Colorado River Environmental Models

Presented to

Mid-Central Water Quality Advisory Committee

by

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LCRA Water Quality Protection

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Presentation Overview

- What is CREMS?
- A Brief History
- Components
- Uses
- Ongoing and Future Work
- Questions and Discussion

What is CREMS?

CREMS Definition:

Coupled watershed and reservoir computer models capable of capturing major spatial and temporal patterns in LCRA reservoirs

CREMS Objective:

Provide the capability to quantitatively assess water quality responses associated with:

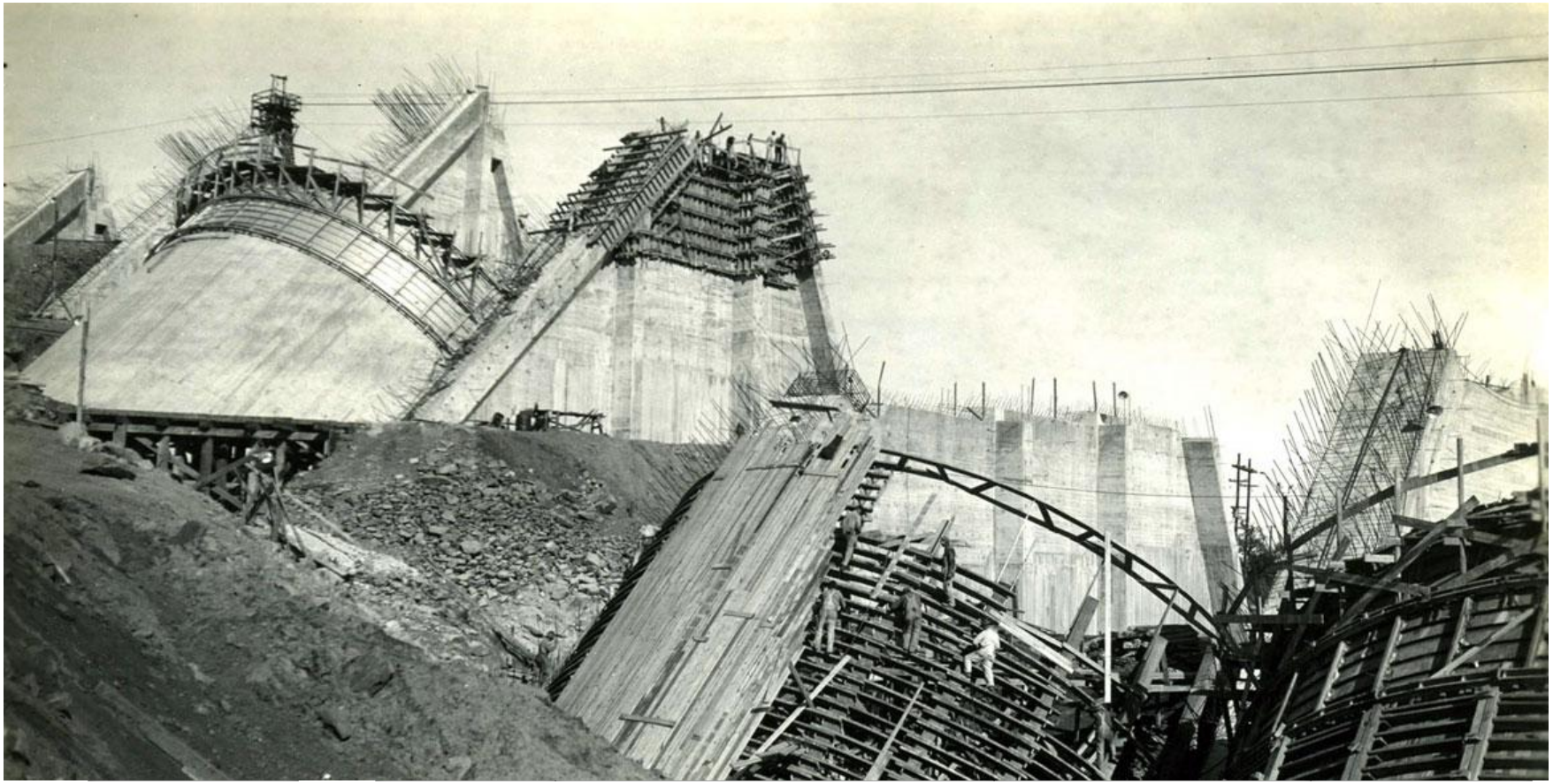
- Projected growth
- Proposed water quality management practices

Quantitative Assessment

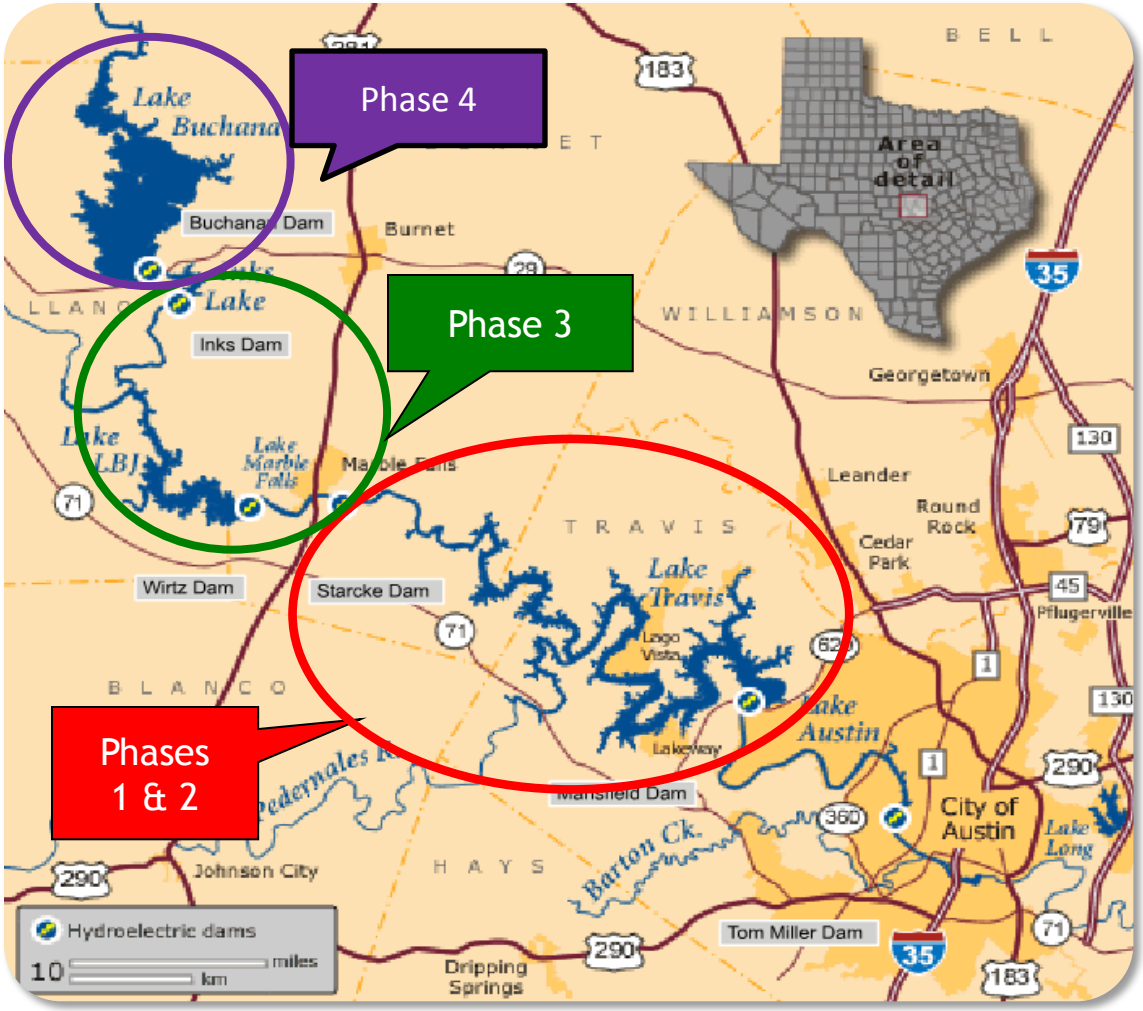
Why Use Models?

- **Understanding**
  - Models can provide an understanding of a watershed or water body and its response to change that is difficult to obtain any other way
- **Cost**
  - Sampling and analysis are resource intensive
- **Prediction**
  - It is not possible to monitor something that has not yet occurred

CREMS History
Timeline of CREMS Project Phases

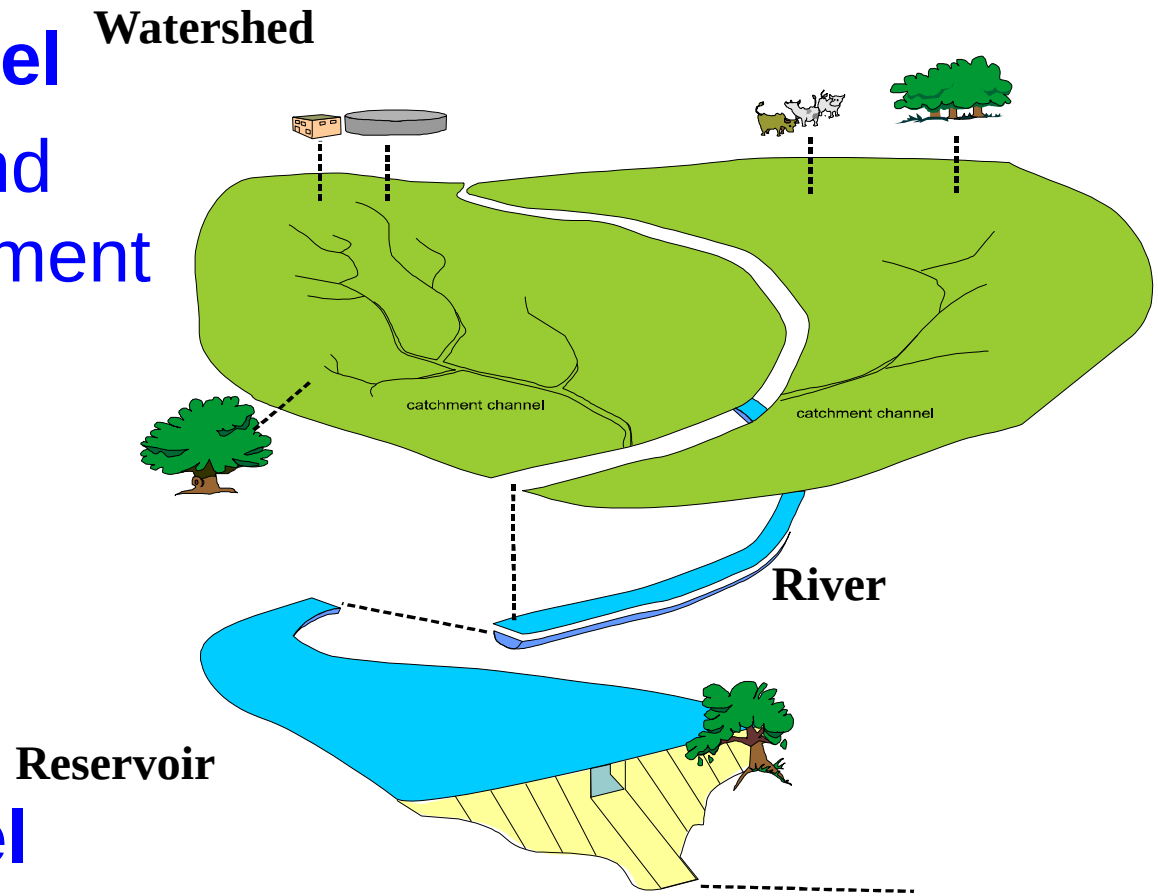


CREMS Phases



CREMS Components

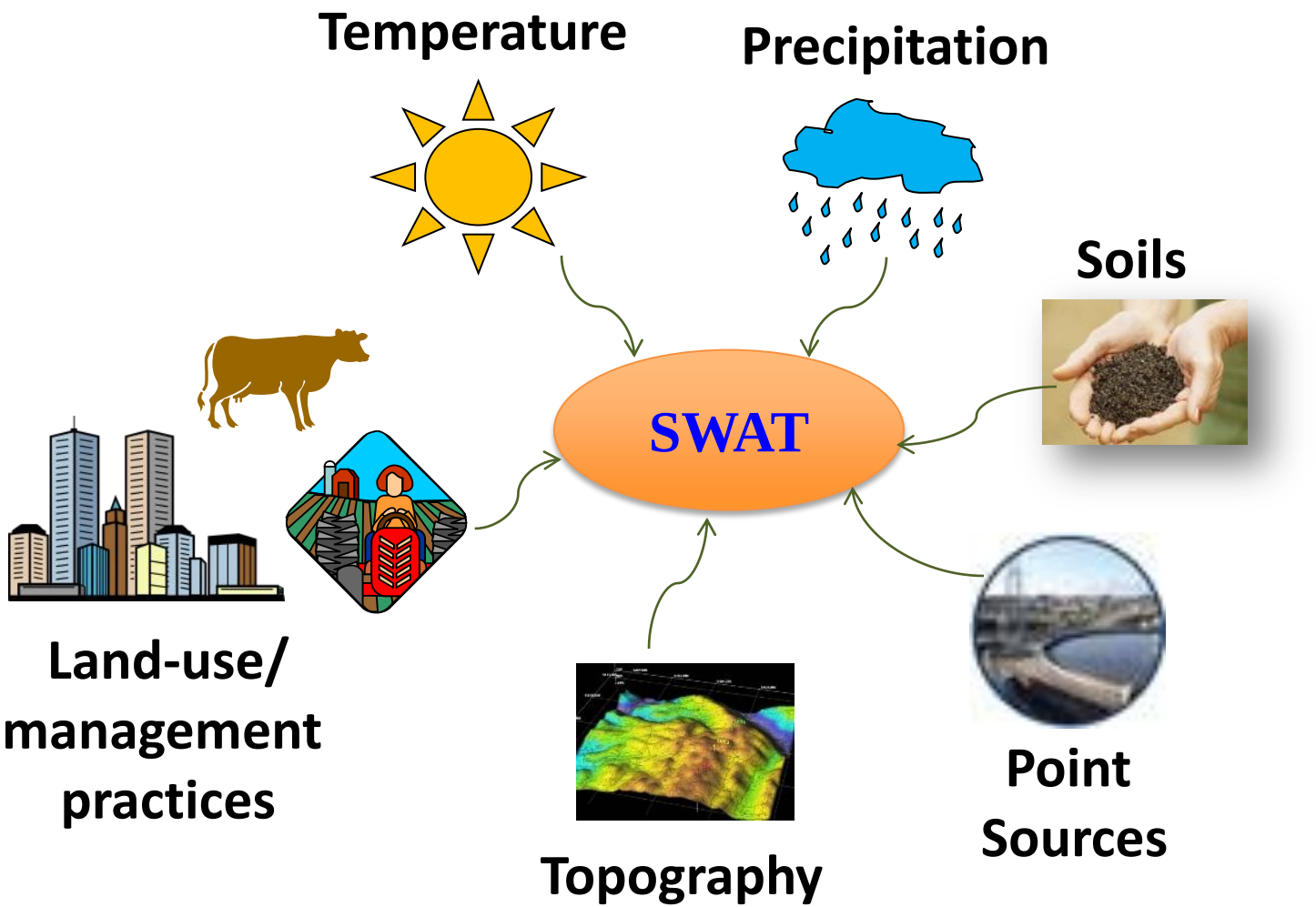
- **Watershed Model**
  - SWAT (Soil and Water Assessment Tool)
- **Linking Tools**
- **Reservoir Model**
  - CE-QUAL-W2



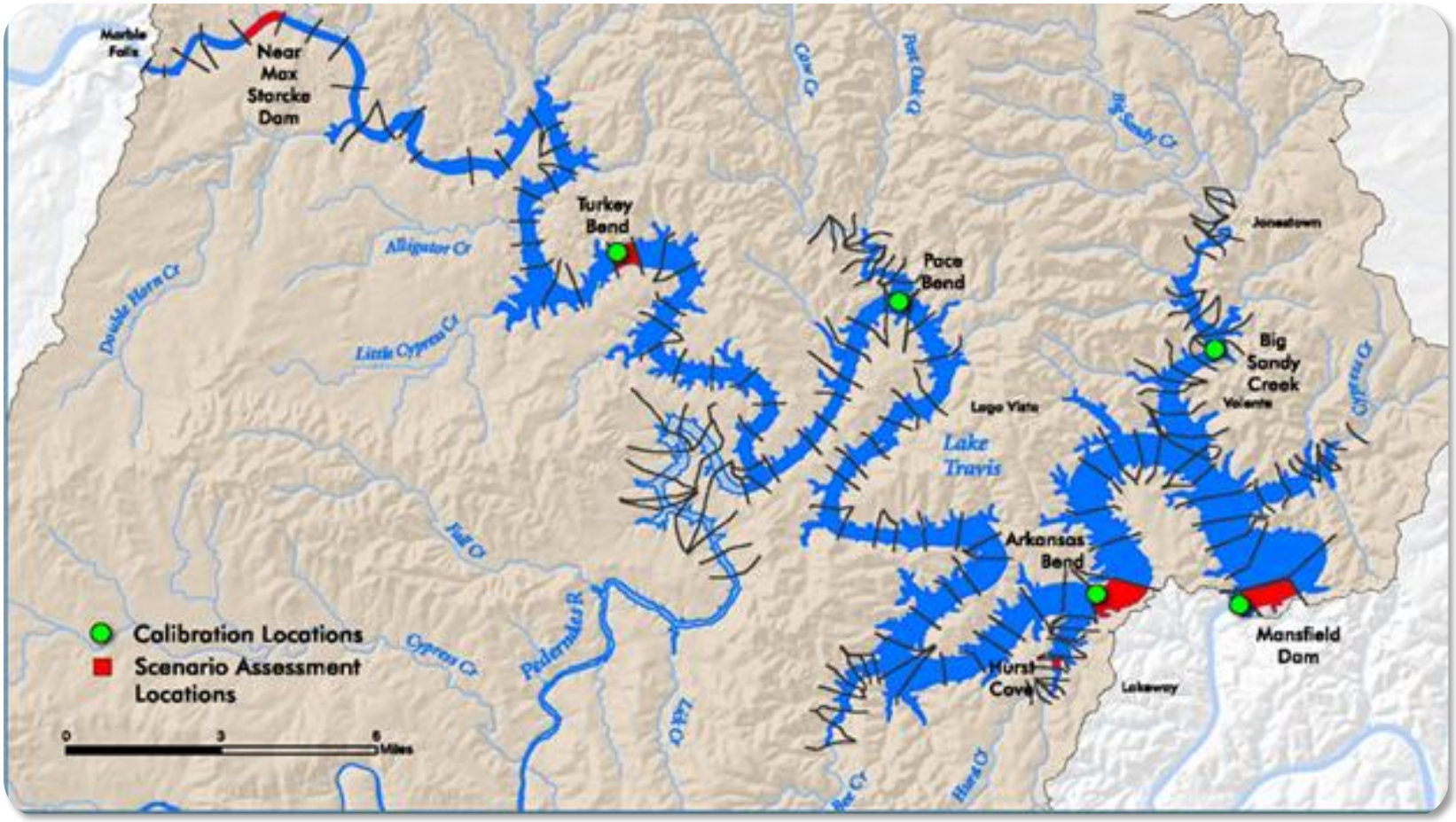
SWAT
(Soil and Water Assessment Tool)

- Developed by U.S. Department of Agriculture
- Public domain
- Watershed-scale model
- Physically based – readily available input
- Comprehensive
- Continuous (long term) yield model
- Outputs hydrology, sediment, and water Quality
- Simulate management options

SWAT Watershed Model



CE-QUAL-W2 Reservoir Model

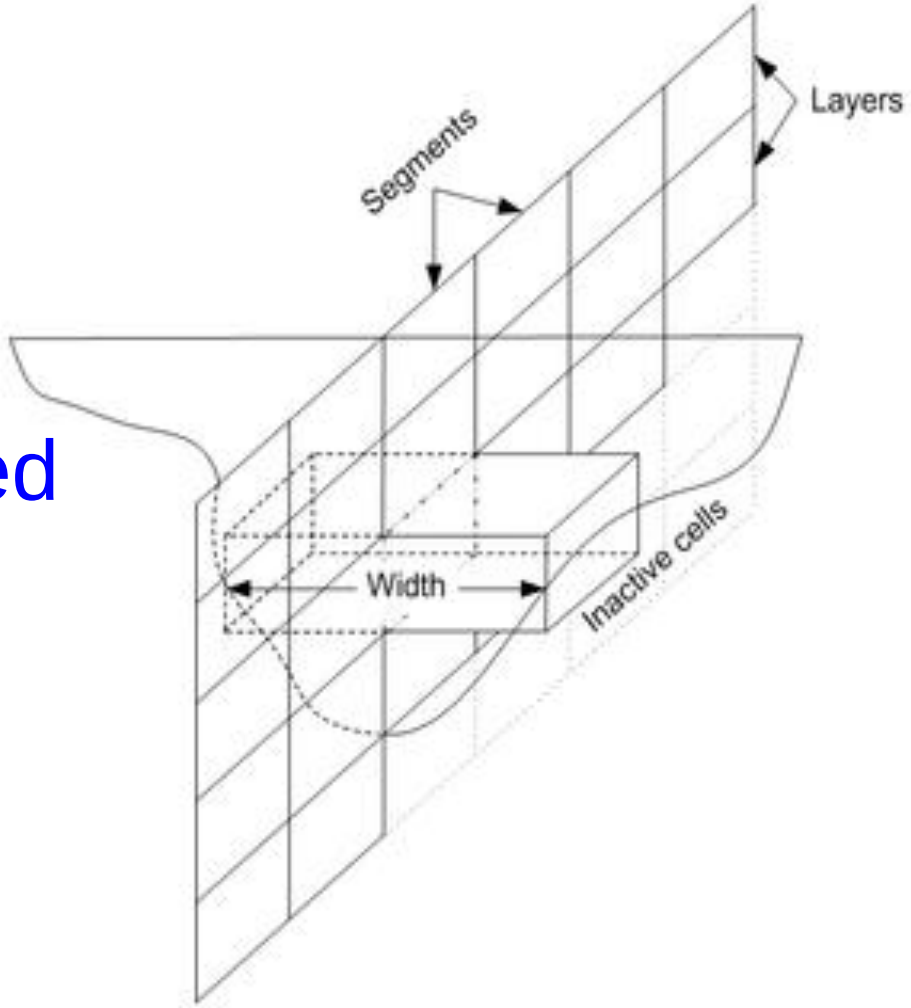


CE-QUAL-W2 Overview

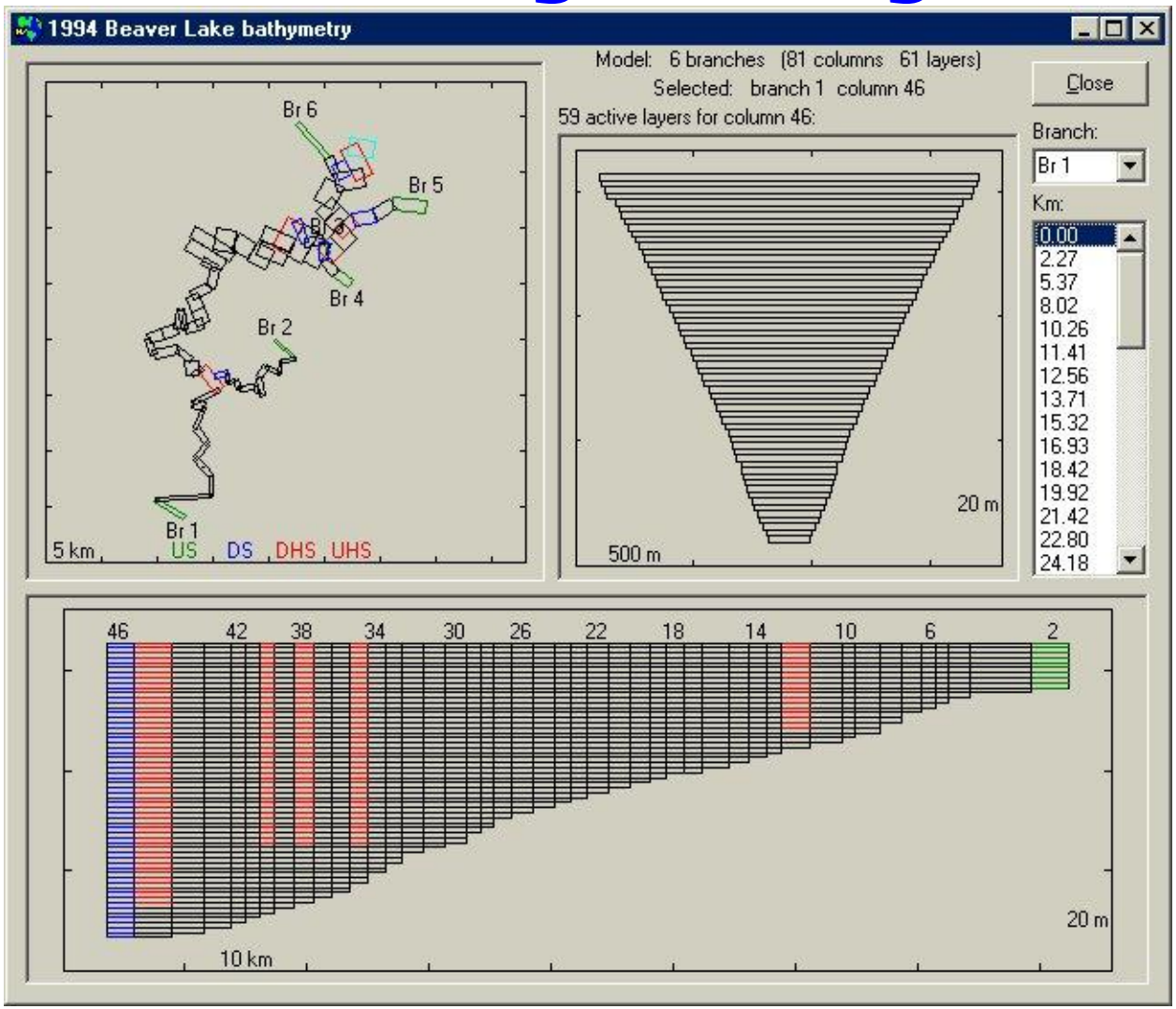
- Developed by Corps of Engineers
- Public domain
- Describes vertical and longitudinal distributions of water quality constituents in response to watershed loadings and meteorology
- Models basic eutrophication processes such as temperature-nutrient-algae-dissolved oxygen-organic matter and sediment relationships

CE-QUAL-W2

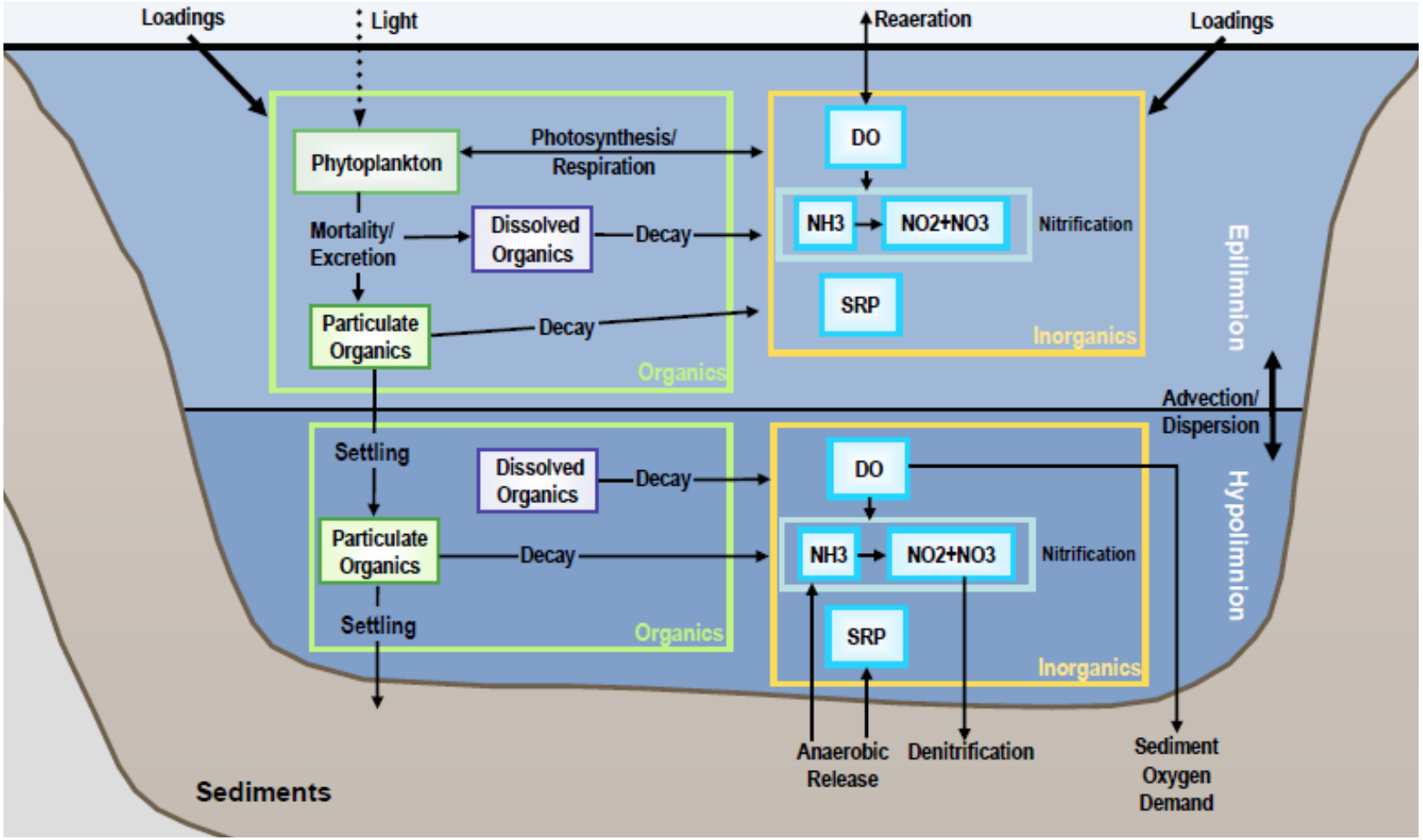
- Two dimensional model
- Laterally averaged
- Hydrodynamics
- Water quality



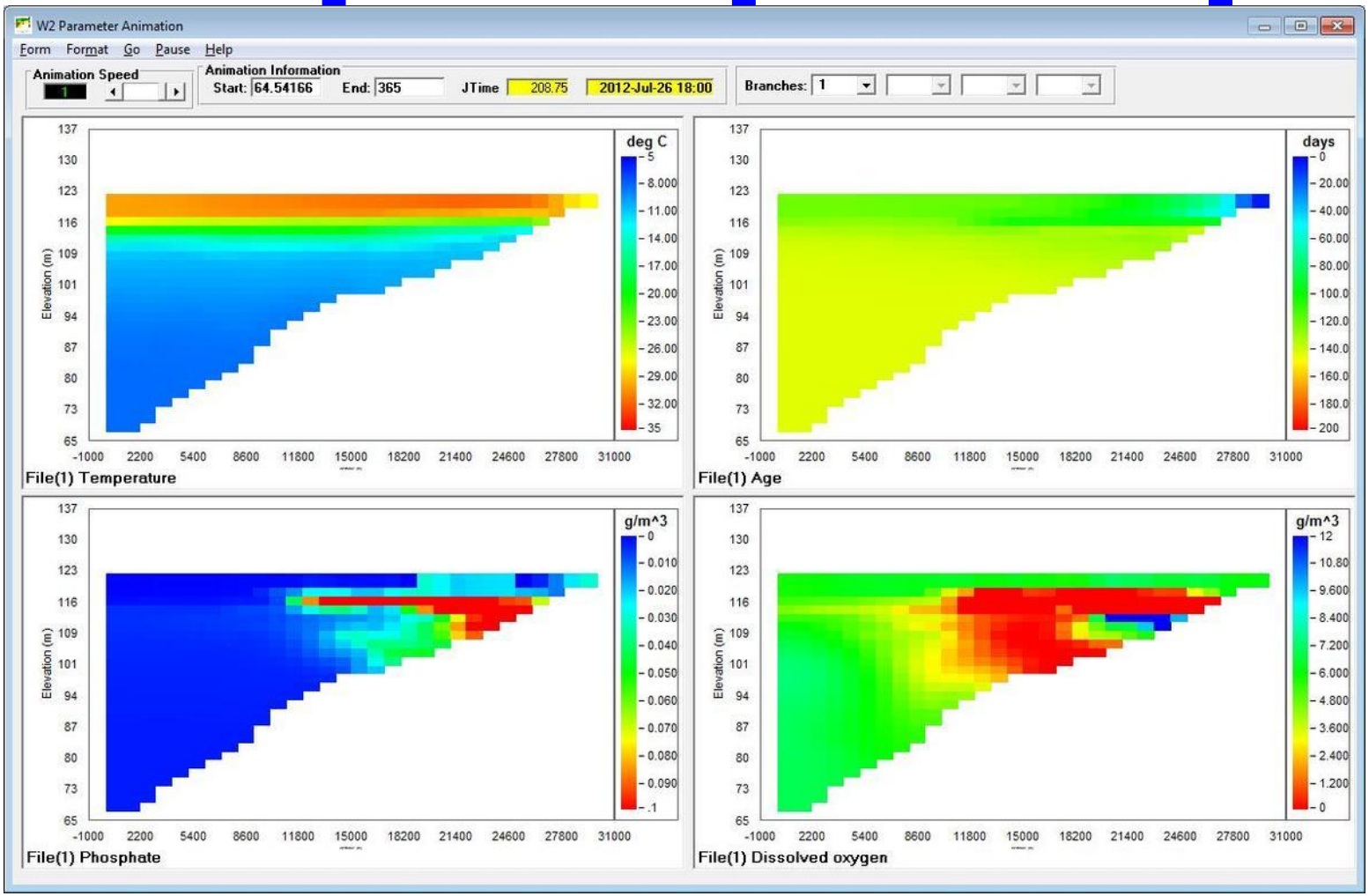
Bathymetry


1994 Beaver Lake bathymetry
Model: 6 branches (81 columns 61 layers)
Selected: branch 1 column 46
59 active layers for column 46:
Close
Branch:
Br 1
Km:
0.00
2.27
5.37
8.02
10.26
11.41
12.56
13.71
15.32
16.93
18.42
19.92
21.42
22.80
24.18
Br 6
Br 5
Br 4
Br 2
Br 1
5 km
US
DS
DHS
UHS
20 m
500 m
46
42
38
34
30
26
22
18
14
10
6
2
20 m
10 km

CE-QUAL-W2 Processes



Example Graphic Output



Linkage Tools

The “coupling” component of CREMS

Linkage tools help automate the synching of watershed model output to reservoir model input

- Spatial linkage
- Linkage for constituents being passed from model to model (connection of state variables)

CREMS Uses

CREMS can help in the assessment and prediction of:

- Existing water quality problems
- Water quality trends
- TCEQ standards and regulations
- Impacts of changing flow regimes
- Algal blooms and eutrophication
- Consequences of various management decisions and associated actions

CREMS Uses

Potential watershed change scenarios analyzed:

-Increased urbanization

- Increased point source flows and concentrations

- Increased upstream loading

- Highland Lakes Watershed Ordinance (HLWO) program

CREMS Findings

- A useful tool to assess potential water quality impacts due to land use changes in the Highland Lakes watersheds
- Highland Lakes have a limited ability to process nutrients
- Point-source discharges have a greater impact on water quality than other nutrient sources
- Maintaining the current water quality in the Highland Lakes requires a “package” of strategies, including the discharge ban, HLWO, and OSSF programs

Ongoing and Future Work

Monitoring

- Routine sampling for additional parameters
  - ✓Orthophosphate
  - ✓Phytoplankton
  - ✓Zooplankton
- Increased frequency of routine sampling
- Installation of automated stormwater samplers

Ongoing and Future Work

Special Studies

- Sediment sampling and analysis
- Sediment traps on Lake Buchanan
  - ✓Sedimentation rate
  - ✓Thermocline flux
- Littoral sediment sampling and analysis
- Sediment re-suspension
- Nutrient mass balance

Ongoing and Future Work

Sediment Diagenesis

- Process by which bound nutrients can be released into the water column from bottom sediments
- In development for incorporation into the next release of CE-Qual-W2
- Thought to be an important source of nutrients during stratification

Ongoing and Future Work

General Model Support

- Extend period of record
- Incorporate new software features
- Recalibrate (if needed)
- Improve linkage tools
- System wide water balance utility

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