Colorado River Environmental Models (CREMs)

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LCRA Water Quality Protection

Colorado River Environmental Models: Overview

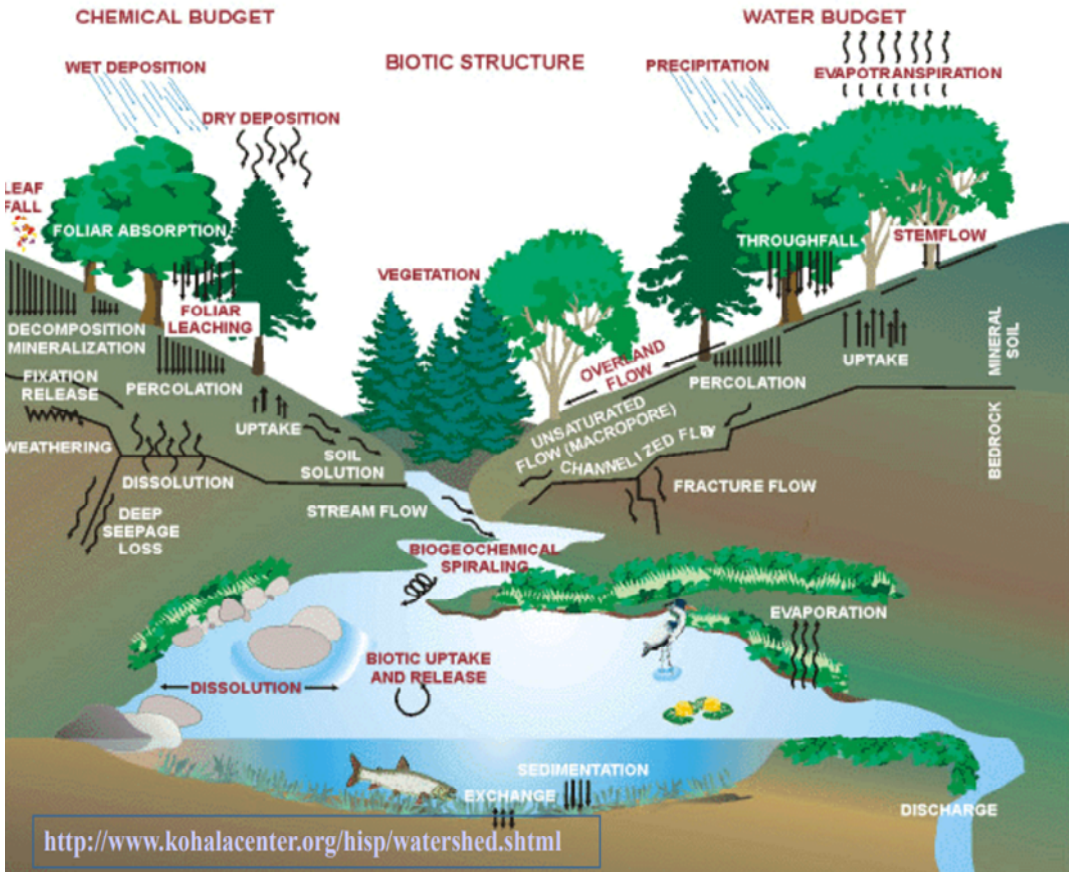
- What are the Colorado River Environmental Models (CREMs) and why are they important?
- A brief look at how and why CREMs was created
- Data collected to create and check the models
- How the watershed and lakes are modeled
- What these models help us understand

Motivation for CREMs: What is a model?

- Simplified representation of the real world
- Conceptual model: qualitative representation
- Mathematical: quantitative representation
- Clearer picture of the water quality
- Benefits: gain understanding, prediction, cost benefits

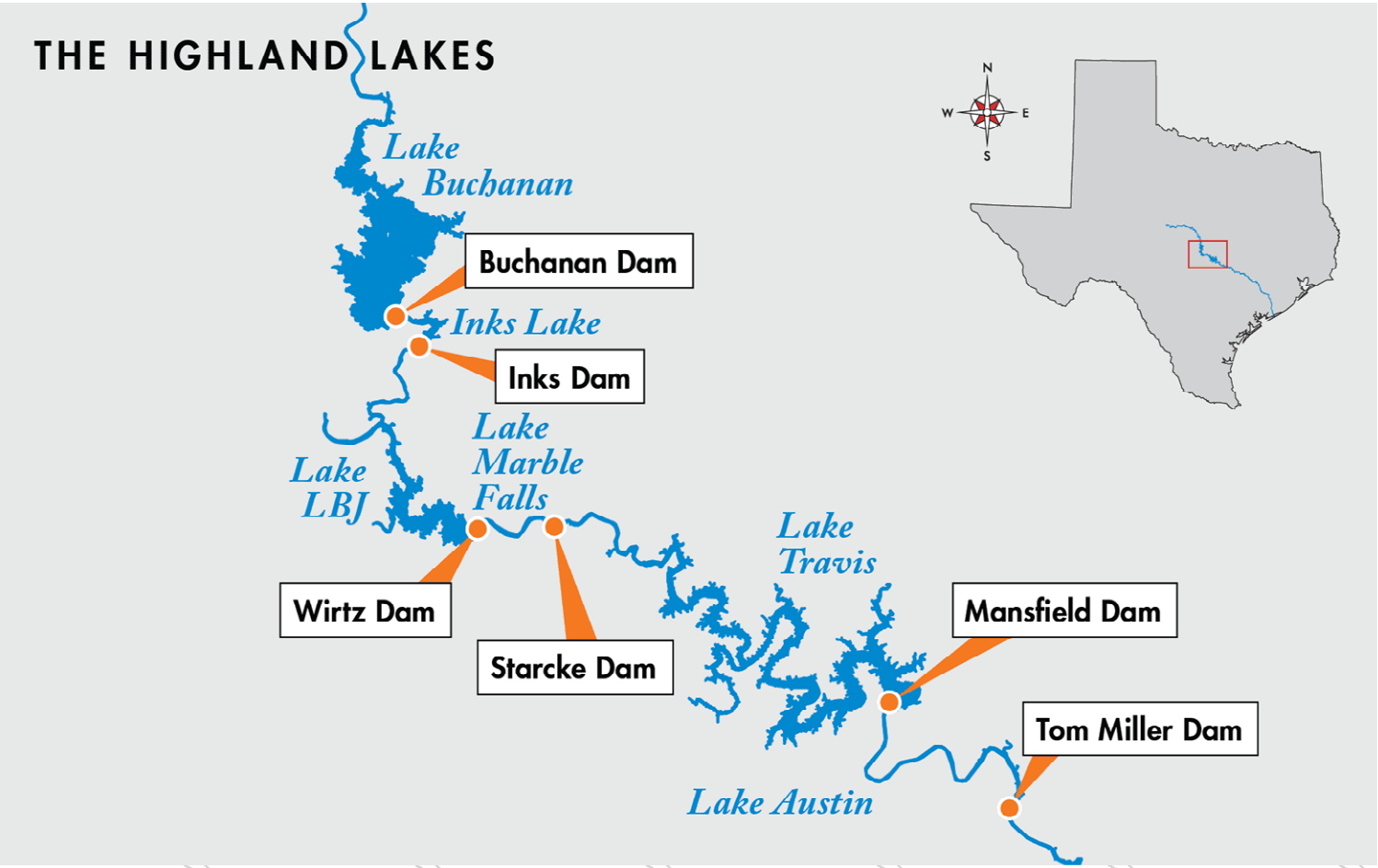
CREMs Benefits: Understanding, Prediction, Cost

- Better understand how watersheds and water bodies respond to change
- Simulation of complex interactions difficult to observe directly
- Cost benefit in long run
- Not possible to monitor something that has not yet occurred



What are the Colorado River Environmental Models?

- A set of simulation models to help us understand how water moves and changes in:
  - Highland Lakes
  - Respective watersheds
- These models show how conditions vary over time and in different parts of the lakes, and the watersheds that feed the lakes



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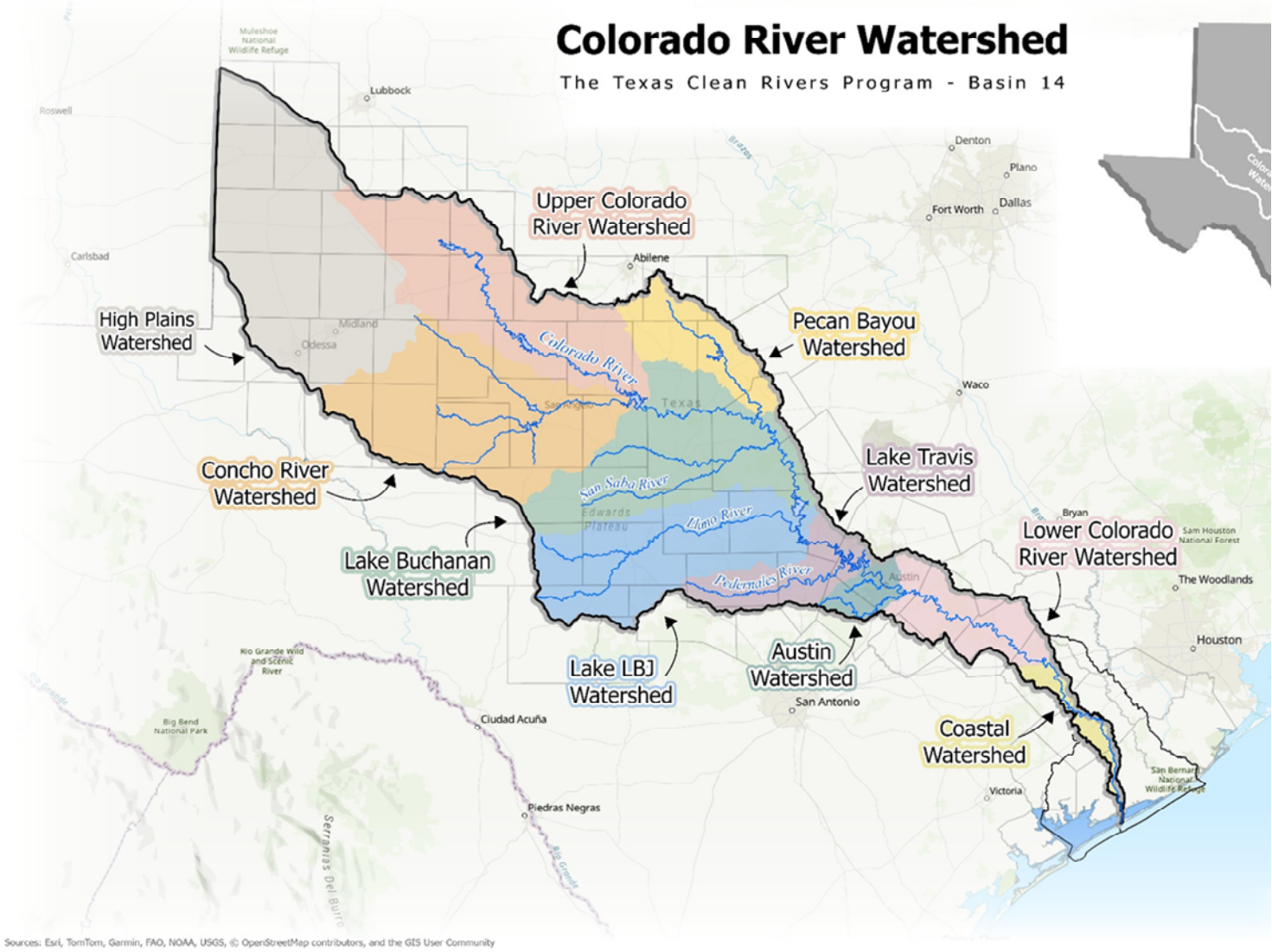

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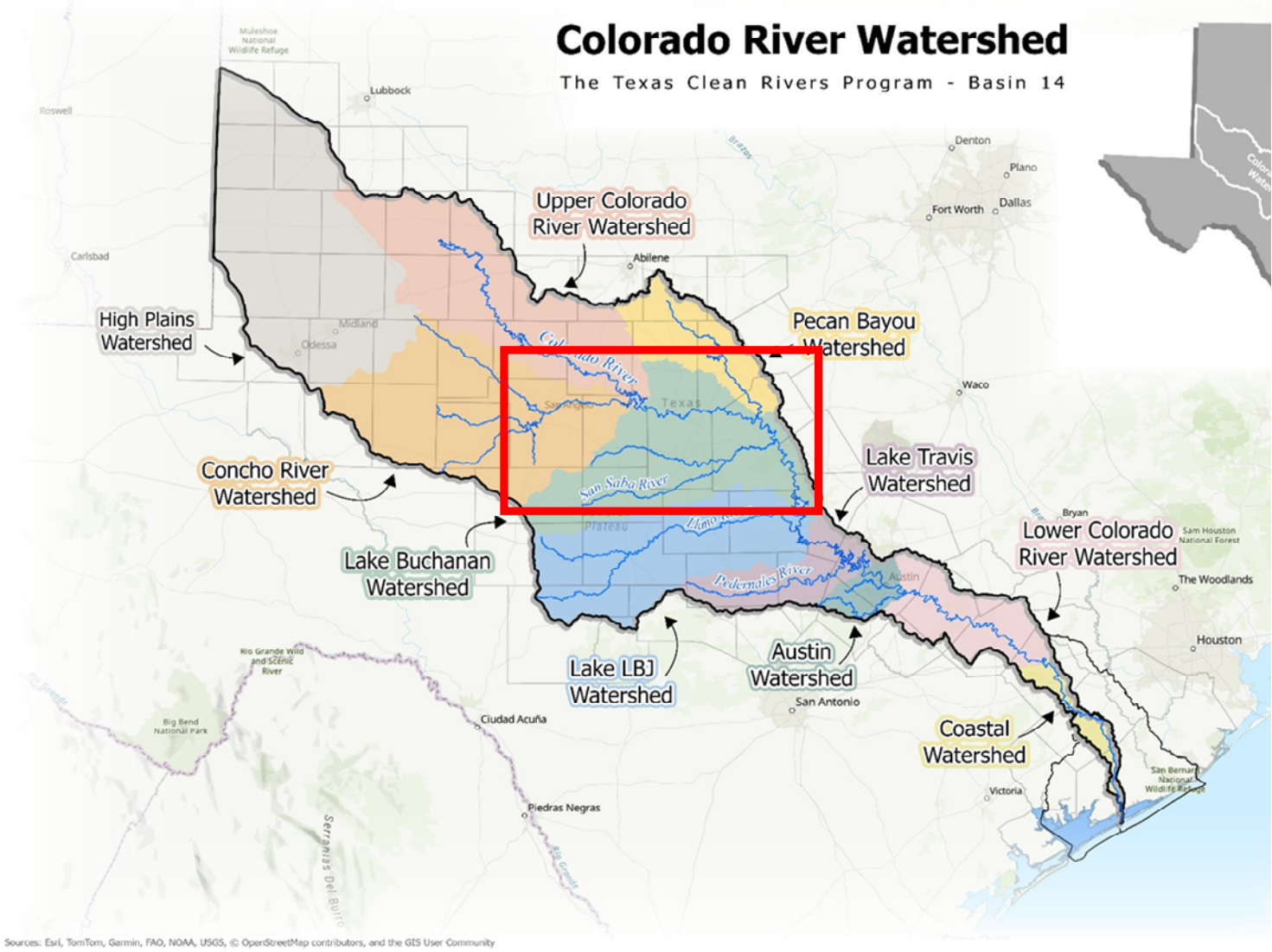

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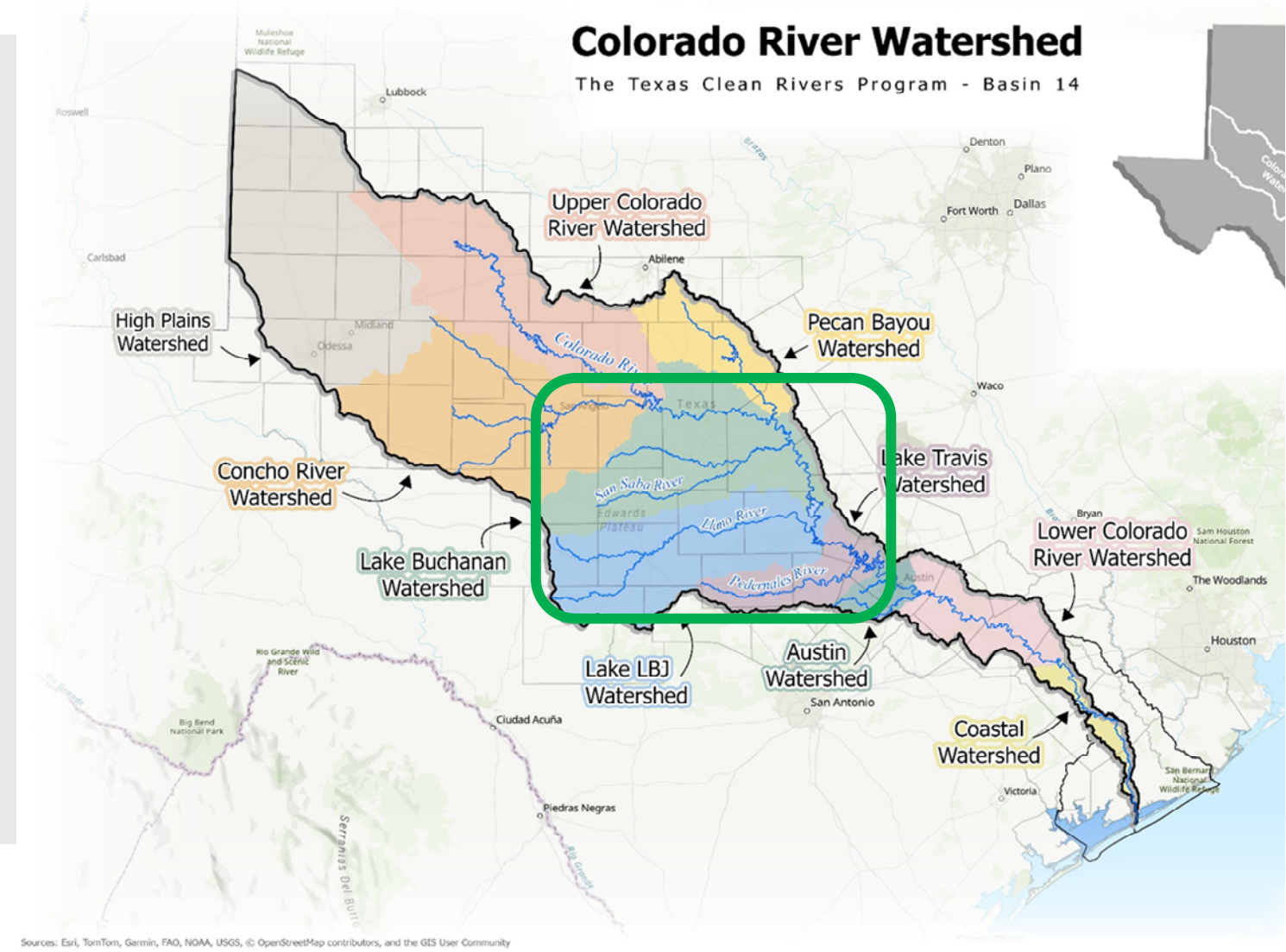
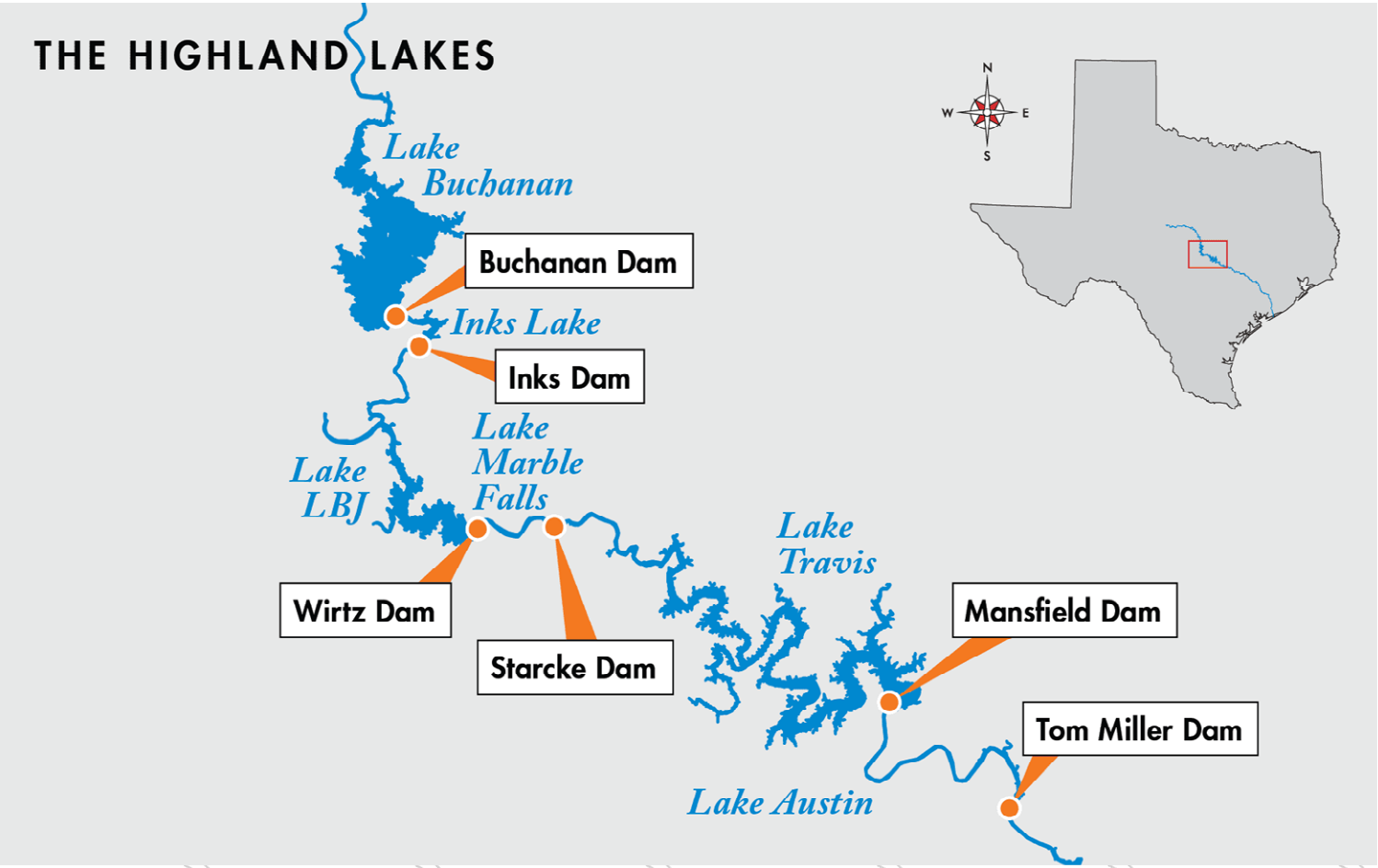


Why was CREMs created?

- Identify water quality problems
- Understand long-term trends
- Predict how land development, changes in water use, or pollution controls might affect the health of the lakes



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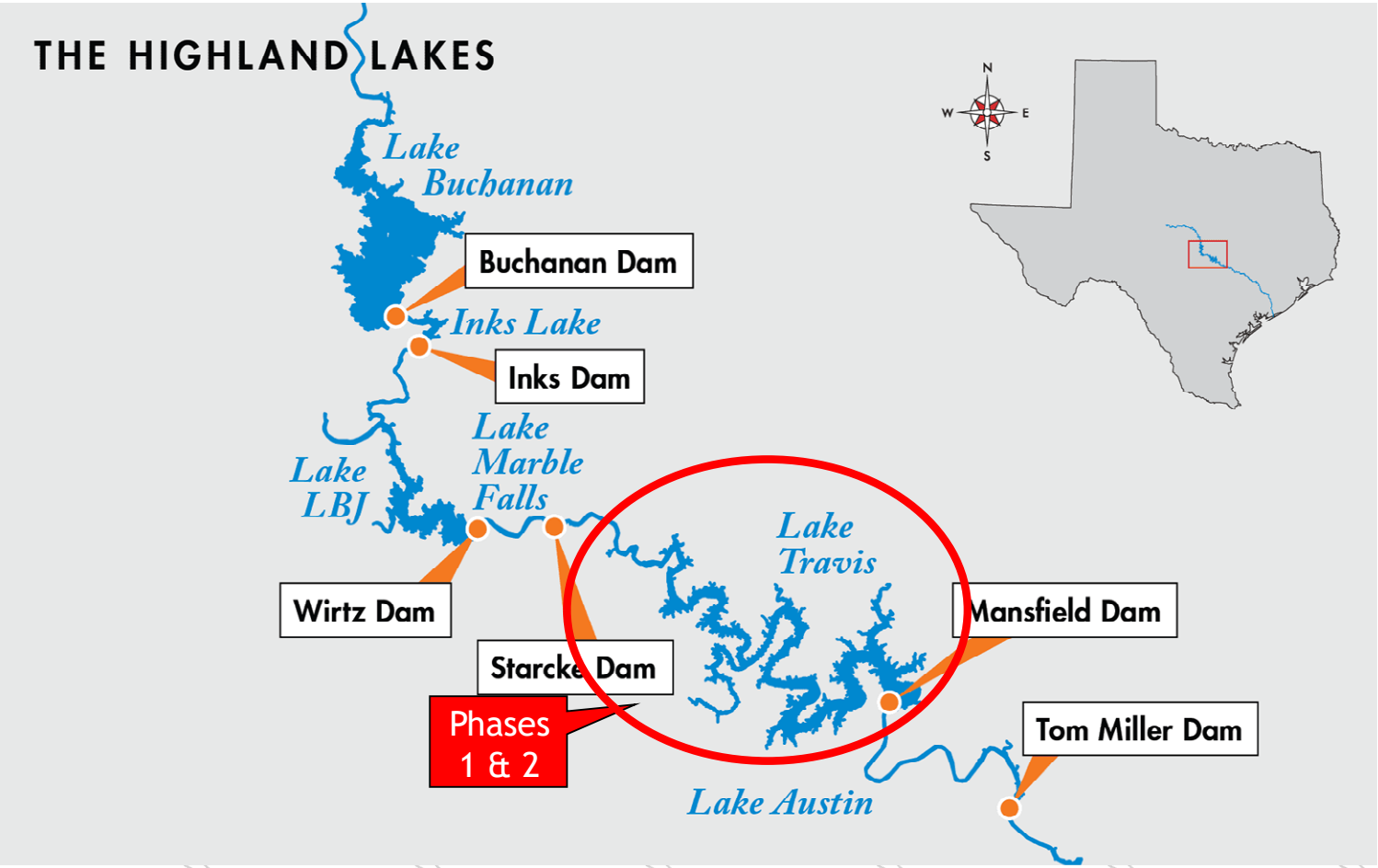

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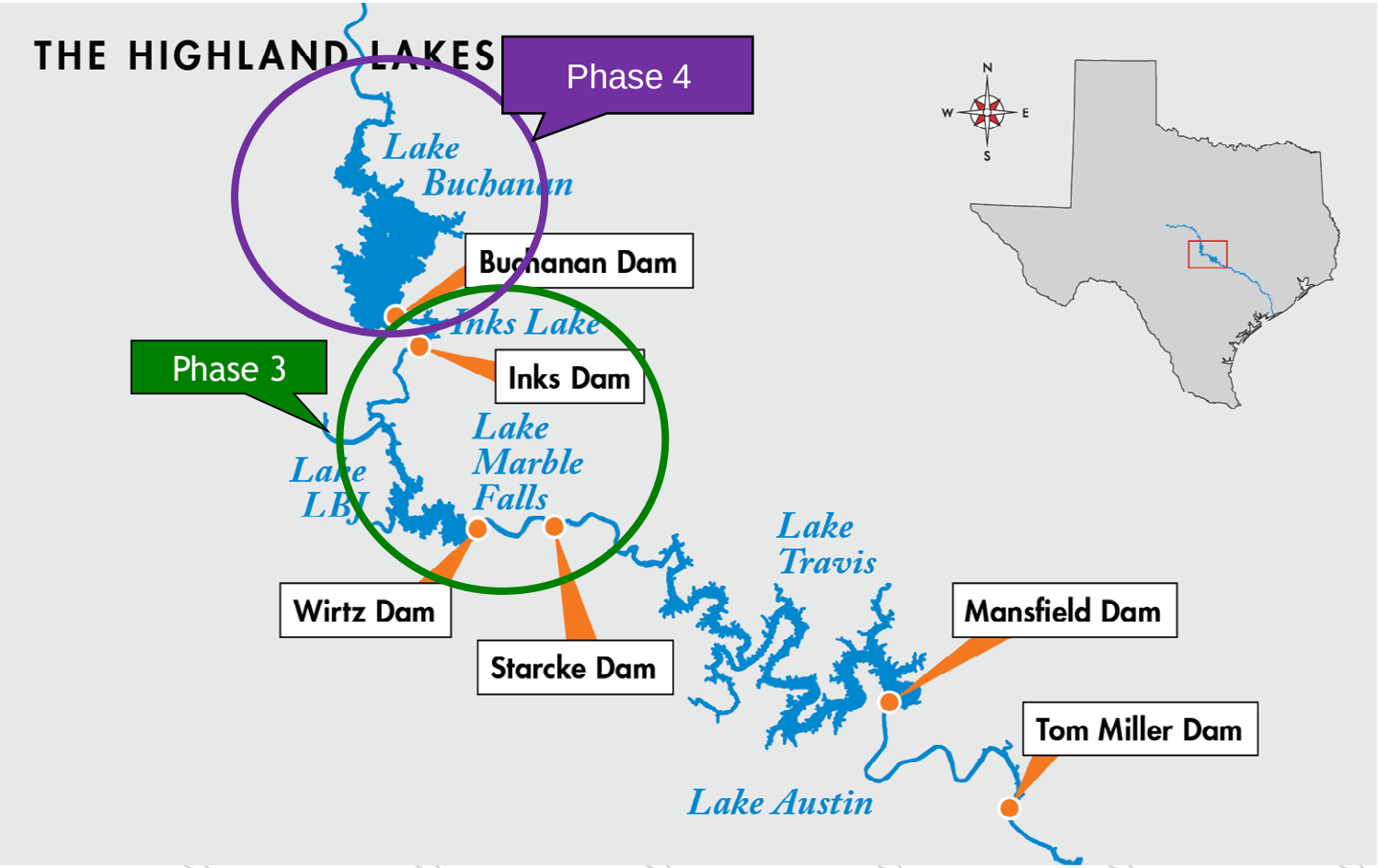
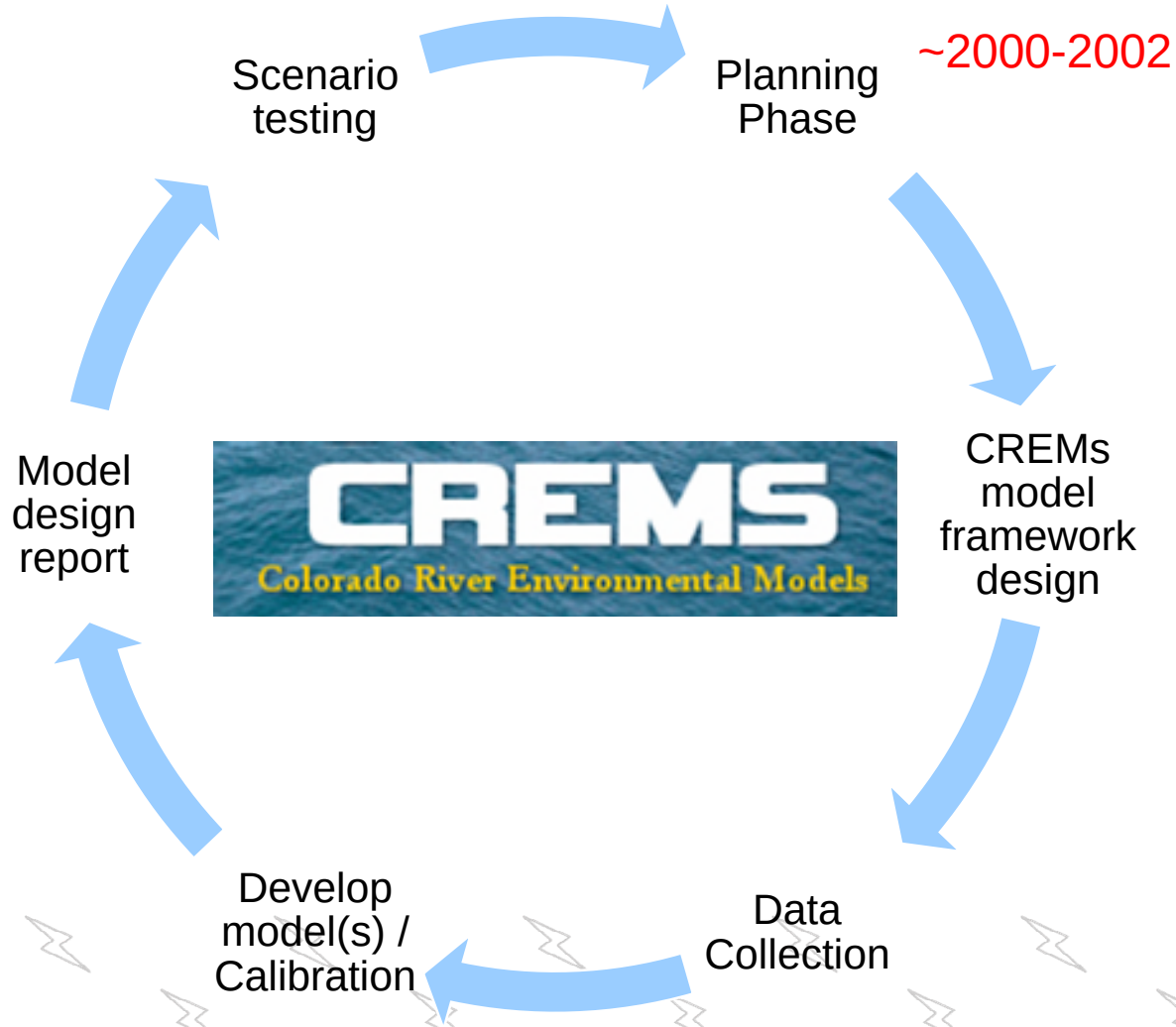


Colorado River Environmental Models: Life Cycle

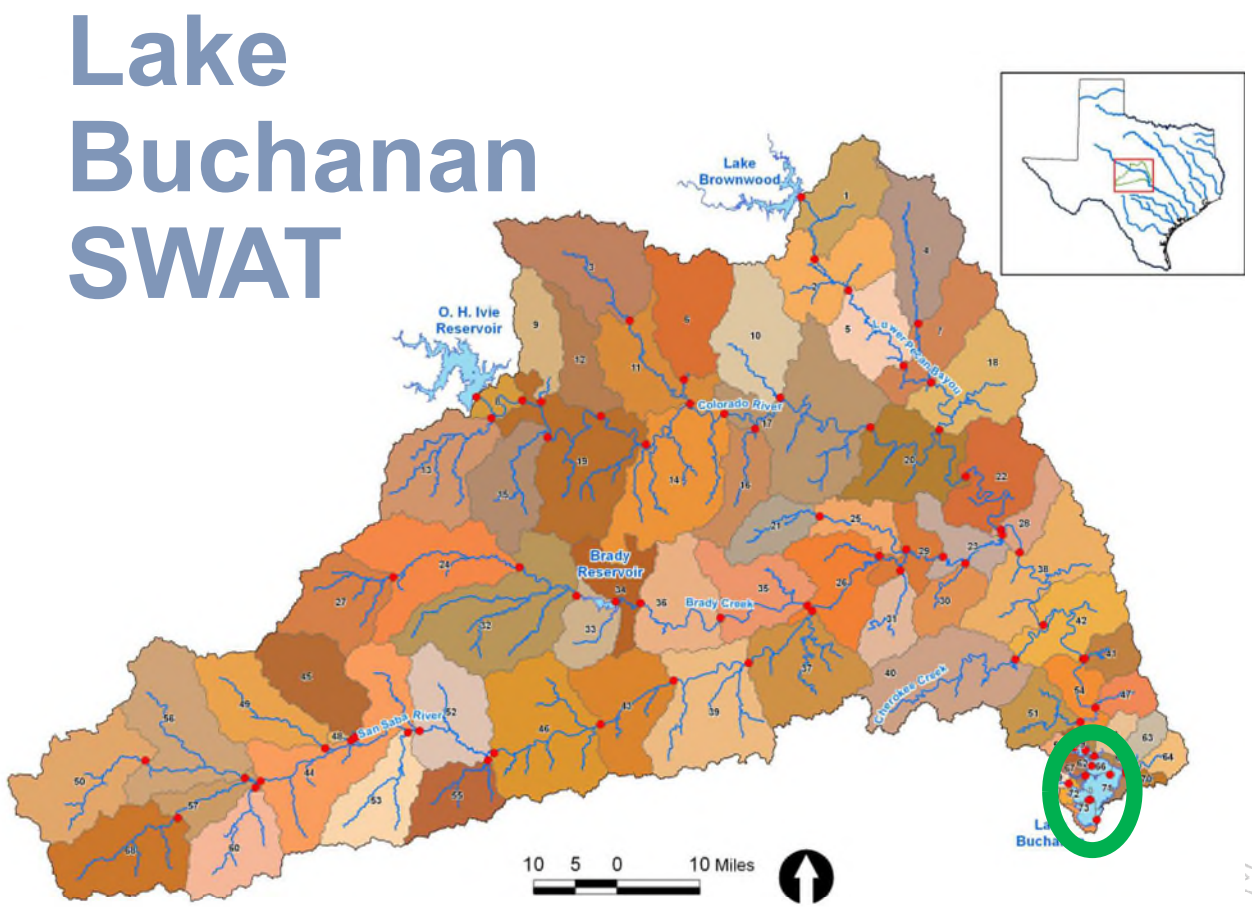


Phases 1-2: Lake Travis

- How land use affects Lake Travis water quality
- Demonstrated how land changes impact the lake
- Need for more data collection
- More advanced models:
  - SWAT: watershed
  - CE-QUAL-W2: lakes

Phases 3-4: Buchanan to Marble Falls

- Same approach as Lake Travis
- Separate watershed / reservoir models for each Highland Lake
- Need for more data collection
- Continued collecting data
- Better information for decisions about water quality



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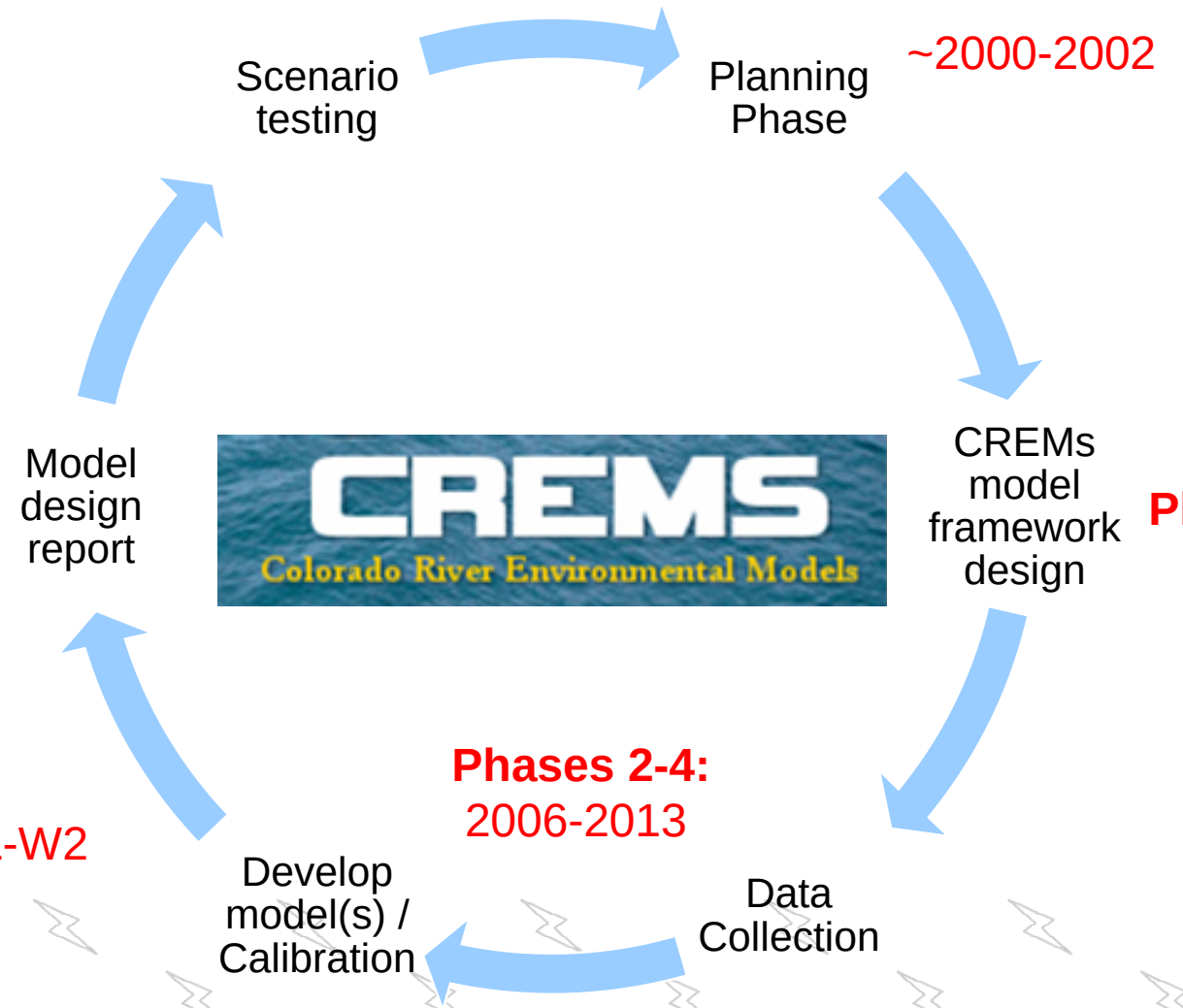
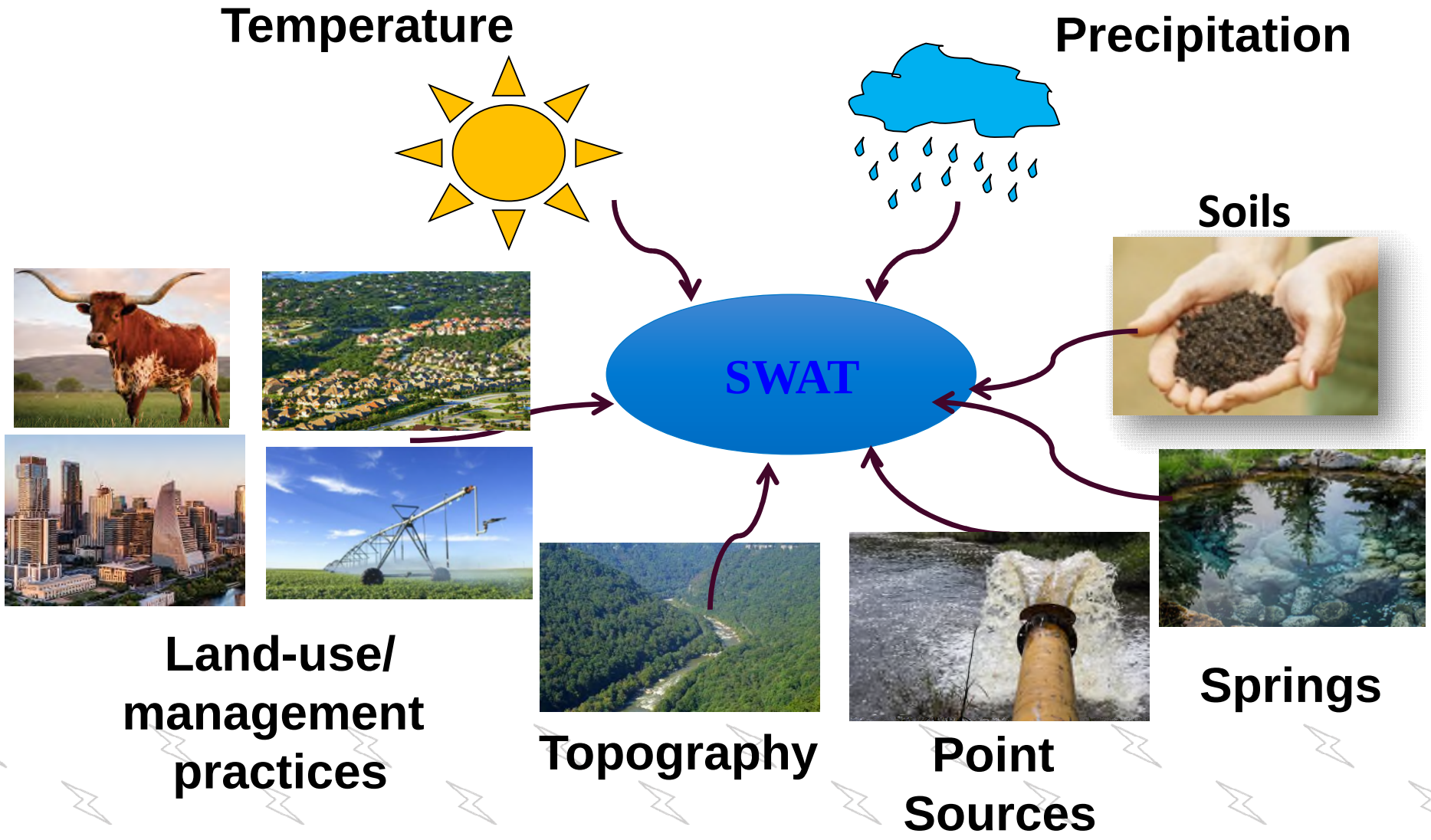
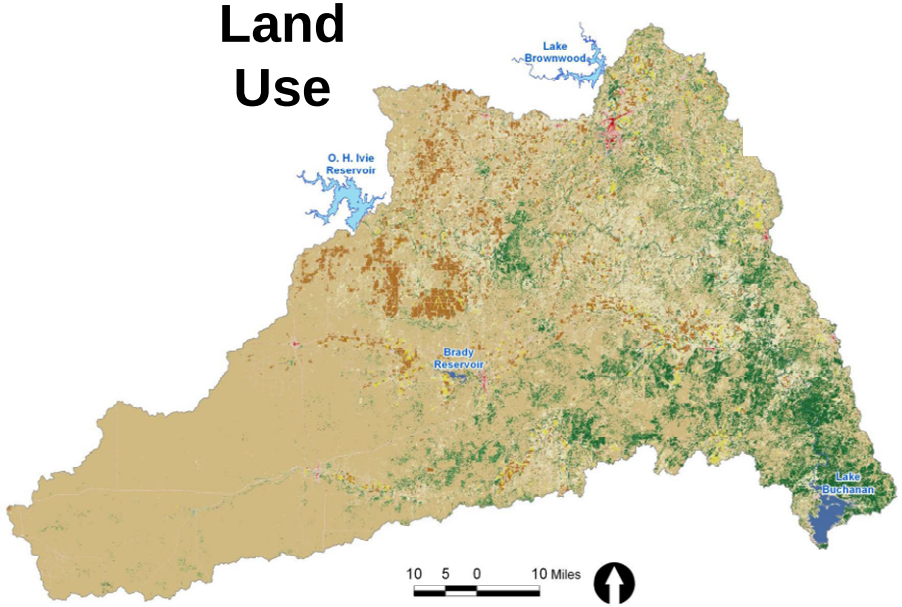


CREMs Watershed Models: SWAT

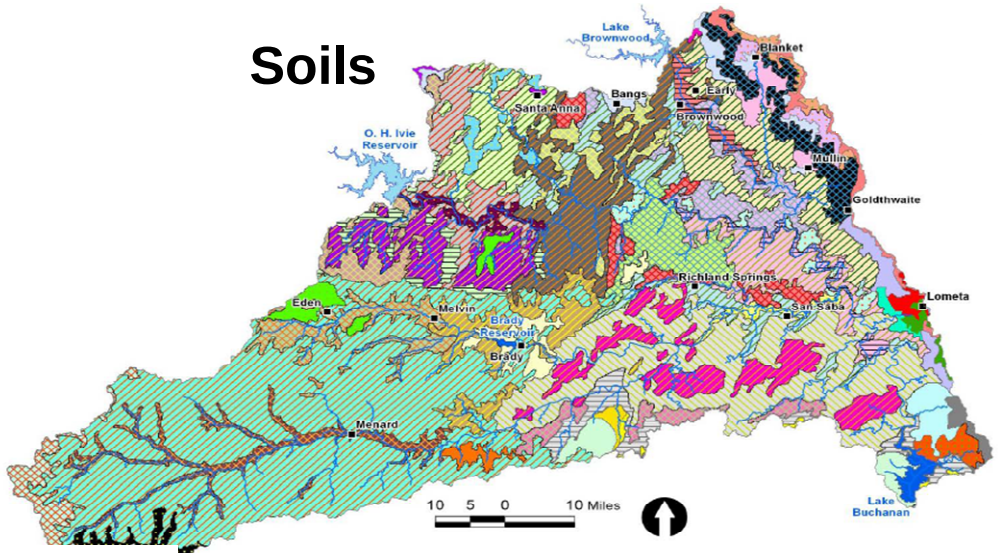


CREMs Watershed Models: SWAT

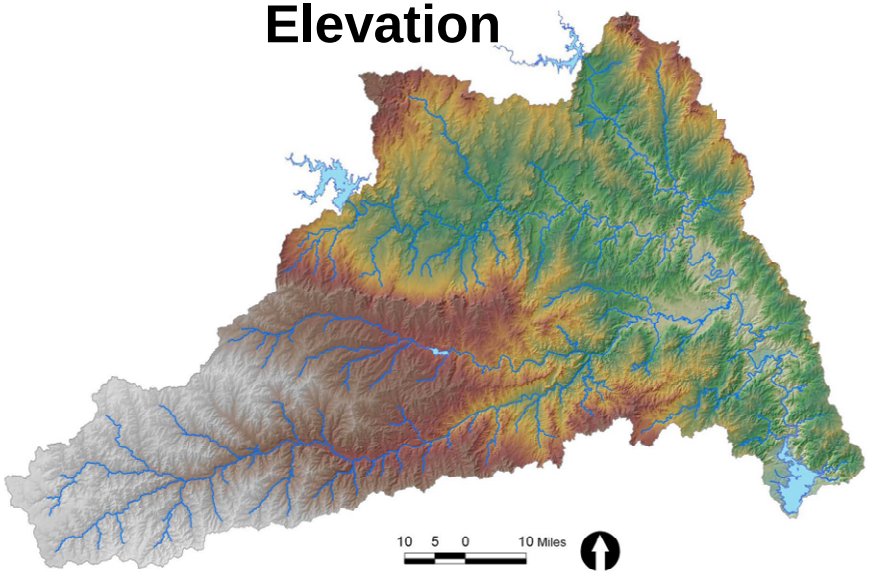
Land Use



Soils



Elevation



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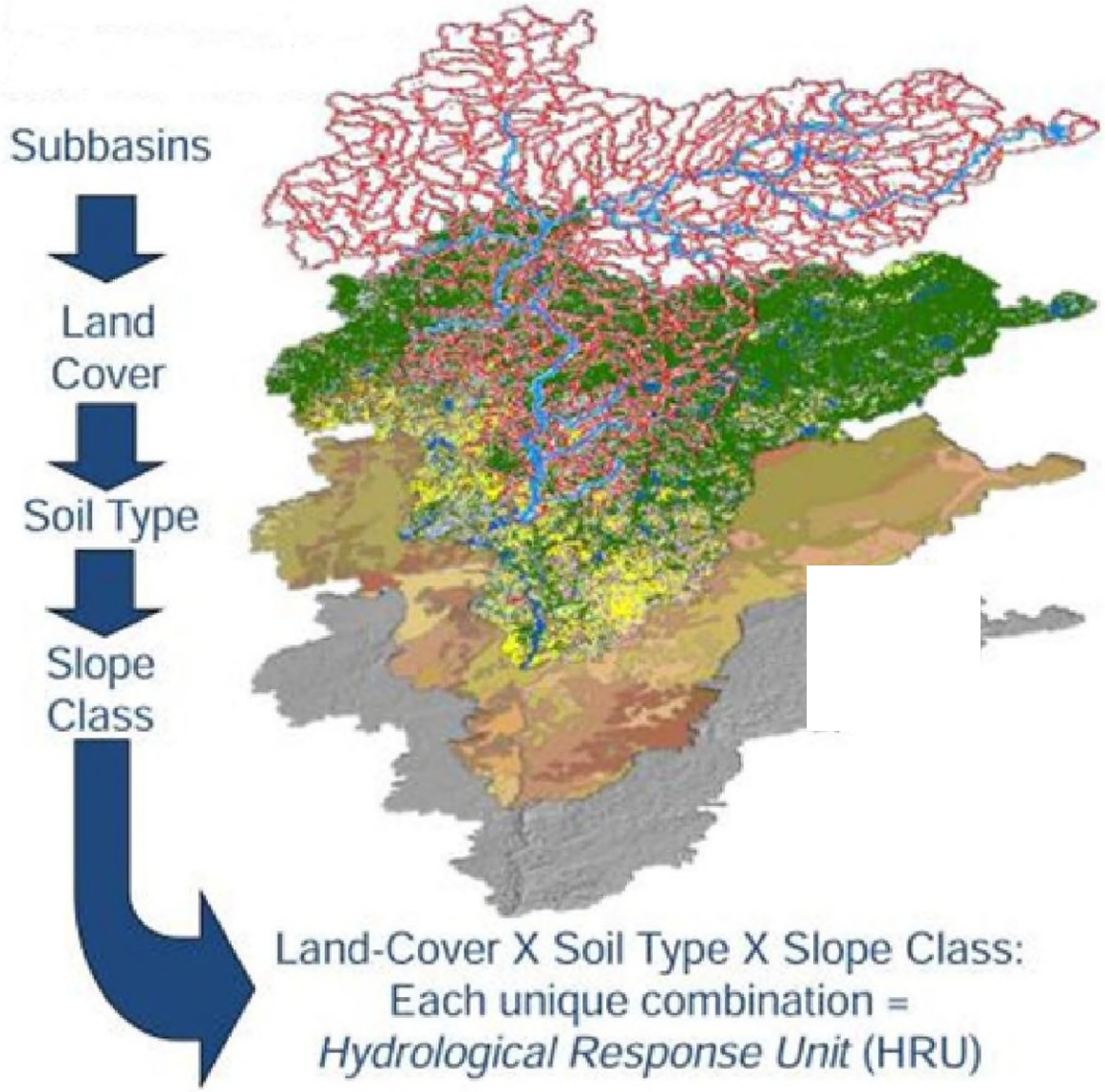
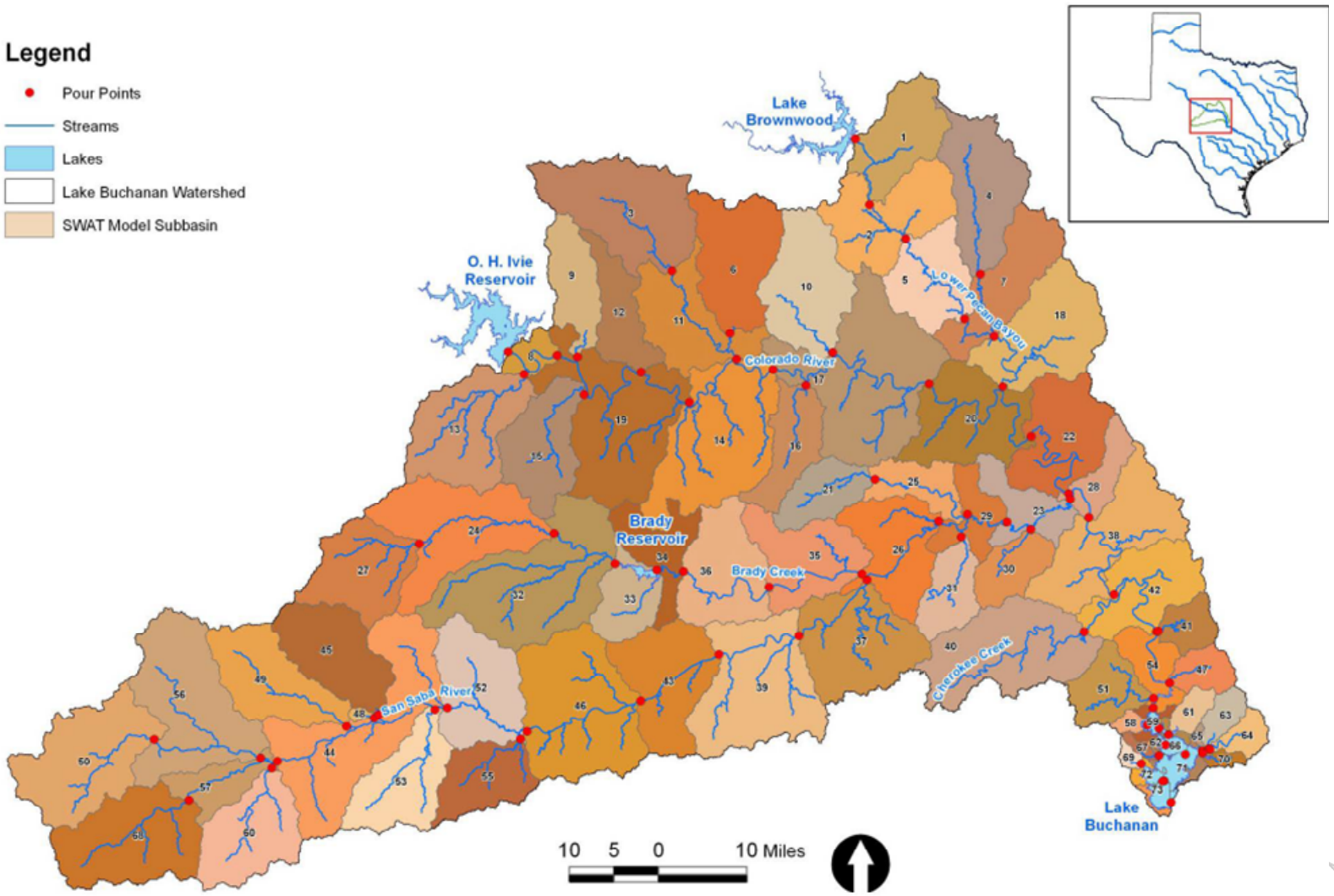


SWAT: Calibrate and Output



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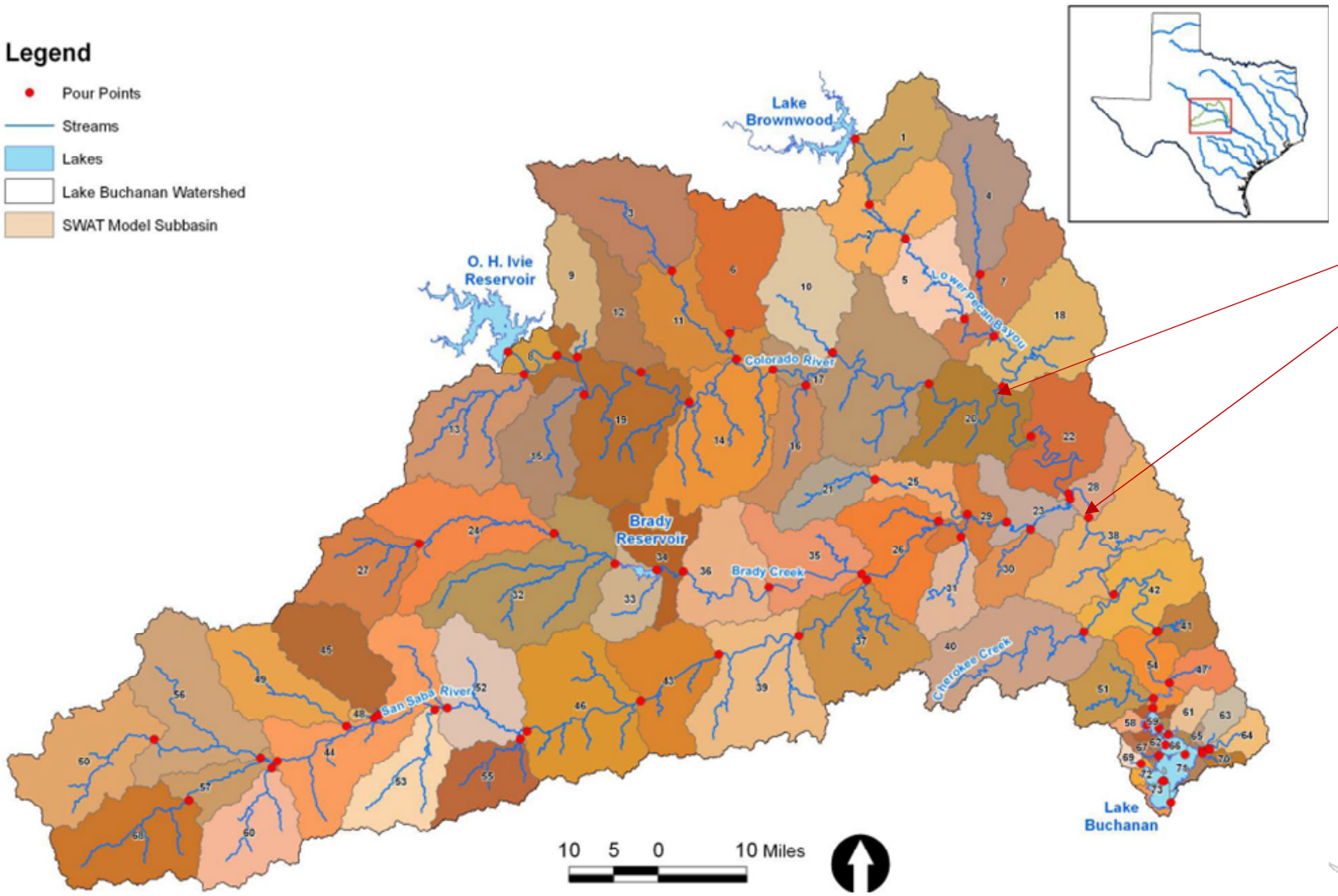
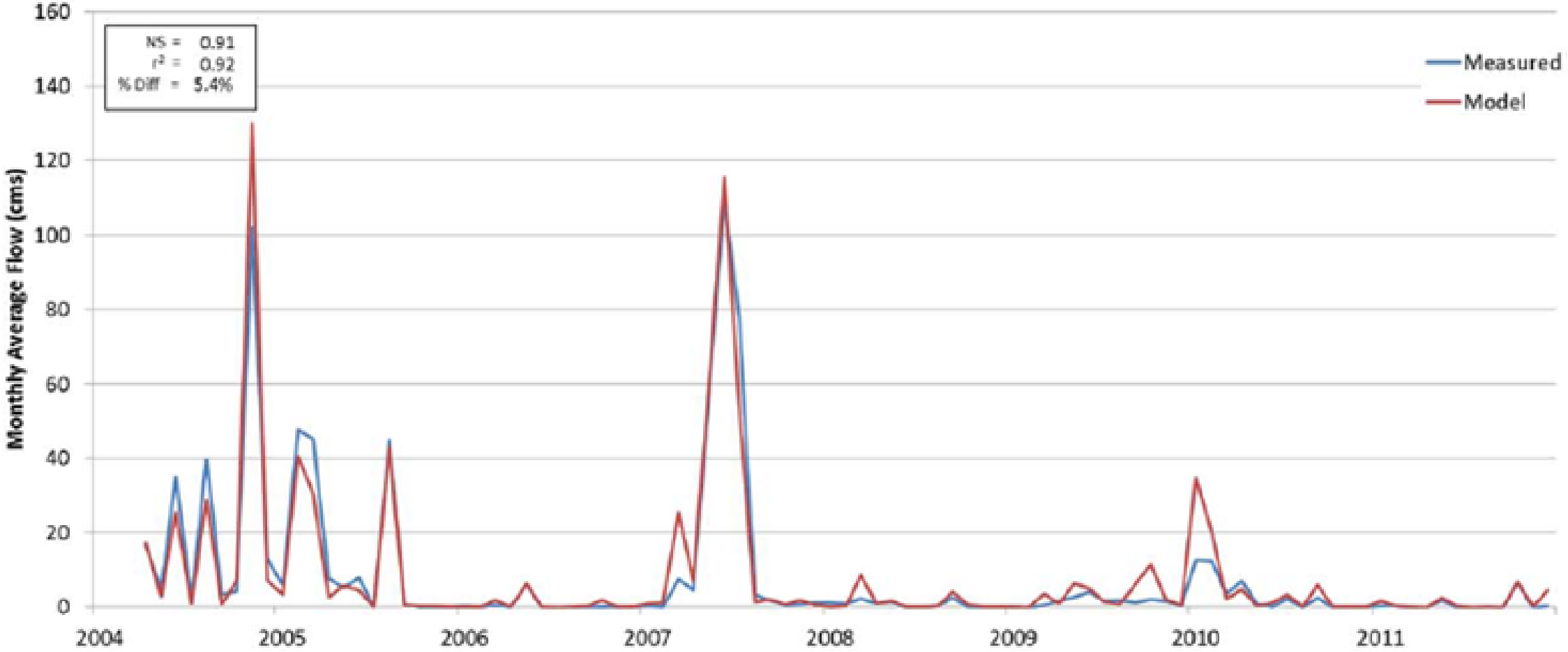


Pour Points

SWAT: Calibrate and Output



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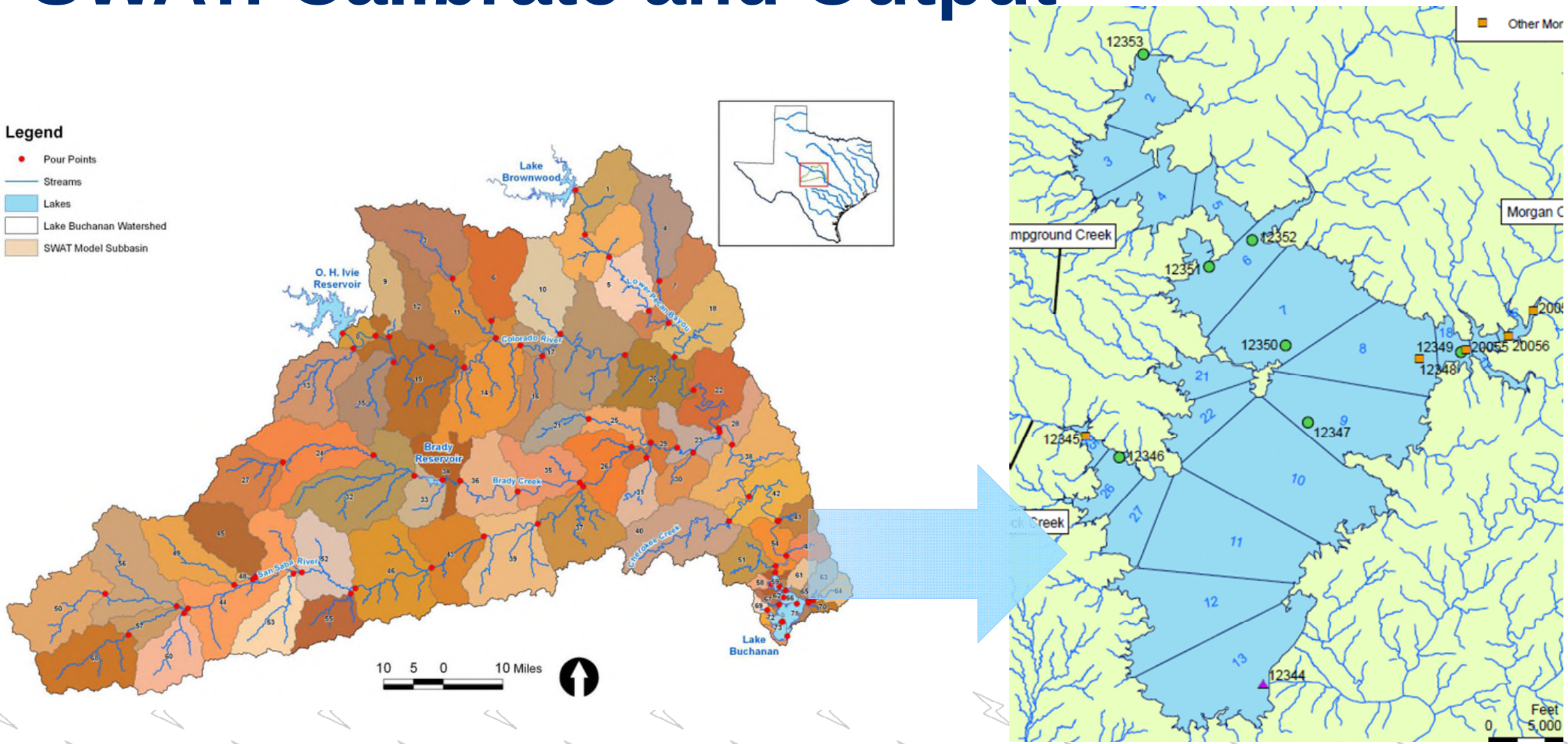
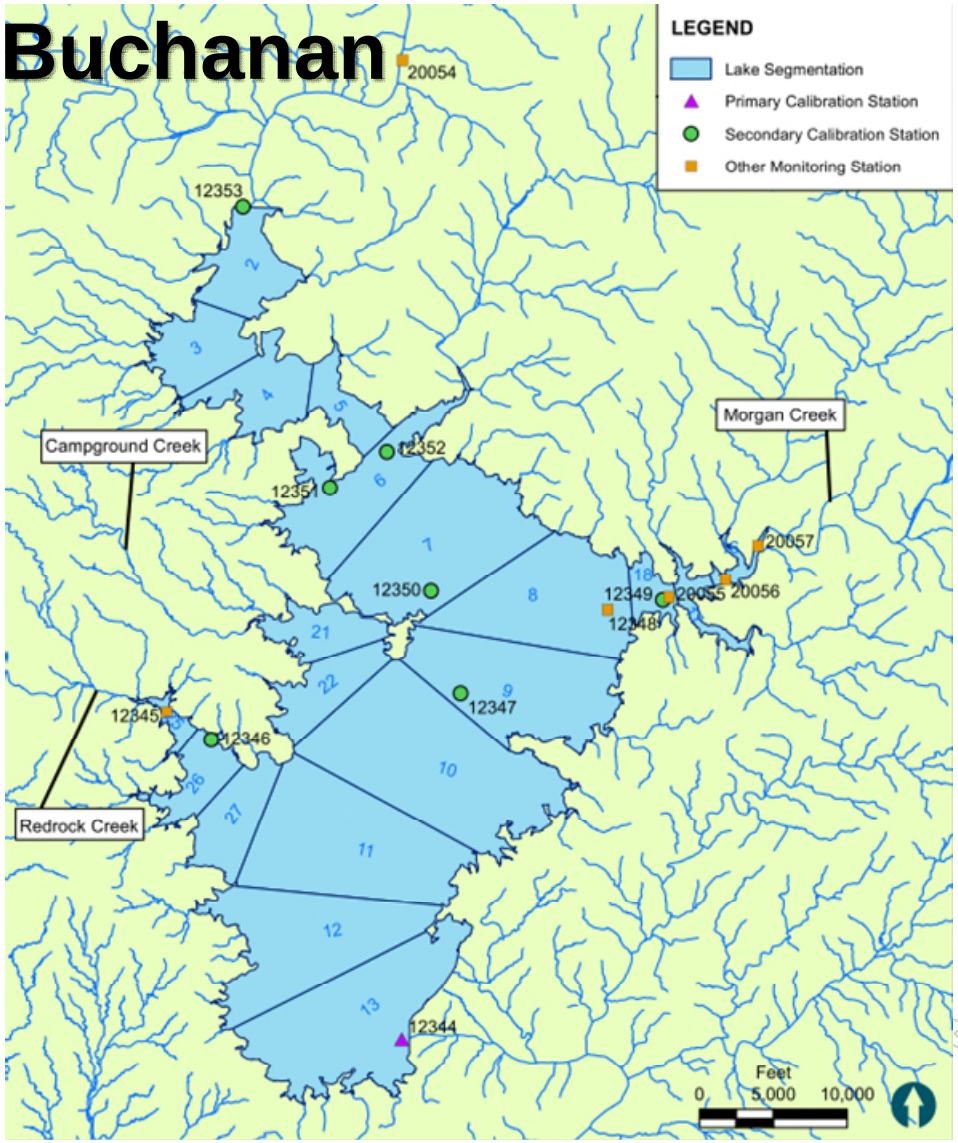
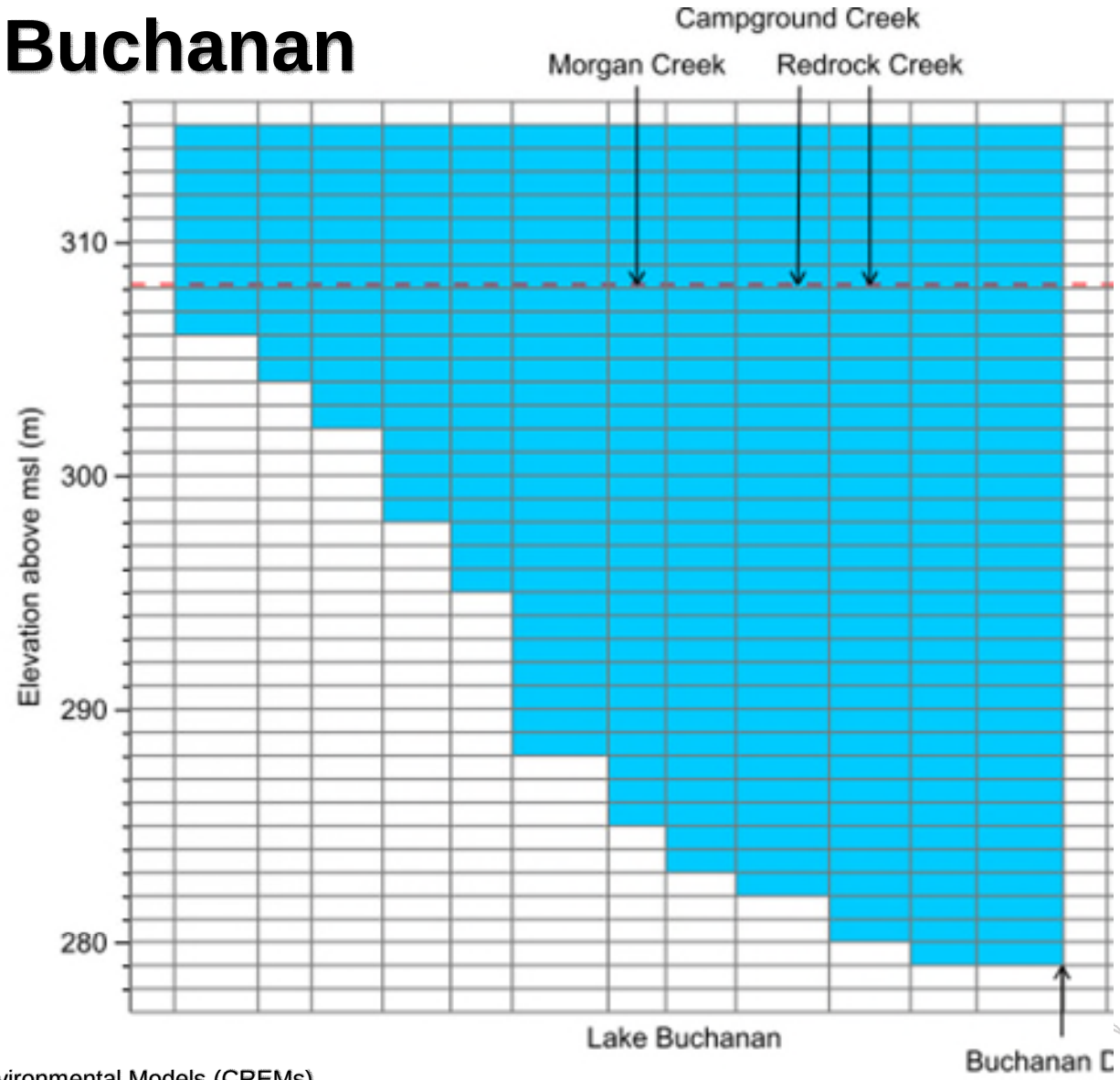


CREMs Reservoir Water Quality: CE-QUAL-W2





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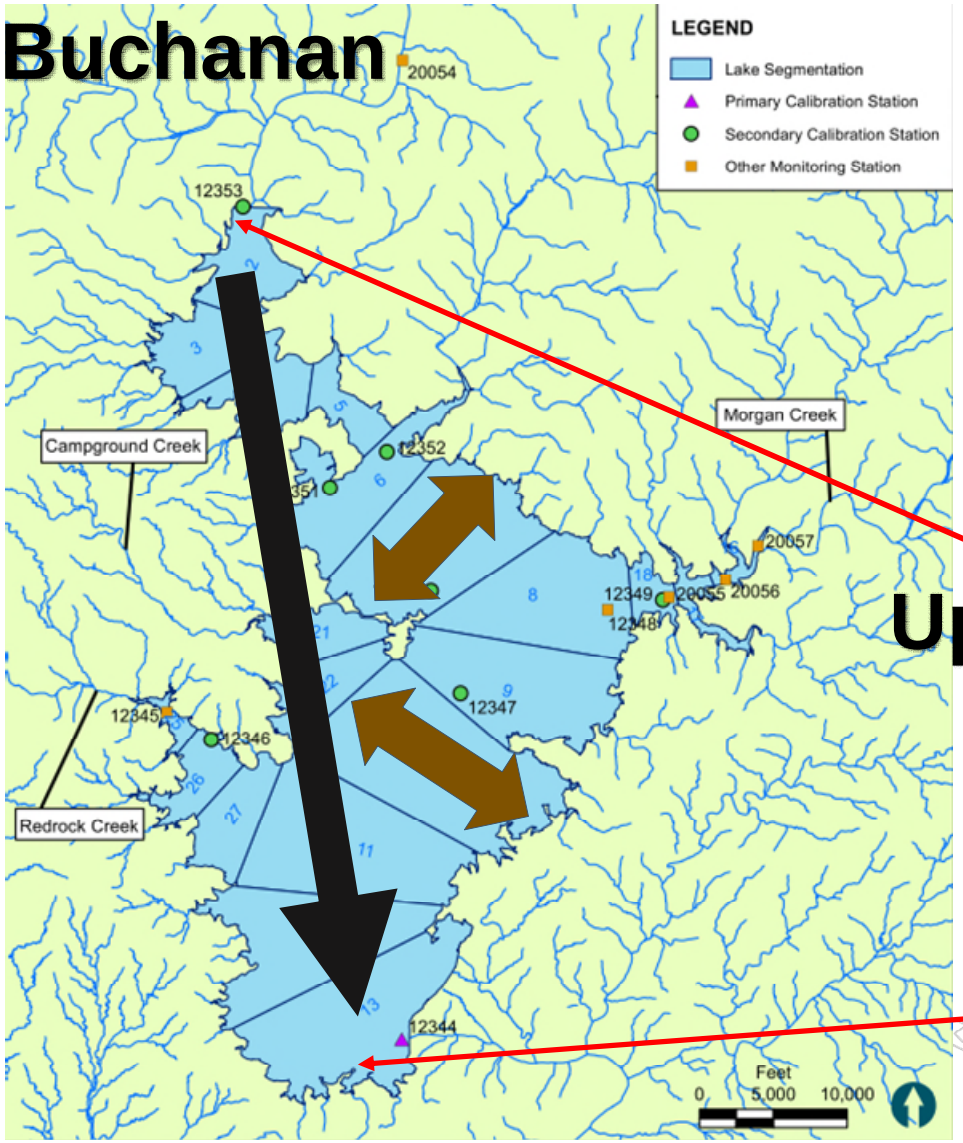

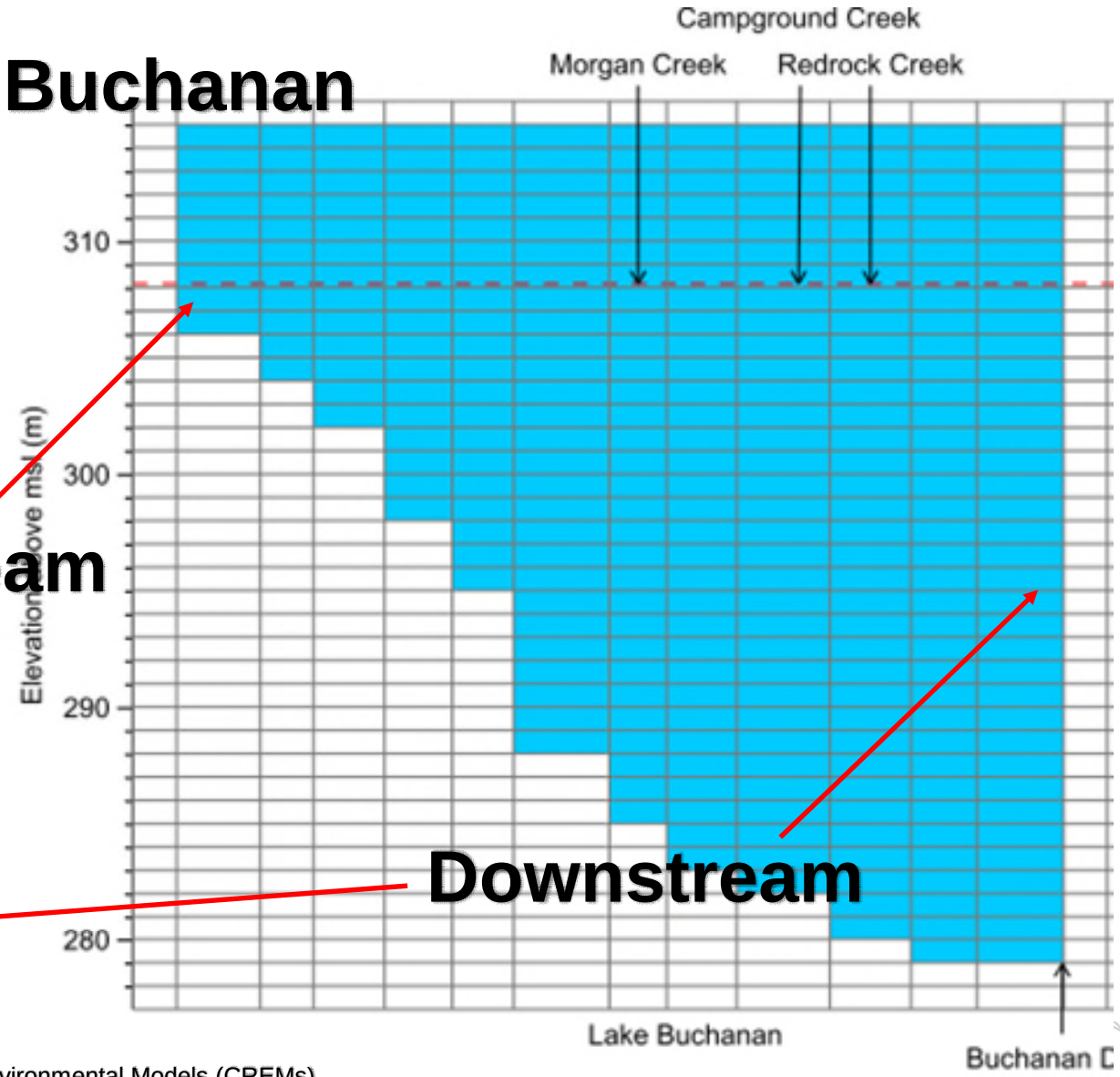

Upstream

Downstream

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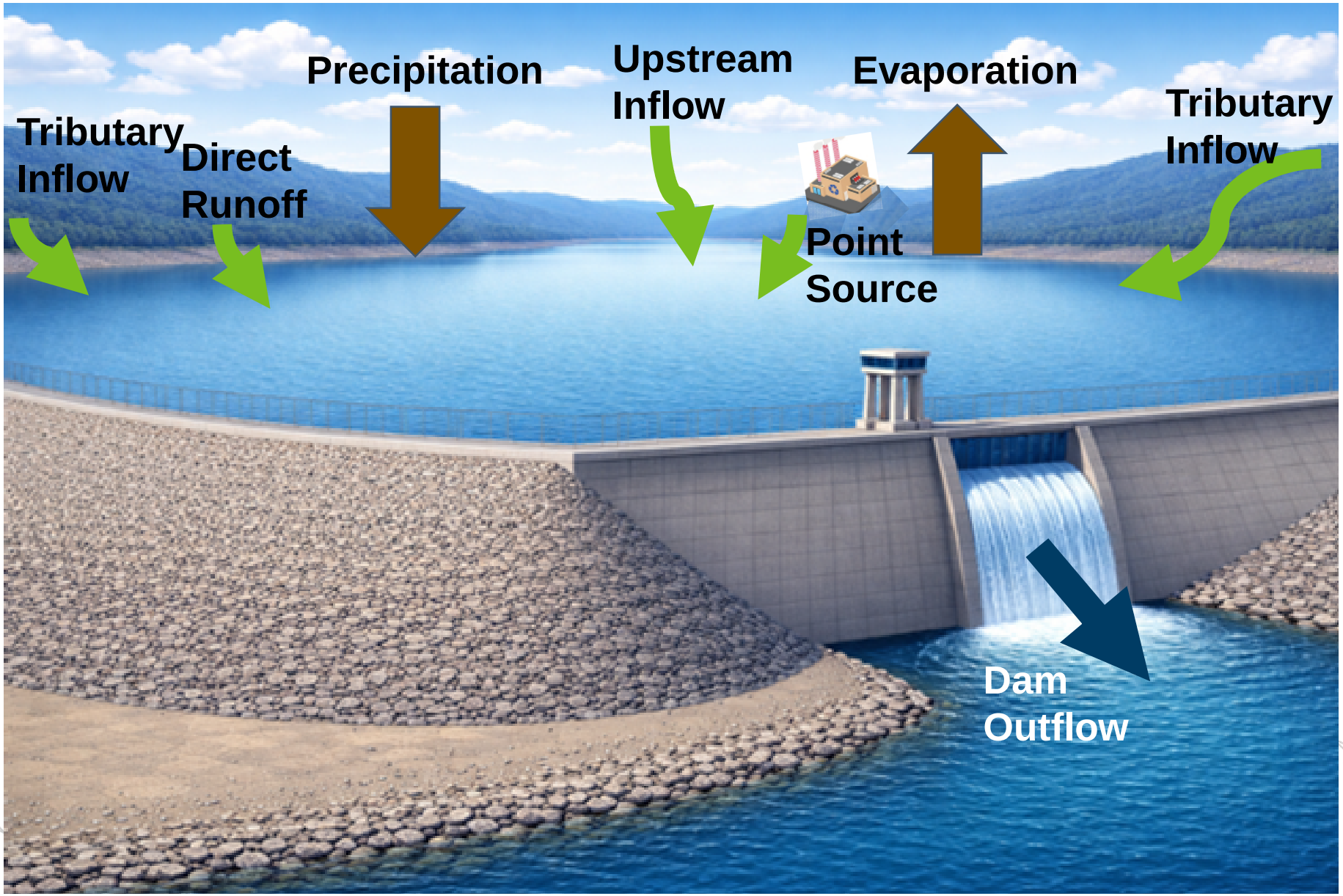

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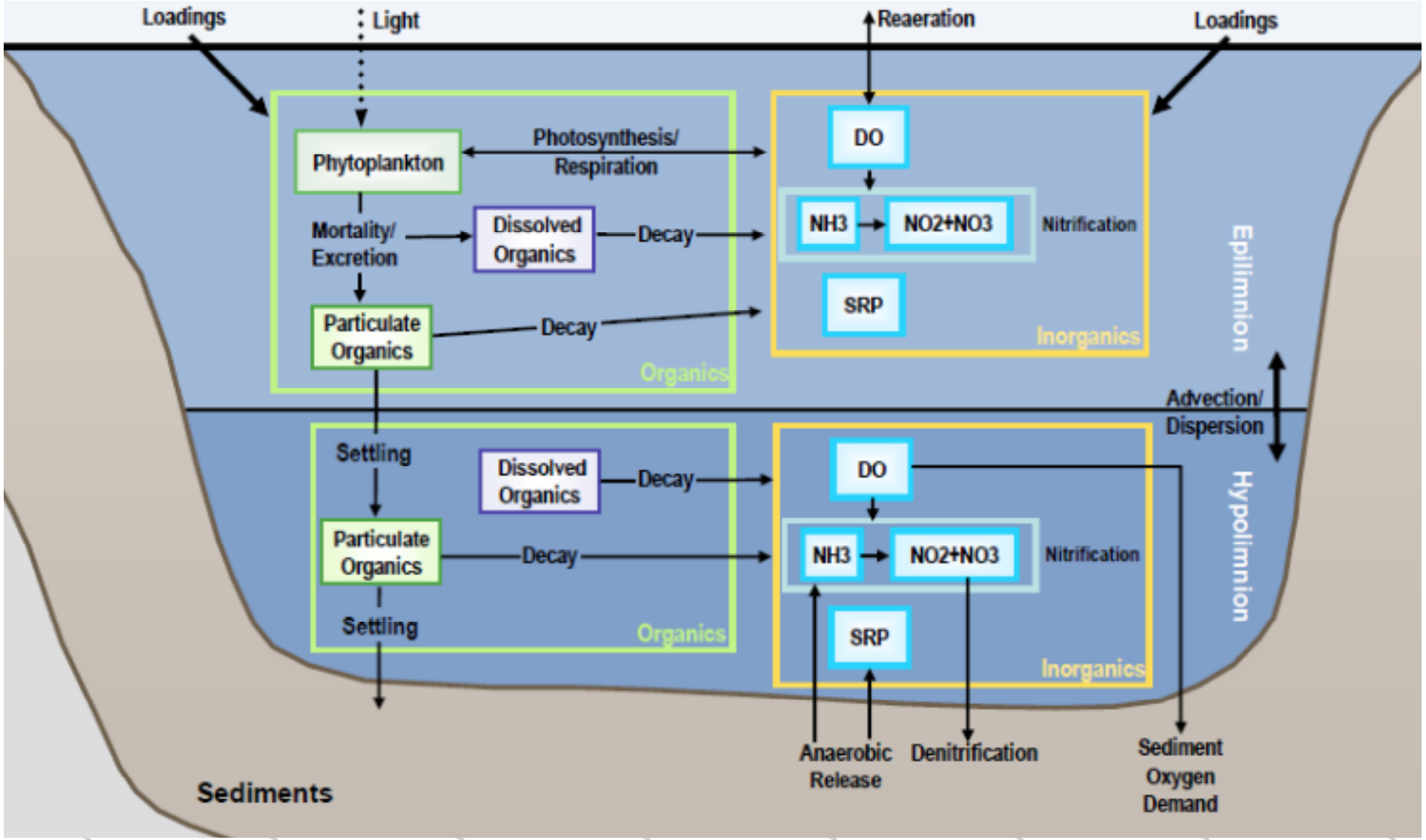

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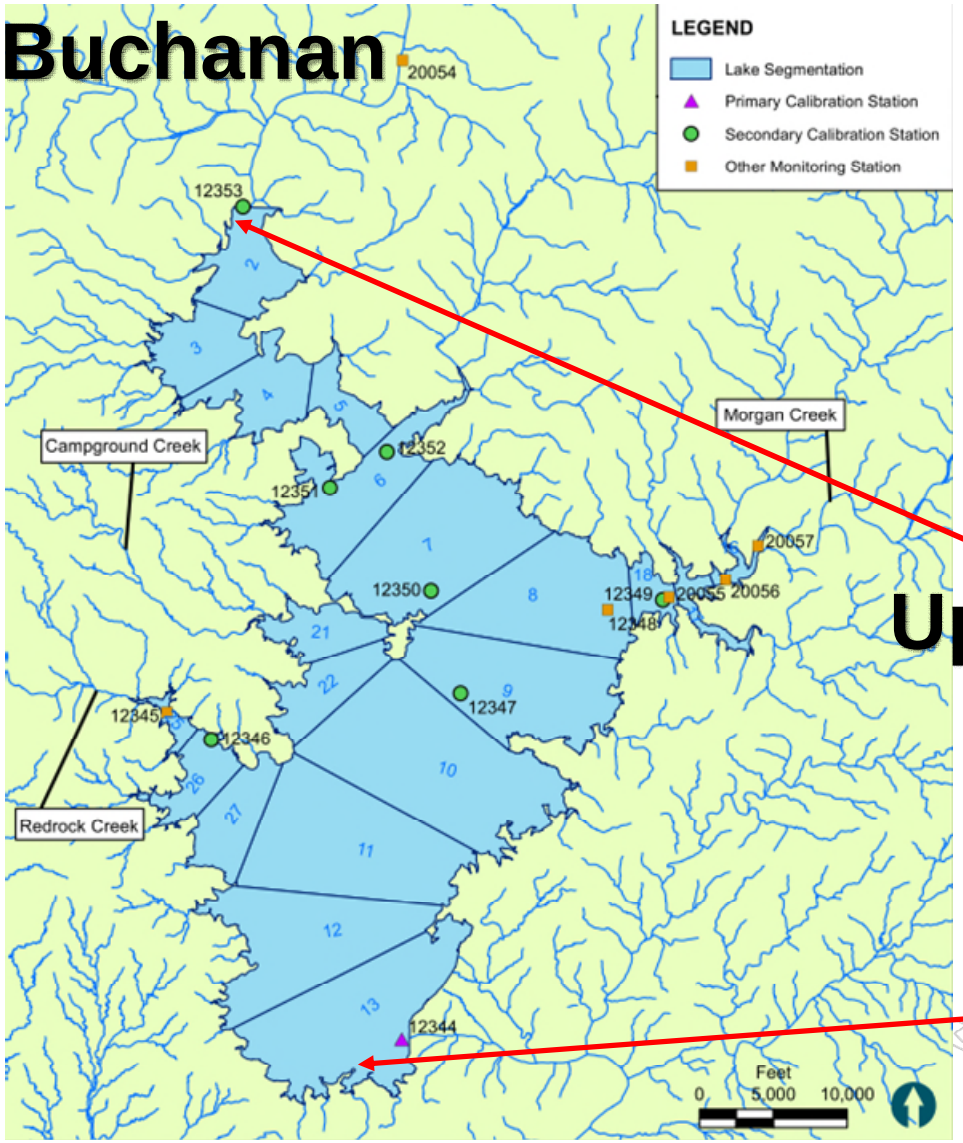

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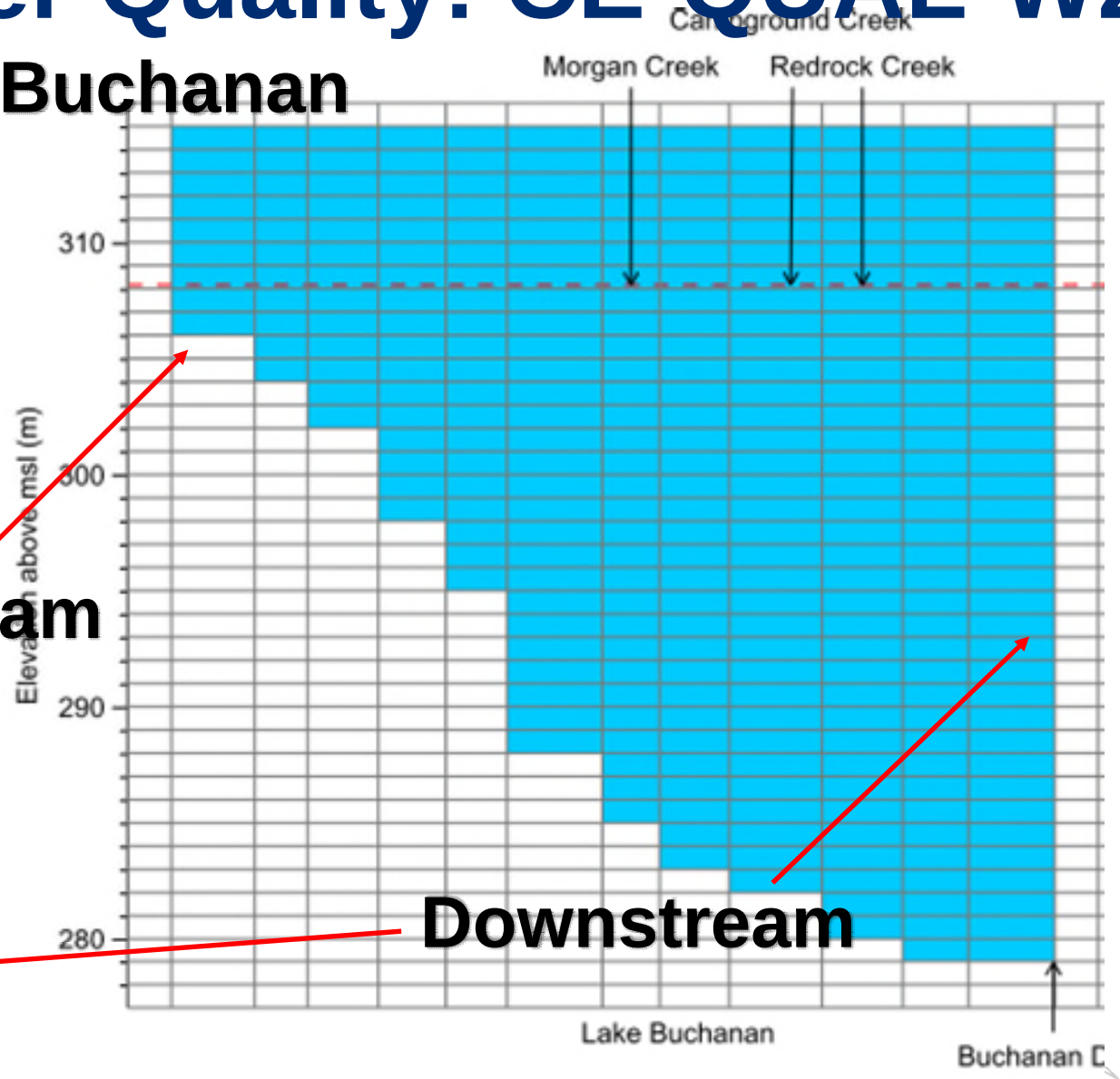

Downstream

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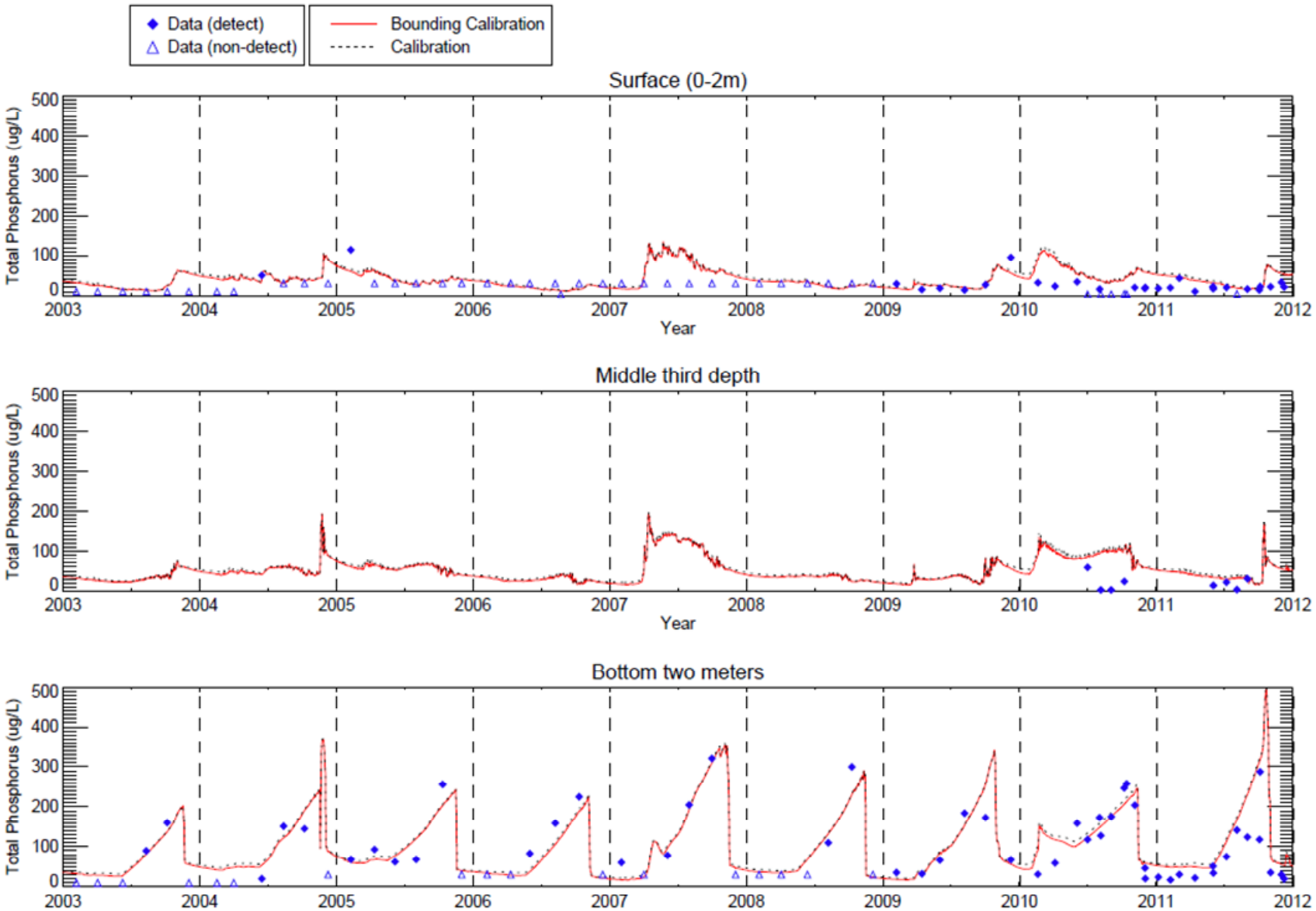


CREMs: Framework for Understanding

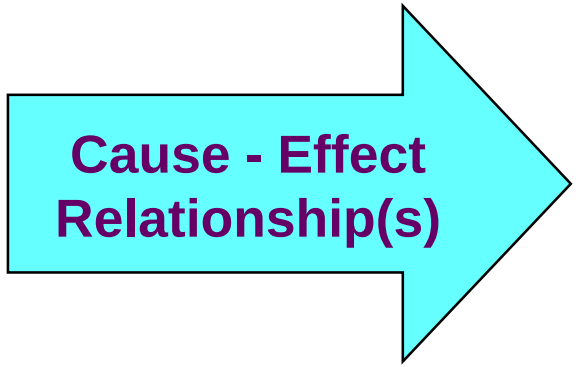
SWAT

Human Activities

- Land use
- Point source loads
- Management practices

Environmental Conditions

- Rainfall
- Temperature
- Topography

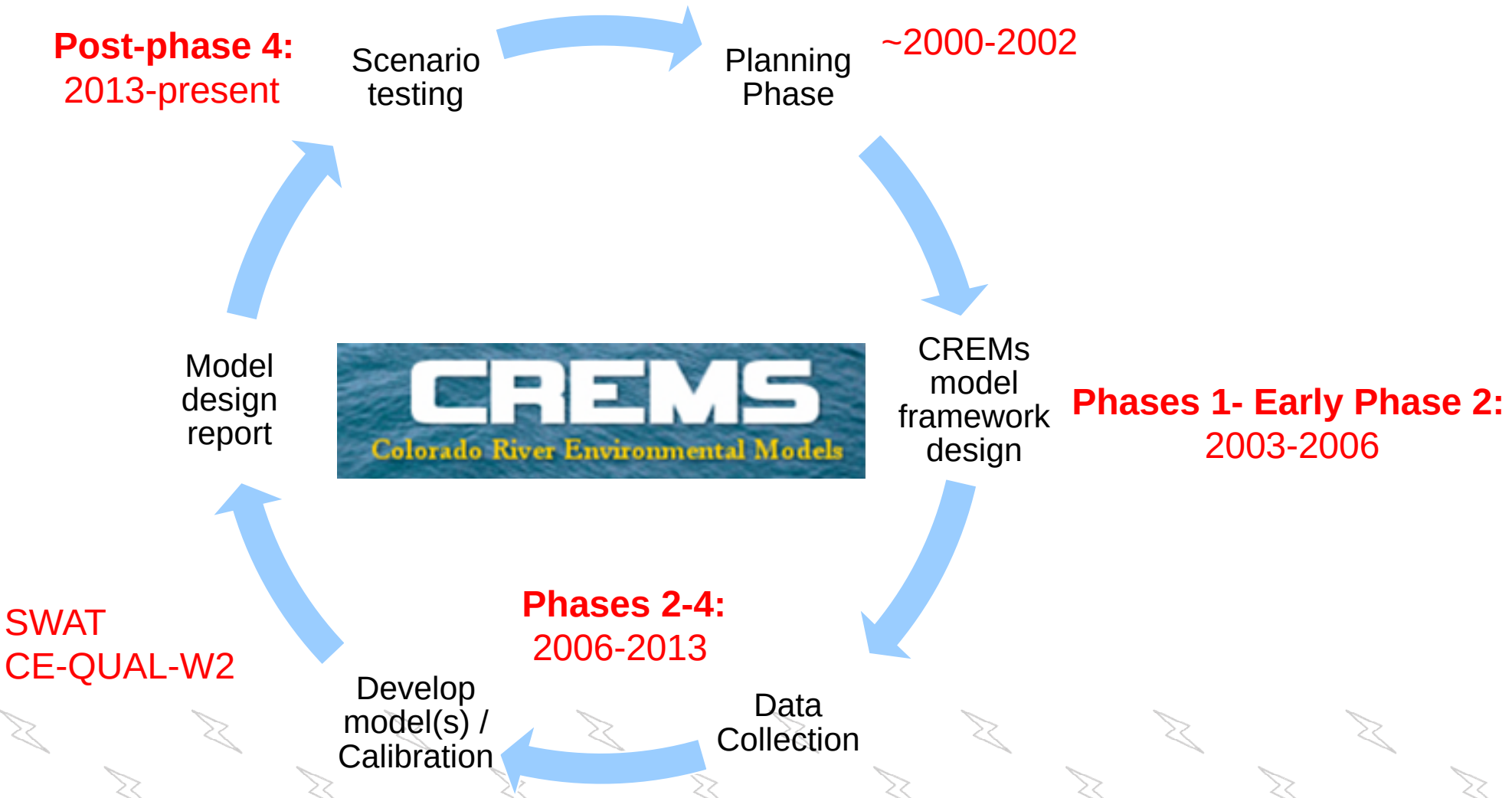


CE-QUAL-W2

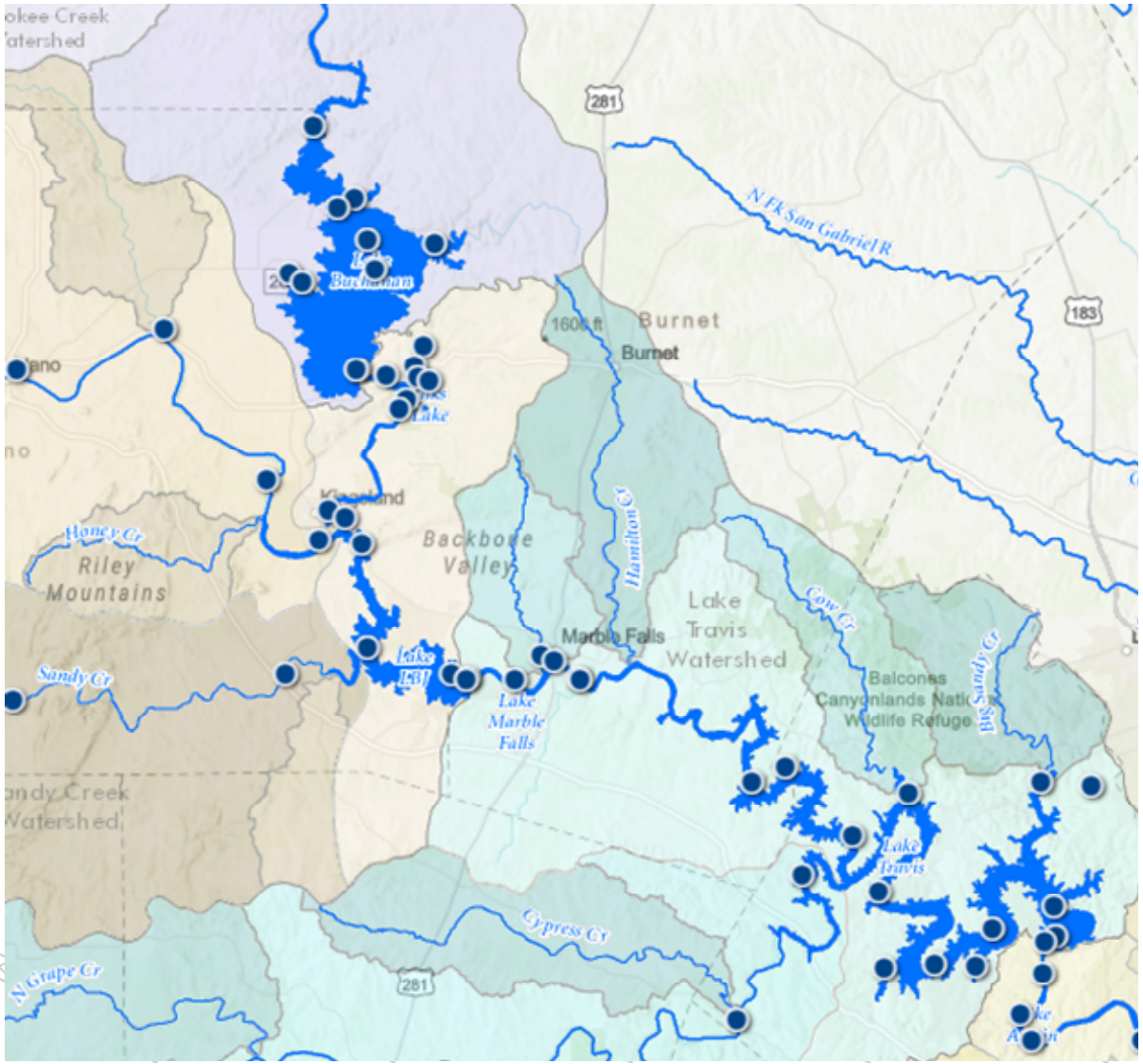
Environmental Response

- Flow through Highland Lakes
- Nutrient and sediment concentrations
- Biomass: algae, submerged aquatic plants
- Physical habitat, lake temperature, dissolved oxygen

Colorado River Environmental Models: Life Cycle



CREMs: Data Collection Efforts



- Spatial and temporal coverage of water quality data across 5 reservoirs
- Tributary sampling – all 5 watersheds
- Input and calibration data for SWAT and CE-QUAL-W2

https://waterquality.lcra.org/

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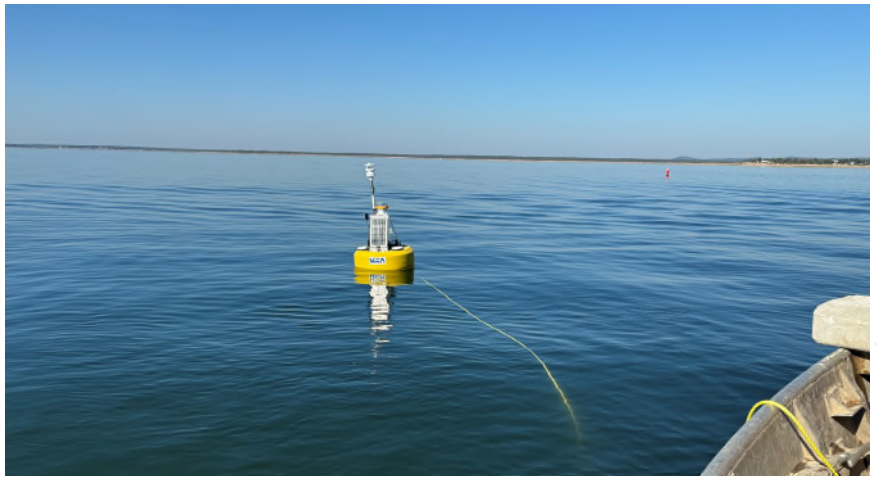

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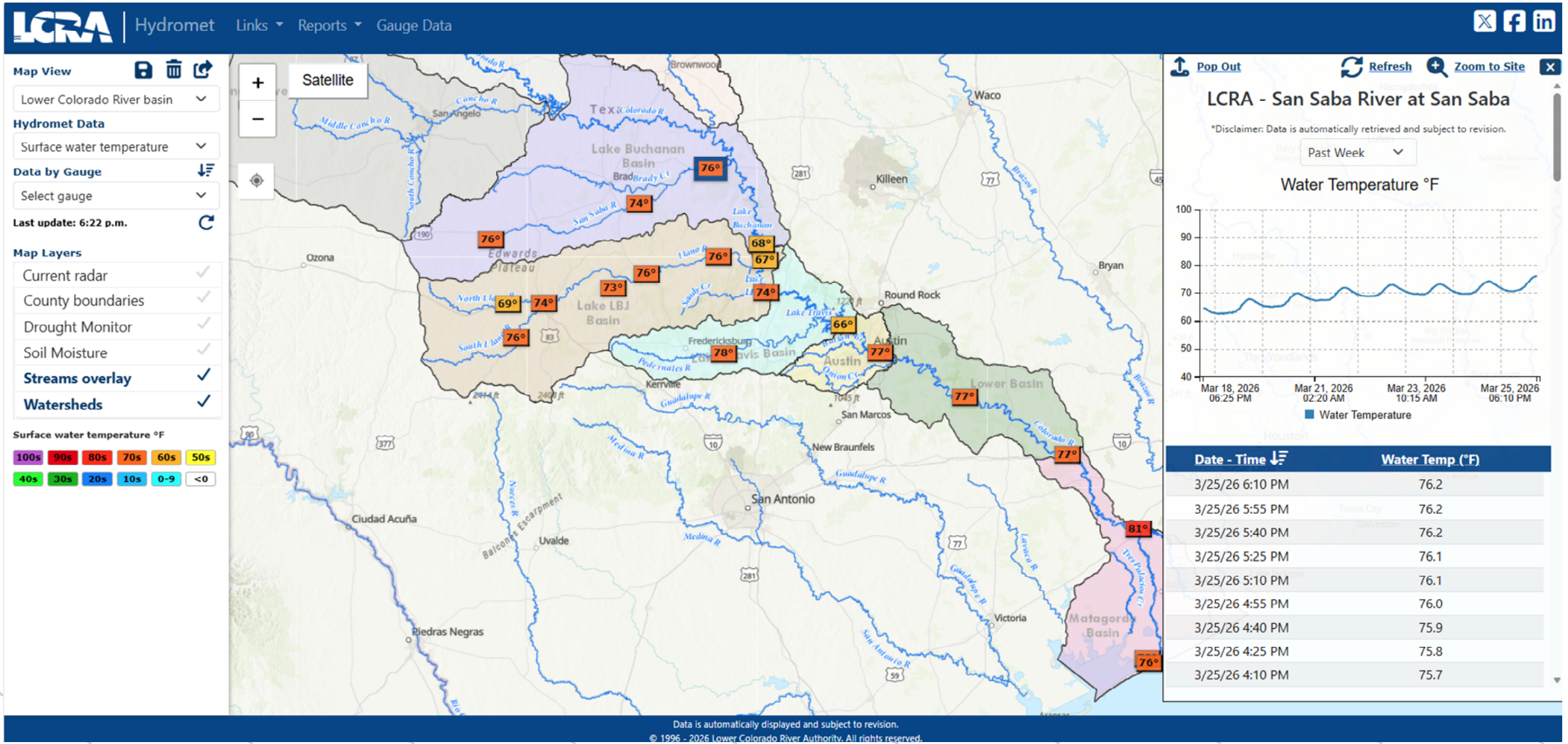
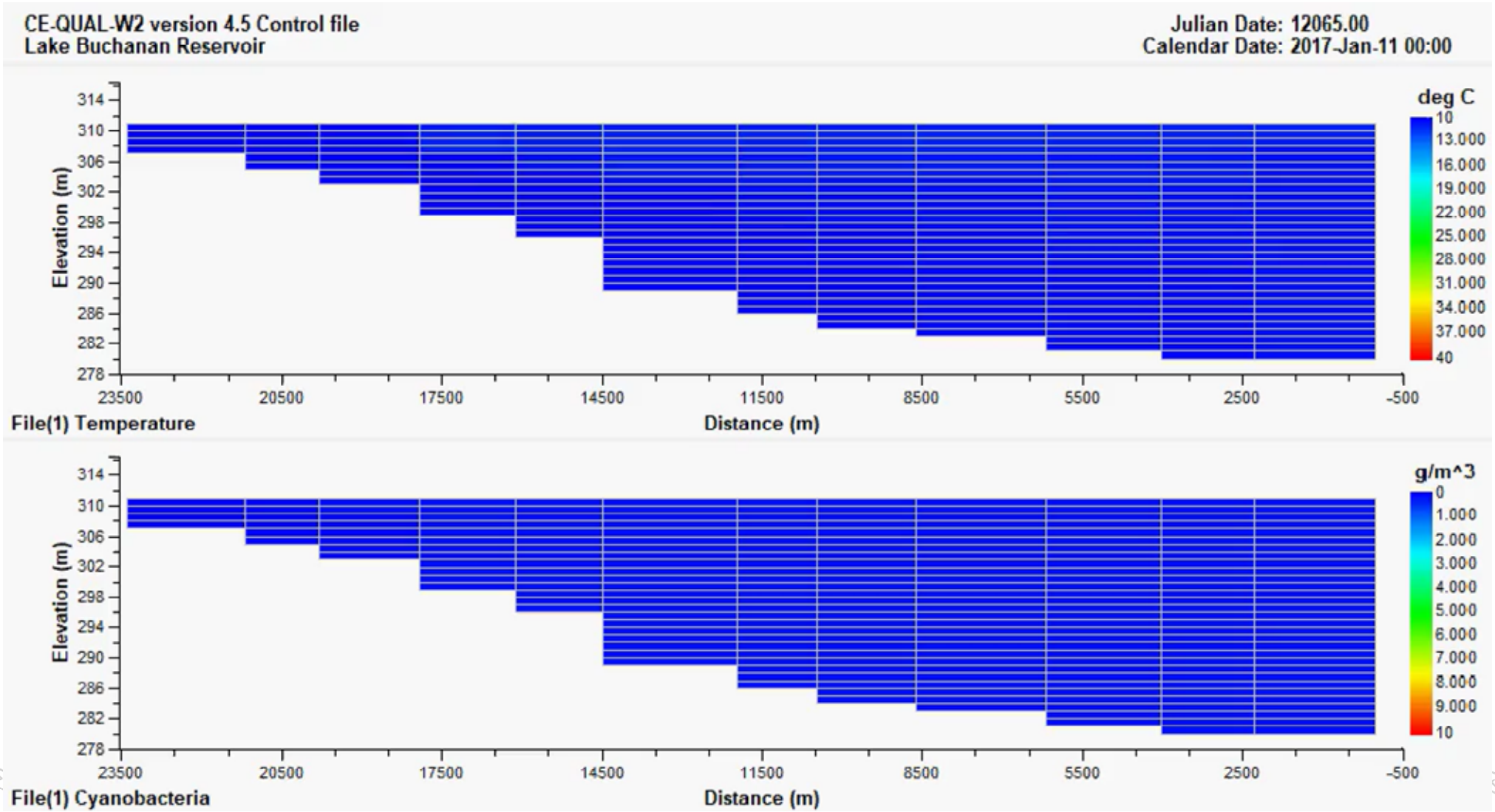


https://hydromet.lcra.org/

CREMs: Insights gained

- **Developed better understanding of how Highland Lakes have a limited ability to process nutrients**
- **Both the discharge ban and the Highland Lakes Watershed Ordinance (HLWO) have a positive impact on water quality protection**
- **Point-source discharges have greater impact on water quality than other potential nutrient sources**
- **Understanding of models' limitations**
- **Models sensitive to assumptions *but* useful as guides for potential outcomes**


CE-QUAL-W2 version 4.5 Control file
Lake Buchanan Reservoir
Julian Date: 12065.00
Calendar Date: 2017-Jan-11 00:00
Elevation (m)
314
310
306
302
298
294
290
286
282
278
23500
20500
17500
14500
11500
8500
5500
2500
-500
Distance (m)
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16.000
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40
File(1) Temperature
Elevation (m)
Distance (m)
g/m^3
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1.000
2.000
3.000
4.000
5.000
6.000
7.000
8.000
9.000
10
File(1) Cyanobacteria

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