BUREAU OF RECLAMATION

Glen Canyon Dam Air Injection Testing September 2023

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Background: Low DO in Glen Canyon

- Dissolved Oxygen concentrations:
  - 2.4 mg/L September 14, 2022
  - 2.9 mg/L September 19, 2023
- Low levels stress fish and cause mortality
- Reclamation and the GCDAMP is concerned about effects in Glen Canyon

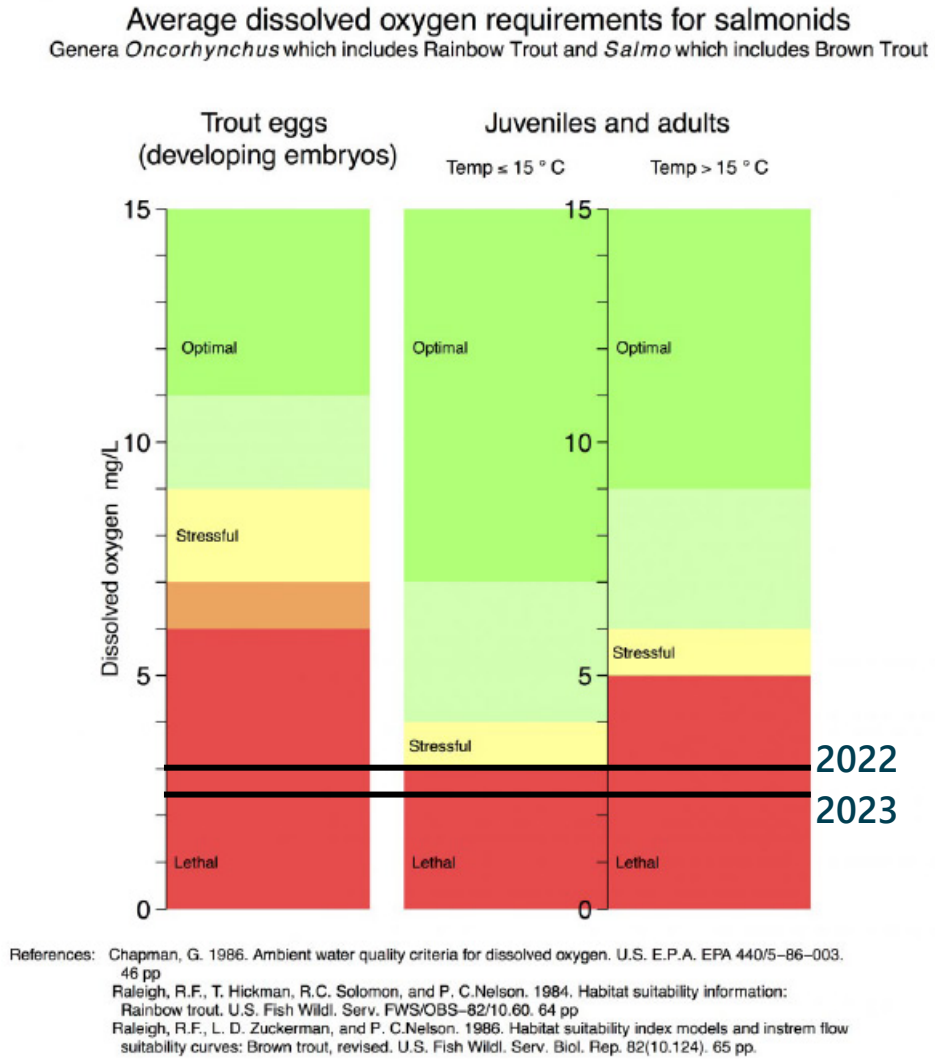
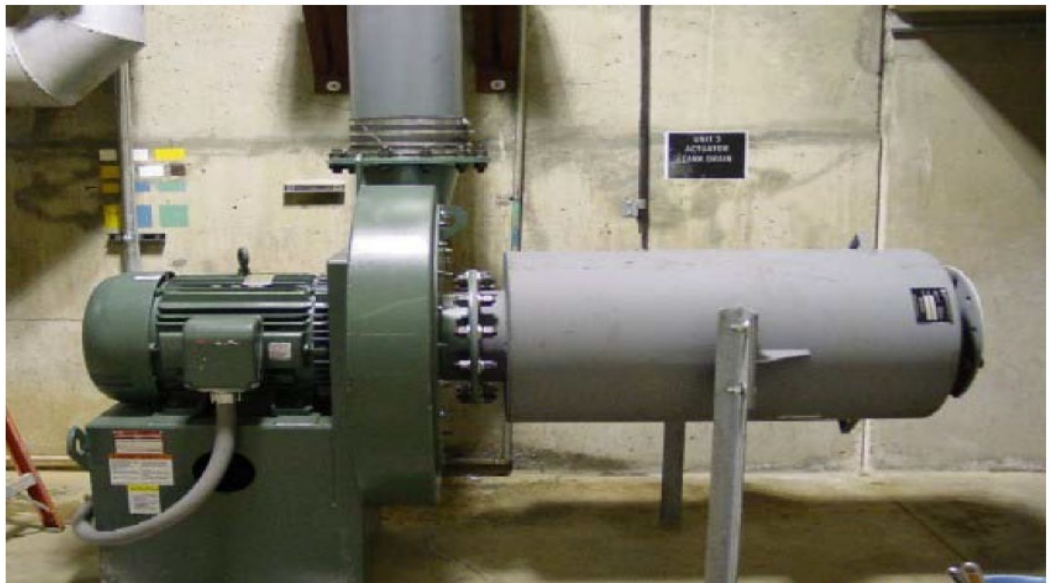


Image courtesy of Bridget Deemer and Ted Kennedy

Treatment: Air Injection



Turbine air injection blower at Canyon Ferry Powerplant

- Augment DO via air injected into draft tubes as it passes through GCD
- Successfully implemented by Reclamation at Canyon Ferry Dam, MT
  - Increased mean downstream DO from 4.6 to 6.0 mg/L
- GCD has service air system that is plumbed to draft tubes
  - No physical modifications needed for testing

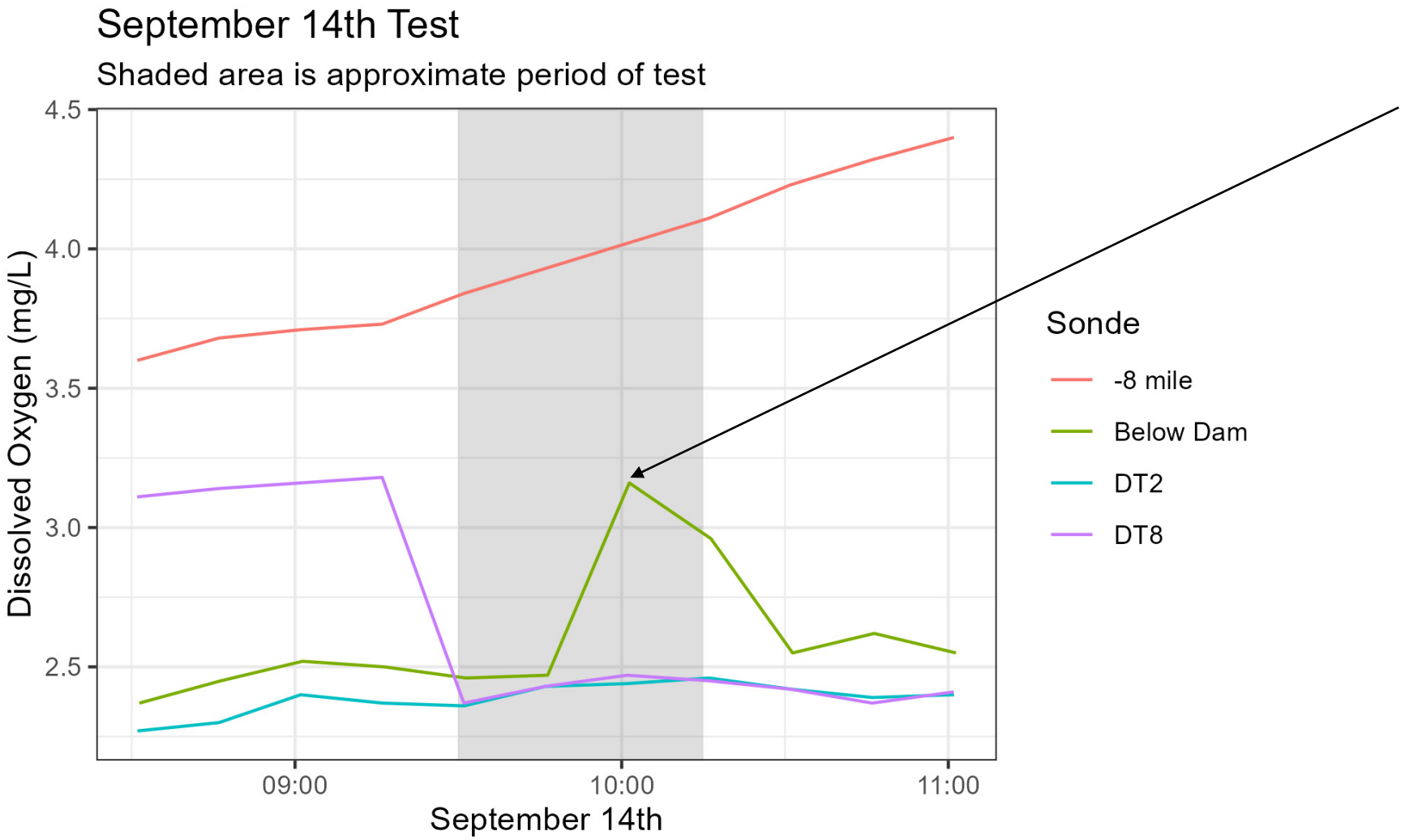
Air Injection Testing

- Coordinated with GCD Operations in fall 2023 to test existing service air system for draft tube injection.
- Two short experiments
  - September 14, 9:30-10:15 am
  - September 18, 8:00-9:00 am
- Injected air into a single draft tube at a rate of ~1700 CFM
- Possible changes in DO monitored by sondes located:
  - Draft Tube 2 (baseline)
  - Draft Tube 8 (experiment)
  - Below Dam (USGS 09379901)
  - -8 mile in Glen Canyon

Testing Goals:

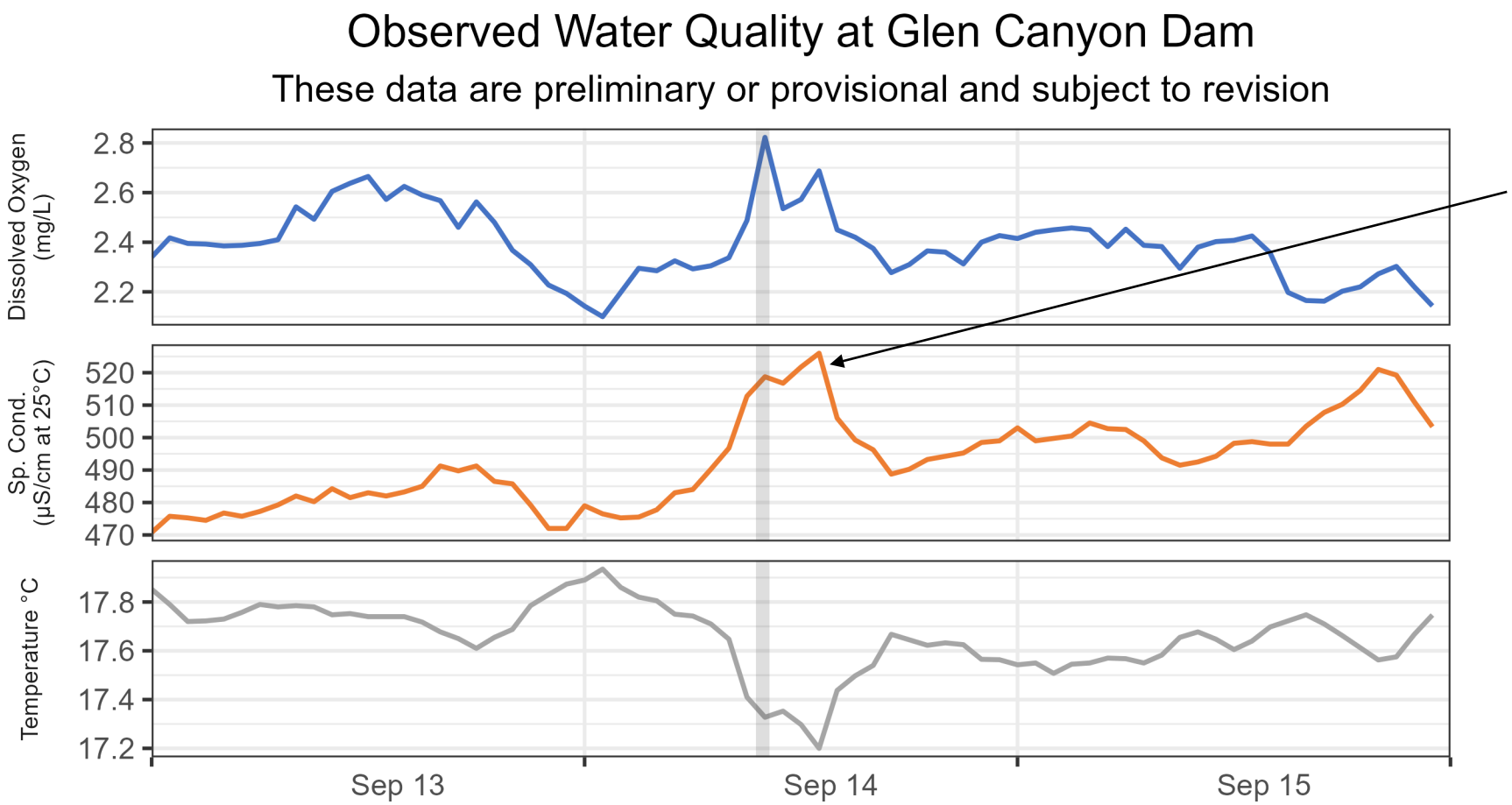
- Does this method measurably increase DO?

Results – September 14th 9:30-10:15



Minor increase in DO immediately below dam during test period, but also an increase in Draft Tube 8 (DT8) preceding start of test.

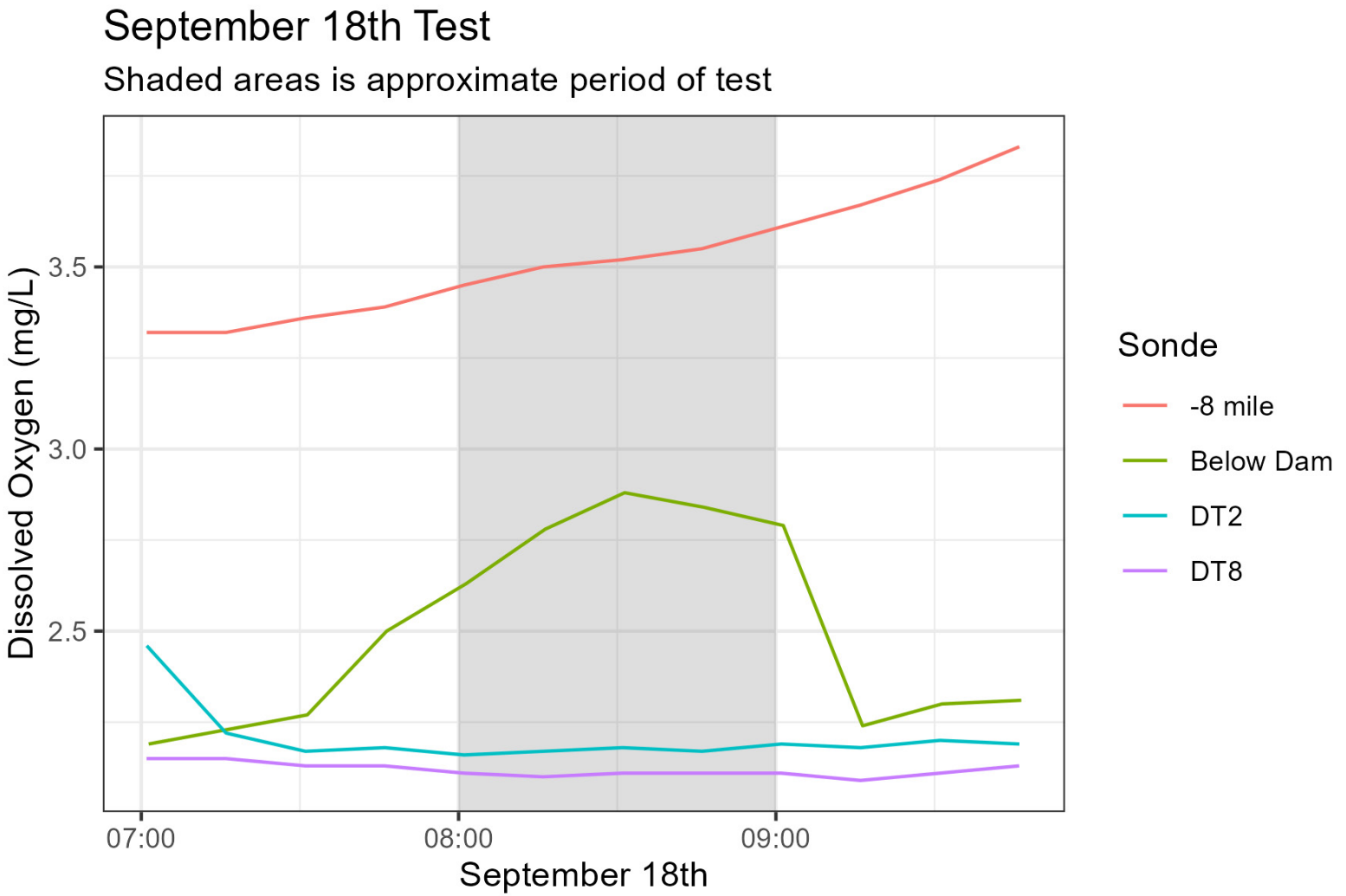
Results – September 14th 9:30-10:15



At time of test, observed a concurrent increase in Specific Conductance and decrease in Temperature

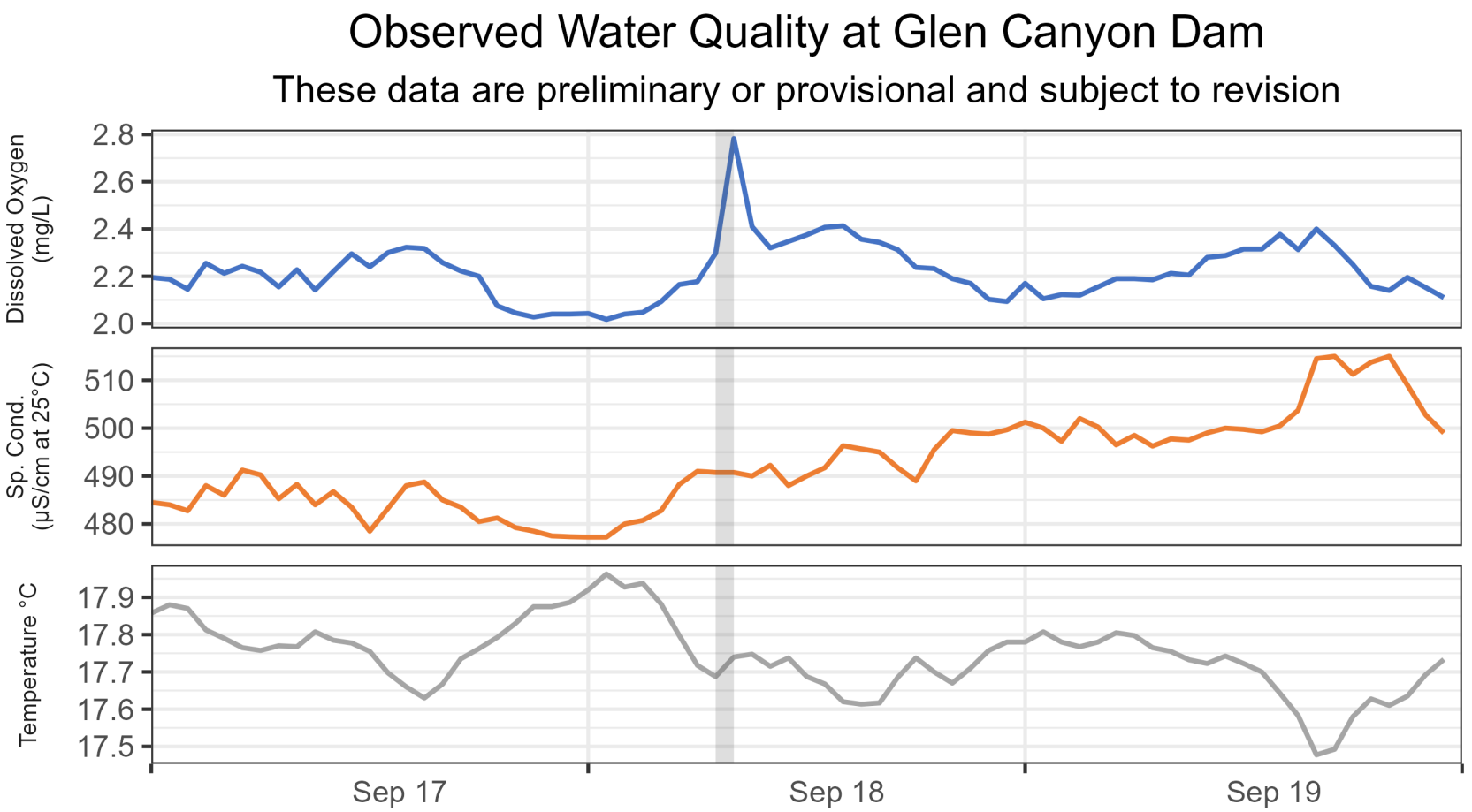
Due to this uncertainty, scheduled a second test for Sept. 18th

Results – September 18th 8:00-9:00



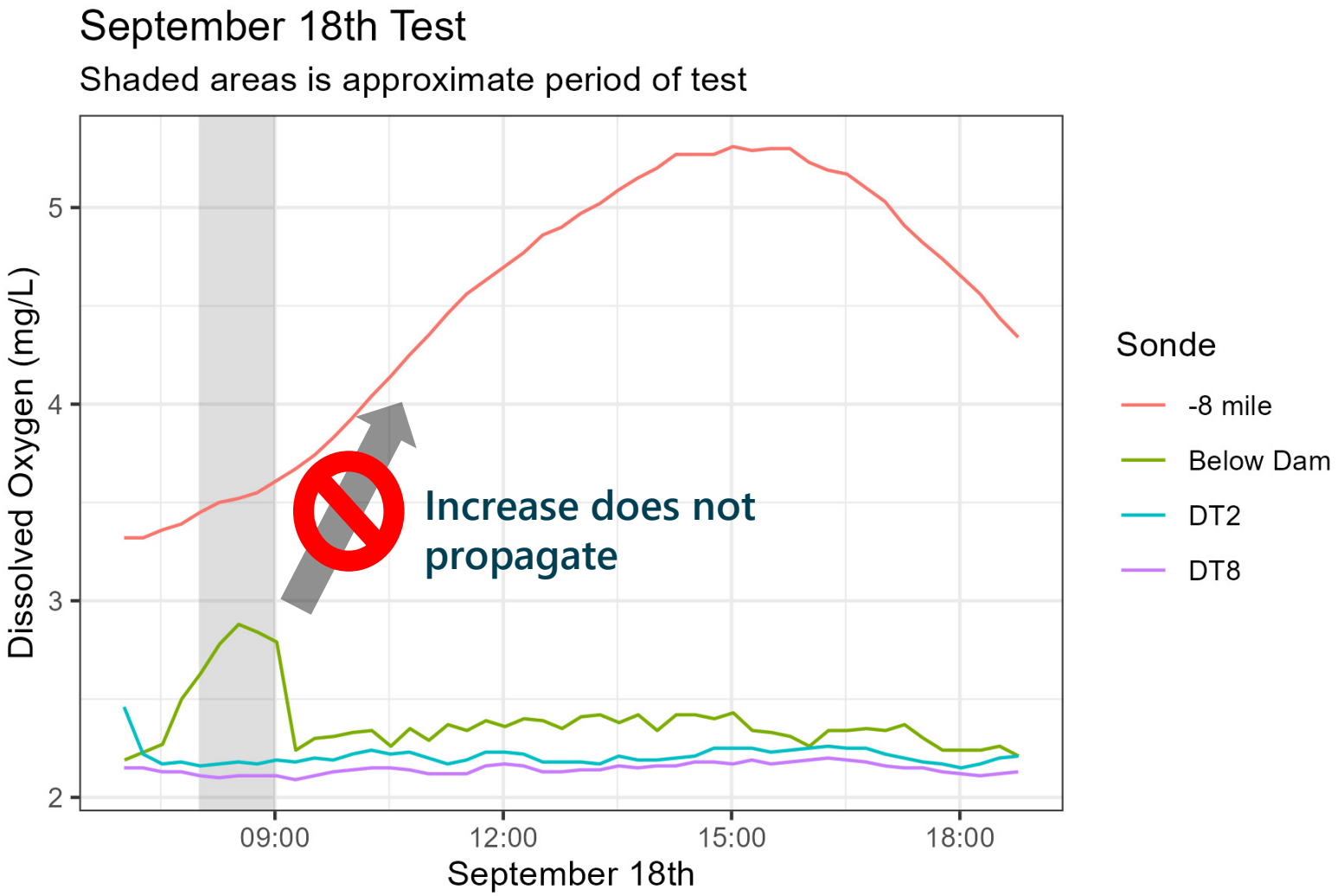
For this test, we see an increase above the baseline DO measured in DT2 and DT8 during the period of testing.

Results – September 18th 8:00-9:00



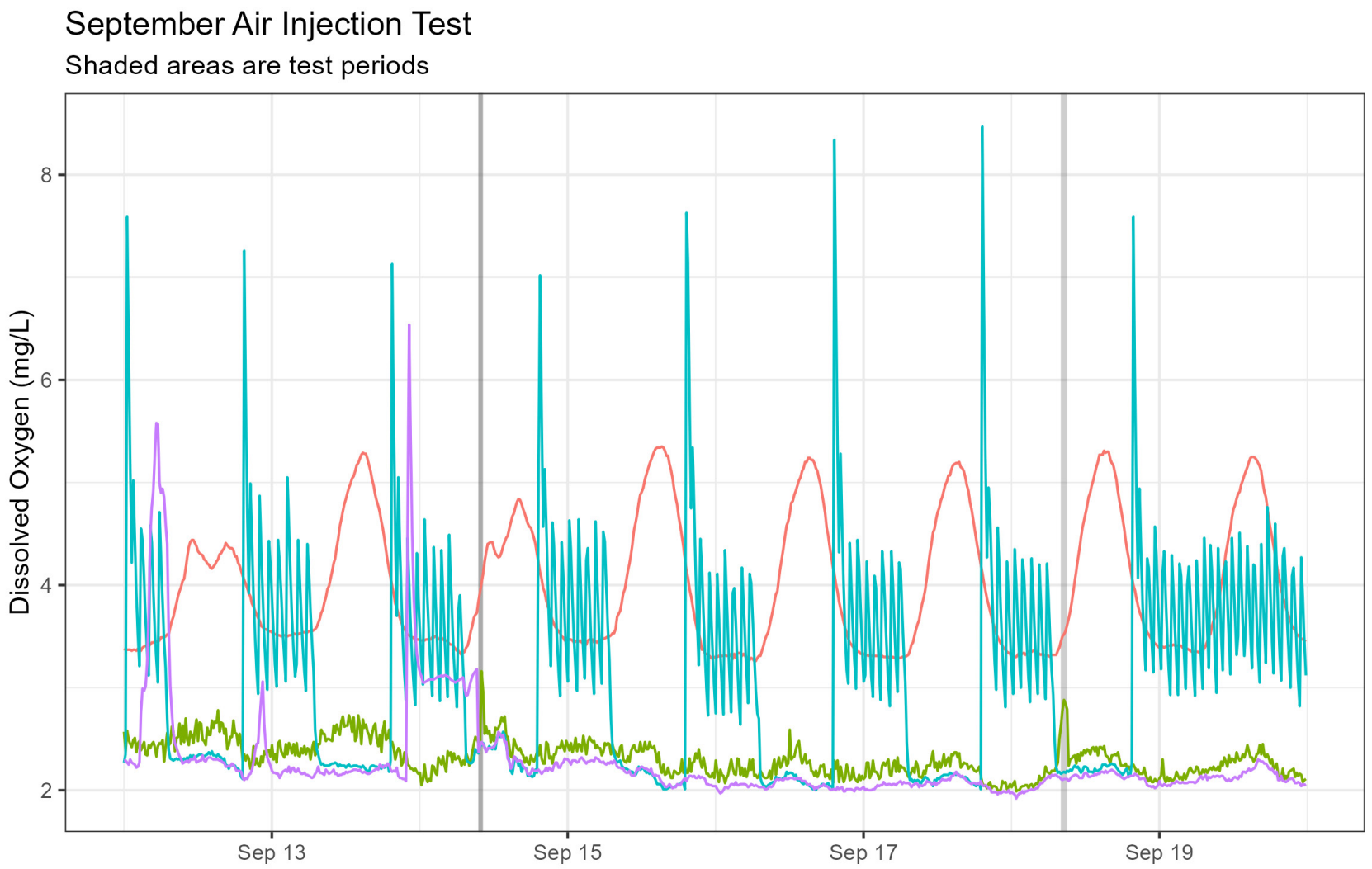
Other WQ parameters stay more stable during test, giving more evidence to air injection increasing DO immediately below dam

Results – September 18th 8:00-9:00



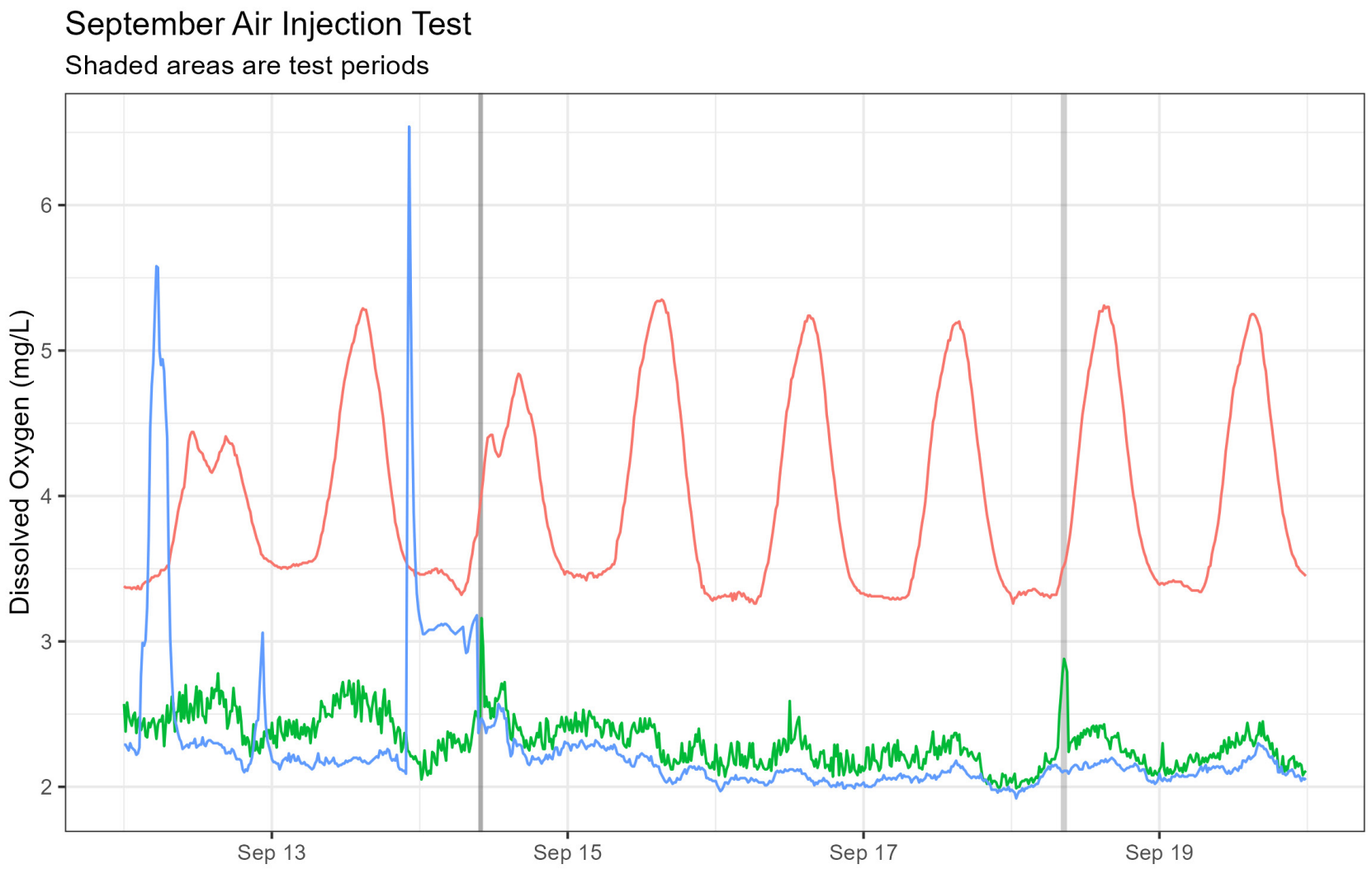
No measurable increase in DO recorded downstream in Glen Canyon.

Test Period



Extreme amount of noise in DT2 DO sensor during nighttime/lower flow periods, likely due to differing flow rates between draft tubes

Test Period



Removing DT2 for clarity - possible increases in DO below dam do not register downstream.

Testing Goals:

- Does this method measurably increase DO?
  - Yes…but also no
  - Did not create a measurable increase in DO downstream.

Takeaways

- In spite of ideal testing conditions (low flows, low starting DO, max possible air injection), we did not see any meaningful increase in dissolved oxygen propagate downstream.

- Air injection with existing equipment at GCD is not suitable for resolving low dissolved oxygen issues.

Potential next steps:

- Need to augment current system if we want more air or a longer test
  - Dedicated blower system.
  - Modify air lines in GCD for blower and to monitor flow rate.
- Understand effects at higher discharges.
- Understand effects on hydropower:
  - Estimated by staff to be marginal, but need dedicated monitoring.
- What are the DO dynamics downstream?
  - How does DO increase?
  - Preferred DO levels?
  - Marginal increase in survival for trout? Decision framework for initiating costly mitigation?

Acknowledgements

- Glen Canyon Dam
  - Kato Miyagishima
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