Utah Lake Water Quality Study

ULWQS Phase 2 Purpose and Initial Charge to Science Panel from Steering Committee

ULWQS Phase 2 Purpose

The main purpose of the Utah Lake Water Quality Study is to guide the development of site-specific nutrient criteria to protect the designated uses of Utah Lake. This will include the development of numeric criteria for both nitrogen and phosphorus, including specific elements for the magnitude (concentration of pollutants), duration (period of exposure to pollutants), and frequency (recurrence of the exposure to pollutants) necessary to protect defined uses. The following represents all of the existing uses for Utah Lake:

- Class 2A – Protected for frequent primary contact recreation where there is a high likelihood of ingestion of water or a high degree of bodily contact with the water. Examples include, but are not limited to, swimming, rafting, kayaking, diving, and water skiing.
- Class 3B – Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
- Class 3D – Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
- Class 4 – Protected for agricultural uses including irrigation of crops and stock watering.

Draft Initial Charge to Science Panel from Steering Committee

The following high-level questions (in bold) were identified by the Steering Committee as ones that need to be answered (i.e., to define what is possible in general and as it relates to how they would use the nutrient criteria lever) before they can articulate management goals for Utah Lake. The Steering Committee is proposing these as a first iteration of high-level questions for the Science Panel to answer.

It is expected that the Science Panel will guide development of answers to these high-level questions through a series of steps: 1) identify additional ‘sub’ questions that need to be answered; 2) assess the current research/existing studies’ ability to answer ‘sub’ questions; 3) develop a conceptual map of nutrient linkages to beneficial uses; 4) identify gaps and commission additional research studies to fill those gaps; and 5) review the research results and finalize responses to the high-level questions.

In moving through these steps, the Steering Committee would like to emphasize the value (time, money, etc.) of relying, wherever possible, on existing studies to address high-level and sub questions. Further, UDWQ is positioned to be able to engage a technical contractor if the Science Panel feels this would benefit their efforts, in addition to the specific efforts that will be commissioned to conduct the studies identified by the Science Panel.

1. **What was the historical condition of Utah Lake with respect to nutrients and ecology pre-settlement and along the historical timeline with consideration of trophic state shifts and significant transitions since settlement?**

    1.1. What does the diatom community and macrophyte community in the paleo record tell us about the historical trophic state and nutrient regime of the lake?

        i. Can diatom (benthic and planktonic) and/or macrophyte extent or presence be detected in sediment cores? And if so, what are they?

        ii. What were the environmental requirements for diatoms and extant macrophyte species?

        iii. How have environmental conditions changed over time?

    1.2. What were the historic phosphorus, nitrogen, and silicon concentrations as depicted by sediment cores?

    1.3. What information do paleo records (eDNA/scales) provide on the population trajectory/growth of carp over time? What information do the paleo records provide on the historical relationship between carp and the trophic state and nutrient regime of the lake?

    1.4. What do pollen, resting spores, photopigments, DNA, midge head capsules, mollusks, and exuviae from zooplankton in the paleo record tell us about the historical water quality, trophic state, and nutrient regime of the lake?

2. **What is the current state of the lake with respect to nutrients and ecology?**

    2.1. What are the impacts of carp on the biology/ecology and nutrient cycling of the lake and how are those impacts changing with ongoing carp removal efforts?

        i. What contribution do carp make to the total nutrient budget of the lake via excretion rates and bioturbation? How much nutrient cycling can be attributed to carp?

        ii. What is the effect of carp removal efforts on macrophytes, nutrients, secchi depth, turbidity, and primary productivity?

        iii. How much non-algal turbidity and nutrient cycling is due to wind action versus carp foraging? How much does sediment resuspension contribute to light limitation, and does wind resuspension contribute substantially in the absence of carp?

    2.2. What are the environmental requirements for submerged macrophytes currently present at Utah Lake?

        i. What is the role of lake elevation and drawdown in macrophyte recovery? Are certain species more resilient to drawdowns and nutrient related impacts? Can some species establish/adapt more quickly?

        ii. What is the relationship between carp, wind, and macrophytes on non-algal turbidity and nutrient cycling in the lake? What impact could macrophyte reestablishment have?

2.3. What are the linkages between changes in nutrient regime and HABs?

i. Where do HABs most frequently start/occur? Are there hotspots and do they tend to occur near major nutrient sources?

ii. Which nutrients are actually controlling primary production and HABs and when?

iii. If there are linkages between changes in nutrient regime and HABs, what role if any does lake elevation changes play?

iv. How do other factors affect HAB formation in Utah Lake (e.g., climate change; temperature; lake stratification; changes in zooplankton and benthic grazers and transparency)?

v. What is the role of calcite "scavenging" in the phosphorus cycle?

vi. What is the relationship between light extinction and other factors (e.g., algae, TSS, turbidity)?

2.4. How do sediments affect nutrient cycling in Utah Lake?

i. What are current sediment equilibrium P concentrations (EPC) throughout the lake? What effect will reducing inputs have on water column concentrations? If so, what is the expected lag time for lake recovery after nutrient inputs have been reduced?

ii. What is the sediment oxygen demand of, and nutrient releases from, sediments in Utah Lake under current conditions?

iii. Does lake stratification [weather patterns] play a result in anoxia and phosphorus release into the water column? Can this be tied to HAB formation?

2.5. For warm water aquatic life, waterfowl, shorebirds, and water-oriented wildlife:

i. Where and when in Utah Lake are early life stages of fish present?

ii. Which species are most sensitive and need protection from nutrient-related impacts?

3. What additional information is needed to define nutrient criteria that support existing beneficial uses?

3.1. For warm water aquatic life, waterfowl, shorebirds, and water-oriented wildlife

3.2. For primary contact recreation

3.3. For agricultural uses including irrigation of crops and stock watering

Future High-level Question

NOTE: the plan for now is to hold off answering questions associated with the improved stable state, recognizing its importance to ultimately achieving the overall goal of developing nutrient criteria, but to revisit it as efforts to answer high-level questions 1-3 are undertaken (and information is obtained).

Is there an improved stable state that can be reached under the constraints of current water and fishery management?

a. **What would be the current nutrient regime of Utah Lake assuming no nutrient inputs from human sources? This question may require the identification of primary sources of nutrients.** [NOTE: discussion of intent of this question would be useful and, depending on discussion, assessing how it is framed?]

b. **Assuming continued carp removal and current water management, would nutrient reductions support a shift to a macrophyte-dominated state within reasonable planning horizons (i.e., 30-50 years)?**

c. **If the lake stays in a phytoplankton-dominated state, to what extent can the magnitude, frequency, and extent of harmful and nuisance algal blooms be reduced through nutrient reductions?**