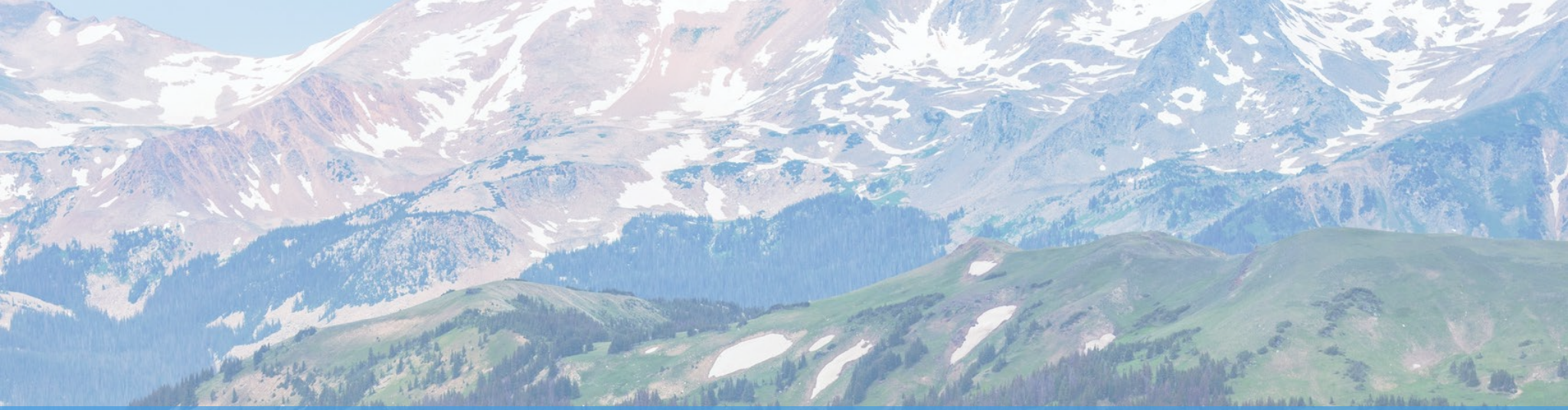


Utah Lake Water Quality Study

Steering Committee Meeting
May 26, 2021

TO THE POINT peak FACILITATION GROUP

Process Commitments

PROCESS COMMITMENTS

- Seek to learn and understand each other's perspective
- Encourage respectful, candid, and constructive discussions
- Seek to resolve differences and reach consensus
- As appropriate, discuss topics together rather than in isolation
- Make every effort to avoid surprises

Ground Rules

GROUND RULES

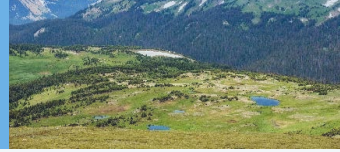
- Focus on the task at hand
- Have one person speaking at a time
- Allow for a balance of speaking time by providing succinct statements and questions
- Listen with respect

Ground Rules Cont.

GROUND RULES

- Be civil
- Keep side conversations to a minimum
- Turn off cell phones or put them in the non-ring mode during formal meeting sessions

Cell Count After Party Update



PROCESS SUMMARY

- Several outside panelists joined the SC meeting to discuss HABs.
- SC members provided questions for the panelists to address.
- At the end of the meeting, most but not all SC members agreed that cell count data should be used.
- A few SC members and others joined a discussion after the meeting to further discuss the remaining concerns about cell count data.
- Panelists have also provided written answers to the questions from the SC.

Cell Count After Party Update

CONCERNS IDENTIFIED / DISCUSSED

- Some epidemiological studies EPA relies on in guidance are based on a **correlative rather than causal** relationship between exposure to cyanobacteria and health effects.

- Some SC members expressed **concern about basing a health advisory on correlative data**.

- Others noted that **epidemiological studies are always correlative**; this is way EPA uses a "weight of evidence" approach.

Cell Count After Party Update

AGREEMENTS

- **Cell counts are useful measures to have**, in addition to data on chlorophyll-a and biovolume. The SC and SP should **use all these data types** to assess progress toward management goals. Speciation of cell counts and toxin measurements should also be used.

- **Agreeing to collect** cell count data and use them to explore options in different future scenarios **does not equate** to agreement that there is a pre-established threshold or target that should be attained.

Cell Count After Party Update

FUTURE DISCUSSIONS

- Future discussions on specific cell count thresholds for advisory warnings are **better suited for the Utah Division of Water Quality and the Department of Health's Water Quality Health and Advisory Panel.**

- Future Steering Committee scenario discussions regarding potential targets or thresholds should **consider achievability for each scenario** in addition to other factors identify by the Steering Committee.

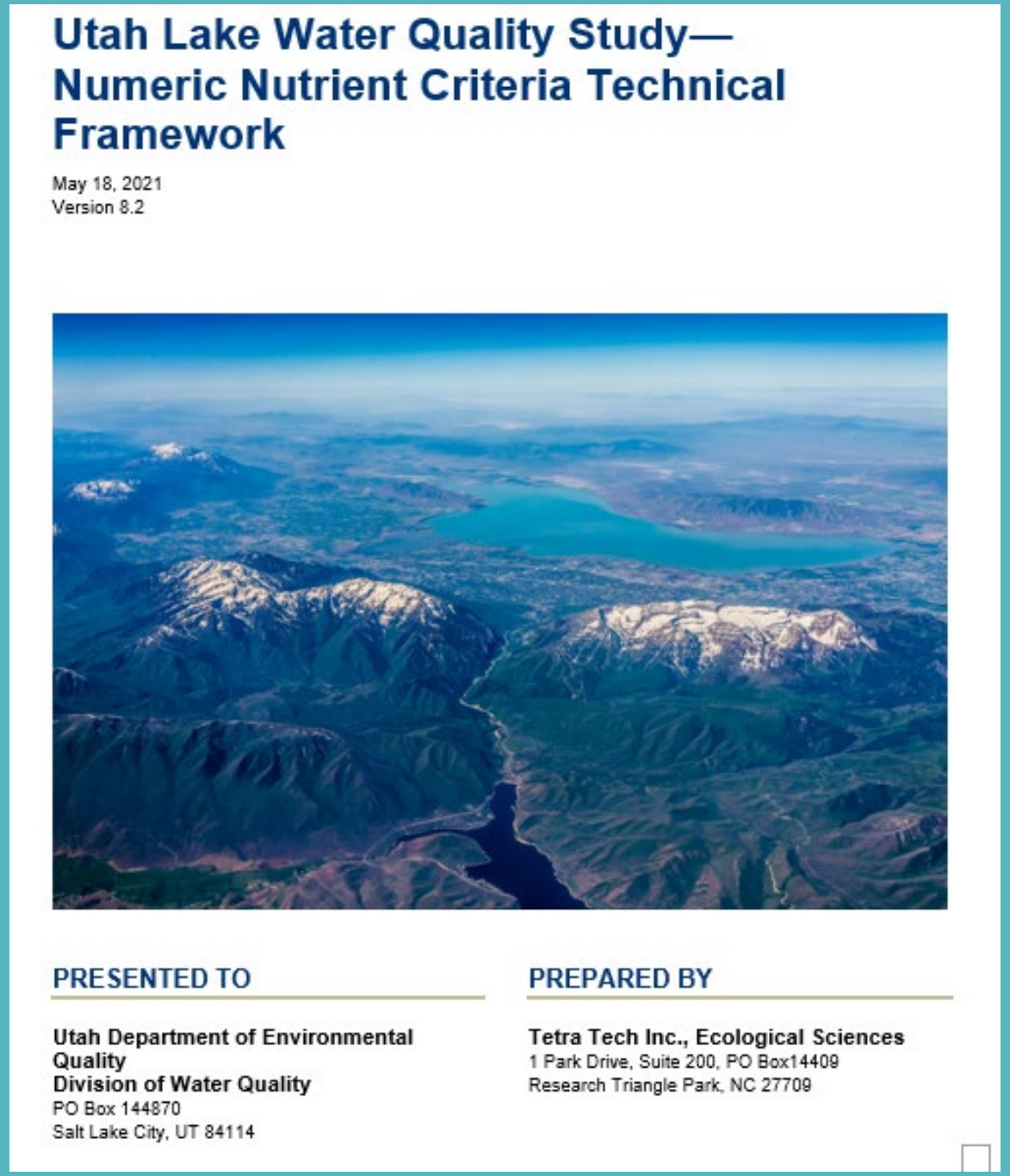
UPDATE FOR STEERING COMMITTEE TECHNICAL FRAMEWORK

Utah Lake Water Quality Study
Steering Committee Call
2021-05-26

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY

GOALS

1. Overview of changes to the Framework document since the previous draft
   - Presentation of the connections between the Steering Committee Management Goals table and stressor-response analyses
   - Presentation of the pathway to criteria presented in the Framework
2. Discussion of final Framework document
3. Approval of framework document



Utah Lake Water Quality Study—Numeric Nutrient Criteria Technical Framework

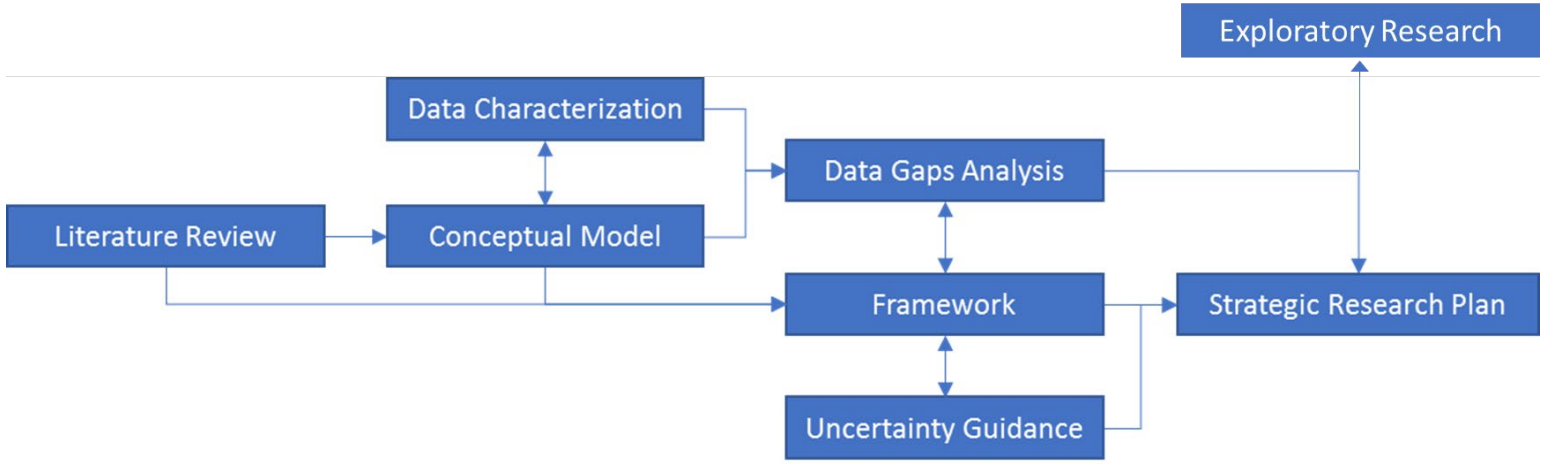
May 18, 2021
Version 8.2

SINCE LAST FRAMEWORK DRAFT…

- Feedback from SC members, DWQ, and EPA
- Incorporated comments and text edits *(see Comment-Response document)*
- Added content:
  - Management Goals table
  - Pathway to Criteria section

1.0 OVERVIEW

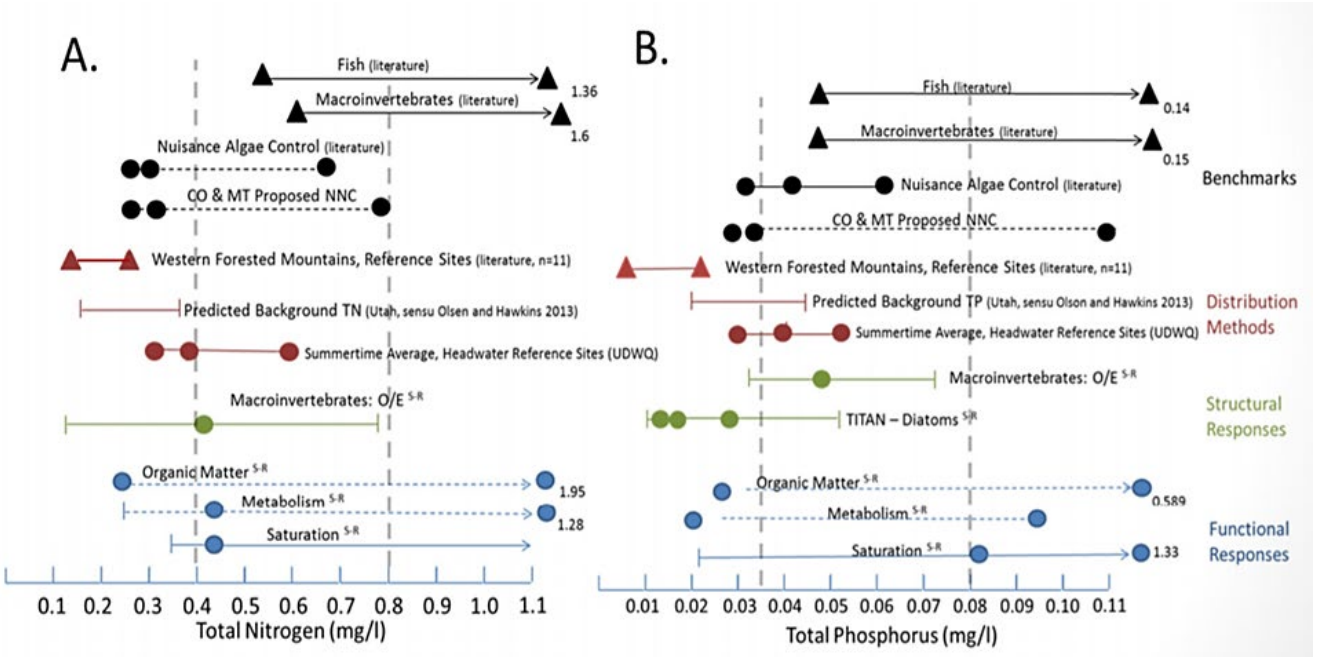
- Utah Lake beneficial use impairments
- Establishment of ULWQS
- Purpose: describe process to develop numeric nutrient criteria



1.1 LITERATURE REVIEW

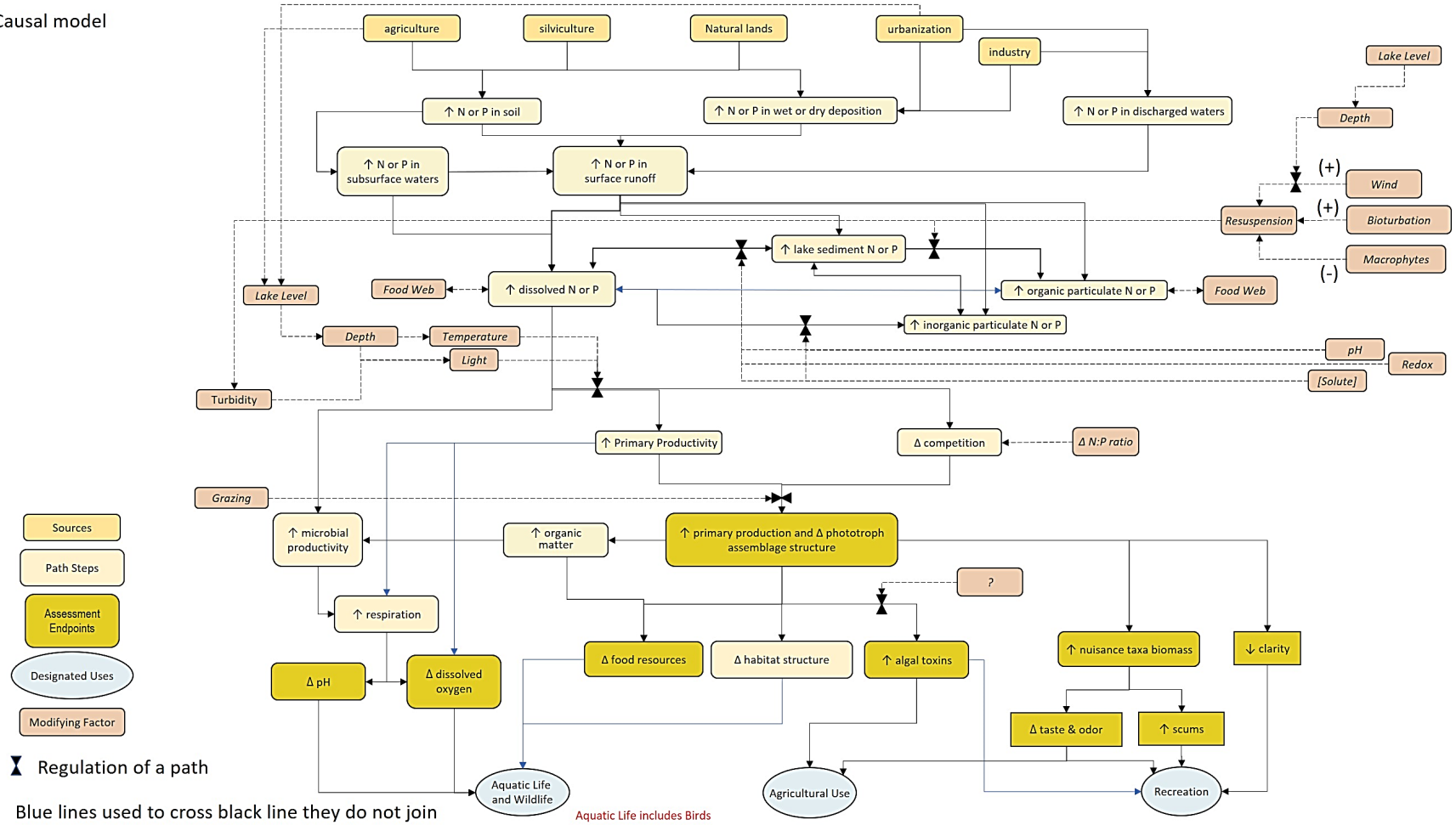
Approaches for developing NNC:

1. Reference-based approach
   - Direct observation
   - Paleolimnological reconstruction
   - Mechanistic modeling
2. Stressor-response analysis
   - Empirical modeling
   - Mechanistic modeling
3. Scientific Literature



1.2 CONCEPTUAL MODEL

Causal model



Regulation of a path

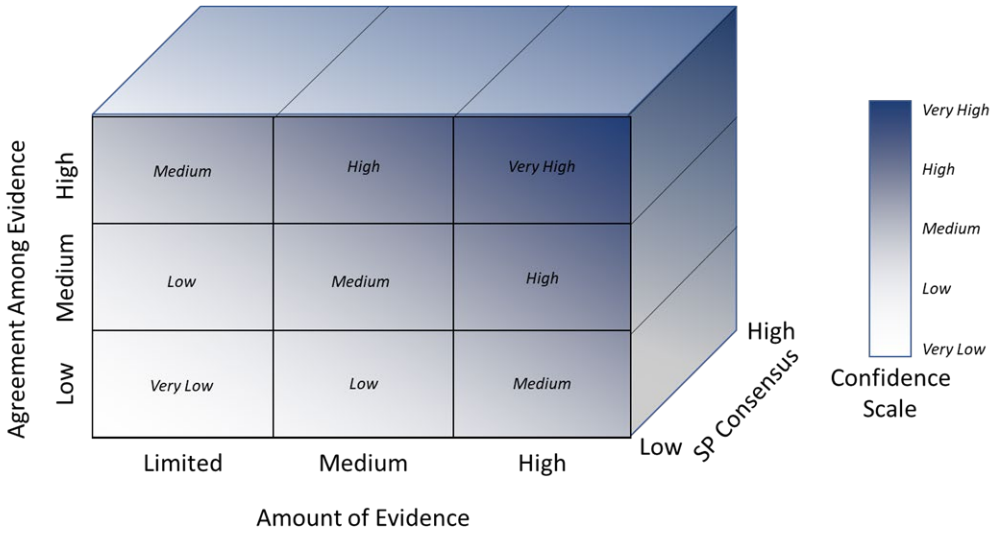
Blue lines used to cross black line they do not join

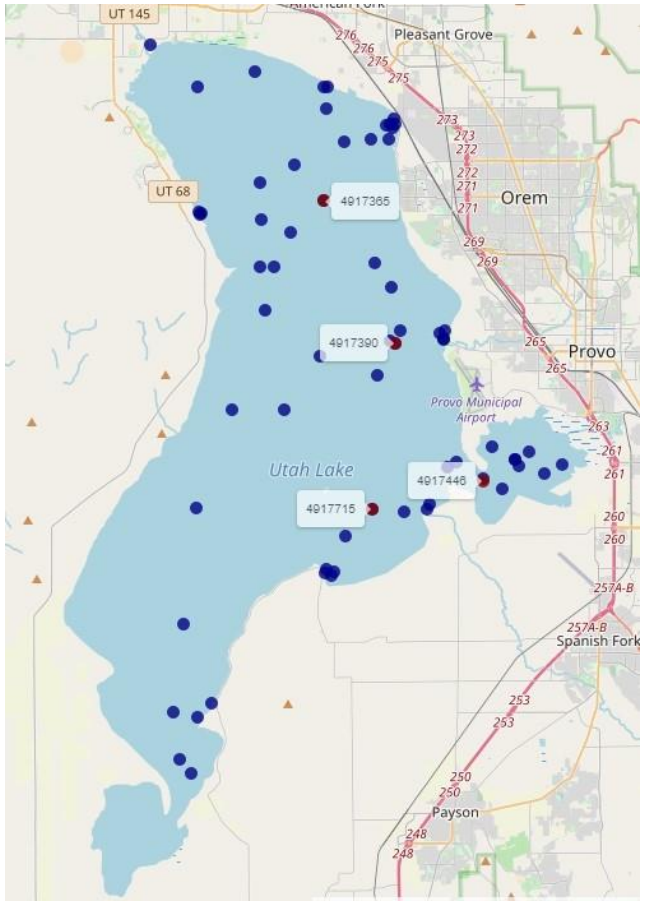
Aquatic Life includes Birds

1.3-1.5 DATA CHARACTERIZATION, UNCERTAINTY, STRATEGIC RESEARCH PLAN

Details work to date on:

- Empirical analyses
- Data gaps ID
- Proposed studies to fill gaps
- Uncertainty guidance





2 APPROACH FOR NNC DEVELOPMENT

Incorporated SC work on Management Goals table:

2.1 Definitions:

- *Management goals:* statements about desired condition. Broader than designated uses
- *Assessment endpoints:* expressions of what is to be protected. Connect mgmt. goals to ecological causal pathway
- *Measures:* attributes of assessment endpoint used to assess & quantify progress
- *Targets:* numeric thresholds of measures

2.2 ASSESSMENT ENDPOINTS, MEASURES, TARGETS

- Divided into designated uses:
  - Recreation
  - Aquatic Life
  - Agriculture
  - Downstream
- Text updated to reflect management goals table
- Content of management goals table added as tables

Designated Use	Management Goal	Assessment Endpoint	Measures	Targets	Target source	Study/information gaps
2A. Primary contact recreation use (human health, Recreation experience, Lake aesthetics)	Harmful algal blooms (HAB) will not create toxins that threaten public health.	Algal toxin concentrations	Microcystin concentration	8 ug/L	EPA guidance WQS, R317-2-14[1]	Frequency/duration to be incorporated from EPA guidance
			Cylindrospermopsin concentration	15 ug/L	EPA guidance WQS, R317-2-14[2]	Frequency/duration to be incorporated from EPA guidance
			Anatoxin concentration	15 ug/L	Utah HAB guidance WQS, R317-2-14[2]	
	HAB occurrence is limited in spatial extent and infrequent to support robust recreational industry and community.	Magnitude, frequency, and duration of algal blooms.	Annual number of lake closures due to HABs	• Microcystin: 2,000 ug/L • Anatoxin: 90 ug/L • Cylindrosprmopsin: 15 ug/L • Cyanobacteria density: 10M cells/mL	Utah HAB guidance WQS, R317-2-7.2[2]	
			Duration/frequency: Percent of recreation season with algal biomass exceeding health and nuisance thresholds at each monitoring site and	• Cyanobacteria density: TBD • Toxigenic Cyanobacteria density: TBD • Cyanobacteria relative abundance: TBD • Toxigenic Cyanobacteria	Recreation survey Proposed EPA NNC criteria[2] R317-2-7.2[2]	Recreation survey to help determine nuisance thresholds for algal/ cyanobacteria density.

2.3 LINES OF EVIDENCE

Lays out how elements from lit review will be used to derive targets

Type	Line of evidence	Planning to use
Reference-based	Paleolimnological reconstruction of past conditions	yes
	Model-based prediction or extrapolation of reference conditions	yes
Stressor-Response	Mechanistic model	yes
	Empirical	yes
Scientific Literature		yes

STRESSOR-RESPONSE ANALYSIS

Candidate variables selected from mgmt. goals table (align with assessment endpoints)

S-R relationships represent mechanistic connections

Can ID stressor thresholds above which target response condition is exceeded

Use	Assessment Endpoint	Stressor	Response	Empirical S-R Data Available	Mechanistic Model Output
Recreation, Aquatic Life, Agriculture, Drinking Water	Algal toxins	Chlorophyll *a*	Microcystin concentration	Yes	No
Recreation, Aquatic Life, Agriculture, Drinking Water	Algal toxins	Cyanobacterial abundance	Microcystin concentration	Yes	No
Recreation	Algal blooms	Chlorophyll *a*	Cyanobacterial abundance	Yes	Yes
Recreation, Aquatic Life	pH	Chlorophyll *a*	pH	Yes	Yes
Recreation	Lake visitation	Chlorophyll *a*	Annual visitation	Yes	No
Recreation	Lake visitation	Cyanobacterial abundance	Annual visitation	Yes	No
Recreation	Lake visitation	K_d, Secchi depth	Annual visitation	Yes	No
Recreation	Public perception	Chlorophyll *a*	Public perception	Upcoming user perception survey	No
Recreation	Public perception	Cyanobacteria abundance	Public perception	Upcoming user perception survey	No
Recreation	Public perception	K_d, Secchi depth	Public perception	Upcoming user perception survey	No
Aquatic Life	DO	Chlorophyll *a*	DO	Yes	Yes
Aquatic Life	Food resources	Chlorophyll *a*	Zooplankton:Phytoplankton	National Model	No
Aquatic Life	Food resources	Chlorophyll *a*	Proportion cyanobacteria	Yes	Yes
Aquatic Life	Food resources	Chlorophyll *a*	Macroinvertebrate diversity/abundance	No	No
Aquatic Life	Food resources	Chlorophyll *a*	Mollusk diversity/abundance	No	No
Aquatic Life	Light	Chlorophyll *a*	K_d, Secchi depth	Yes	Yes

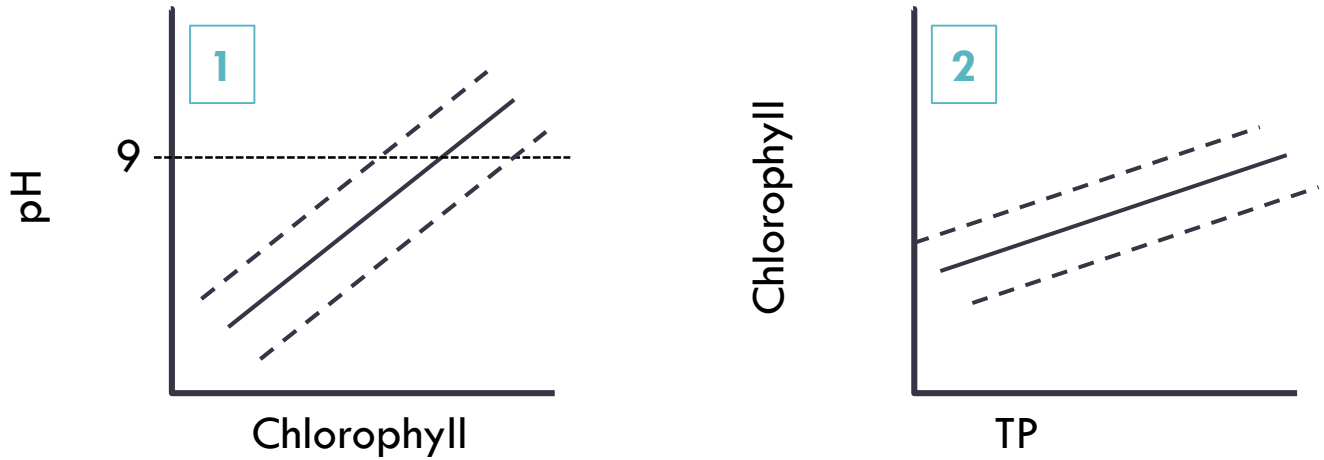
STRESSOR-RESPONSE ANALYSIS

Create S-R relationships for nutrients:

1. Identify stressors from S-R table → become response
2. Nutrients become stressors
3. Thresholds from previous S-R relationship help to identify target nutrient ranges

Use	Stressor	Response	Empirical S-R Data Available	Mechanistic Model Output
Criteria Setting	TN	Chlorophyll *a*	Yes	Yes
Criteria Setting	TP	Chlorophyll *a*	Yes	Yes
Criteria Setting	TN	Cyanobacterial abundance	Yes	Yes
Criteria Setting	TP	Cyanobacterial abundance	Yes	Yes
Criteria Setting	TN	K_d, Secchi depth	Yes	Yes
Criteria Setting	TP	K_d, Secchi depth	Yes	Yes

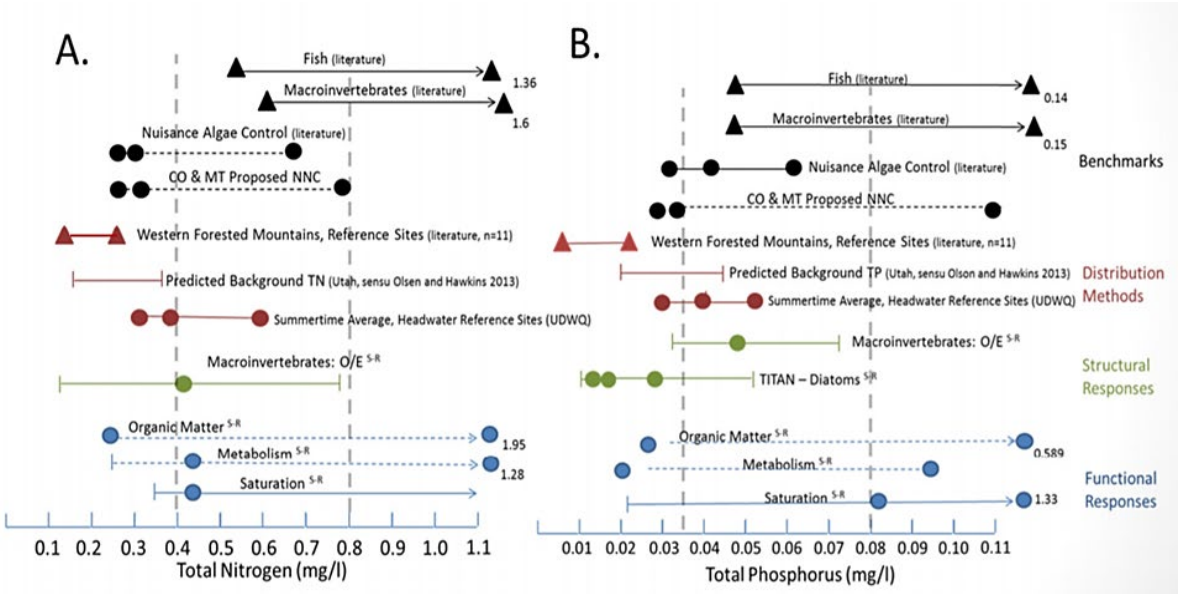
STRESSOR-RESPONSE ANALYSIS



2.3 COMBINING LINES OF EVIDENCE

Goal: link nutrient concentrations with protection of designated uses

- Interpret endpoints in the context of uncertainty
- Assessment of probability
- Results in a range of values → compare across lines of evidence

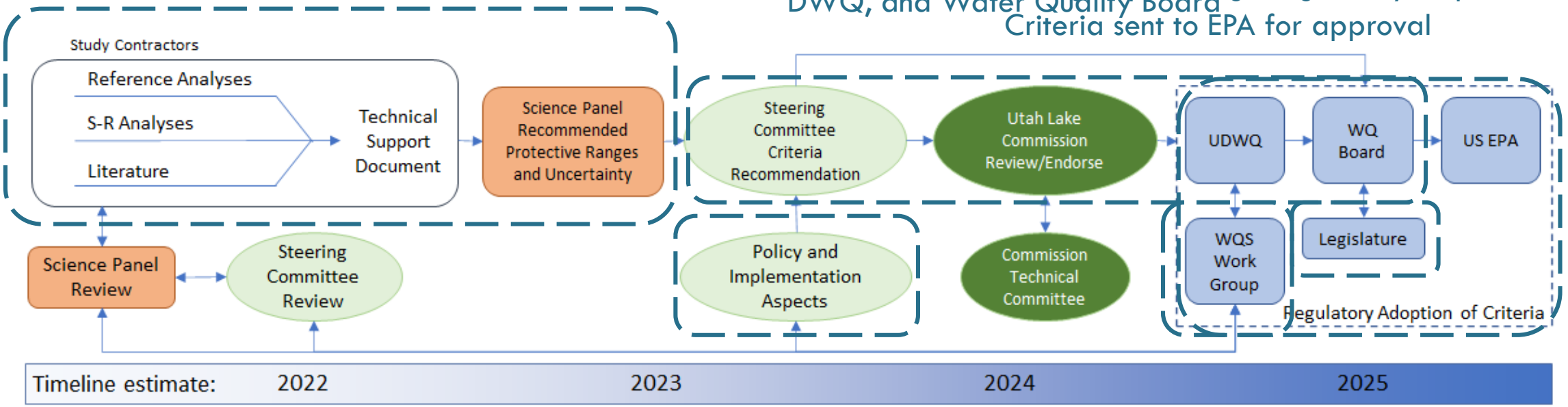


3.0 PATHWAY TO CRITERIA

SP oversees analyses & development of a TSD to recommend TP and TN ranges that protect uses

SC constructs recommended NNC and sends to the Utah Lake Commission, DWQ, and Water Quality Board

Formal criteria adoption: DWQ and WQS workgroup manage regulatory requirements. Criteria sent to EPA for approval



Adapted from ULWQS Stakeholder Process, v. 10

Pursuant to legislation, costs and Water Quality Standards consulted on an ongoing basis to ensure compliance with regulatory requirements

legislative review requirements are evaluated & communicated

DISCUSSION AND QUESTIONS

Science Panel Update

STEERING COMMITTEE 5/26 MEETING

Science Panel Charge

High Level Charge Questions

1. What was the historical condition and how has it changed?
2. What is the current state with respect to nutrients and ecology?
3. What additional information is needed to develop nutrient criteria?
4. Is there an improved stable state that can be reached under current water and fishery management?

Ongoing Studies

- Bioassay Study
- Carbon, Nitrogen, and Phosphorus Budget Study
- Phosphorus-Binding Study
- Paleoecology Studies
- Littoral Sediment Study
- Utah Lake Watershed Model
- Atmospheric Deposition Study
- TSSD Mesocosm Study

Sediment-Water Nutrient Interactions

Primary investigator

Dr. Ramesh Goel, U of U and Dr. Greg Carling, BYU

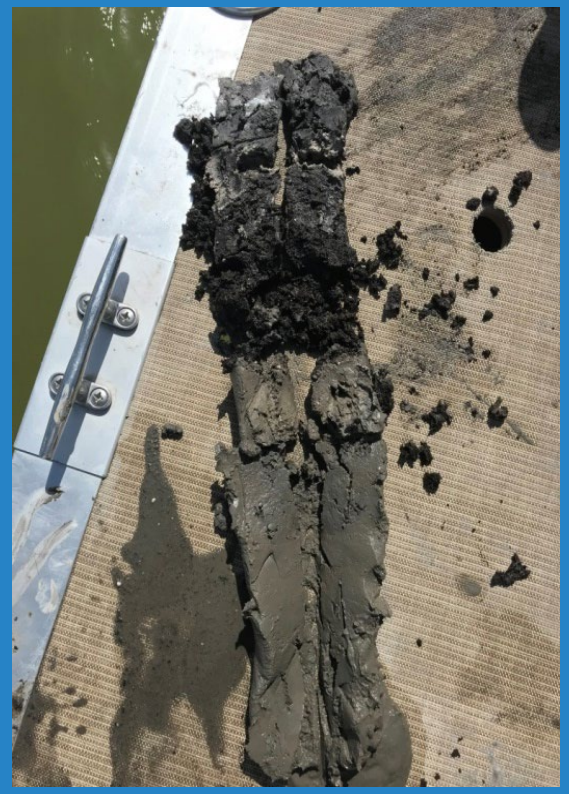
What will it tell us?

- Nutrient fluxes associated with the sediments
- Inform lag time for lake recovery
- Sediment Oxygen Demand (SOD)

Progress report

Completed

Sediment-Water Nutrient Interactions Findings



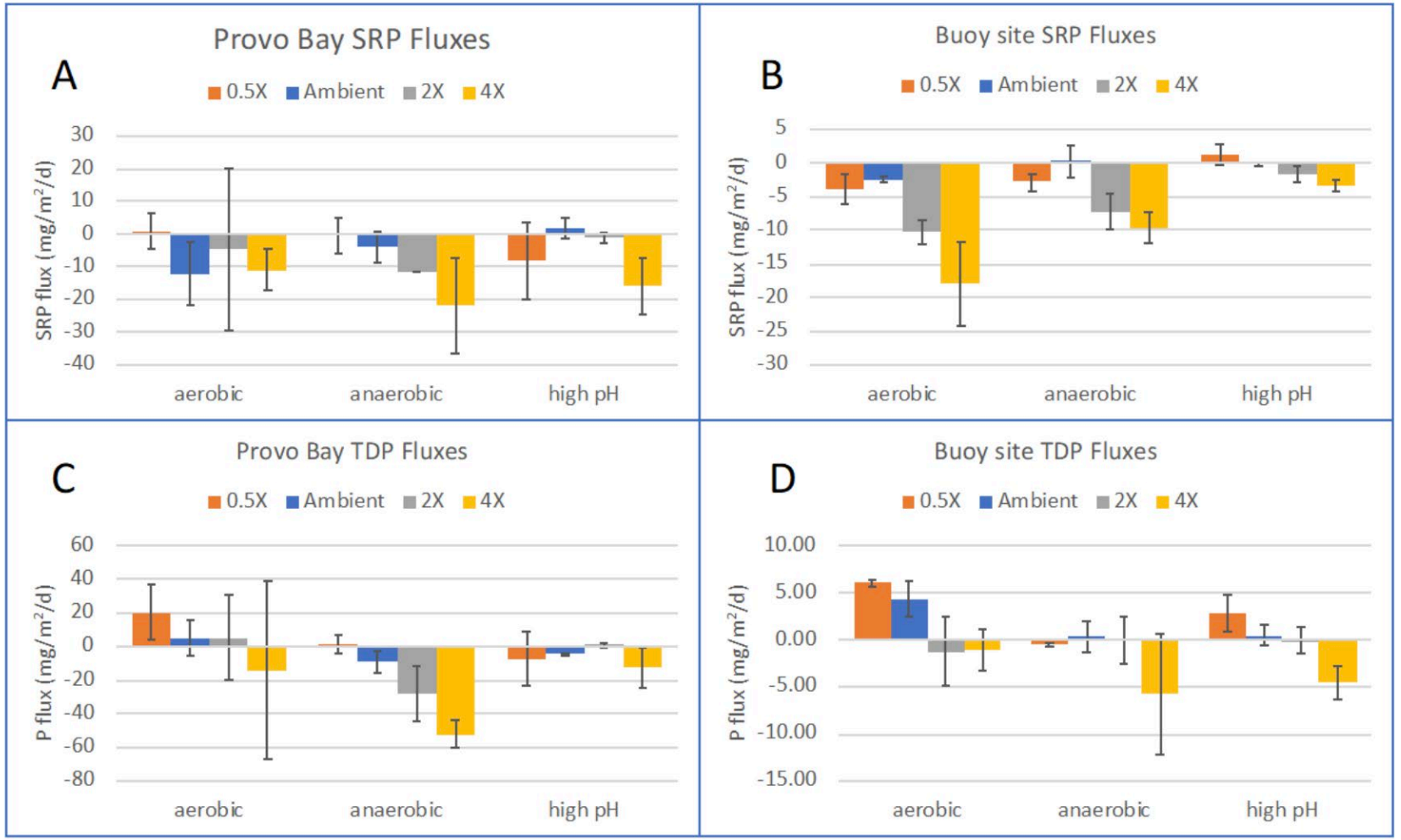


Figure 6. SRP and TDP fluxes under different conditions at two sites.

Bioassay Study

Primary investigator

Dr. Zach Aanderud, BYU

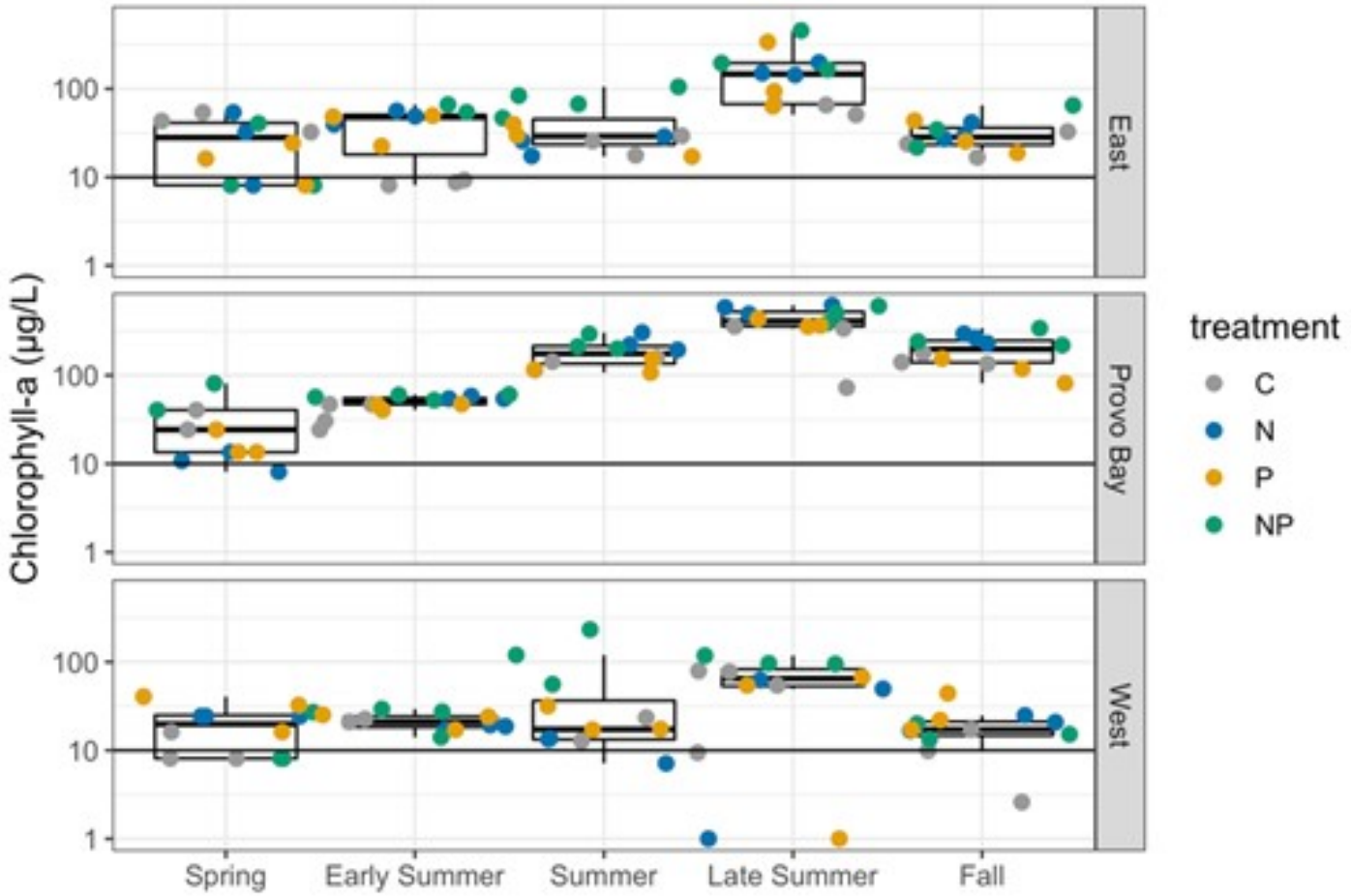
What will it tell us?

- How algal and cyanobacterial communities seasonally and spatially respond to varying levels of nitrogen and phosphorus concentrations
- Whether nitrogen, phosphorus, or both are limiting algal and cyanobacterial growth

Progress report

Final report is completed and under final review from the Science Panel

Bioassay Study Findings



Bioassay Study Findings

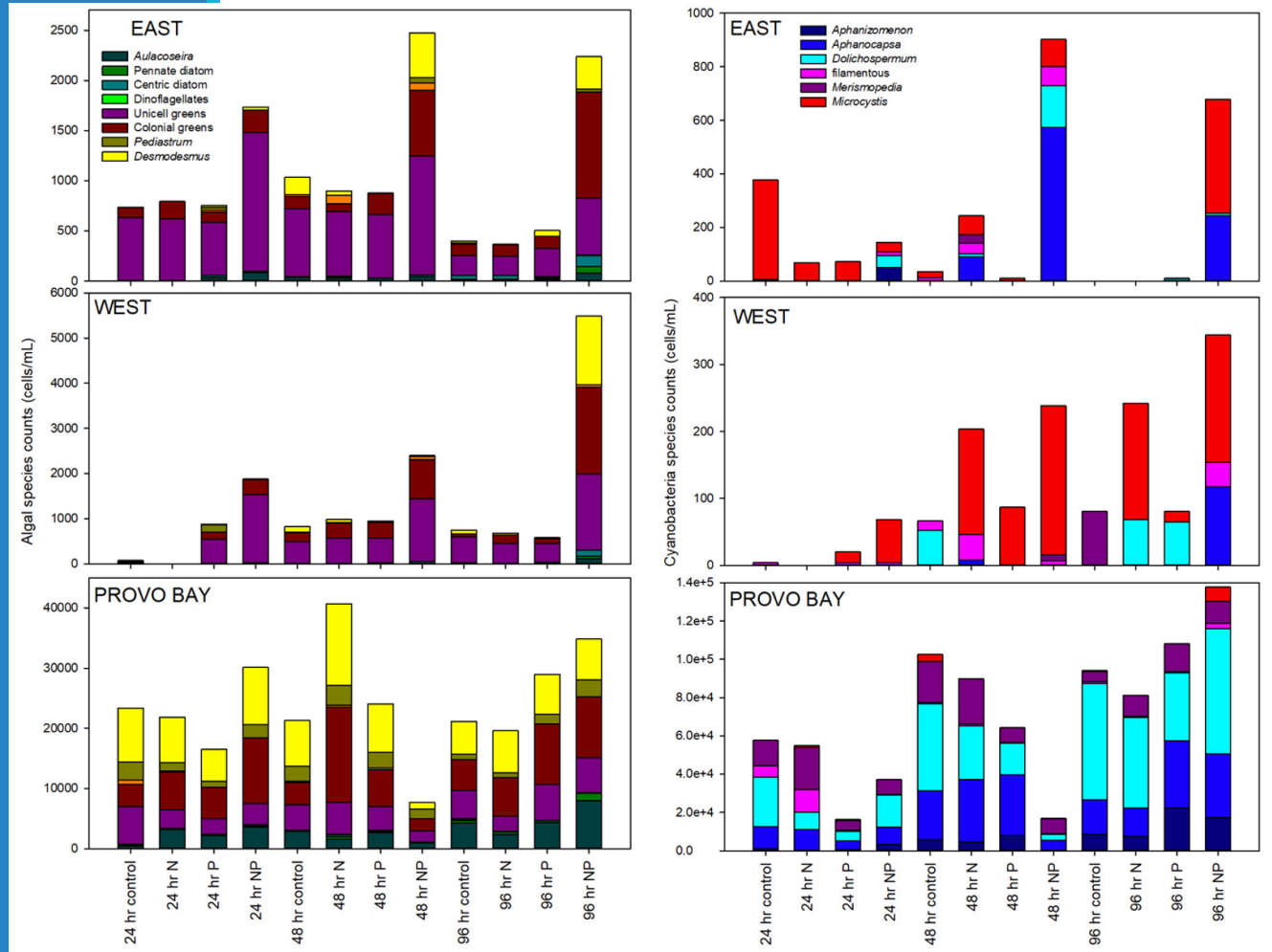


Figure 14. The abundance (cells/mL) of phytoplankton and cyanobacteria species and categories in the nutrient additions through the 96-hour time series. Values are presented as stacked bars from direct microscopy counts (n=2).

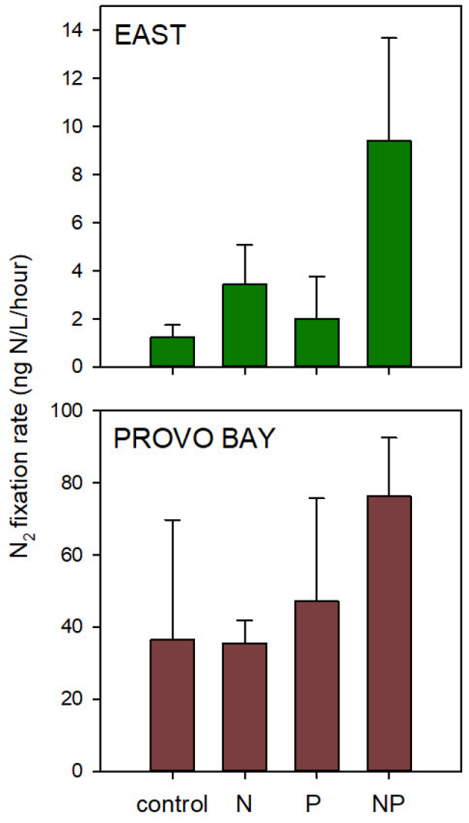


Figure 11. N_2 fixation rates in the three nutrient treatments and a control across the three lake locations in the early summer. Values are based on acetylene reduction assay (n=3).

Carbon, Nitrogen, and Phosphorus Budget Study

Primary investigator

Dr. Kateri Salk, Tetra Tech

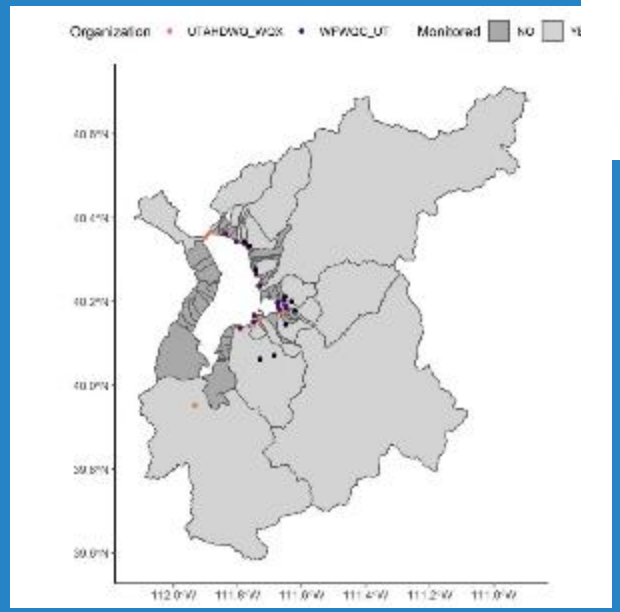
What will it tell us?

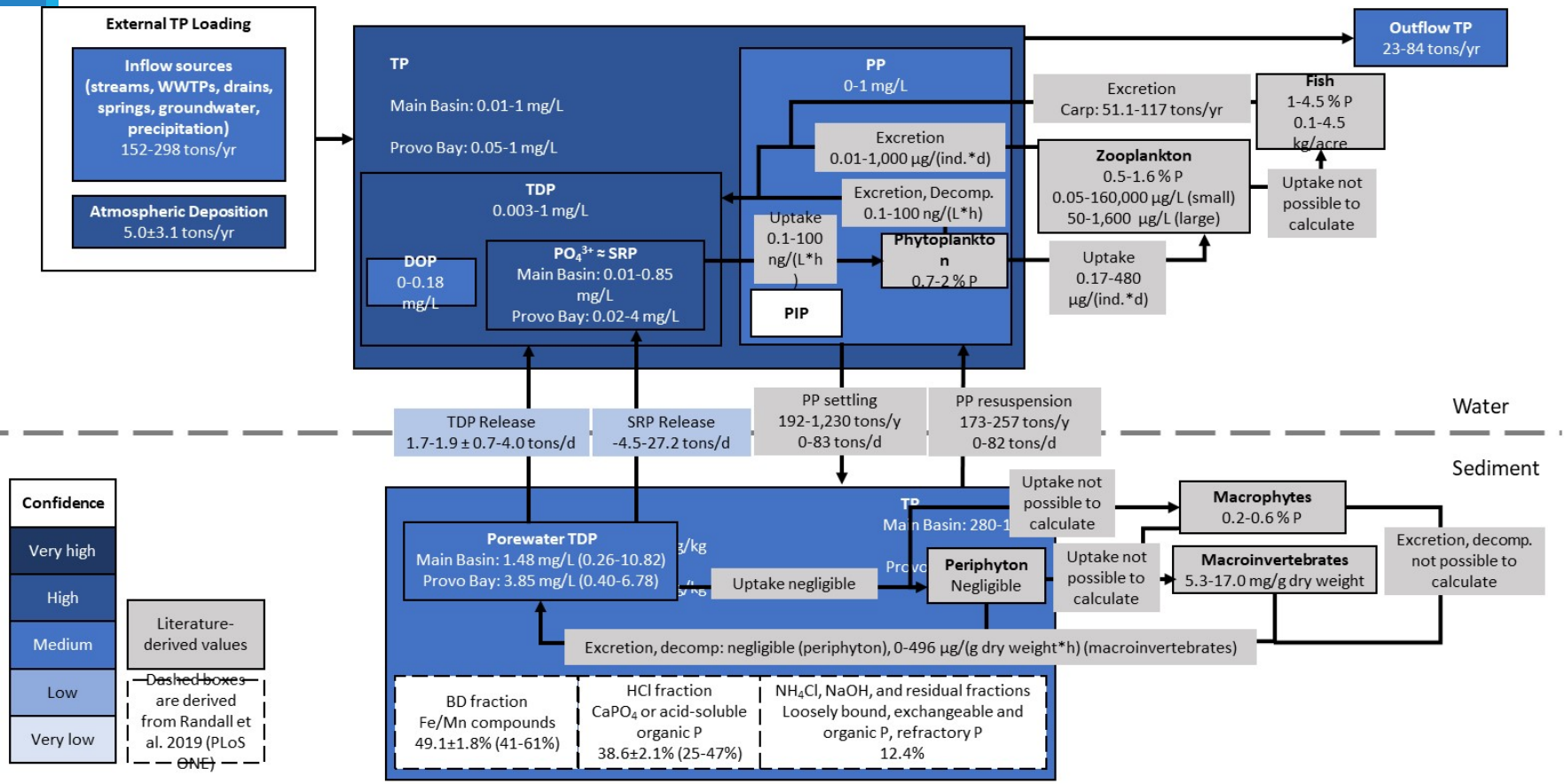
The nutrient loads and amount of water leaving and entering Utah Lake on an annual basis

Progress report

- Kateri Salk is building the Carbon, Nitrogen, and Phosphorus Budget study model for Science Panel evaluation.
- Target completion date – June 30, 2021

Carbon, Nitrogen, and Phosphorus Study Preliminary Findings





Phosphorus-Binding Study

Primary investigator

Dr. Josh LeMonte, BYU

What will it tell us?

- How phosphorus molecules interact with other molecules (e.g., calcium) once they are in Utah Lake
- How interactions between phosphorus and other molecules affect how much phosphorus is available for living organisms (e.g., algae and cyanobacteria)

Progress report

- Josh LeMonte and his research team are conducting the literature review and developing the sampling plan to collect samples this summer.
- Target completion date – March 2022

Paleoecology Studies

Primary investigator

Dr. Janice Brahney, Utah State University

Dr. Soren Brothers, Utah State University

What will it tell us?

The historic conditions and nutrient concentrations of Utah Lake and how major events impacted the conditions of Utah Lake.

Progress report

- Janice Brahney and Soren Brothers have collected the data and are in the process of analyzing it.
- Target completion date – January 2022

Paleoecology Studies Preliminary Findings

Initial Cores Description

Bird Island

Goshen Bay

Lighter

Darker

*Goshen was sectioned for eDNA

Provo Bay 2

North Core

Littoral Sediment Study

Primary investigator

To be determined

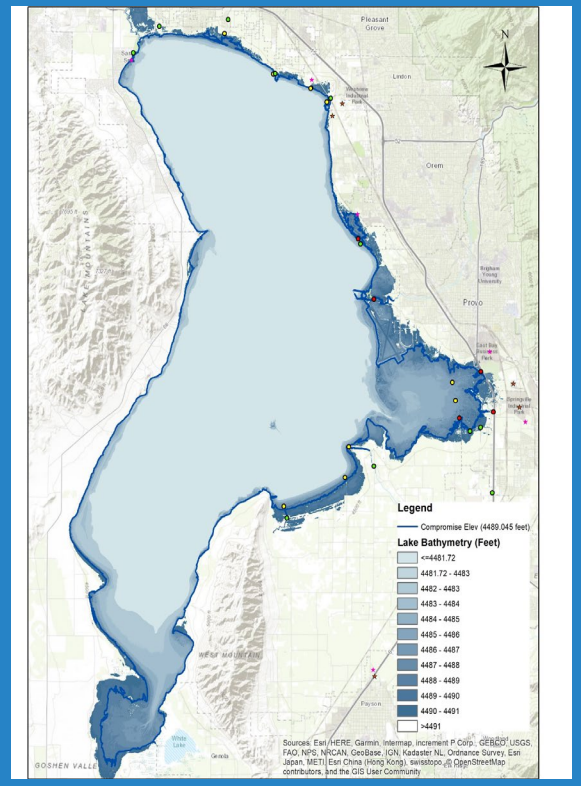
What will it tell us?

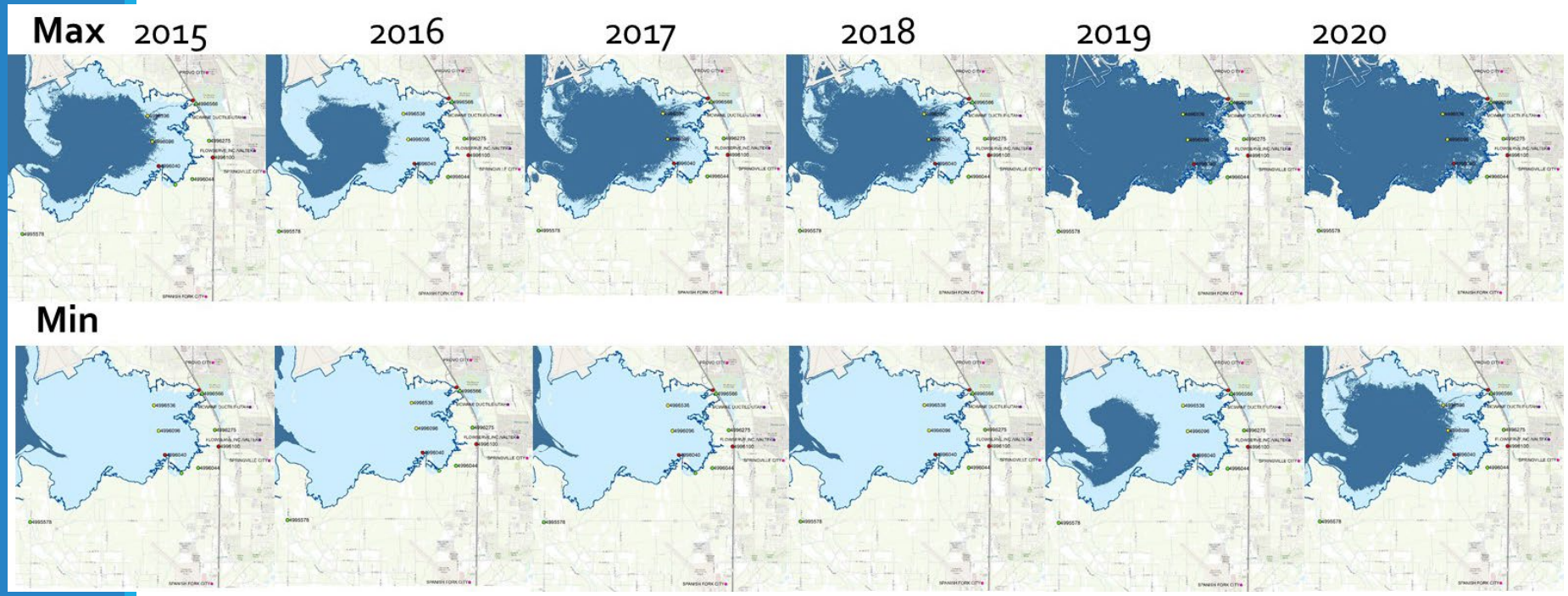
How the wetting and drying of sediments due to changing lake levels affects nutrient cycling

Progress report

- Division of Water Quality is finalizing an agreement with the primary investigator
- Target completion date – February 2022

Littoral Sediment Study





Atmospheric Deposition Study

Primary investigator

Wasatch Front Water Quality Council

What will it tell us?

Provide estimates of the wet and dry deposition to the surface of Utah Lake from the atmosphere

Progress report

Science Panel will review the results of the study soon.

Lake Mesocosms

Primary investigator

Timpanogos Special Services District (TSSD)

What will it tell us?

- Effects of carp on nutrient cycling
- Effects of carp on zooplankton and phytoplankton
- Effects of carp on macrophytes
- Effects of turbidity on primary producers
- Role of macrophytes on biogeochemistry

Progress report

TSSD researchers installed mesocosms and are developing the research plan.

Utah Lake Watershed Model

Primary investigator

To be determined

What will it tell us?

Synthesize information from all Science Panel studies to model nutrient loading and cycling in Utah Lake

Progress report

Division of Water Quality and Science Panel members are reviewing submitted proposals.

Utah Lake Watershed Model

UTAH LAKE HYDRODYNAMIC (EFDC) AND WATER QUALITY (WASP) MODEL REPORT

IN SUPPORT OF EPA PROJECT NUMBER 835866-01: PREDICTION OF NONLINEAR CLIMATE VARIATIONS IMPACTS ON EUTROPHICATION AND ECOSYSTEM PROCESSES AND EVALUATION OF ADAPTATION MEASURES IN URBAN AND URBANIZING WATERSHEDS

University of Utah
Department of Civil and Environmental Engineering

Prepared For:
Division of Water Quality
Utah Department of Environmental Quality
195 North 1950 West
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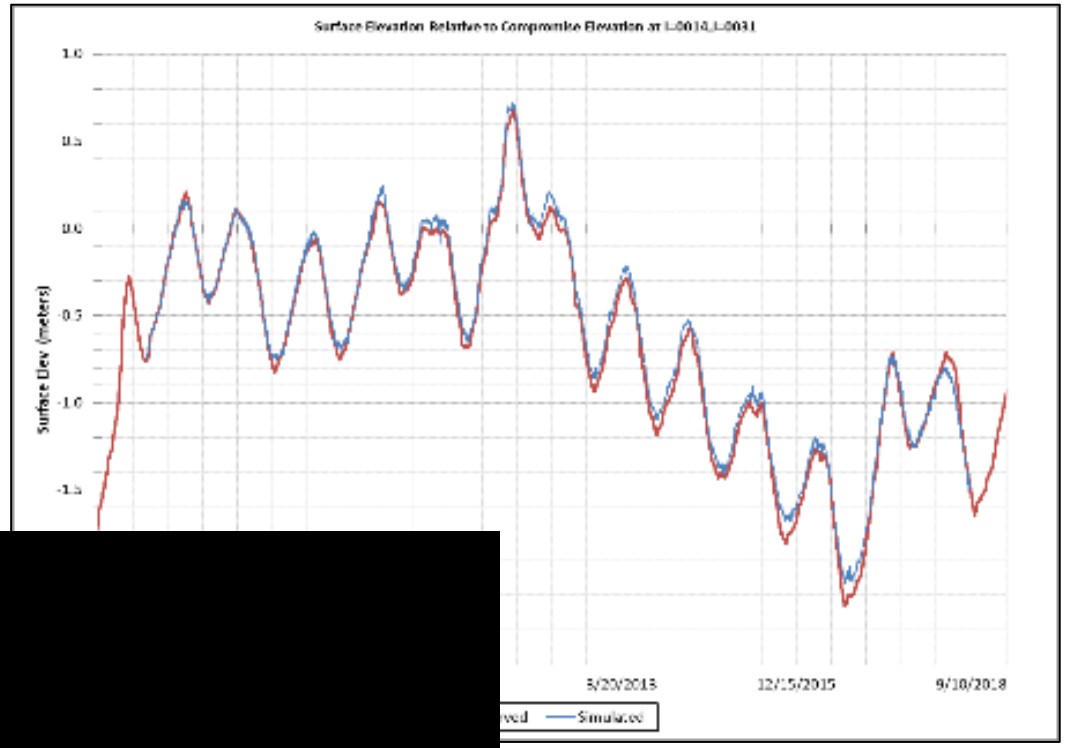
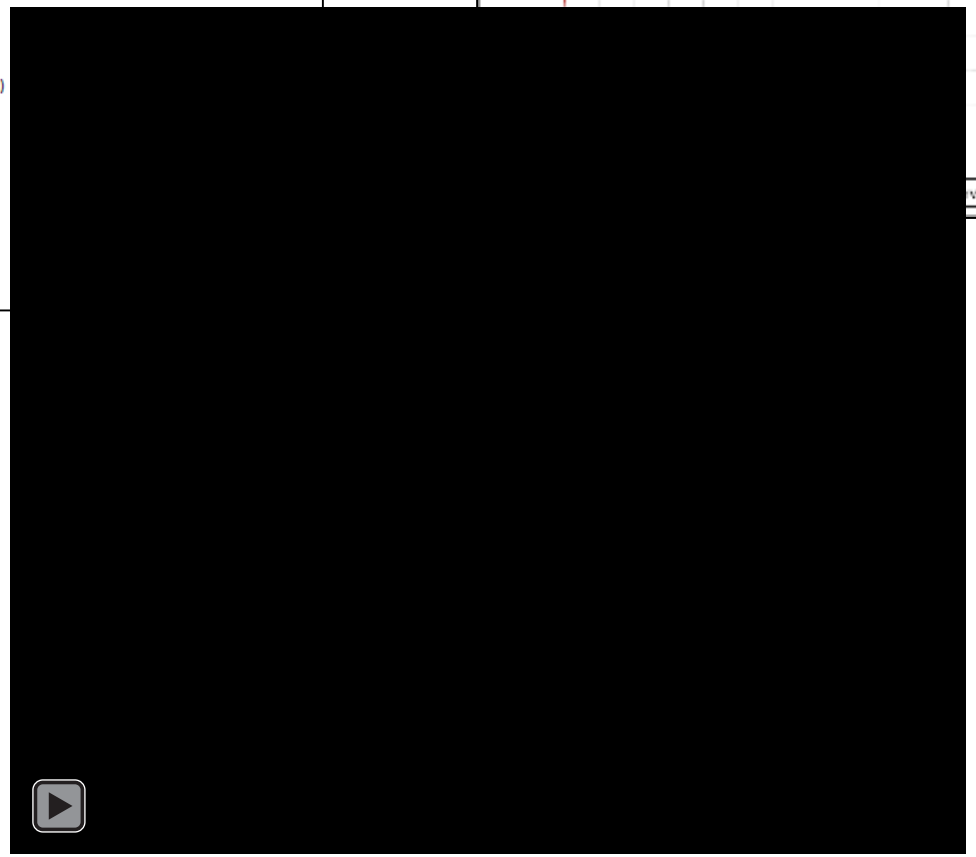
Salt Lake City, UT

Advisor: Dr. Michael E. Barber

June 30, 2020 (Revised from the April 9, 2020 Version)





Next Steps – Progress Report

Primary investigator

Science Panel

What will it tell us?

- Assess information and data available to answer Steering Committee Charge Questions
- Develop responses to each question
- Identify remaining knowledge gaps

Progress report

The Science Panel will initiate this effort at their June 10, 2021 meeting.