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Trout Management Flows

A Literature Review and Stranding Risk Modelling

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Background on Trout Management Flows (TMFs)

- Rainbow trout abundance at Little Colorado River (LCR) inflow reach is periodically elevated and may impact humpback chub
- Large rainbow trout recruitment events (many young) in Glen Canyon in 2008, and especially 2011, led to elevated abundance near the LCR
- Mechanical removal used to reduce trout abundance at LCR 2003-2006
  - Can't keep up with immigration when rates are high
  - Tribes object to taking of life, especially near LCR
  - Expensive
- Is there a flow regime that can limit production of young in years when recruitment is expected to be high?
  - Limit downstream dispersal
  - Avoid high densities in Glen Canyon that can lead to collapse (e.g., 2011 → 2014)

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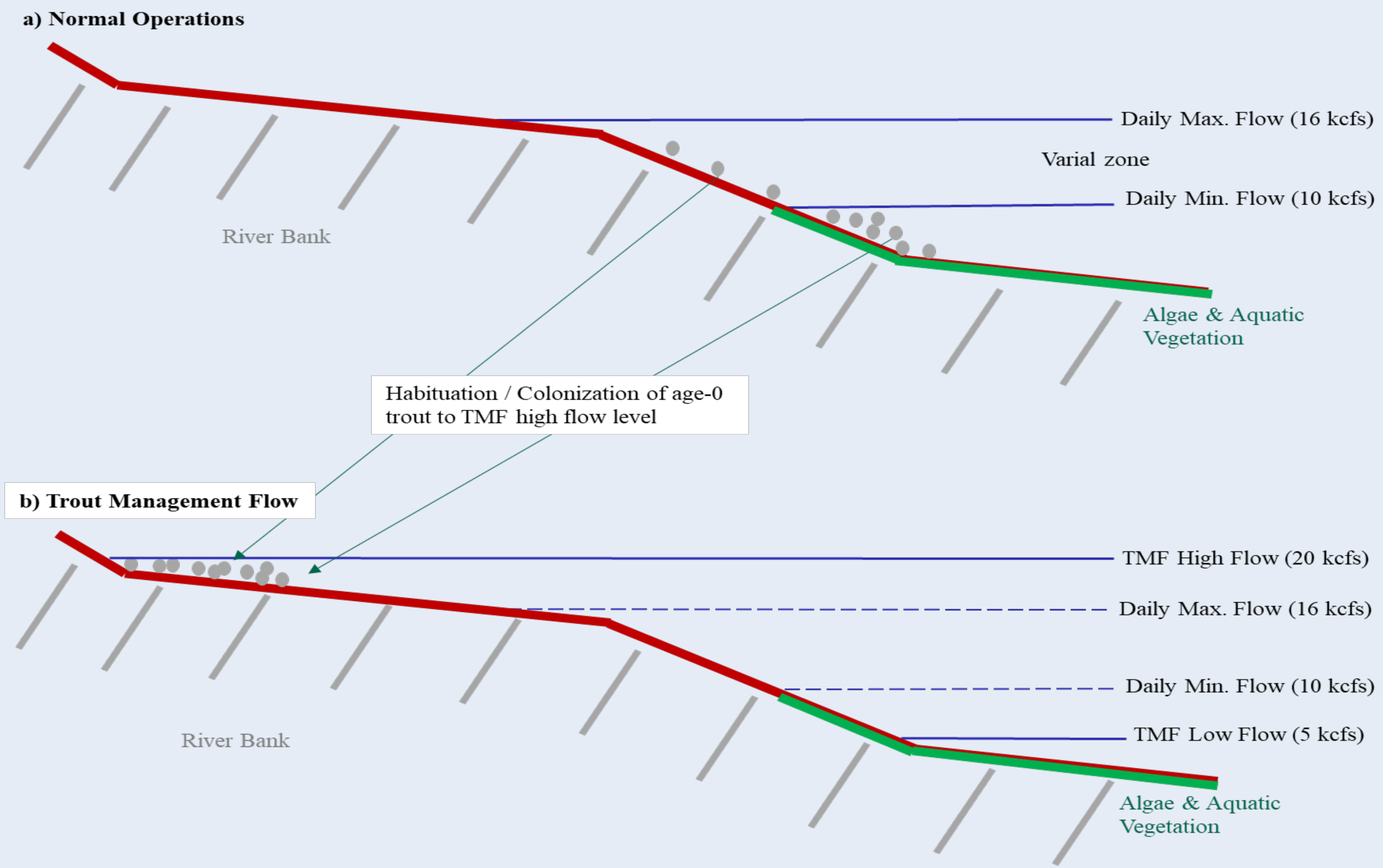
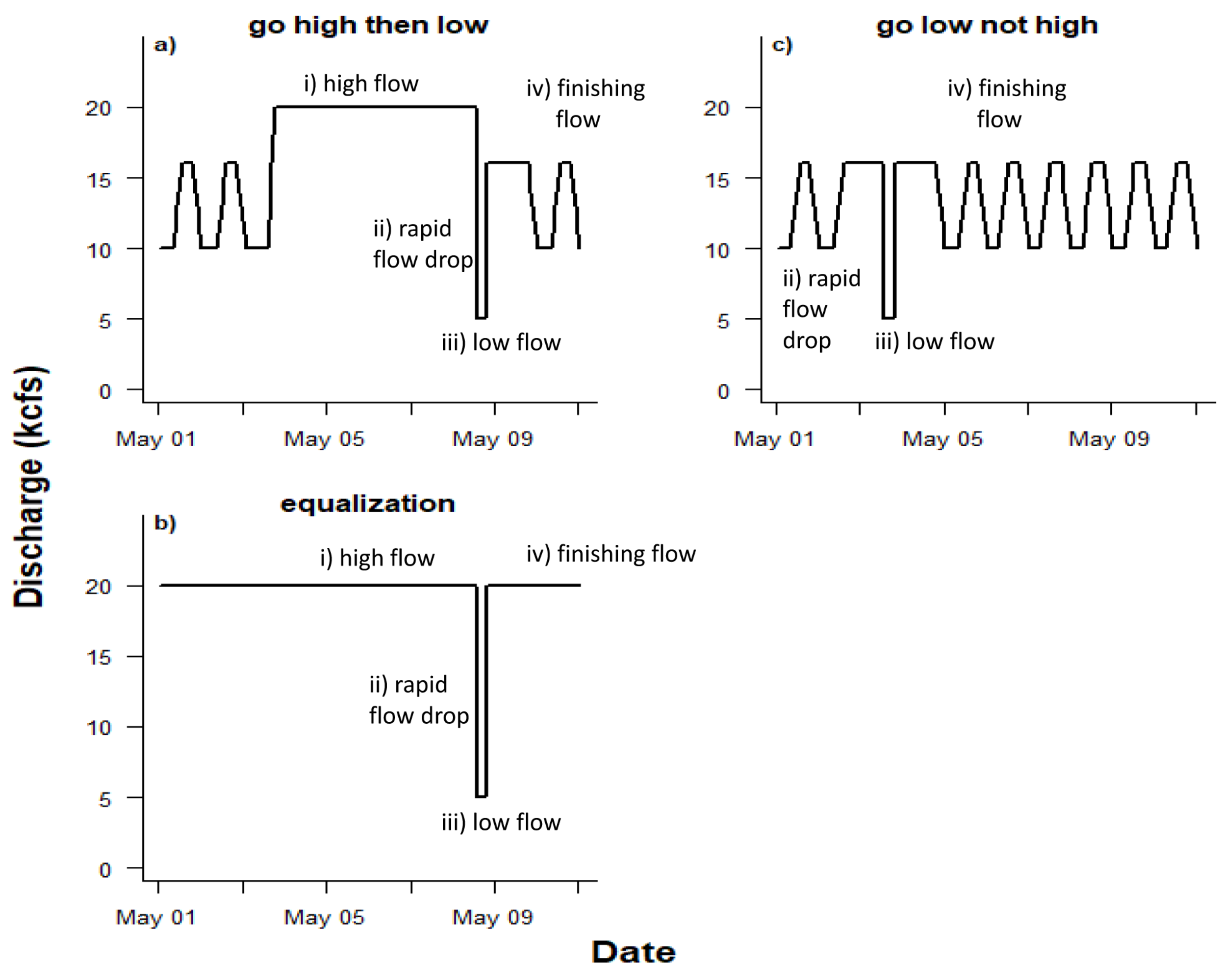
Fry Shoreline Use in Relation to Discharge



Three Potential TMF Flows



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Literature Review to Identify Factors Influencing Stranding

1. Flow characteristics
    - Magnitude of flow change
    - Down-ramp rate
    - Flow range (topography)
    - Duration of high (colonization) and low (mortality) flows
    - Frequency of flow fluctuations (cycles)

2. Life stage and size class

3. Channel morphology
    - Substrate
    - Lateral slope
    - Vegetation

4. Diel cycle (night vs. day)

5. Water temperature

Literature Review – Main Findings

Stranding is not an established management tool for fish population control

- Stranding will kill fish and upset humans
- Stranding may only affect a small % of juvenile population and therefore not appreciably influence the trajectory of the population

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Literature Review – Main Findings

Fish size

- Small Fry are more vulnerable to stranding (<50mm FL)
- Glen Canyon rainbow trout = May-July

Diel Cycle (day vs. night)

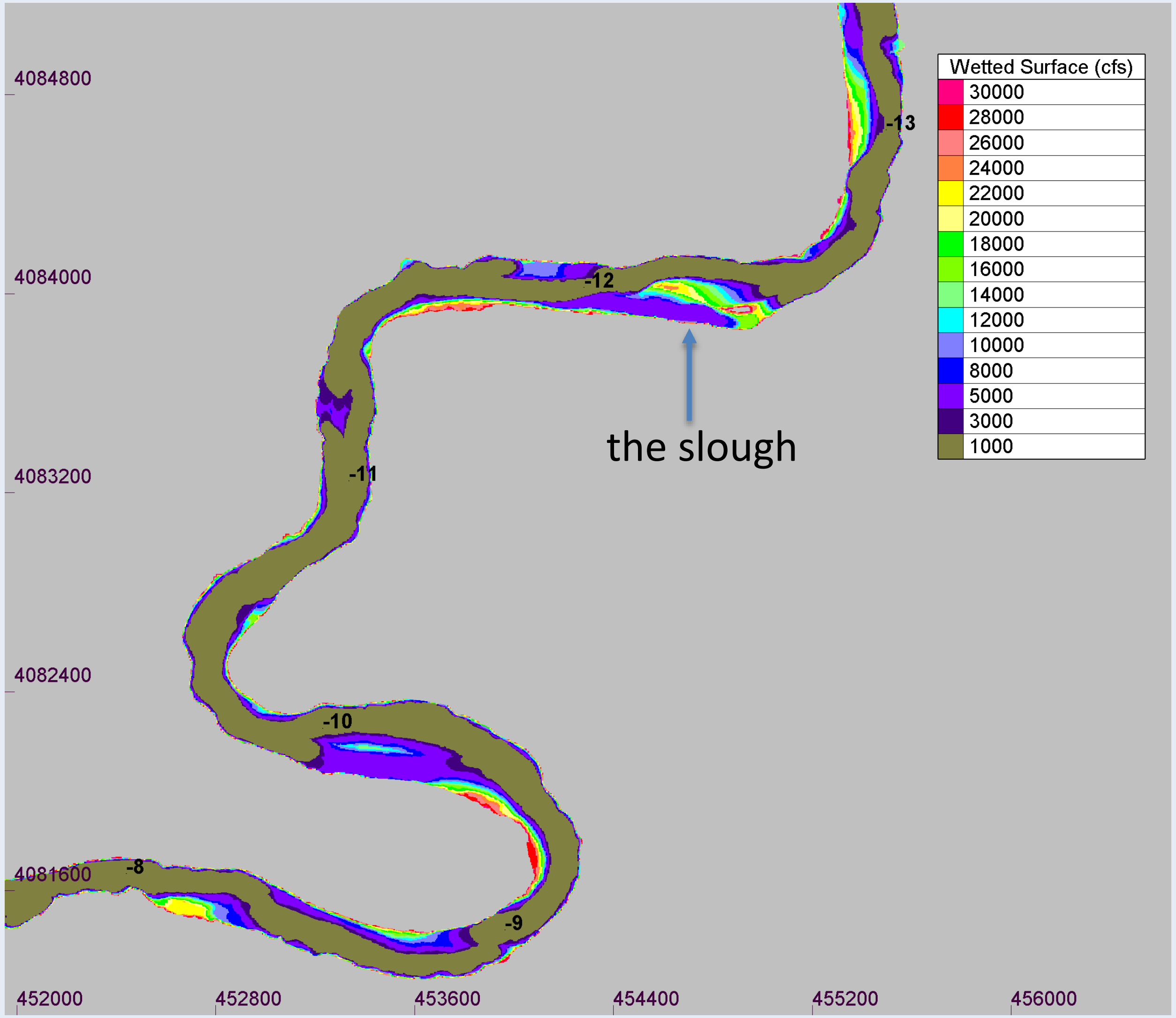
- More stranding if flows decreased during daytime
- Glen Canyon = Increased air temperature

Channel Morphology

- Shallow lateral slope leads to more stranding
    - <4% slope
- Stranding higher when habitat is complex
    - Aquatic vegetation
    - Isolated pools

-4 mile bar (TRGD sub-reach 1C) at ~4,000 cfs PC: M. Giardina

Predicted Changes in Wetted Area with Flow



Large areas exposed between 26-18 kcfs

- Stranding fry over this flow range requires sustained high flows of ~ 26 kcfs (option a).
- Only feasible in equalization years (e.g. 2011, option b)

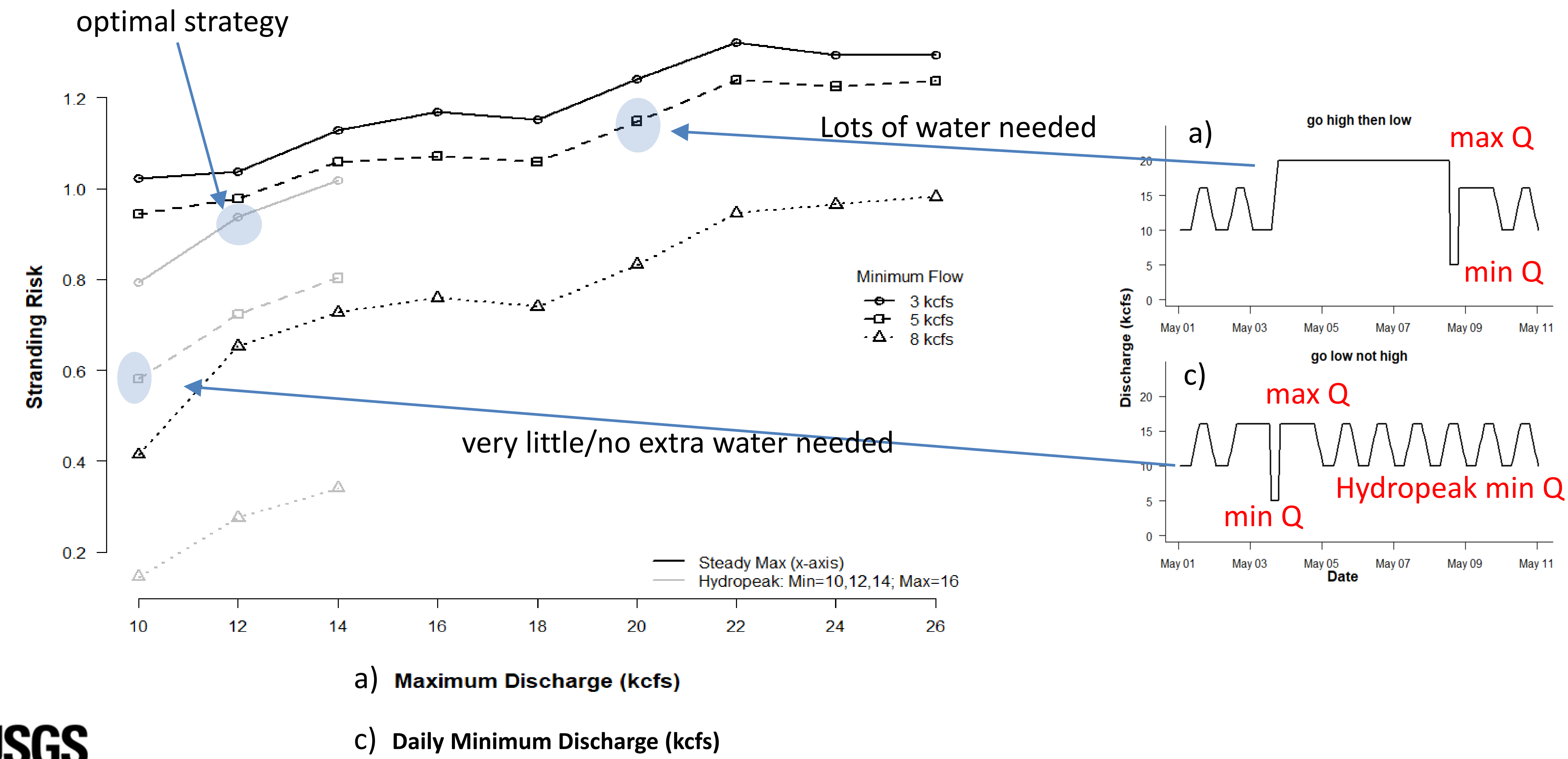
Large areas exposed between 5-3 kcfs

- Dropping flows from normal daytime highs of ~ 16-18 kcfs to 3 kcfs is feasible given constraints on release volume (option c)

Majority of shoreline in Glen Canyon is steep

- TMFs have to occur when young fry (< 50 mm) are using low angle shorelines
- Not all young fry will be using habitats that are vulnerable to stranding

Predicted Stranding Risk as a Function of Discharge



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Remaining Uncertainties

Unknowns:

- Proportion of YoY population removed per TMF cycle
- Number of TMF cycles to overcome compensatory response and achieve a substantive population-level effect
- Duration of low flow element of TMF
- Duration of high stable flows to maximize YOY trout colonization if implementing TMF option a)

Key considerations:

- Model predicting RBT recruitment, to determine if TMF is needed, has only moderate predictive power
- Current rainbow trout abundance and recruitment is low, and further reductions through TMFs will harm fishery and possibly lead to further increases in brown trout abundance

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