BUREAU OF RECLAMATION

Thermal Curtain Update

AMWG Meeting August 21, 2025

Long Term Strategy

Invasive Fish Species Below Glen Canyon Dam: A Strategic Plan to Prevent, Detect and Respond

Developed by the Smallmouth Bass Ad Hoc Group, through the Technical Work Group of the Glen Canyon Dam Adaptive Management Program in partnership with the Grand Canyon Monitoring and Research Center and the Bureau of Reclamation

Presented to the Glen Canyon Dam Adaptive Management Group
Technical Work Group on January 26, 2023, and accepted by the Adaptive Management Work Group on February 16, 2023.

Executive Summary

This Strategic Plan (Plan) was written in response to the May 2022 Secretary of the Interior's Designee's (Designee) Directive to the Adaptive Management Work Group to provide a plan to '*...prevent, detect, and respond to cool- and warmwater invasive fish establishment below Glen Canyon Dam*'. The Smallmouth Bass Ad Hoc Group was then convened to develop the Plan, as well as discuss the immediate concerns related to smallmouth bass which have been identified as the invasive fish species of most concern to humpback chub recovery and the health of the trout fishery as of fall 2022. To prevent the establishment of invasive fish species in the Colorado River ecosystem (CRe), a combination of long-term, mid-term, and short-term actions will be required. Entrainment through Glen Canyon Dam (GCD) is considered a primary source of invasion. The Lees Ferry reach is expected to be an initial point of establishment. Ultimately, the two approaches to prevent establishment within the Colorado River below GCD are (1) preventing fish passage through GCD, and (2) preventing establishment below the dam.

Long-term actions should include the installation of a fish exclusion device at GCD, while mid-term actions identified in the Plan include targeted flow and temperature changes at GCD. Short-term rapid response actions are meant to be used in the interim to prevent widespread dispersal and establishment, while planning and implementation of mid- and long-term actions are underway. Actions should be implemented as experiments to allow for proper assessment and evaluation. Research and monitoring before, during, and after actions will provide data to evaluate the effectiveness. For example, monitoring for fish entrainment *before* and *after* installation of a fish exclusion device to assess passage through the dam will provide information on the effectiveness of the fish exclusionary device(s). The Glen Canyon Dam Adaptive Management Program (GCDAMP) should maintain the ability to discontinue actions, as the likelihood of success, cost-effectiveness, changing environmental conditions, and the ability to carry out actions may change. Discontinuation of measures (e.g., off-ramping) will require coordination amongst agencies and stakeholders.

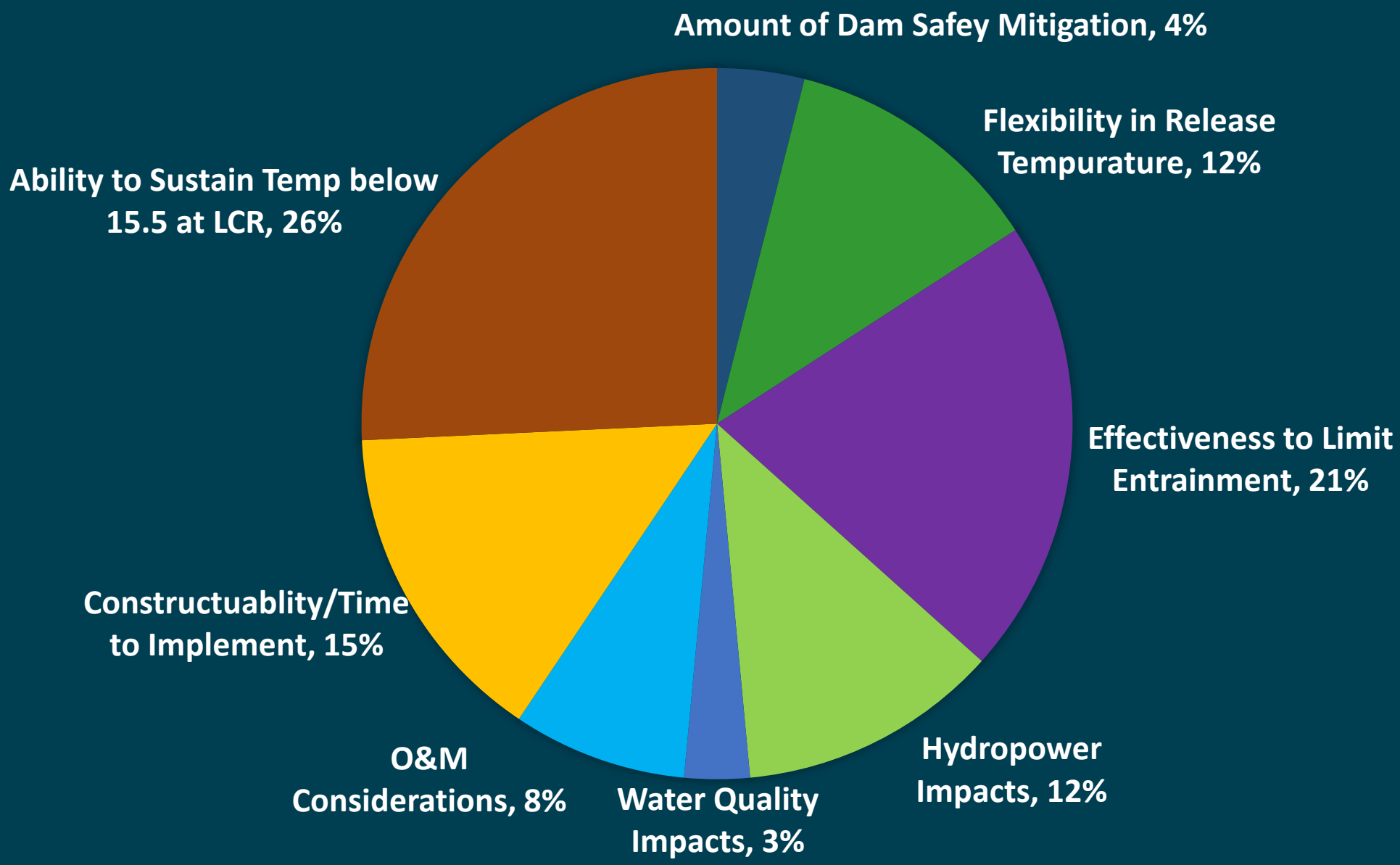
Long-term management is focused on prevention. The two approaches to prevention within the CRe are (1) the prevention of fish from passing through GCD (entrainment), and (2) the prevention of establishment in the reach(es) below GCD if entrainment occurs.

Value Planning Study – Alternative Development Phase

Alternatives Studied

1. Cold and Warm Water Thermal Curtains
2. Selective Temperature Withdrawal
3. Destratification
4. Floating Pumping Platform or Trunnion Cold Water Withdrawal
5. Entrainment Prevention Options
6. Fixed Selective Withdrawal System
7. Continue Bypass

Evaluation Phase – Criteria Weights



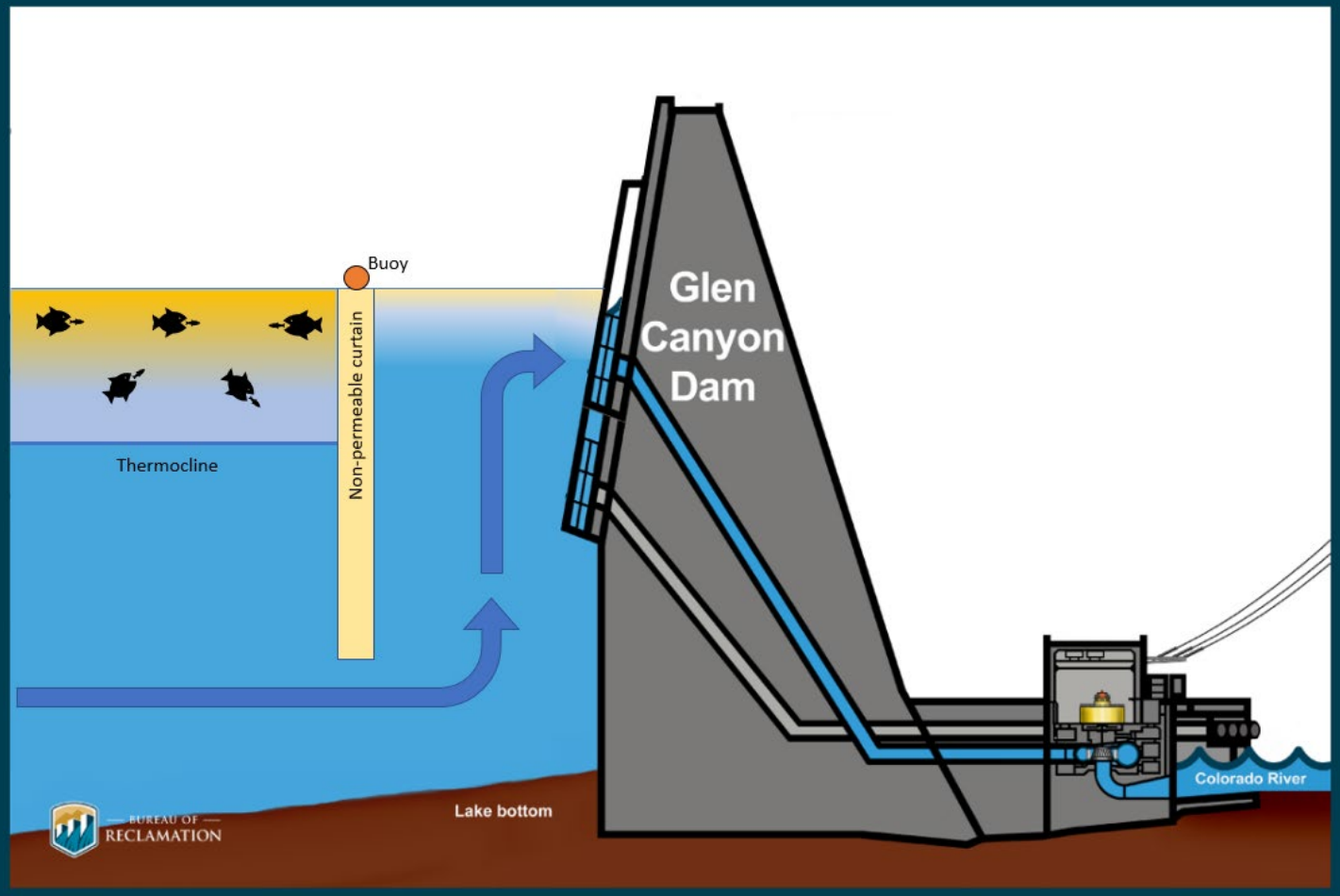
Alternative 1A: Cold Water Thermal Curtain

A nonpermeable barrier that spans across the reservoir and extends below the thermocline.

<u>Objective:</u> to draw hypolimnetic water up into the forebay through the penstocks to cool release temperatures and reduce entrainment to discourage smallmouth bass from spawning below the dam.

A thermal curtain would create a cold-water barrier between the curtain and dam to serve as a behavioral deterrent to warmwater fish occupying the forebay, preventing their entrainment through GCD.

- Could be designed for a tight seal at canyon walls, or allow for gaps w/ use of multi-stimulus barriers (Alt. 5b)

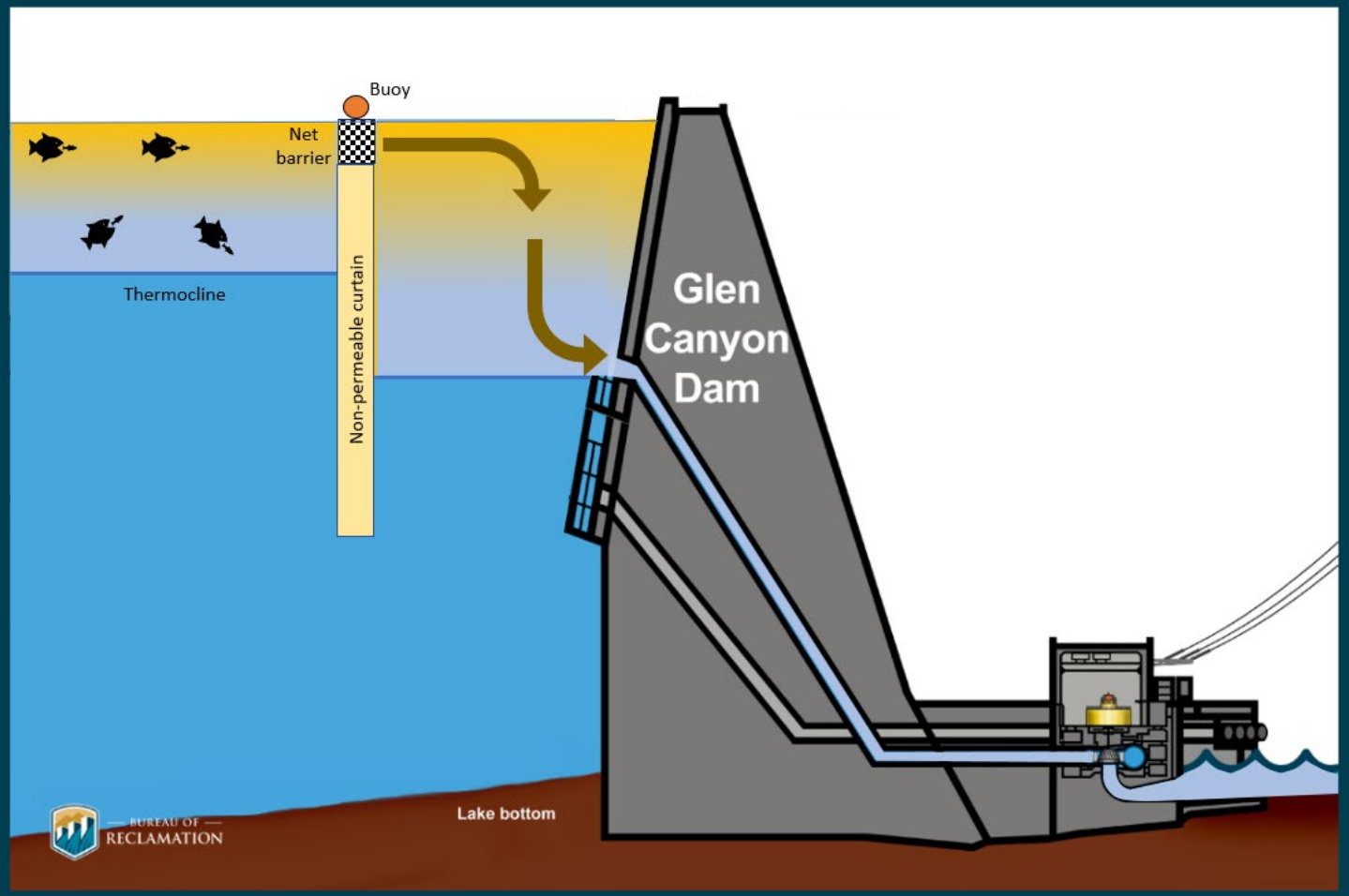


Alternative 1B: Cold and Warm-Water Thermal Curtain

Modular curtain sections replaced with modular net sections constructed of ¼" Dyneema.

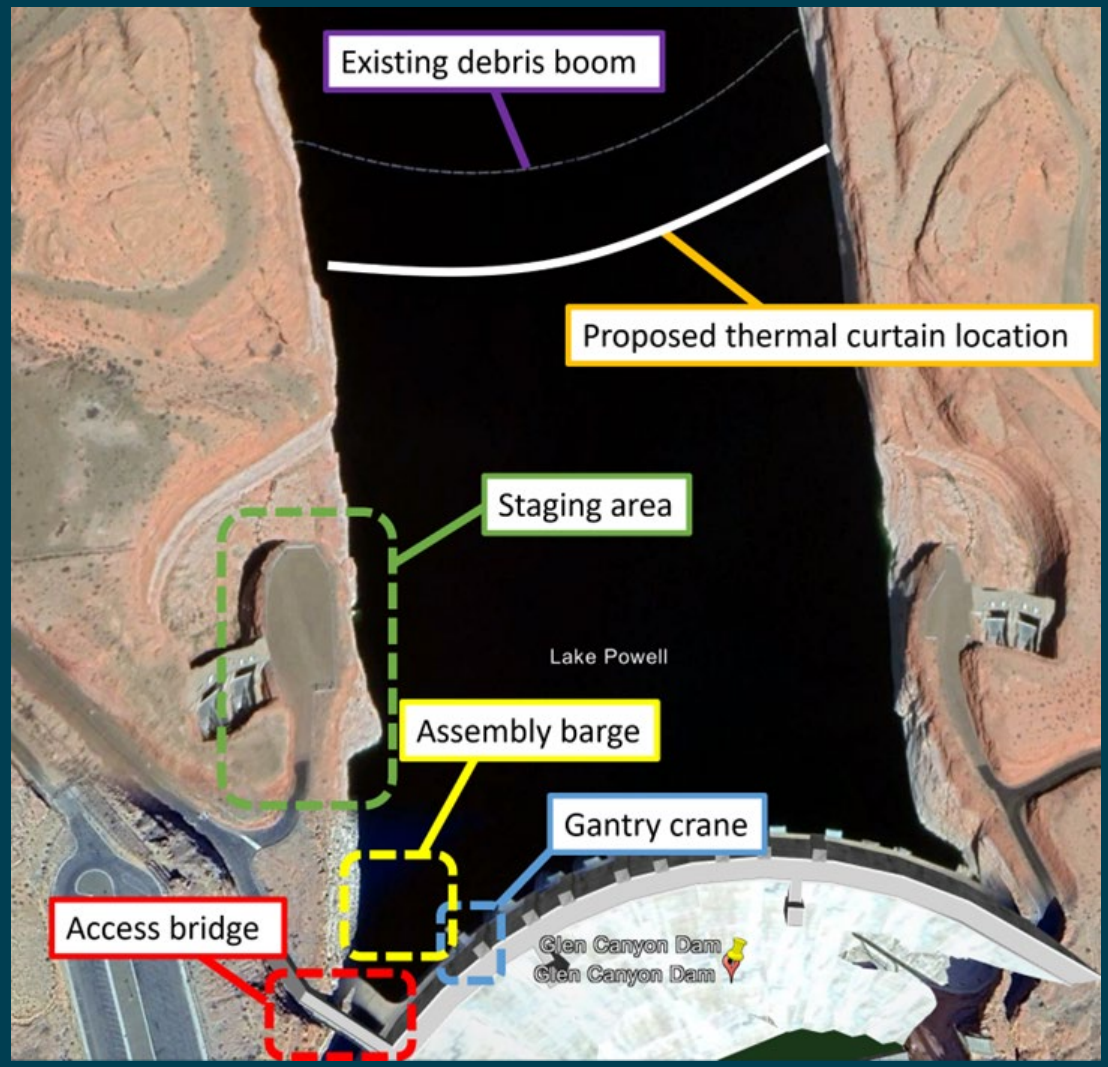
<u>Objective:</u> Allow warmer surface water to pass into the forebay between the curtain and dam, and through the penstocks to increase release temperatures.

Greater flexibility in range of release temperatures compared to Alternative 1A.



General Dimensions For Alternatives 1A & 1B

- Extend 100-150 ft deep
- Span across reservoir, 1000 ft wide
- Location 1200 ft upstream of dam, downstream of existing buoy line



Alternatives 1A&B – Advantage and Critical Items to Consider

Advantages:

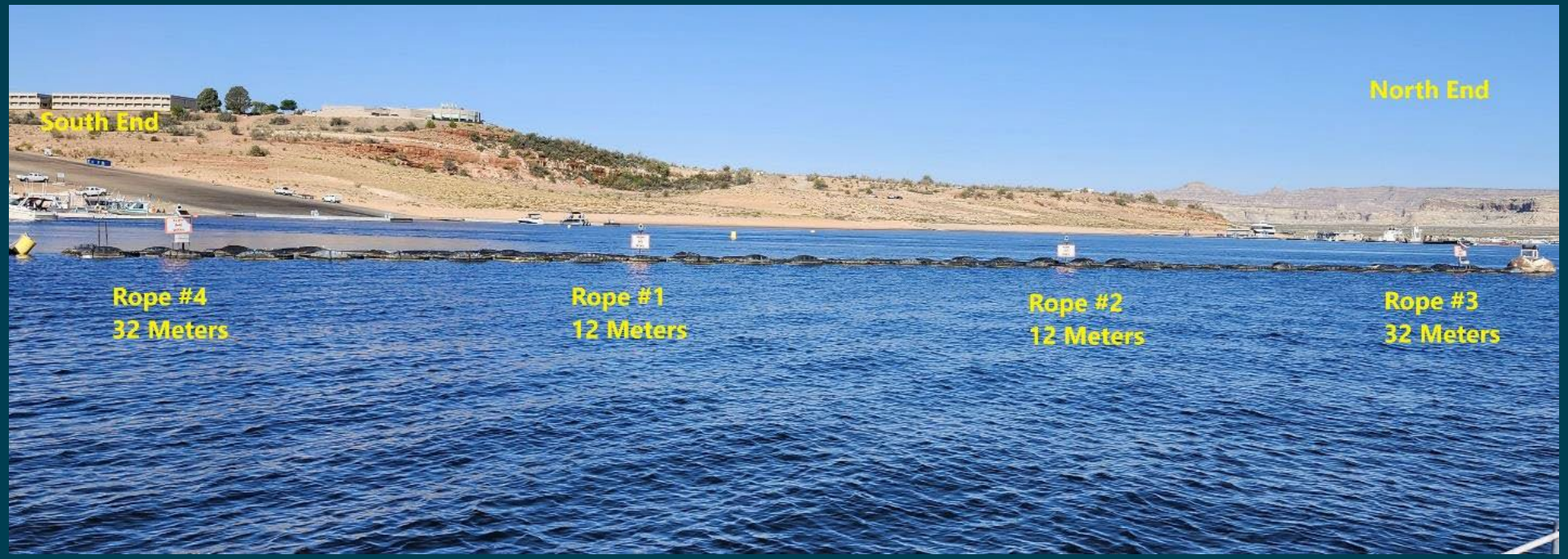
- Facilitates cold-water releases that would prevent smallmouth bass from spawning below the dam.
- Creates a cold-water barrier in the forebay that would prevent entrainment of warmwater fish through the dam.
- Modular design with net sections could allow for flexibility to increase forebay/release temperatures in future operations.
- A thermal curtain meets the purposes of continued operations at Glen Canyon Dam without impacting water deliveries or power generation.

Critical Items to Consider:

- Location of the curtain (distance relative to dam) and effect of curtain location on surface and subsurface water temperature control in the forebay.
- Anchoring and vertical adjustment mechanisms. A mounting apparatus which completely seals passage against near-vertical canyon walls is a novel engineering question with no known precedent.
- Biofouling and related O&M needs (inspections and repairs).
- Downstream effects on dissolved oxygen and total dissolved solids (TDS).

Lake Powel Biofouling Study

- Background
  - Investigate quagga mussels' accumulation on Thermal Curtain material
  - Netting and curtain materials with and without coatings designed to protect from mussel attachment will be tested to determine how quickly mussels accumulate, how much weight they add, and how frequently and easily they can be removed.
- Pilot Test Goals - Wahweap
  - Fouling rates of mussels' at different depths
  - Fouling rates on different materials (N = 2) and different coats (N=4)
  - Cleanability and Feasibility
- Early Observations
  - Fouling worse on uncoated material then coated
  - All materials cleanable but some coating material easier than others
- Next Steps
  - Pilot study appeared promising and methods will be upscaled
  - Project will be moved to forebay of Glen Canyon Dam among other areas in Lake Powell


South End
North End
Rope #4
32 Meters
Rope #1
12 Meters
Rope #2
12 Meters
Rope #3
32 Meters

Next Steps

- Feasibility
  - The formulation and evaluation of a range of alternative plans to meet established planning objectives and lead to the selection of a recommended plan or a recommendation to take no action.
  - Data collection for design considerations
  - Technical analysis - ex. modeling different designs to determine if it will meet project purpose
  - Compliance (ex. NEPA, ESA, NHPA)


Questions