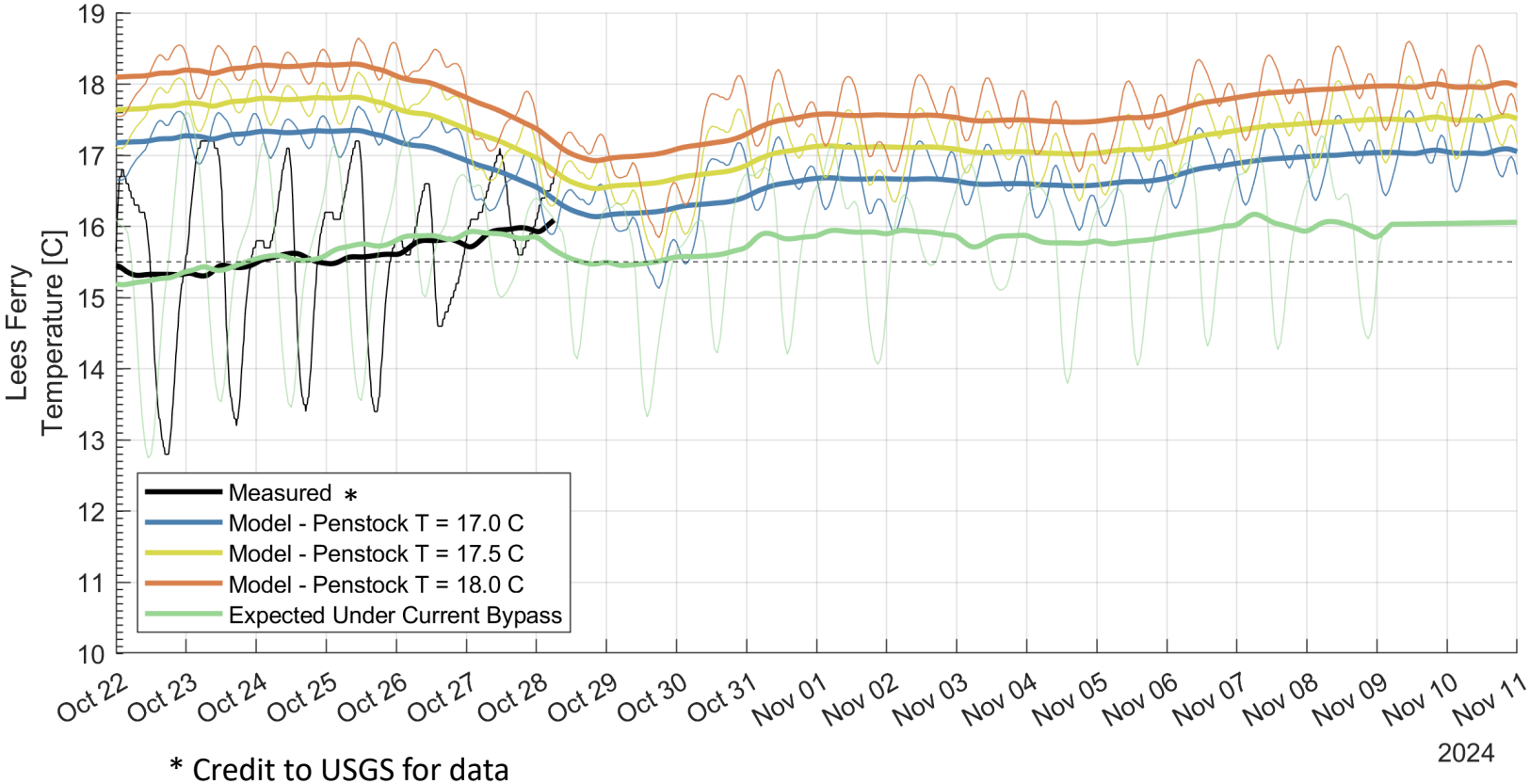
*Argus Forward Curve (FWD Curve) based on the Palo Verde Index

#Preliminary MCG Values are weighted average of prescheduled and real-time energy transaction prices

Western Area Power Administration

Lees Ferry Temperature (Ran Oct 28)

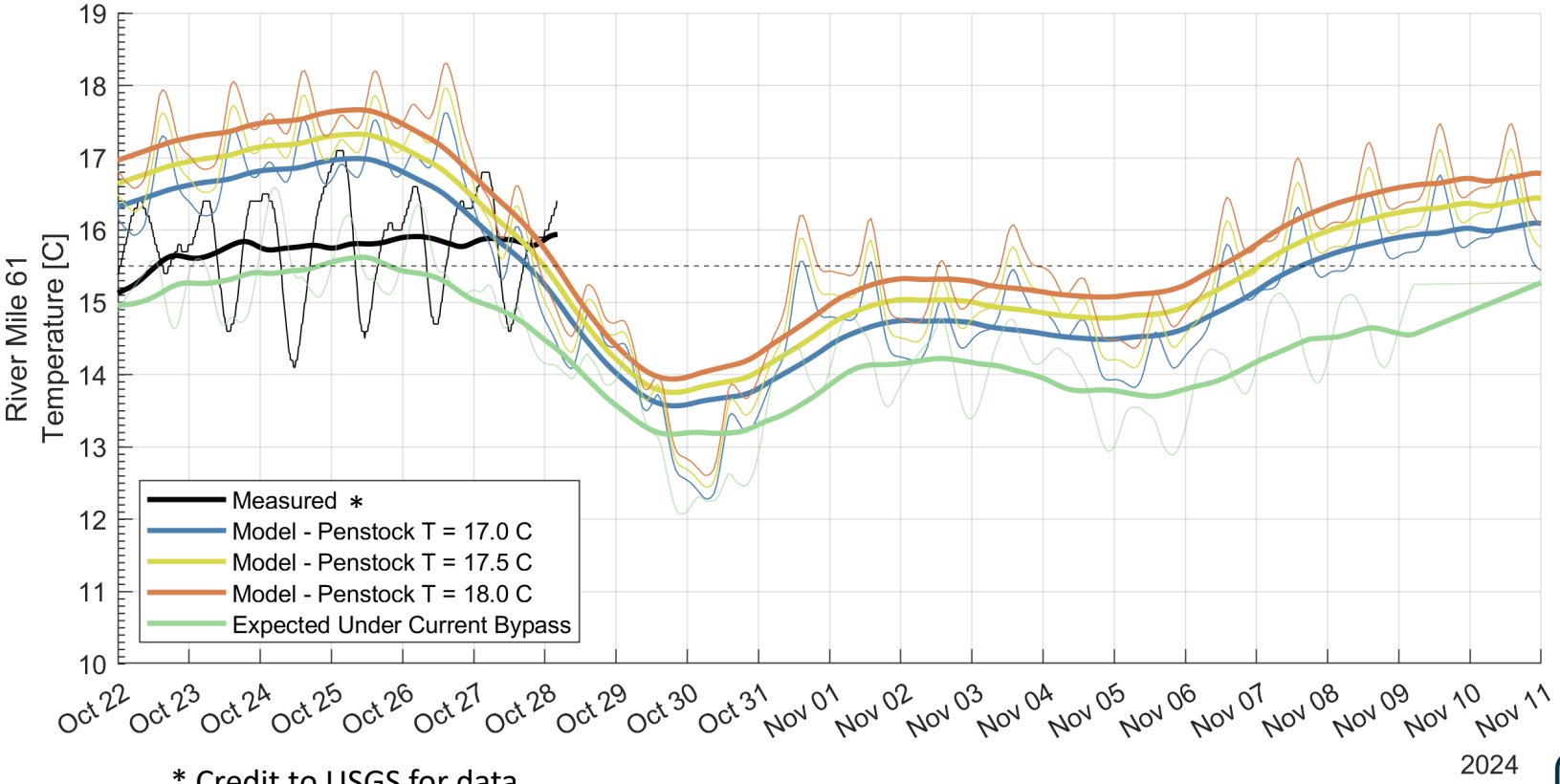
Mihalevich et al
1D Model



* Credit to USGS for data

River Mile 61 Temperature (Ran Oct 28)

Mihalevich et al
1D Model



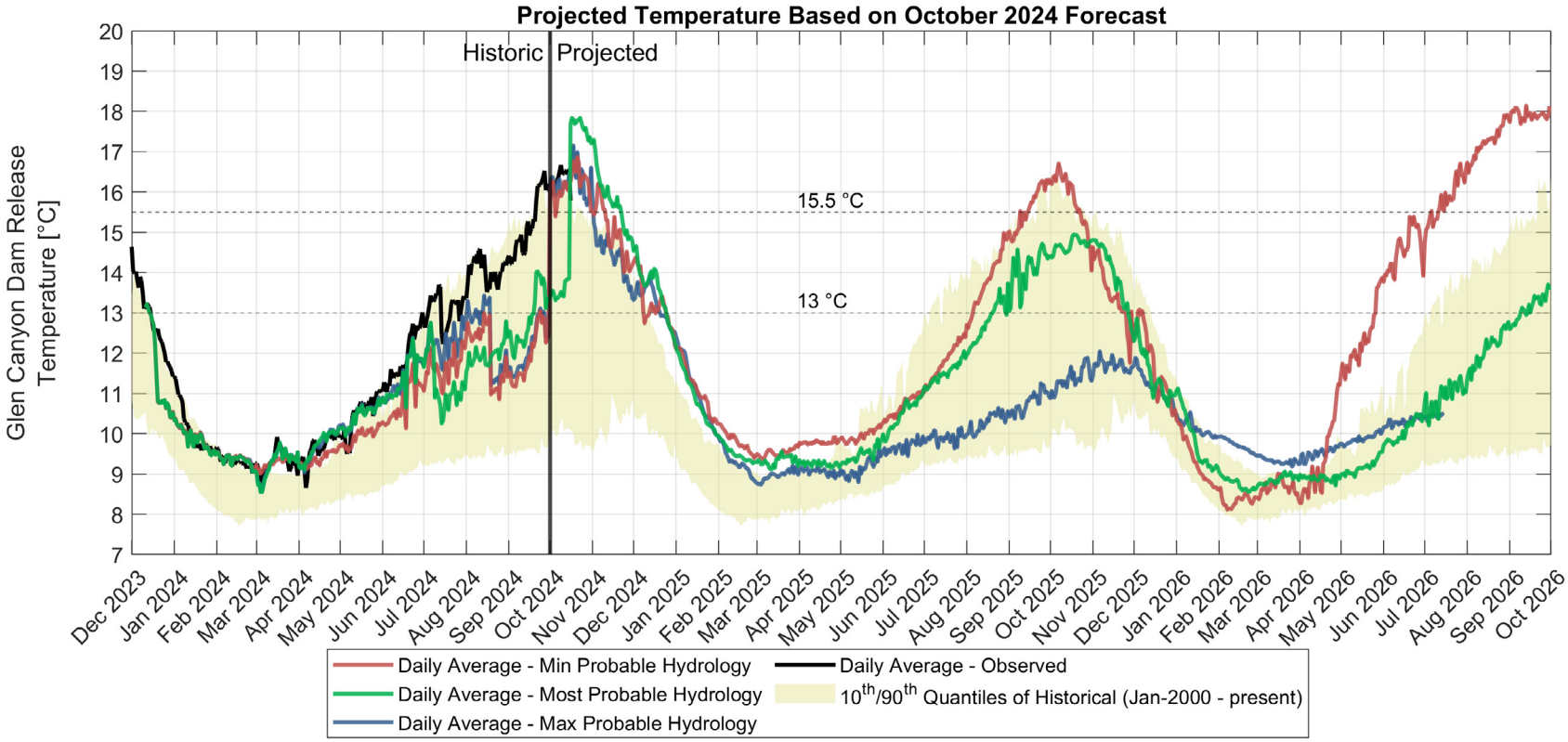
* Credit to USGS for data

Tentative Timeline

- This week: a group of experts from GCMRC, FWS, NPS, WAPA, AZGFD and Reclamation have been asked to assess biological risk of off ramping given current conditions.
- End of this week: a summary of the assessment compiled for the PI teams consideration
- Early next week: PI team will review assessment and be prepared to discuss and make a recommendation during PI call (Nov 5th).
- Nov 6th: Reclamation will decide how to proceed based on PI recommendation and expert panel feedback and will coordinate with WAPA

Long Term Forecasting/Planning For Next Year

CE-QUAL-W2 Modeled Temperature (October 24MS)



Questions?