The Tuttle Creek Lake Water Injection Dredging Demonstration Project

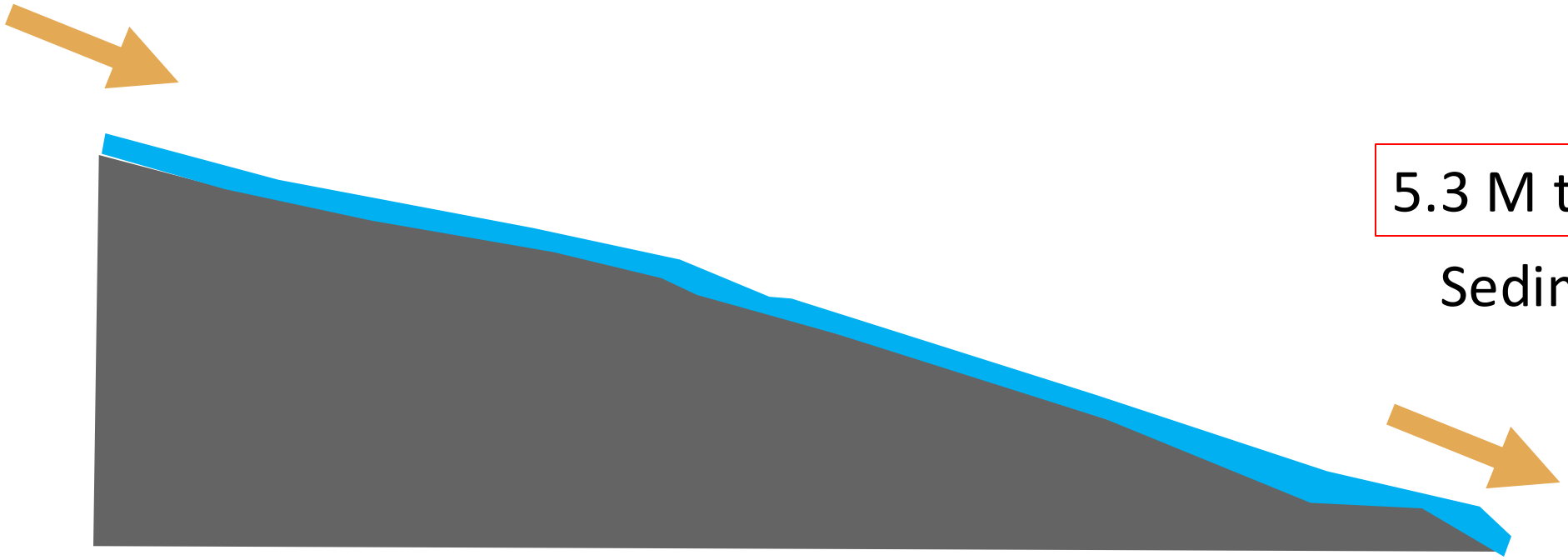
John Shelley, Ph.D., P.E.

Sediment Management Research Group
Civil, Environmental, and Architectural Engineering | University of Kansas

Big Blue River

5.3 M tons/year

Sediment In



5.3 M tons/year

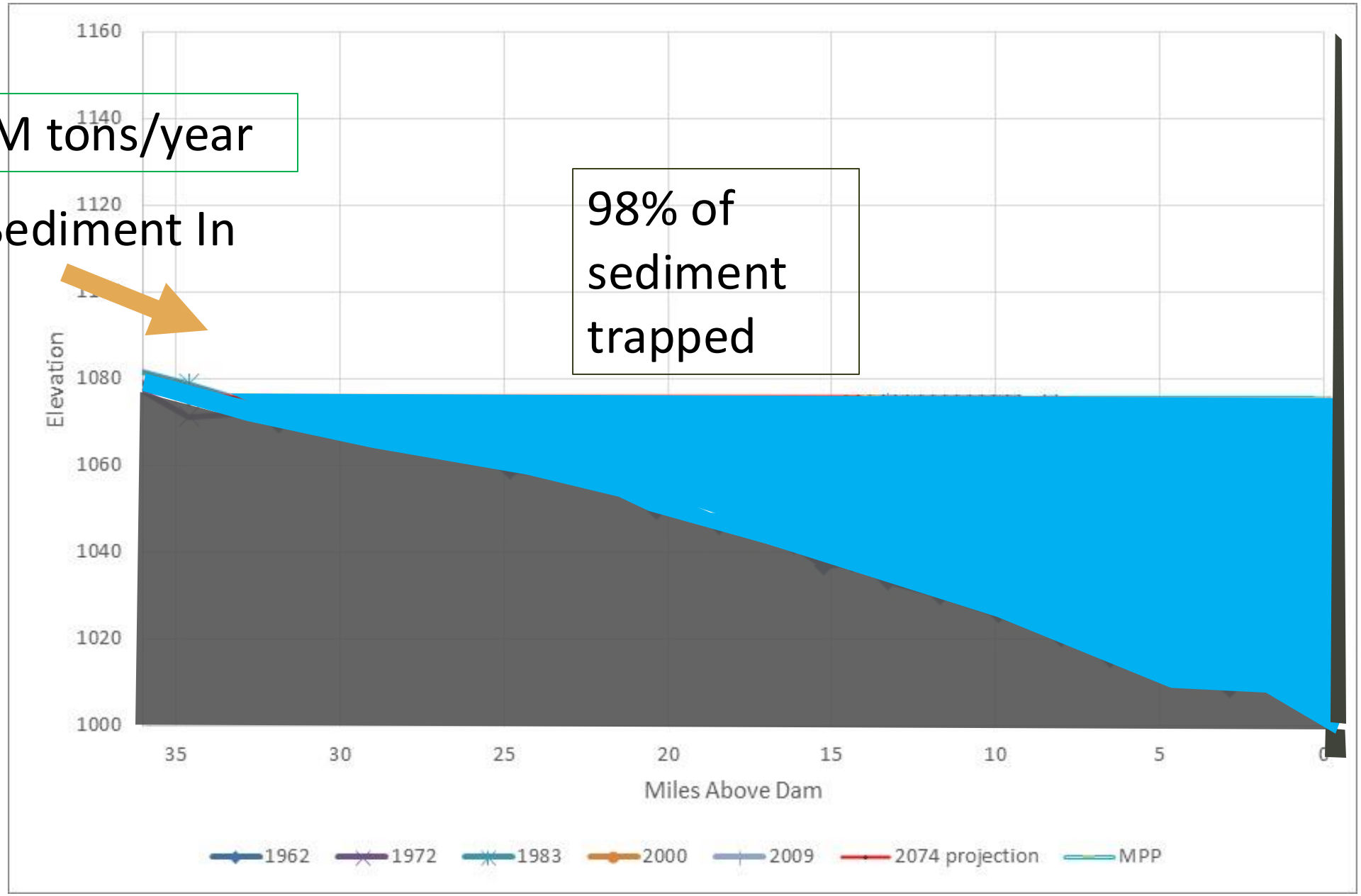
Sediment Out

Tuttle Creek Lake

5.3 M tons/year

Sediment In

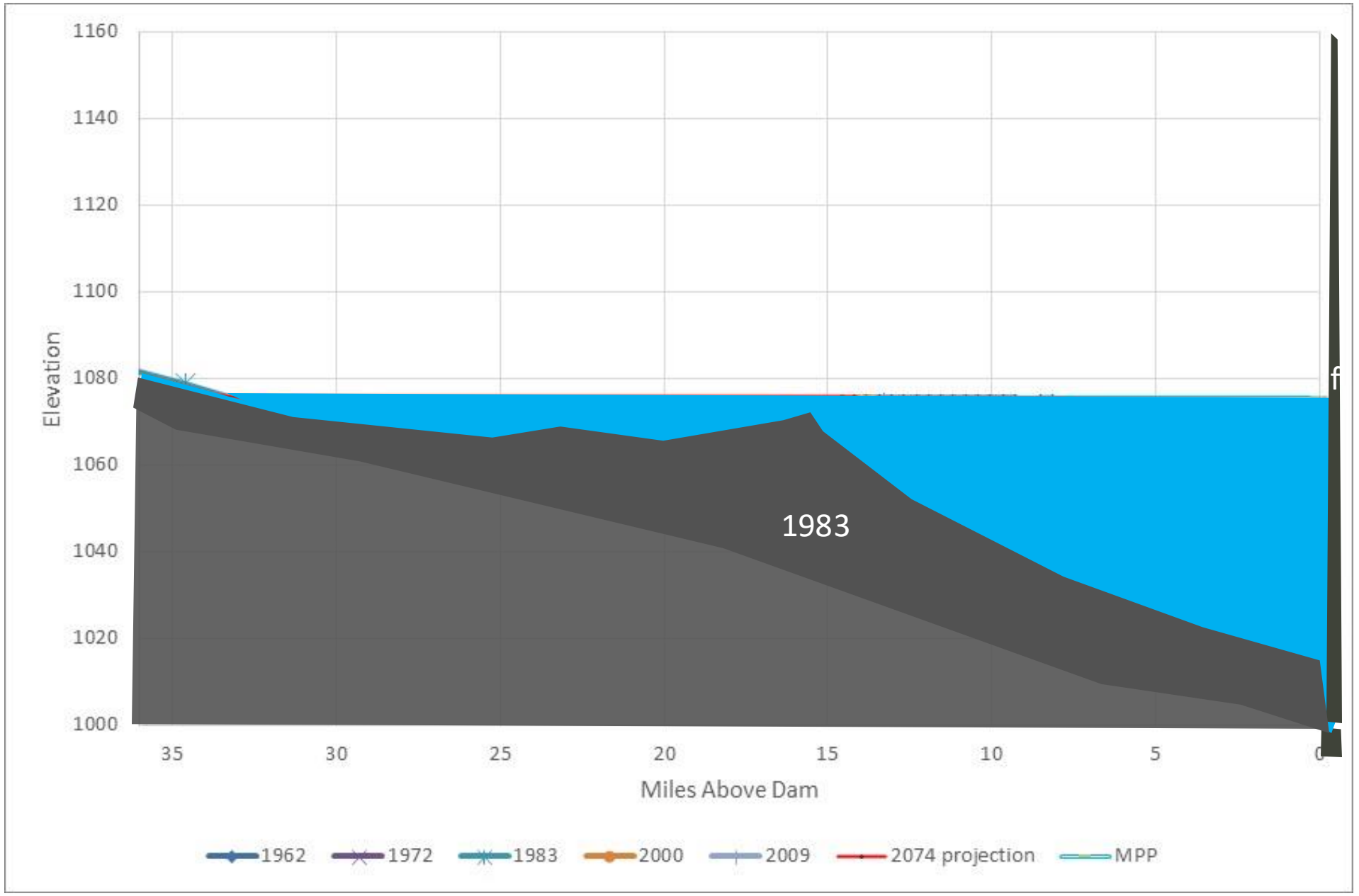
98% of sediment trapped



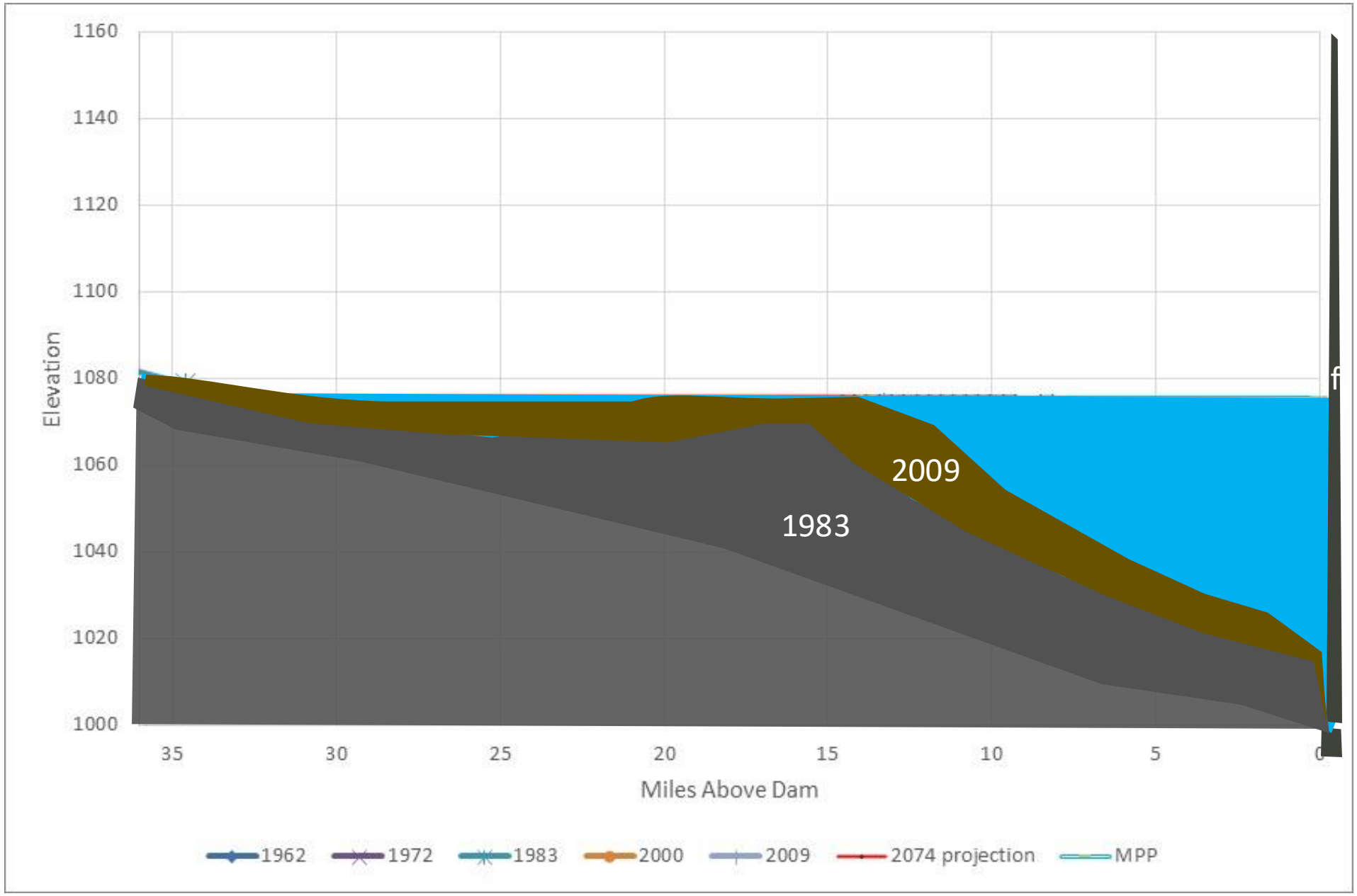
Sediment Out

107k tons/year

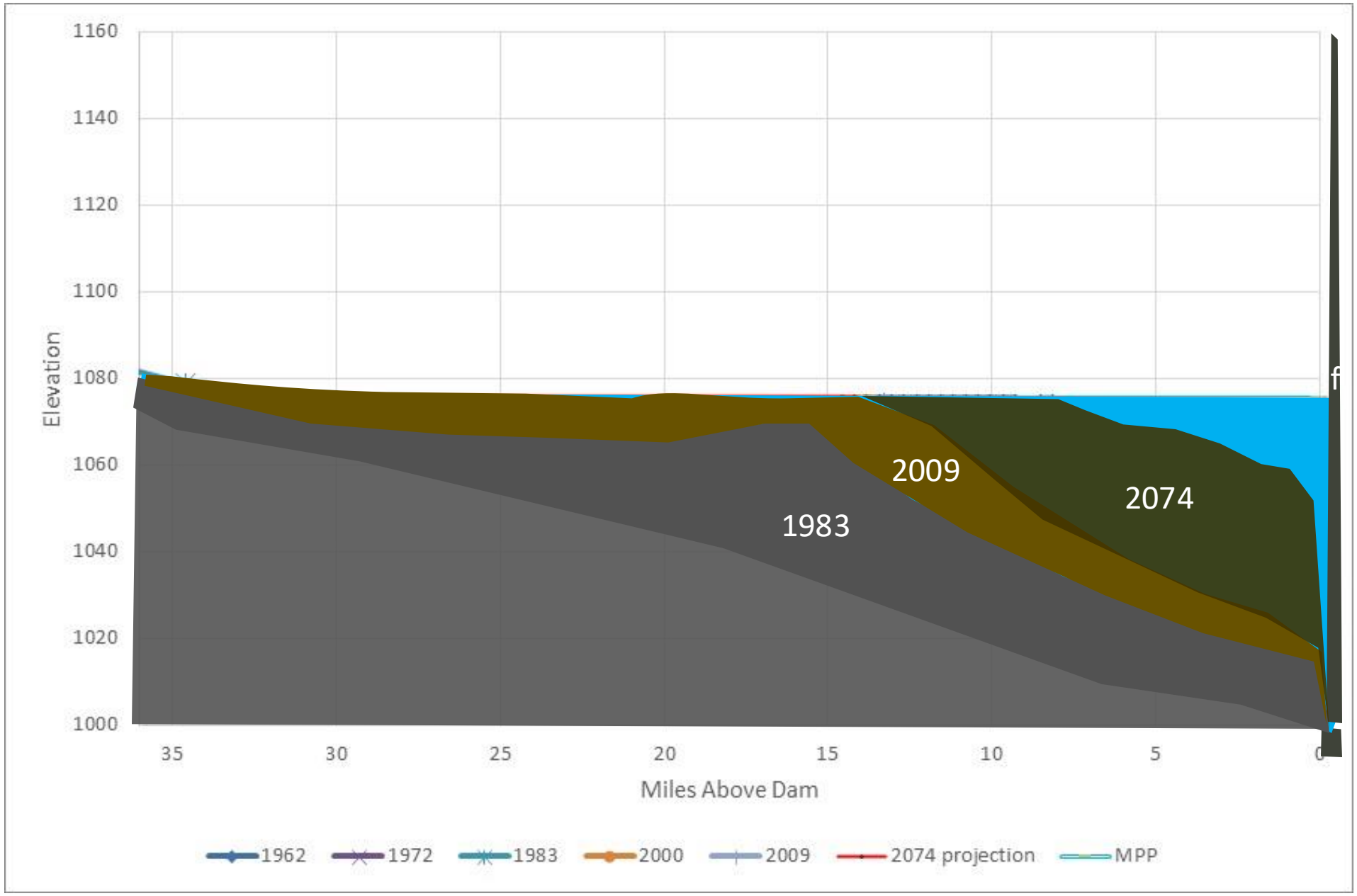
Tuttle Creek Lake



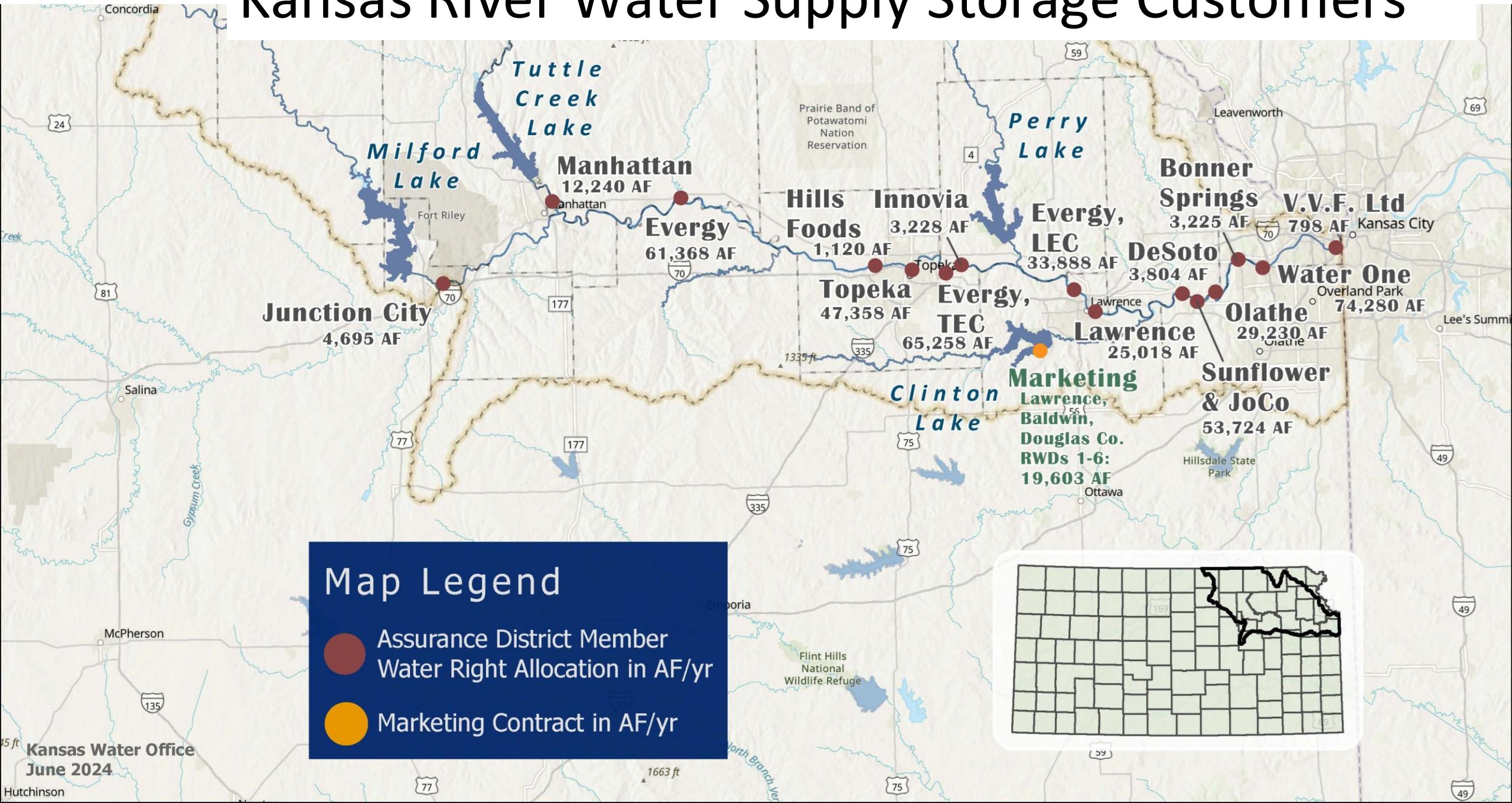
Tuttle Creek Lake



Tuttle Creek Lake



Kansas River Water Supply Storage Customers



Remaining Storage within Kansas Reservoirs

The vertical height of each bar represents total storage capacity. The blue indicates the 2070 capacity of each reservoir. The brown indicates the volume of sediment in each reservoir.

Legend

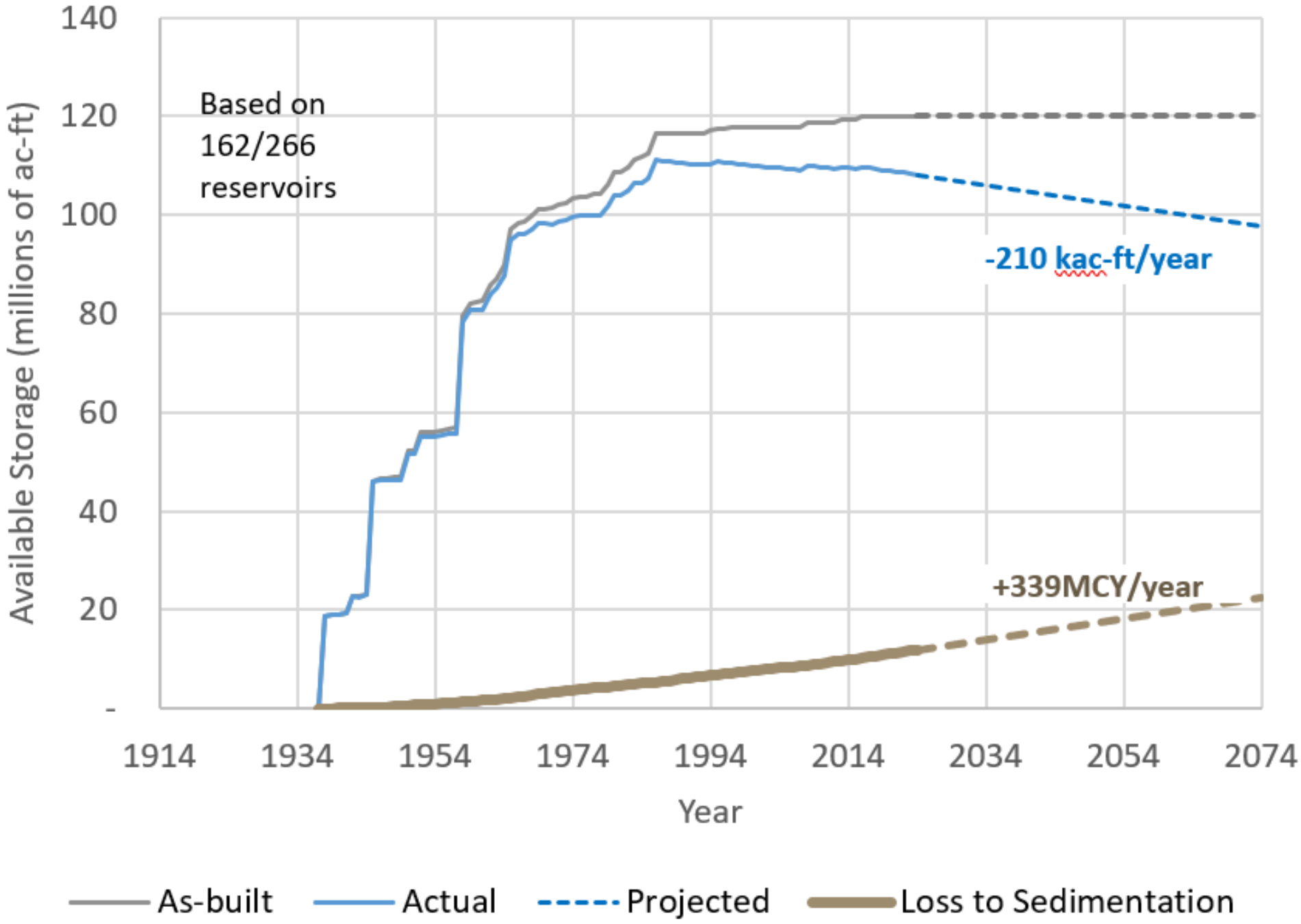
- Remaining Capacity
- Volume of Sediment by 2070

Tuttle Creek Lake
10.1% Remaining capacity
89.9% Capacity lost to sediment

Cedar Bluff Reservoir
Keith Sebelius Lake
Webster Reservoir
Kirwin Reservoir
Wilson Lake
Waconda Lake
Lovewell Reservoir
Kanopolis Lake
Cheney Reservoir
Milford Lake
Marion Reservoir
Tuttle Creek Lake
El Dorado Lake
Council Grove Lake
Perry Lake
Clinton Lake
Pomona Lake
Melvern Lake
Hillsdale Lake
John Redmond Reservoir
Toronto Lake
Fall River Lake
Elk City Lake
Big Hill Lake

Kansas Water Office

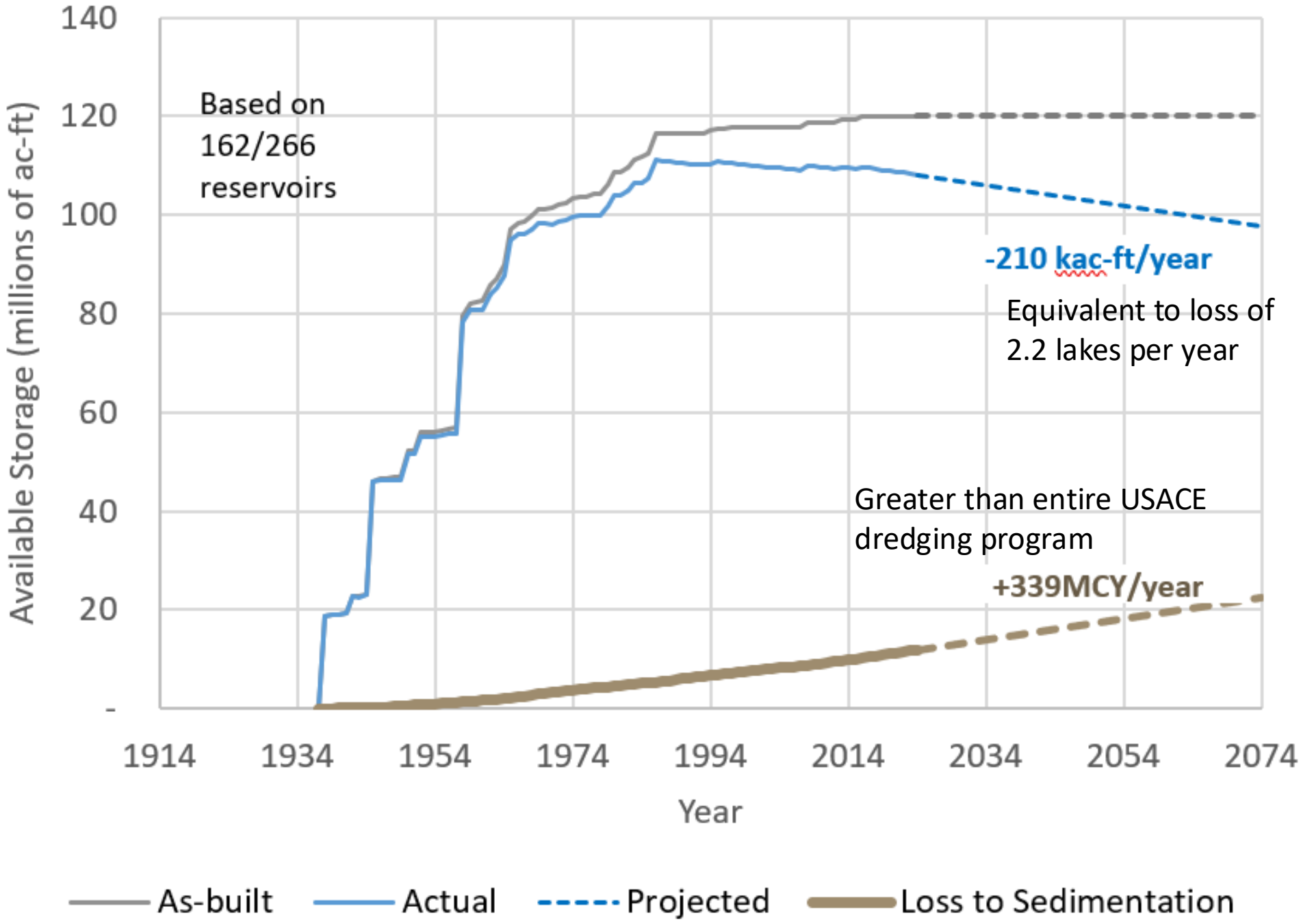
A National (And International) Problem



Sedimentation in USACE Reservoirs

Shelley and Boyd (2025)

A National (And International) Problem



Sedimentation in USACE Reservoirs

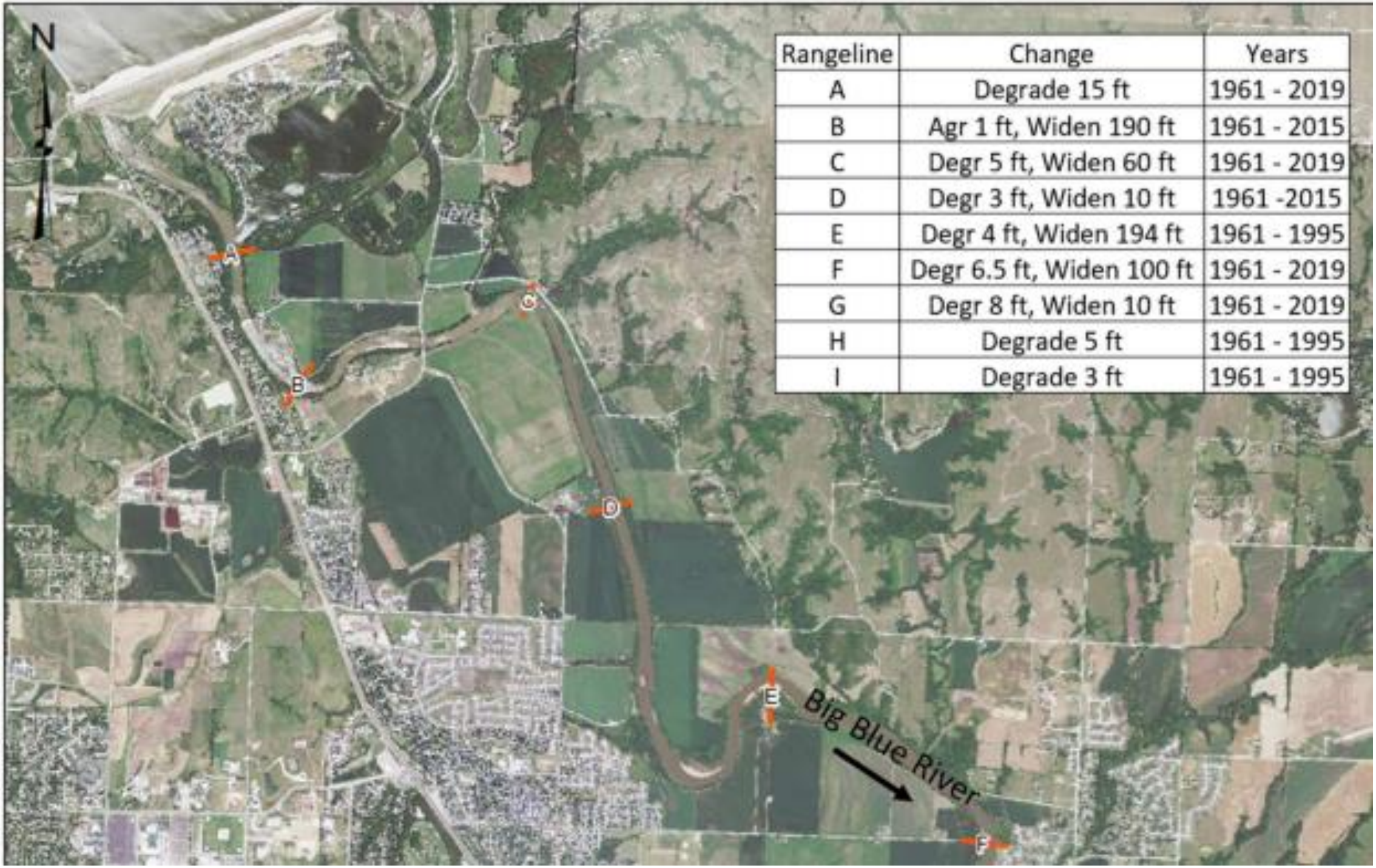
Shelley and Boyd (2025)

Degradation in the Downstream Channels

Sediment starved water erodes bed and banks

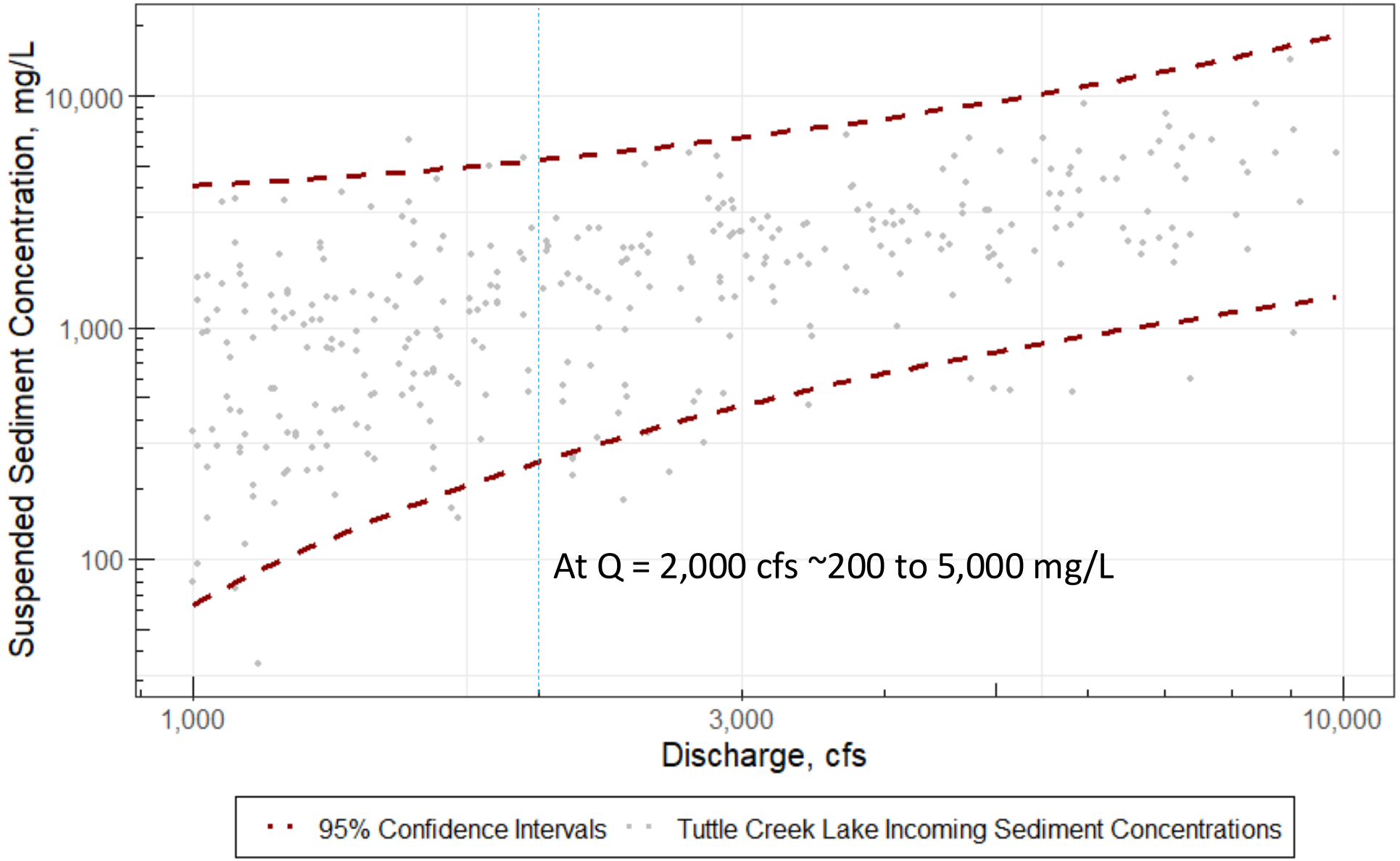
- Land loss
- Exposed pipelines
- Exposed bridge piers
- Groundwater lowering

Sediment starved channels may have higher losses

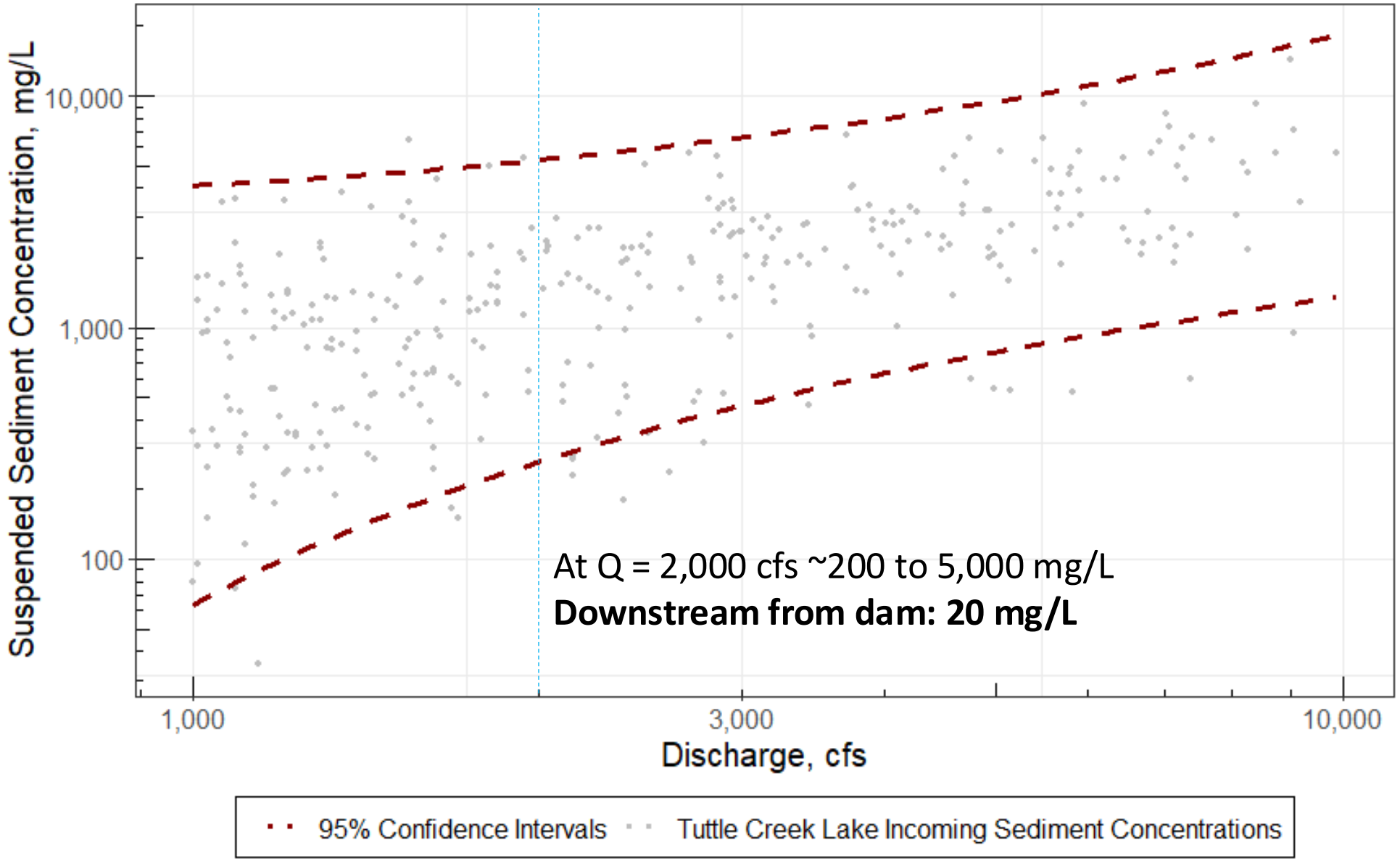


Rangeline	Change	Years
A	Degrade 15 ft	1961 - 2019
B	Agr 1 ft, Widen 190 ft	1961 - 2015
C	Degr 5 ft, Widen 60 ft	1961 - 2019
D	Degr 3 ft, Widen 10 ft	1961 -2015
E	Degr 4 ft, Widen 194 ft	1961 - 1995
F	Degr 6.5 ft, Widen 100 ft	1961 - 2019
G	Degr 8 ft, Widen 10 ft	1961 - 2019
H	Degrade 5 ft	1961 - 1995
I	Degrade 3 ft	1961 - 1995

Sediment Regime Flowing Into Tuttle Creek Lake

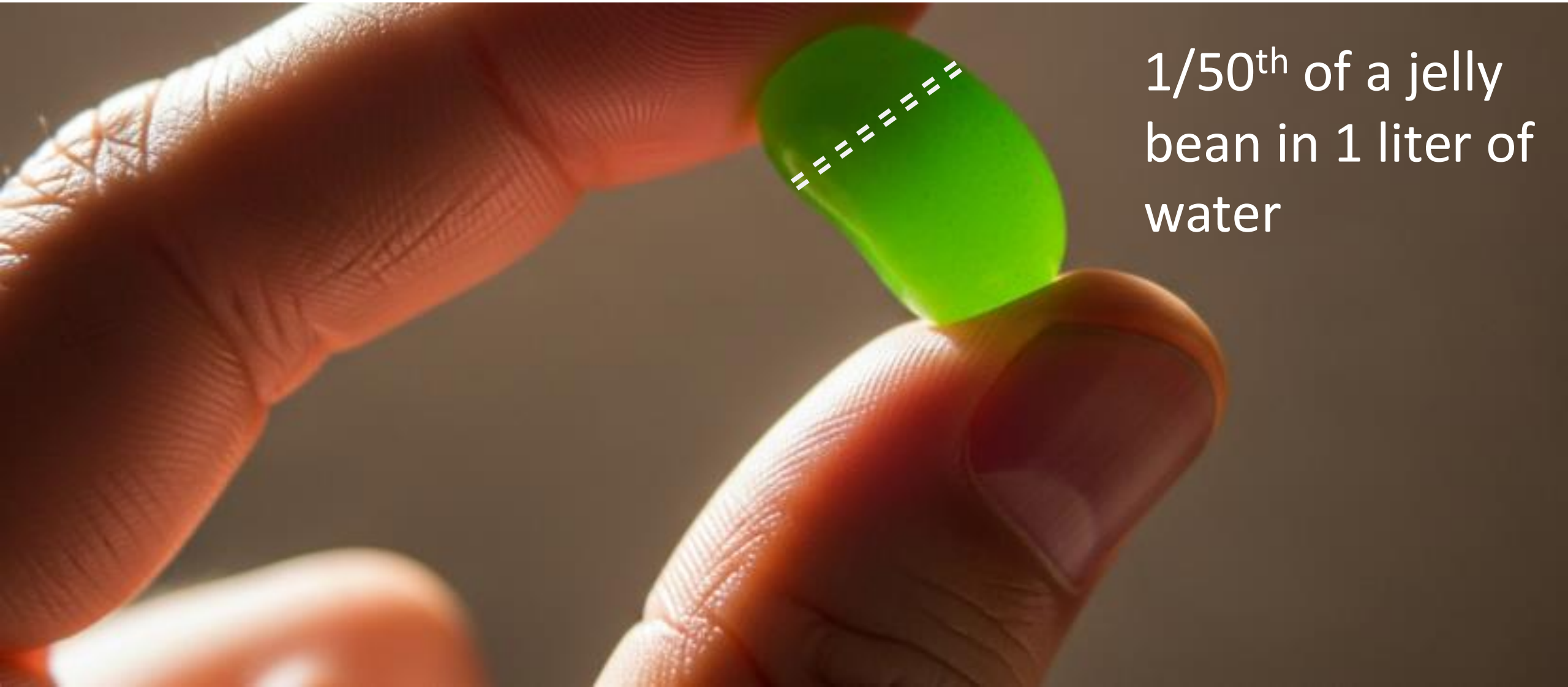


Sediment Regime Flowing Into Tuttle Creek Lake

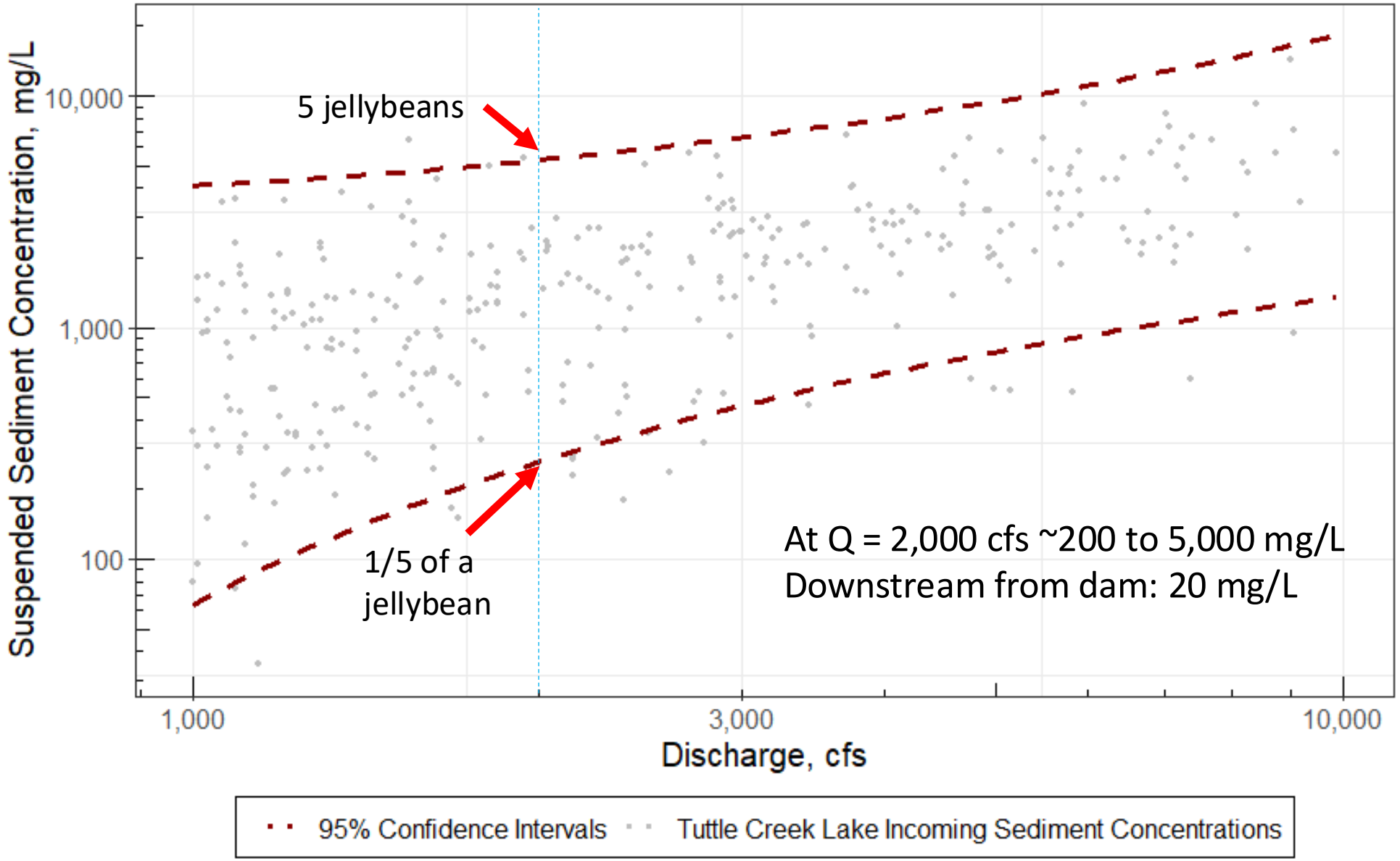


How much sediment is 20 mg/L?

How much sediment is 20 mg/L?



Sediment Regime Flowing Into Tuttle Creek Lake



Outline

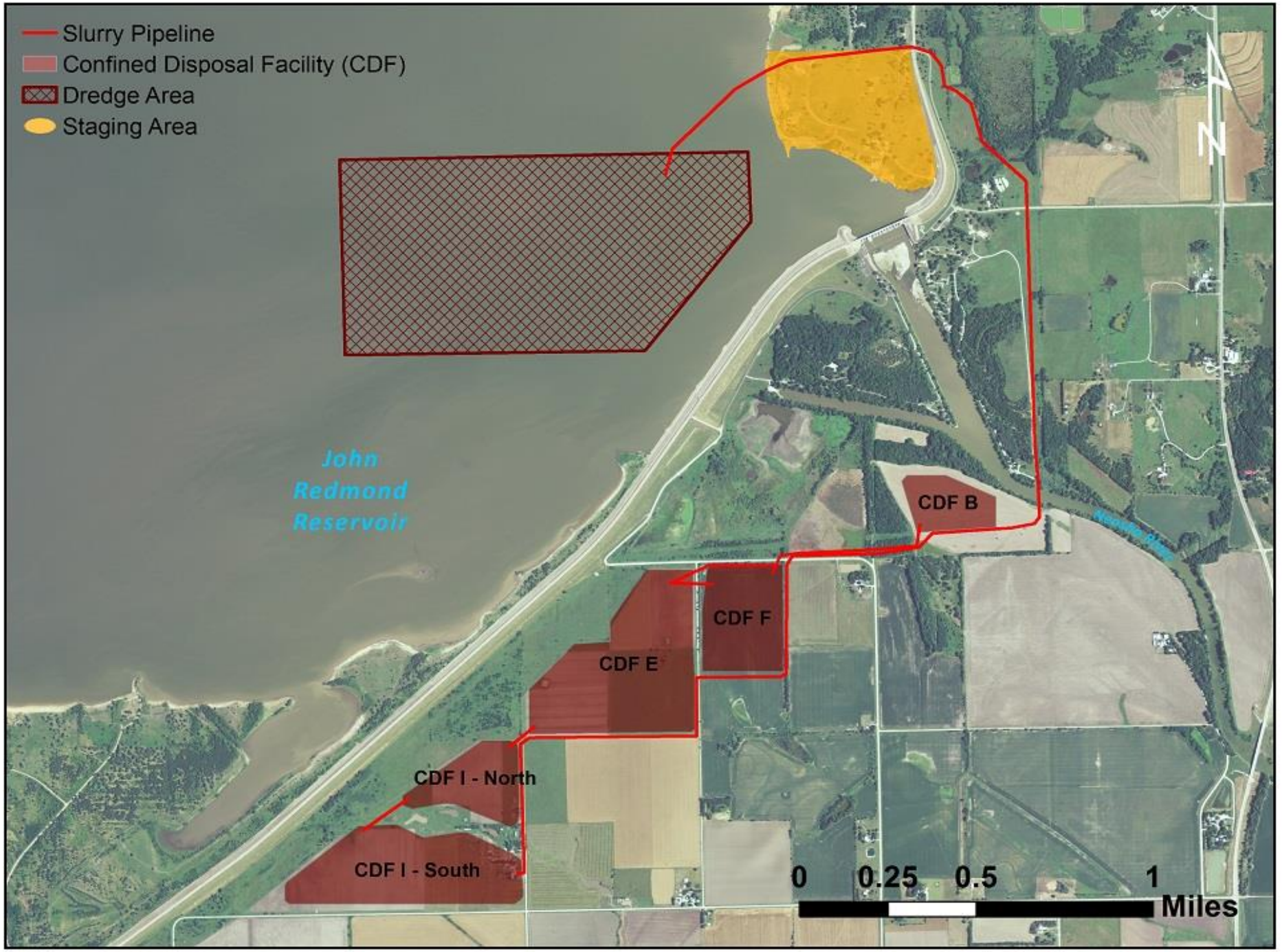
1. Introduction
2. **Traditional Hydraulic Dredging**
3. Water Injection Dredging
4. Solutions

John Redmond Reservoir Dredging
May - October 2016

Traditional Dredging with Confined Disposal Facilities

2016 John Redmond Reservoir Dredging

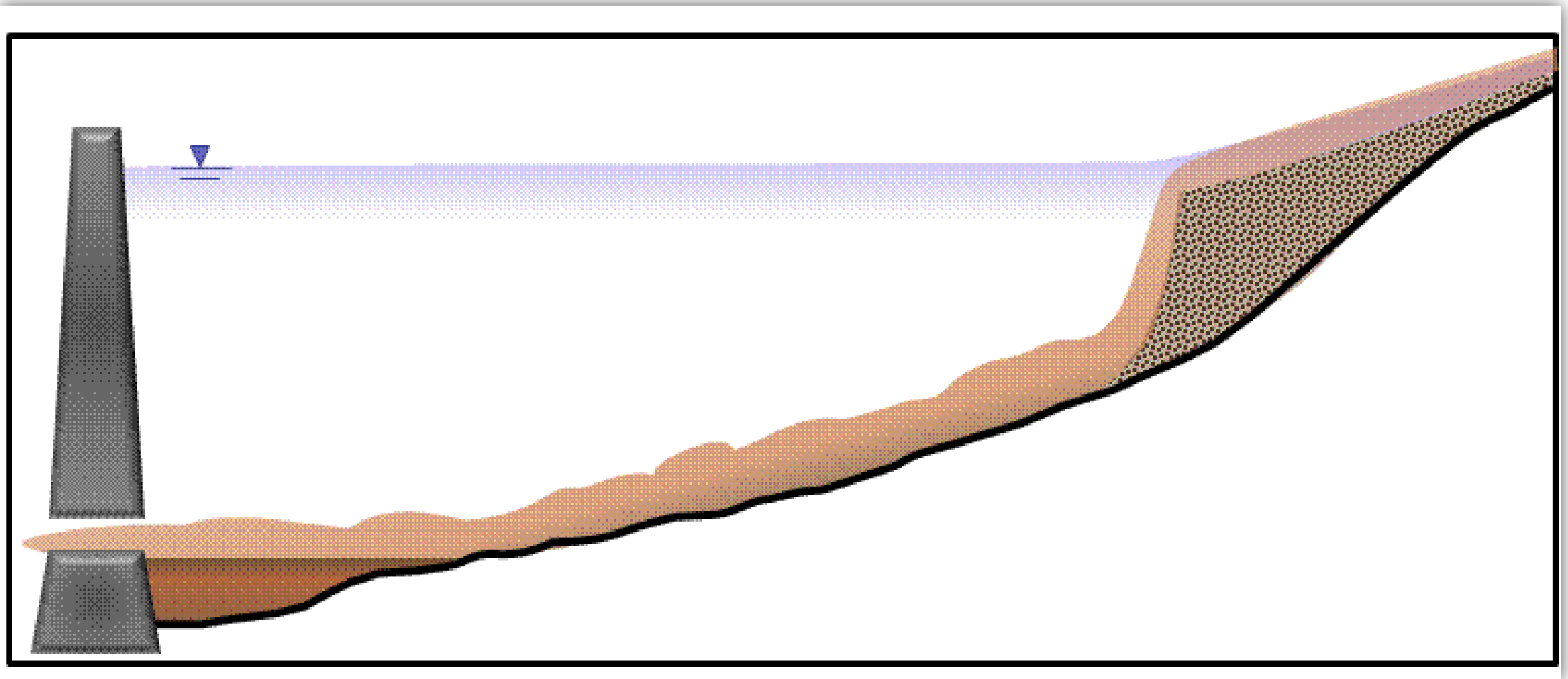
- 3M yd^3 of sediment removed
- $20M
- $6.67/CY (2016) → ~$11/CY (2025)


Slurry Pipeline
Confined Disposal Facility (CDF)
Dredge Area
Staging Area
John Redmond Reservoir
CDF B
CDF F
CDF E
CDF I - North
CDF I - South
0 0.25 0.5 1
Miles
N

Outline

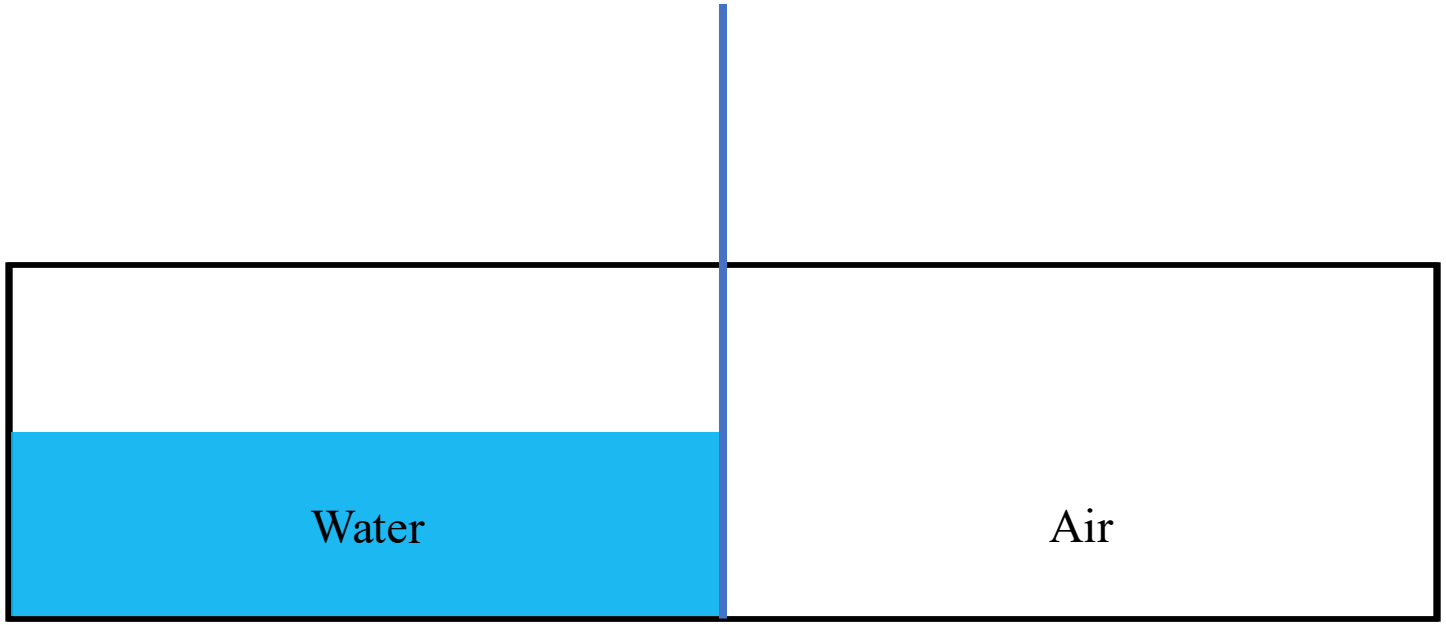
1. Introduction
2. Traditional Hydraulic Dredging
3. **Water Injection Dredging**
4. Solutions

Density Currents



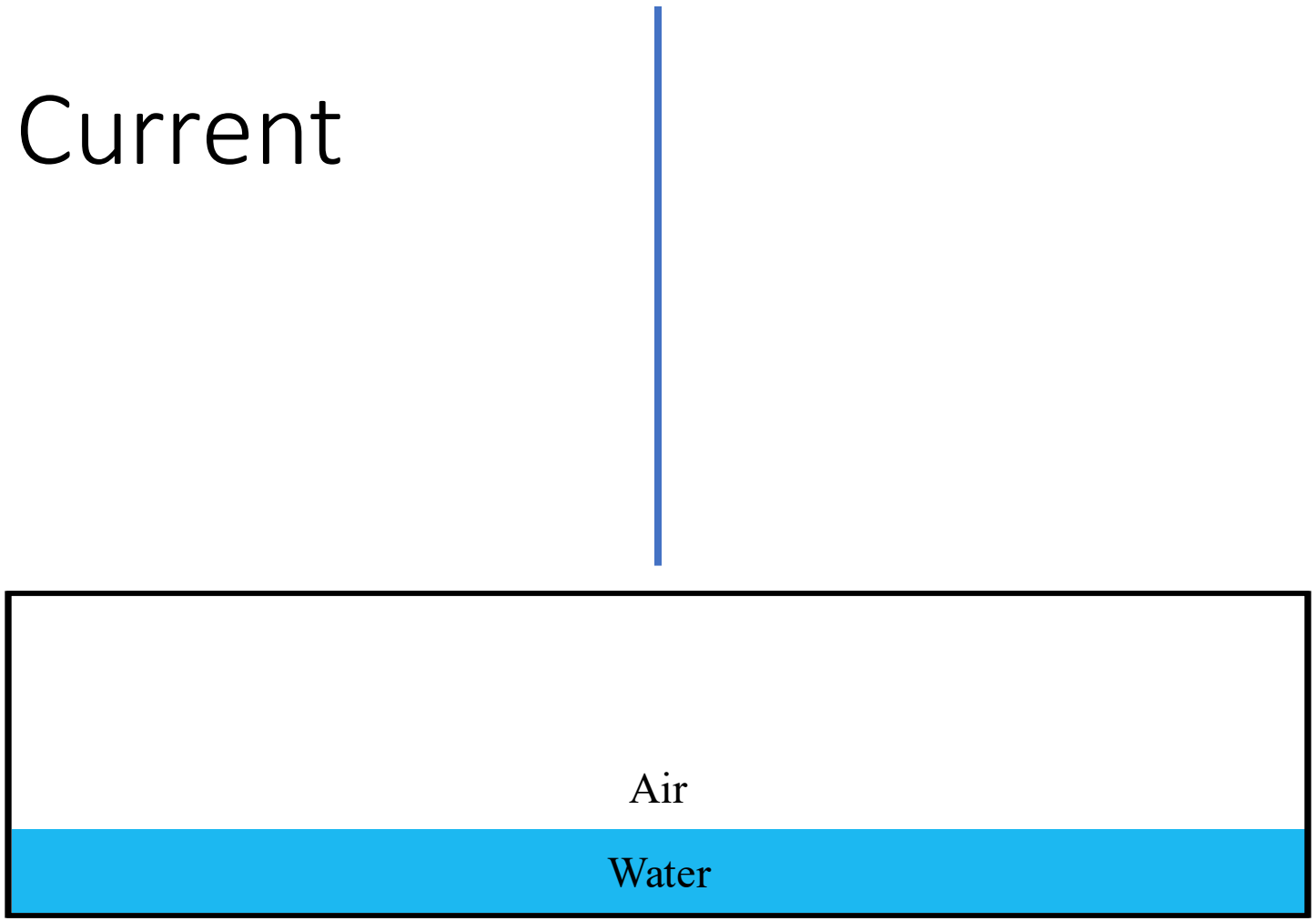
Heavy things sink

Density Current



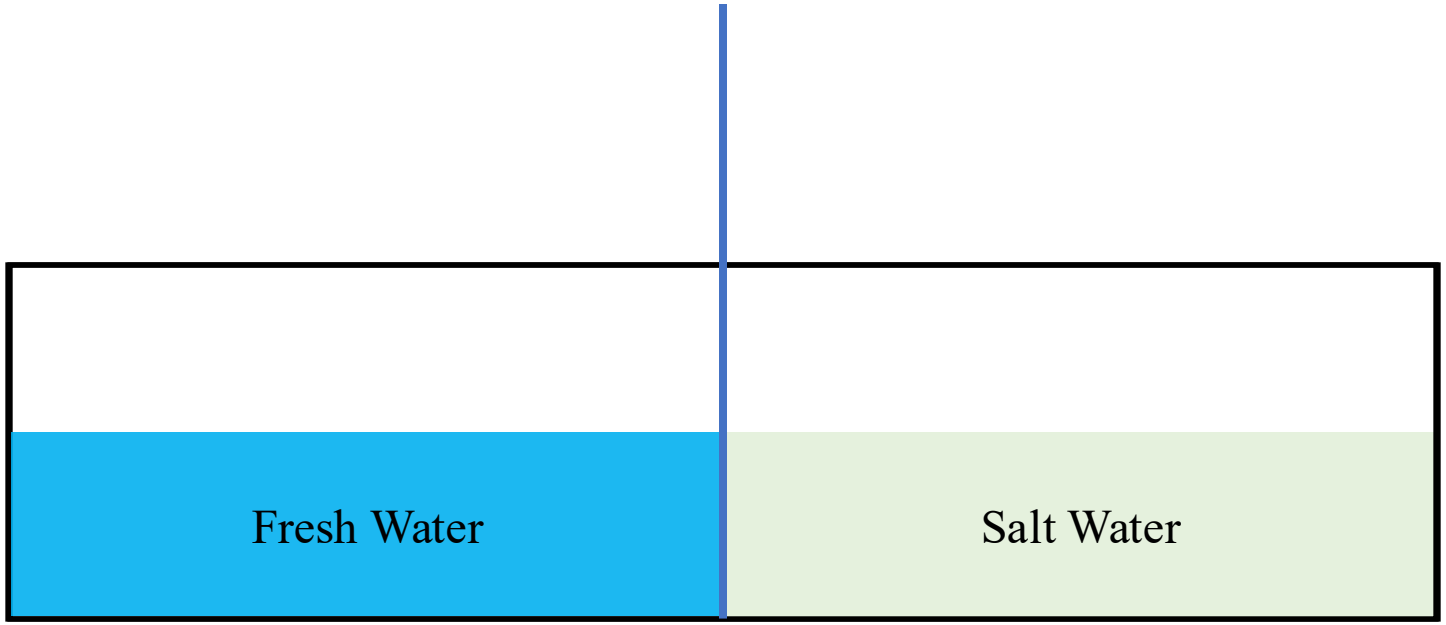
Slide Credit: Michael Mansfield

Density Current



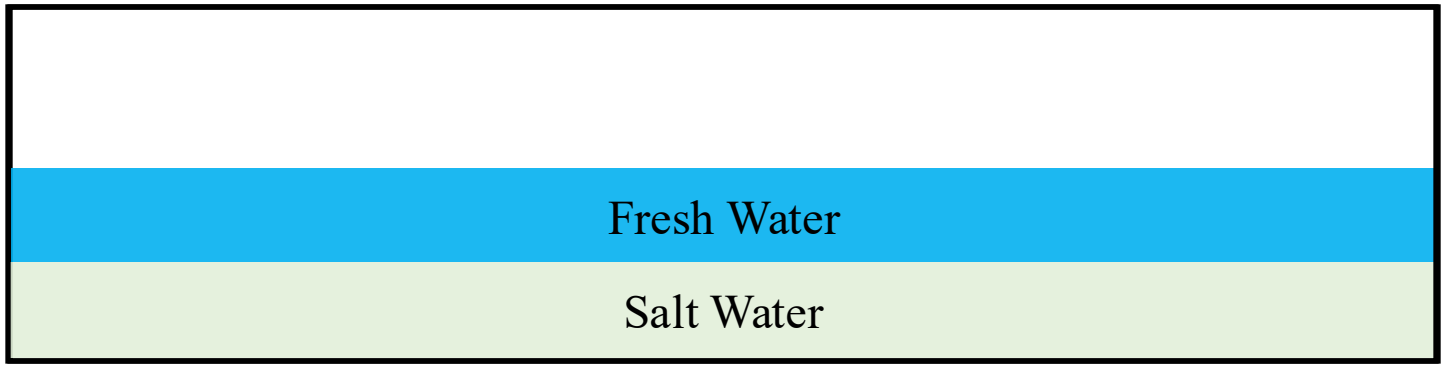
Slide Credit: Michael Mansfield

Density Current



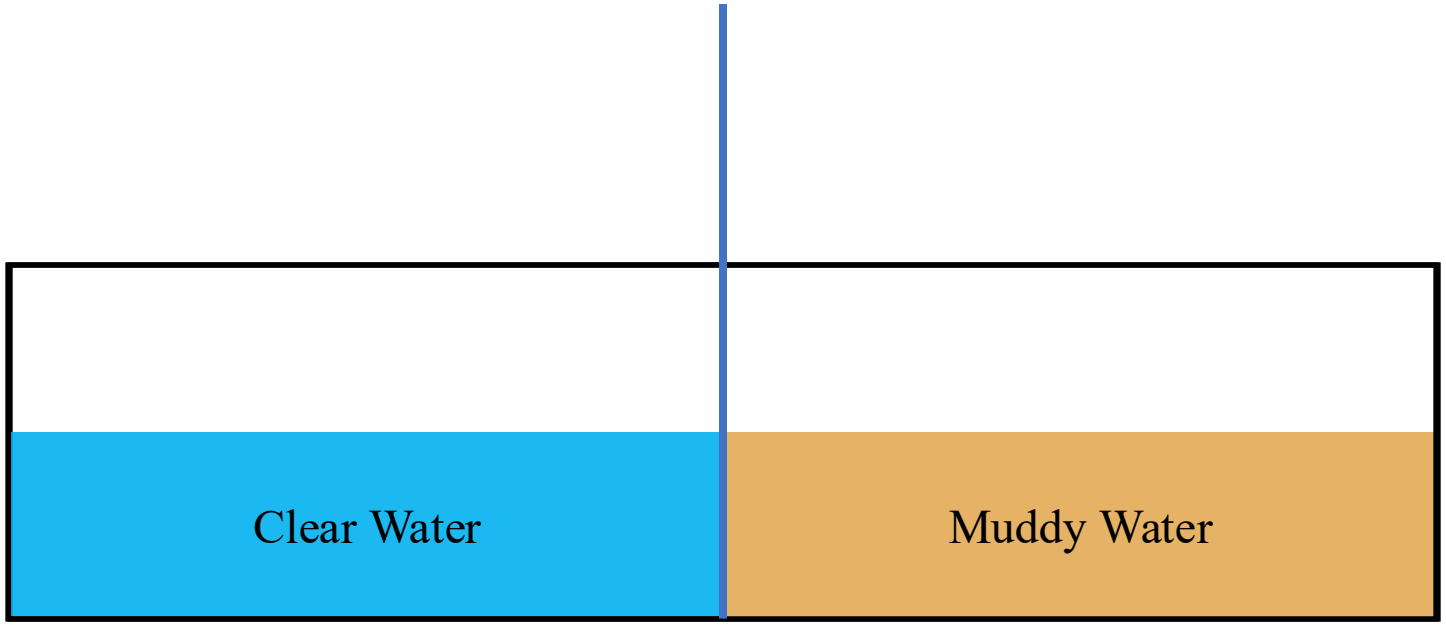
Slide Credit: Michael Mansfield

Density Current



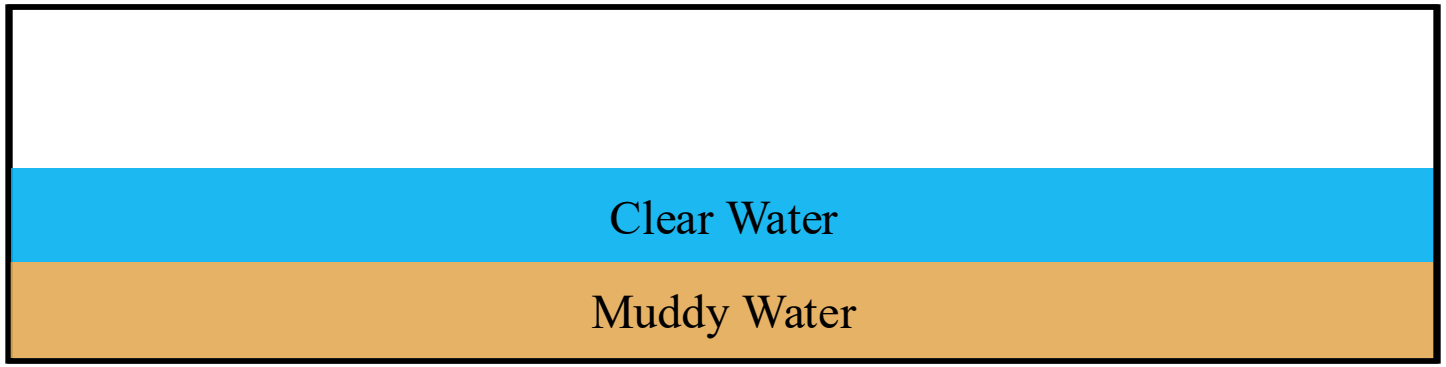
Slide Credit: Michael Mansfield

Density Current



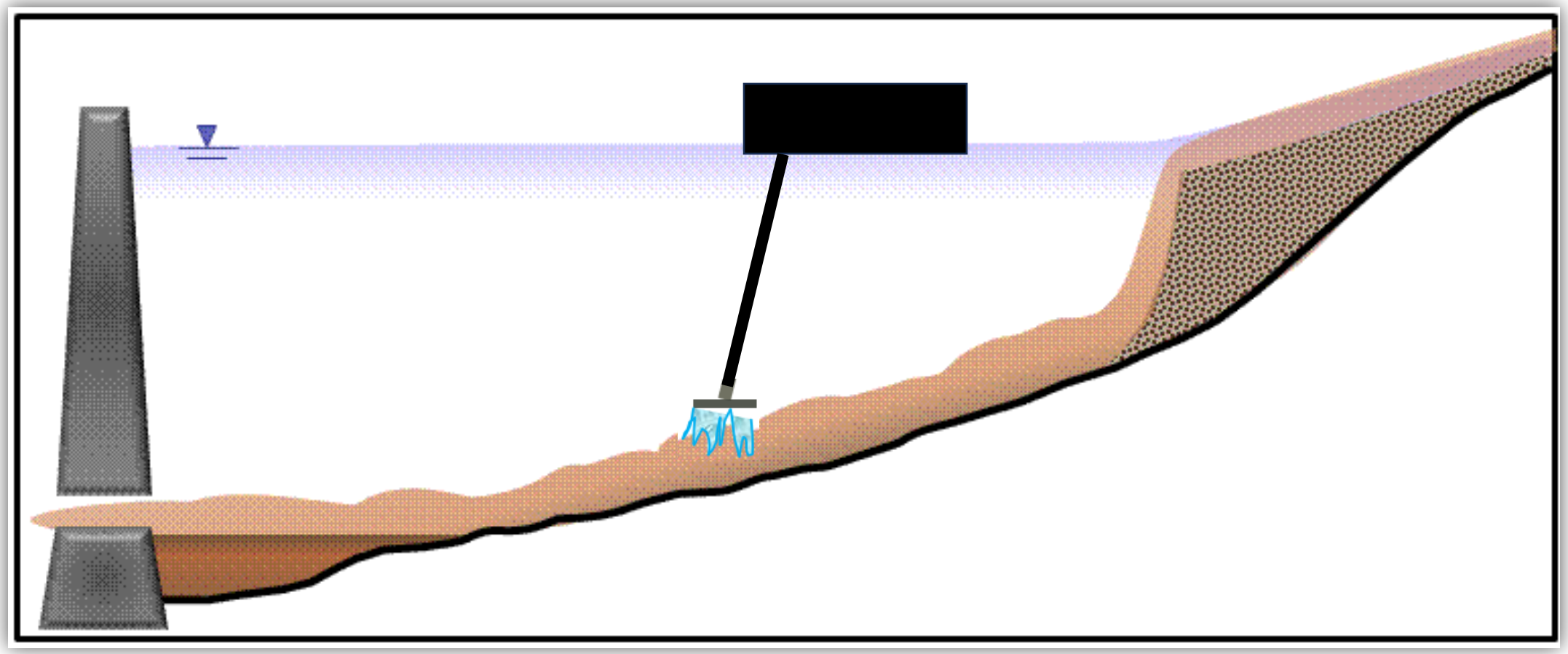
Slide Credit: Michael Mansfield

Density Current



Slide Credit: Michael Mansfield

Water Injection Dredging



Turbidity current discharges downstream through bottom service gates


https://www.youtube.com/watch?v=J2Zikq6Zx68

Traditional Dredging

- Land disposal
- Miles of pipelines
- Pump sediment slurry 1000s of ft
- $$$
- Total control of discharge rate and timing

Water Injection Dredging

- Recharge to river
- No pipelines
- Pump clear water 10s of feet
- $
- Much less control over discharge rate and timing

Tuttle Creek Lake Water Injection Dredging Demonstration

- **Authorization:** Flood Control Act of 1938

- **Funding**: Total Project Cost $9.1M
  - Federal: Consolidated Appropriations Act FY22 ($1.3M); FY23 ($2.8M) Operations and Maintenance – Water Supply (WS); and $3M reprogrammed from Tuttle Creek operations project
  - State: State of Kansas - Kansas Water Office contributed an additional $2M directly to USACE for the project.

- **Project Managers**: Laura Totten (USACE); Josh Olson (KWO)
- **Technical Lead**: Michael Mansfield (USACE)
- **Water Quality Lead**: Marvin Boyer (USACE)

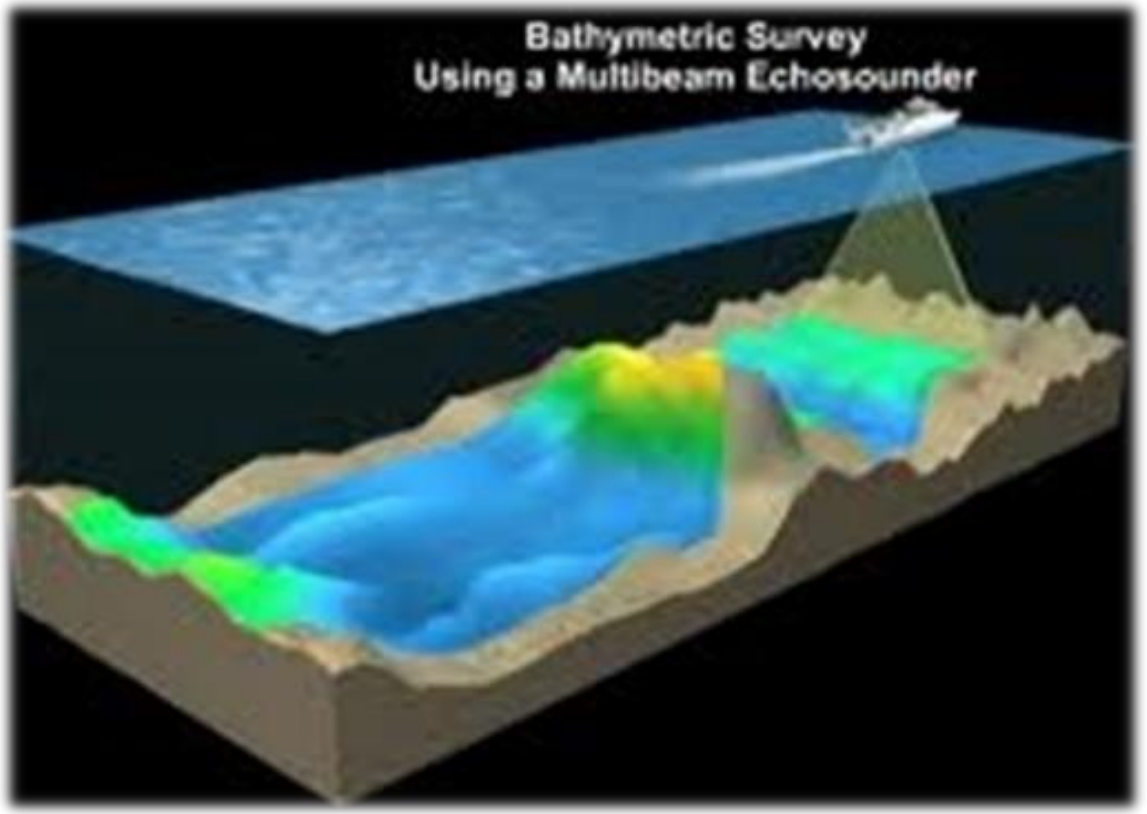
Demonstration Objectives

Test of the technology– not a typical dredging project

- Goal: Answer questions
- Not: Dredge to a certain elevation or volume

Tuttle Creek Lake Primary Questions

- How much sediment can WID move?
- WID production rate (cubic yards/hour)
- How much will it cost per cubic yard?
- What are the downstream effects? (water quality/ecological/geomorphology)
- Fully successful if we answer these questions.



Extensive multibeam bathymetric data and downstream sediment and water quality monitoring

Collaborators

State

Kansas Water Office
Kansas Department of Wildlife and Parks
Kansas Department of Health and Environment

Academic

University of Kansas (Engineering)
Kansas Biological Survey
Kansas Geological Survey
Kansas State University (Aquatic Biology, Engineering)
Virgina Tech
University of Delft

USACE

Kansas City District
Omaha District
ERDC - DOER Program
ERDC - EMMRP Program
IWR - Sustainable Rivers Program

Other Federal

USGS
Bureau of Reclamation
National Science Foundation

WID Demonstration Schedule

- **WID Demonstration Fall 2025 – September 17 – September 27**
  - Dredging operation for 10 total days and demobilization.
    (200 hours of active dredging)

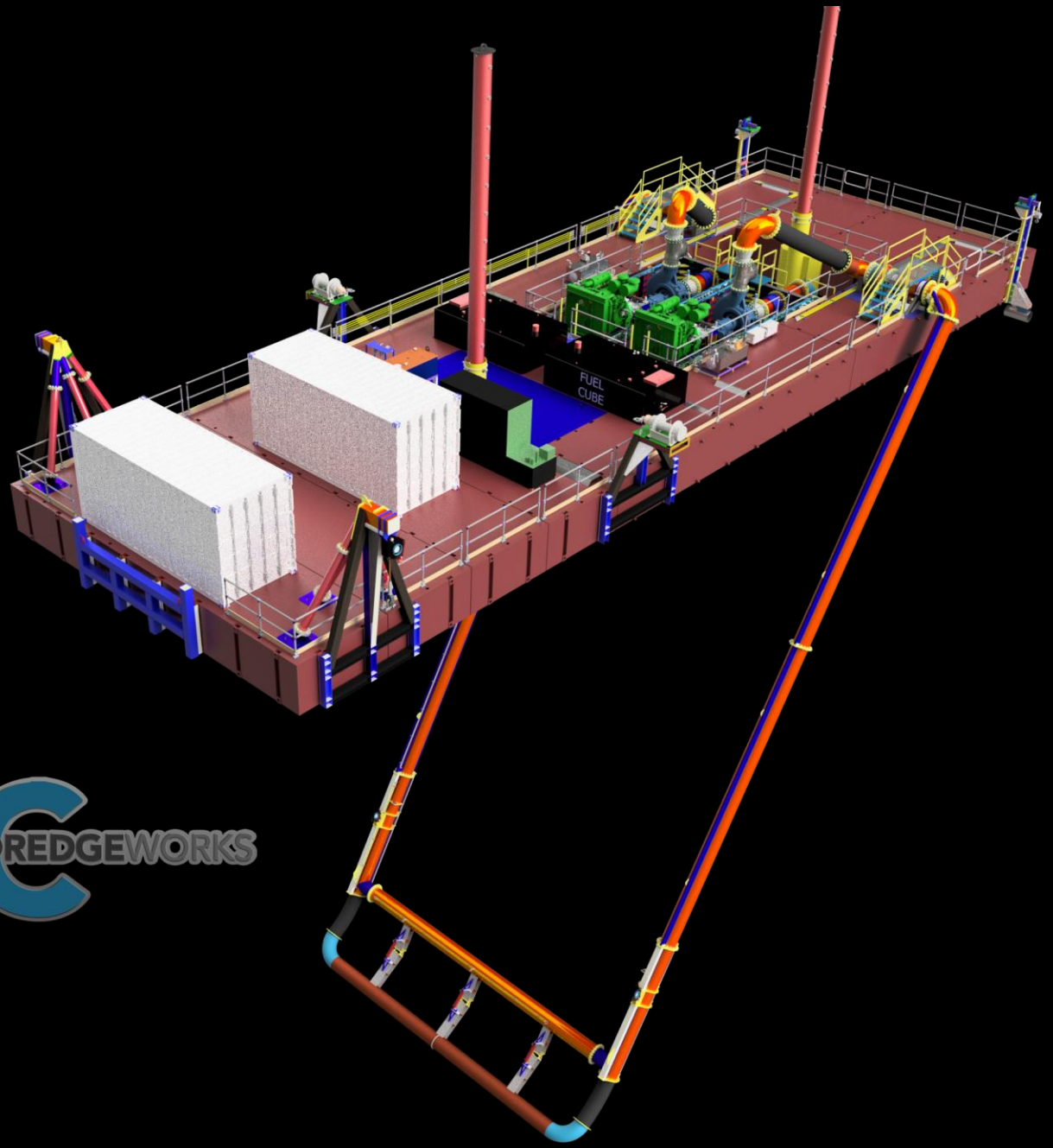
- **WID Demonstration Spring 2026 – March 2026**
  - Dredging operation for 10 total days and demobilization.
    (**200 hours** of active dredging – assumes 20 hours of dredging per day)

- **WID Demonstration Summer 2026 – June-July***
  - Dredging operation for 10 total days and demobilization.
    (200 hours of active dredging – assumes 20 hours of dredging per day)

*Subject to change

WID Demonstration Schedule

- **Fall 2025 -** The purpose of the Fall 2025 is to determine the optimal dredge operation (dredge location, speed, nozzle spacing, direction, reinjection), assess the water quality, and ecological impact during the Fall.
- **Spring 2026** - The optimal parameters derived from the Fall 2025 test will be employed during the Spring 2026 test to determine the maximum production rate and cost per cubic yard and assess downstream changes from dredge operation and flow management. Assess the downstream water quality and ecological effects during the spring.
- **Summer 2026** - The optimal parameters derived from the Fall 2025 test and any lessons learned from the Spring 2026 test will be employed during the Summer to determine the maximum production rate and cost per cubic yard. Additionally, the downstream water quality and ecological effects during the Summer will be assessed.



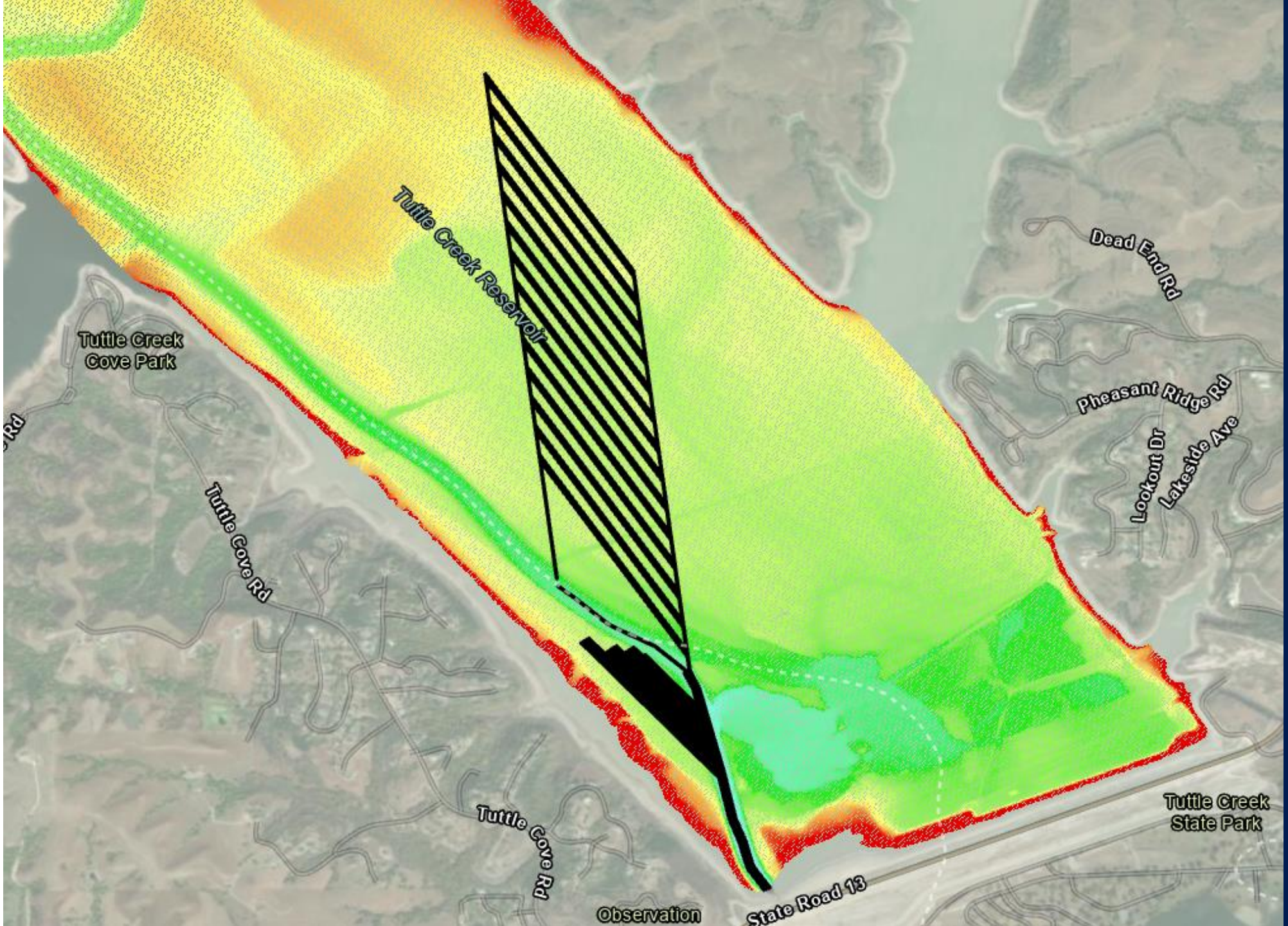
Kansas Water Office

CUSTOM DREDGEWORKS

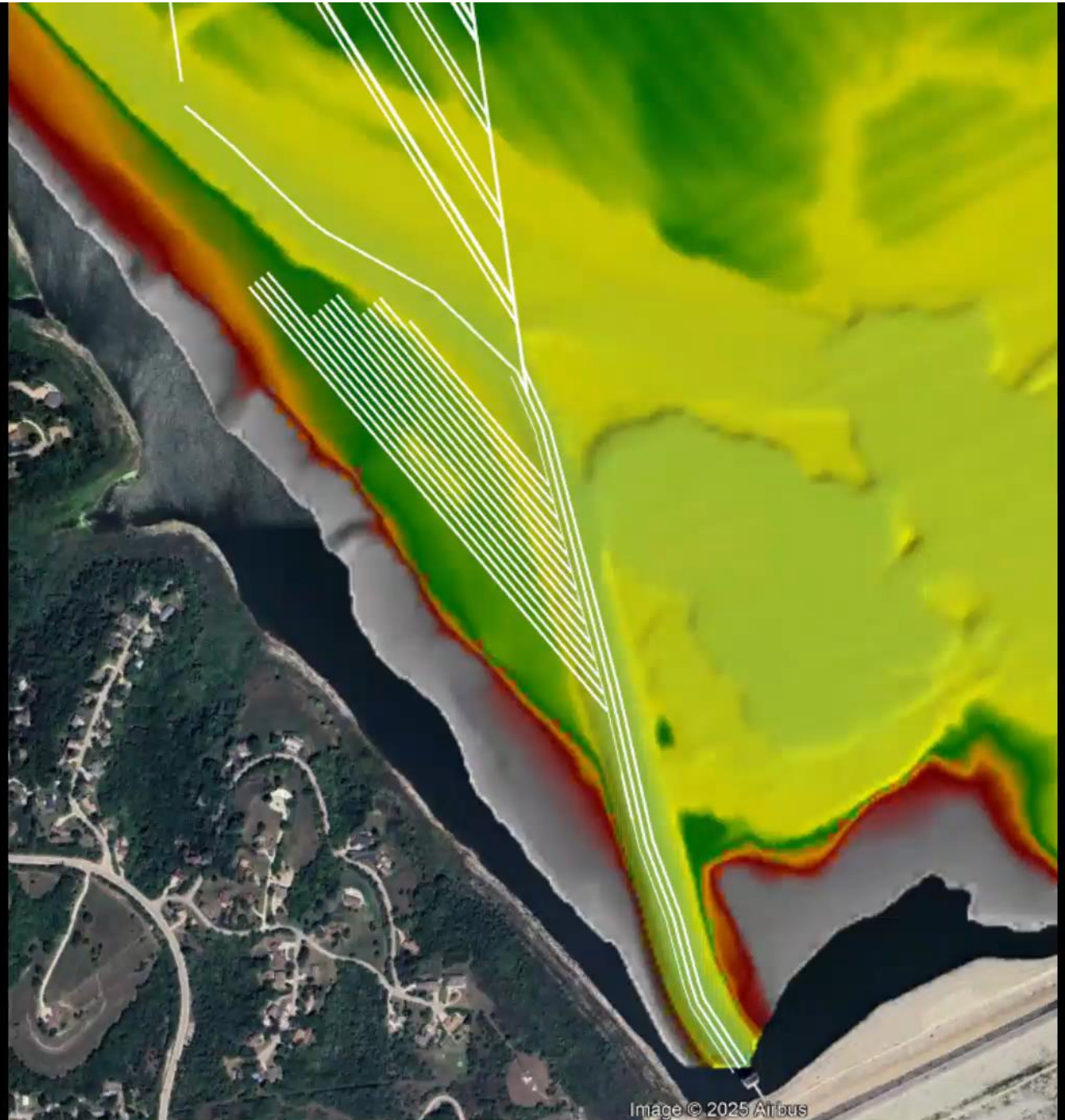
KU

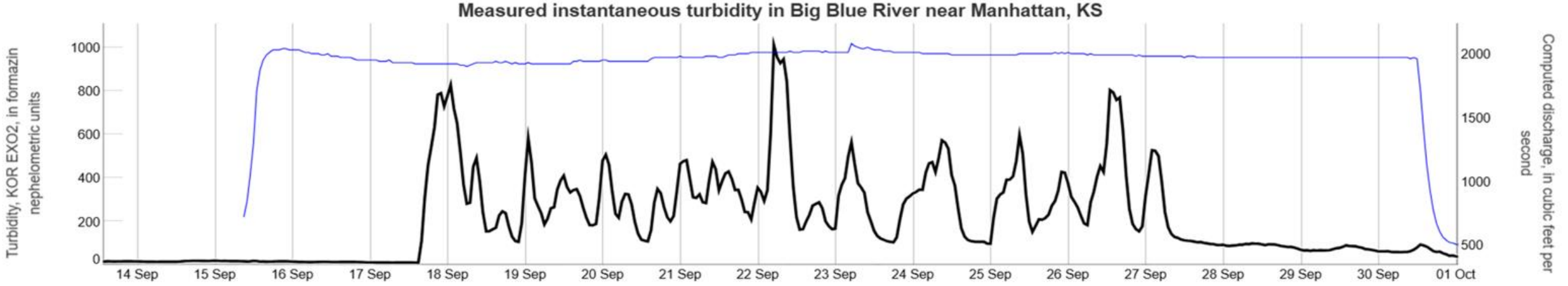
Dredging began around 11:45 AM on Wednesday, September 17th.

Dredging operations continued during the night.


Tuttle Creek Reservoir
Tuttle Creek Cove Park
Tuttle Cove Rd
Tuttle Cove Rd
Dead End Rd
Pheasant Ridge Rd
Lookout Dr
Lakeside Ave
Tuttle Creek State Park
State Road 13
Observation

* Graphic Credit: John Shelley

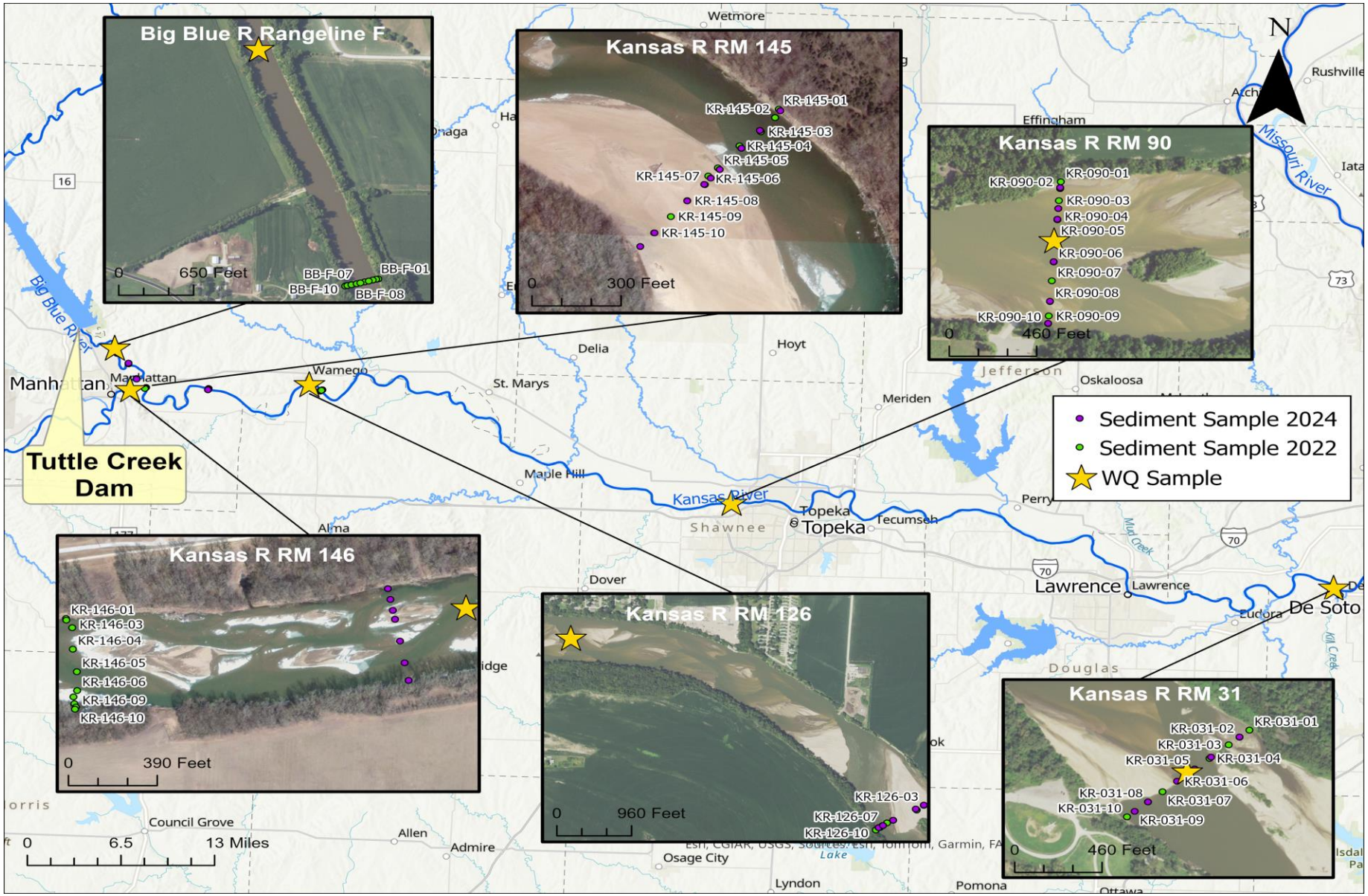




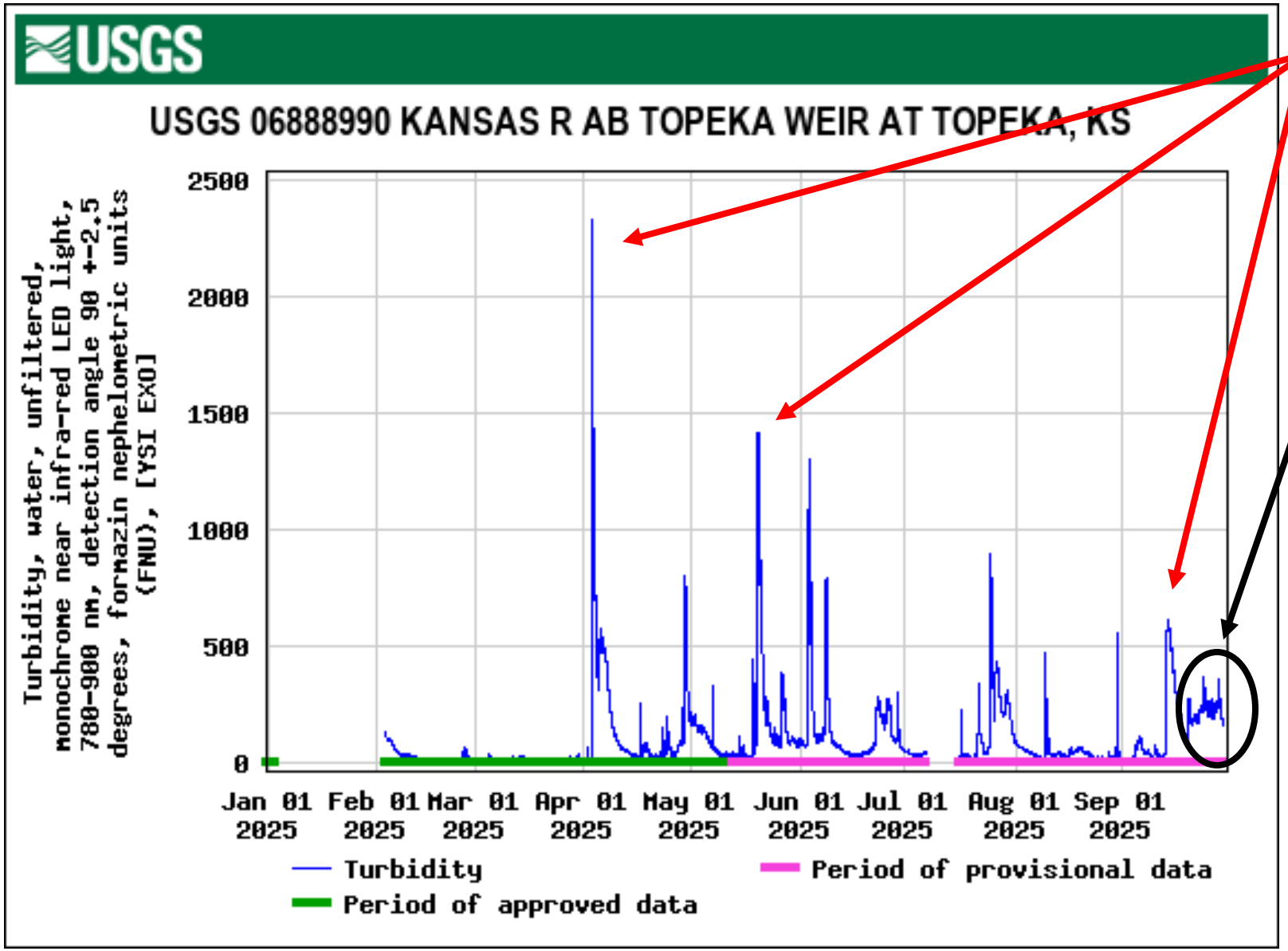
Discharge (blue line) and turbidity (black line) in the channel downstream of Tuttle Creek Lake September 2025, showing a very significant release of sediment during the Water Injection Dredging Demonstration Project.

Downstream Channel Monitoring

- 5 continuous gage stations (turbidity/water quality)
- Additional pre/post water/sediment quality measurements
- Cross-sections
- Bed/sandbar sediment
- Invertebrates

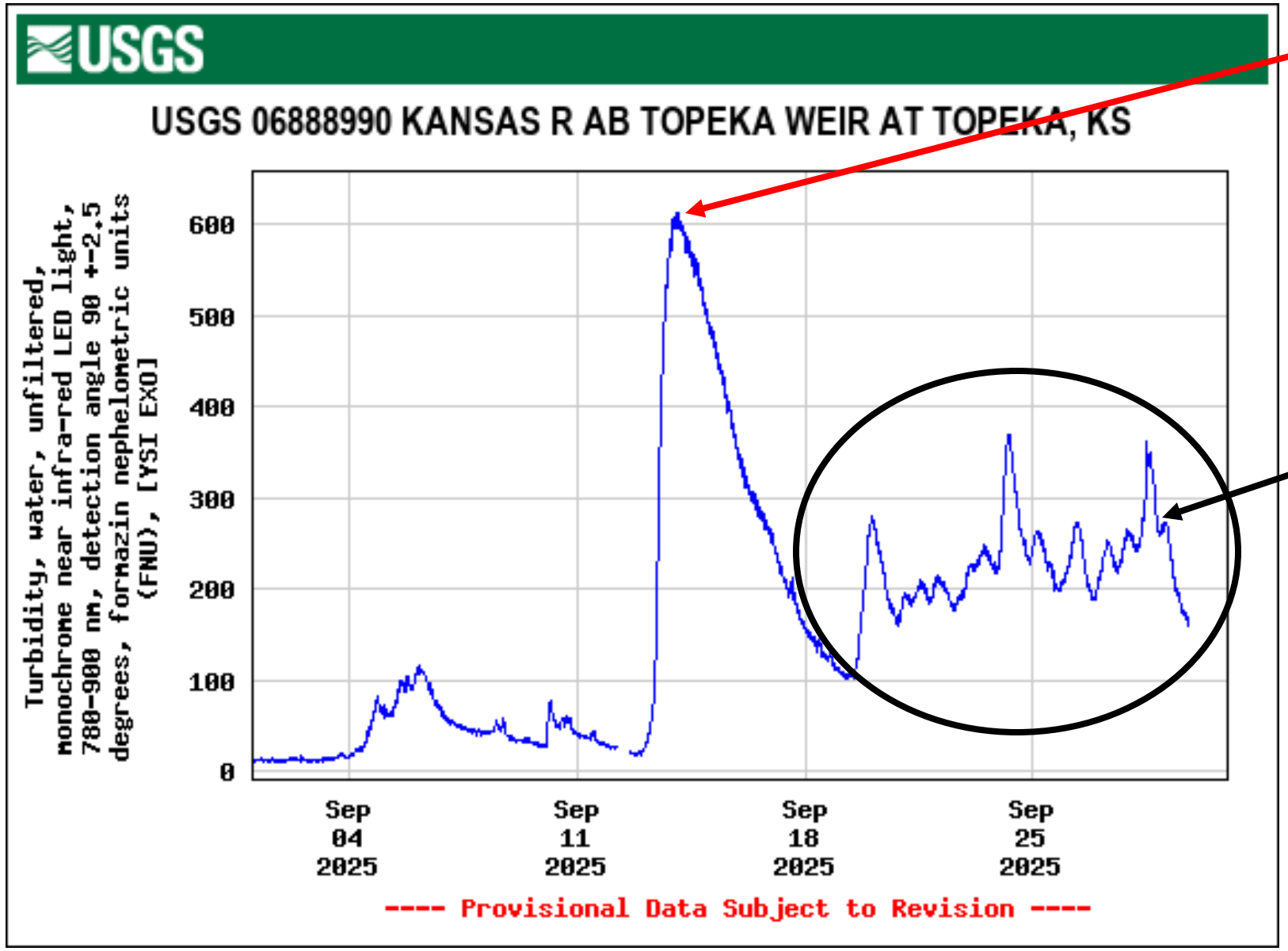


Turbidity at Topeka – 1/1/2025 to Arrival of WID Sediment

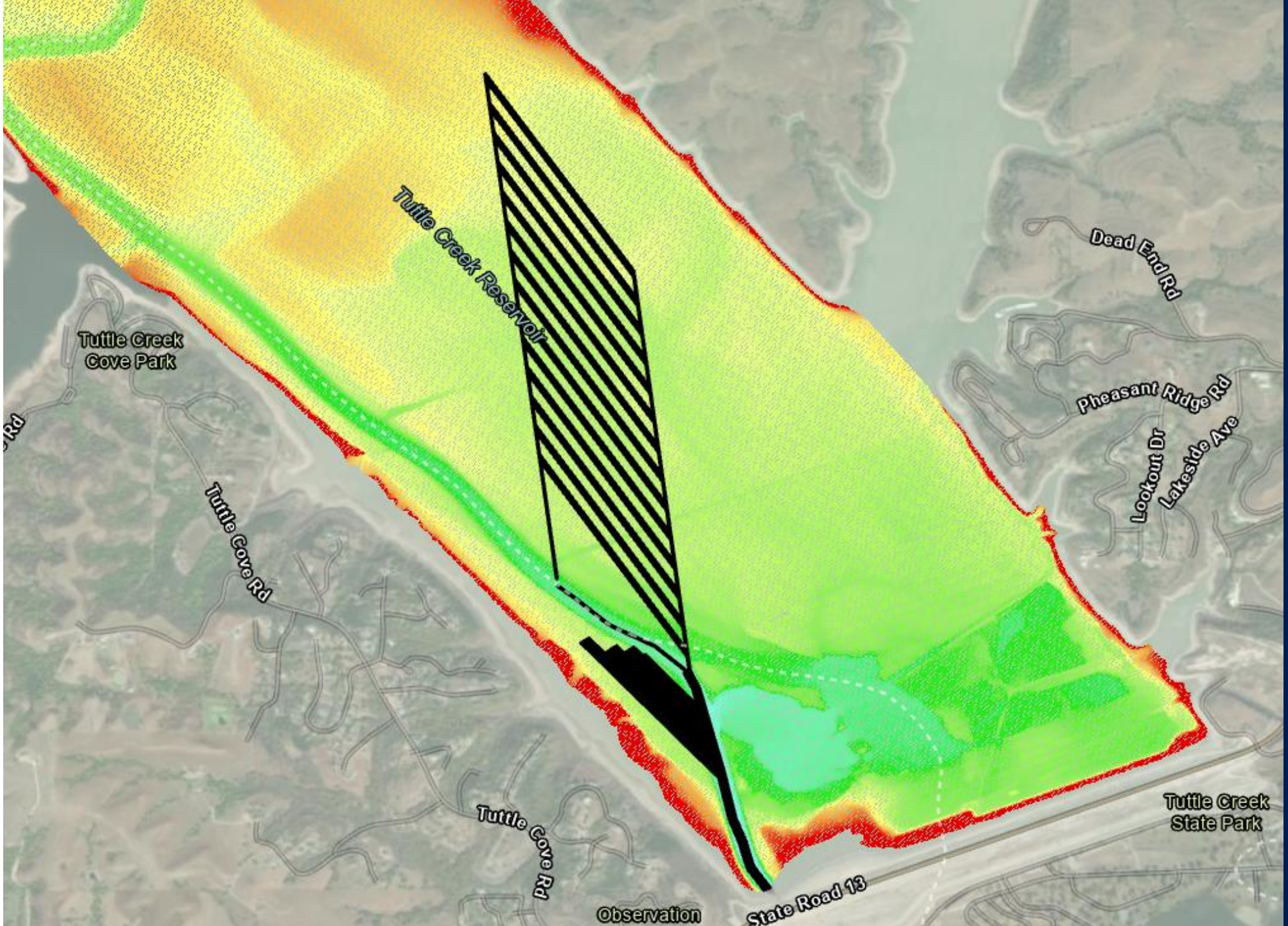


- **Note prior turbidity spikes for year from natural runoff events**
- **Water Injection Dredging (WID) sediment arrival at Topeka**

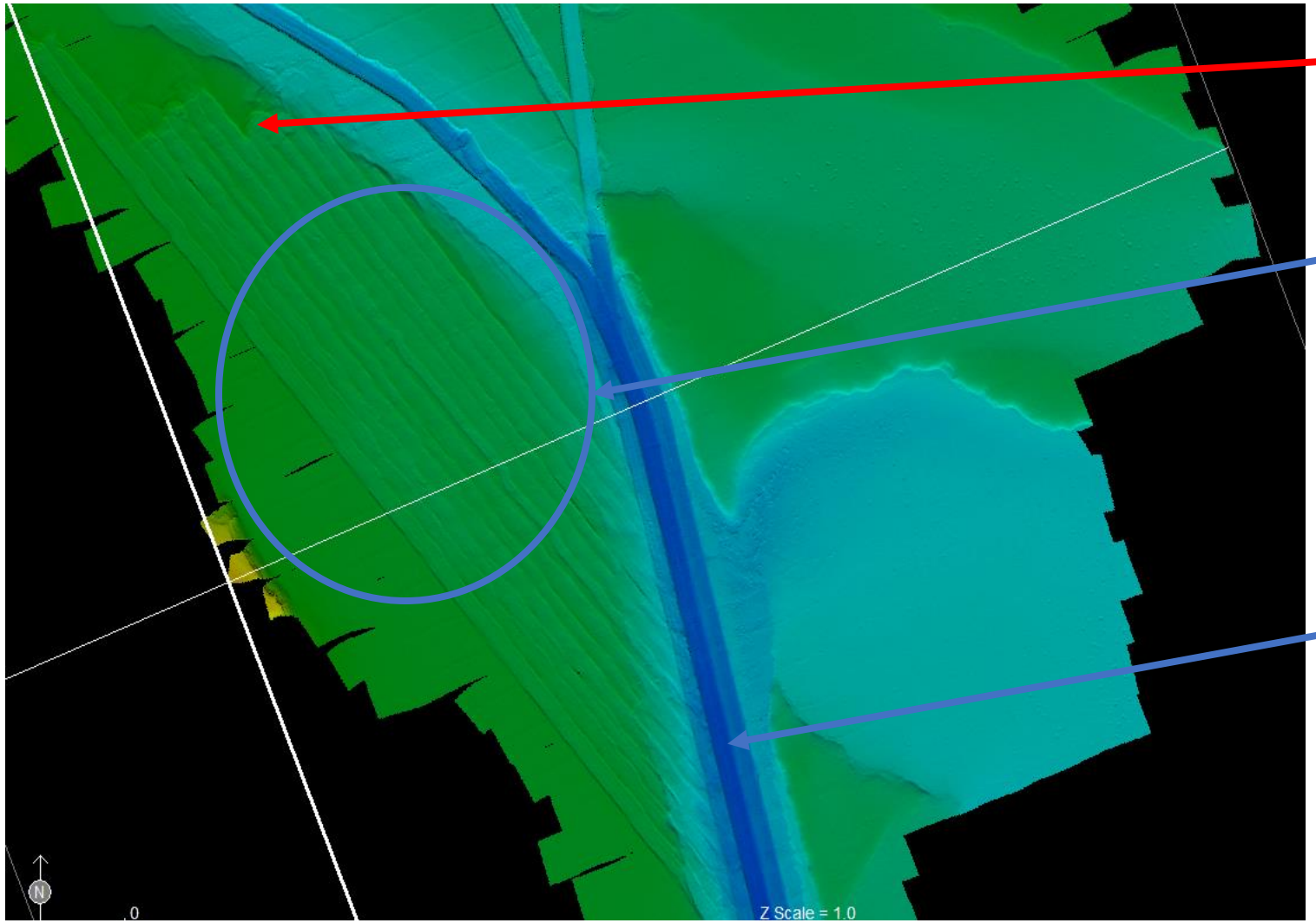
Turbidity at Topeka – 9/1/2025 to Arrival of WID Sediment



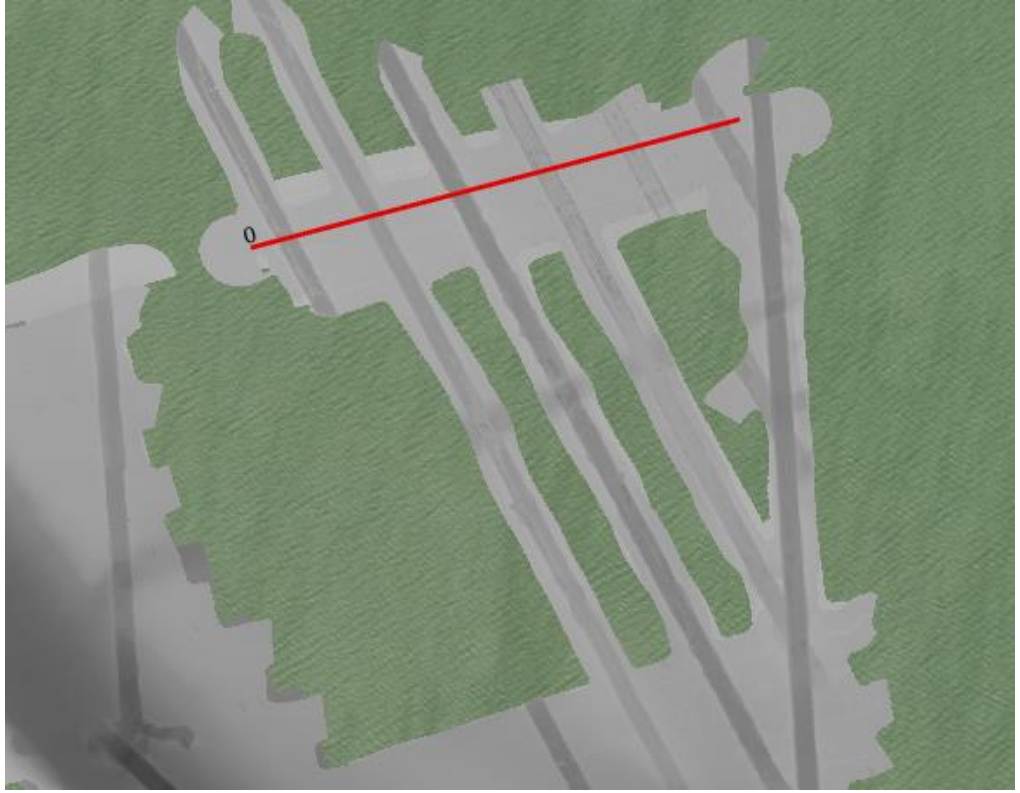
- **Turbidity increase from Smoky Hill River high flow event.**
- **Water Injection Dredging (WID) sediment arrival at Topeka**


Tuttle Creek Reservoir
Tuttle Creek Cove Park
Tuttle Cove Rd
Tuttle Cove Rd
Dead End Rd
Pheasant Ridge Rd
Lookout Dr
Lakeside Ave
Tuttle Creek State Park
State Road 13
Observation

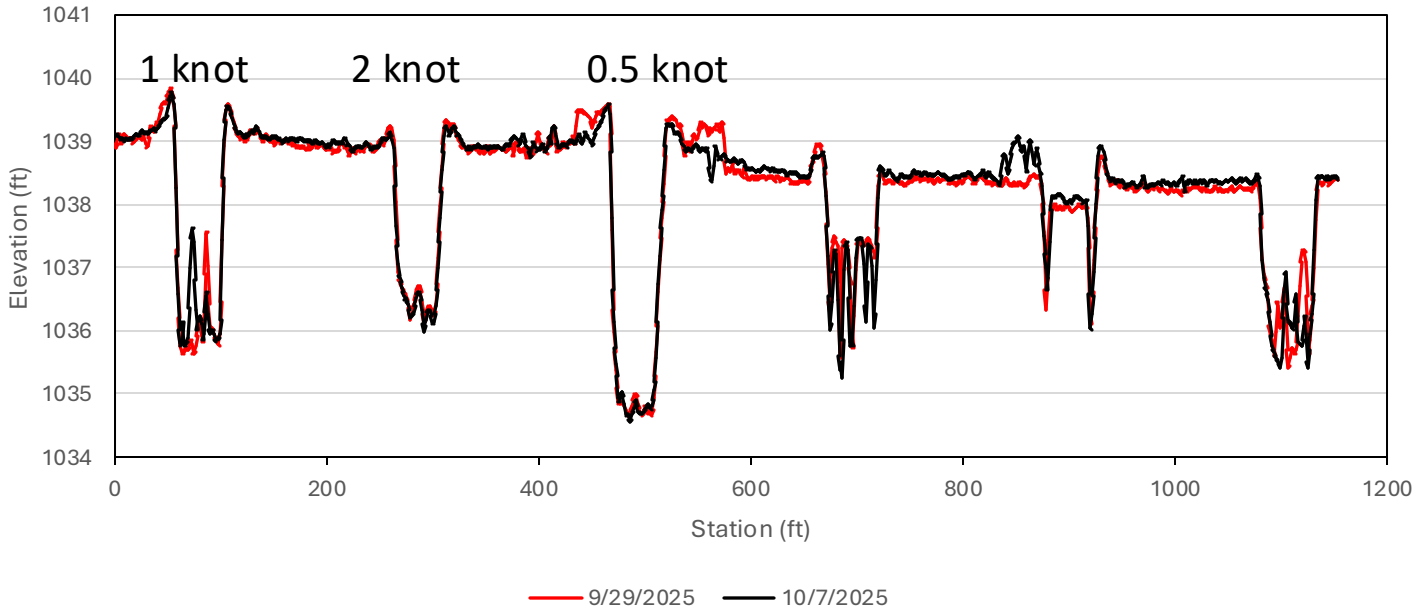
Fall 2025 WID Demo – Post Dredging Survey 10/17/2025



- **North/south lines where dredge ran**
- **Differences of multiple feet from pre-dredge survey**
- **Outlet channel deepened**



- **Adjacent dredging lanes are used to investigate the impacts of various dredging parameters on efficiency and effectiveness.**



Spring 2026

KANSAS

Fuel cell filled with 1,800 gallons of diesel sinks in Tuttle Creek Reservoir

by: Matthew Self
Posted: Mar 16, 2026 / 01:12 PM CDT
Updated: Mar 16, 2026 / 06:06 PM CDT

To be clear– 1,800 gallons of fuel did not spill into the lake.

A tank holding 1,800 gallons of fuel fell into the lake.

The tank and almost all the fuel was retrieved.

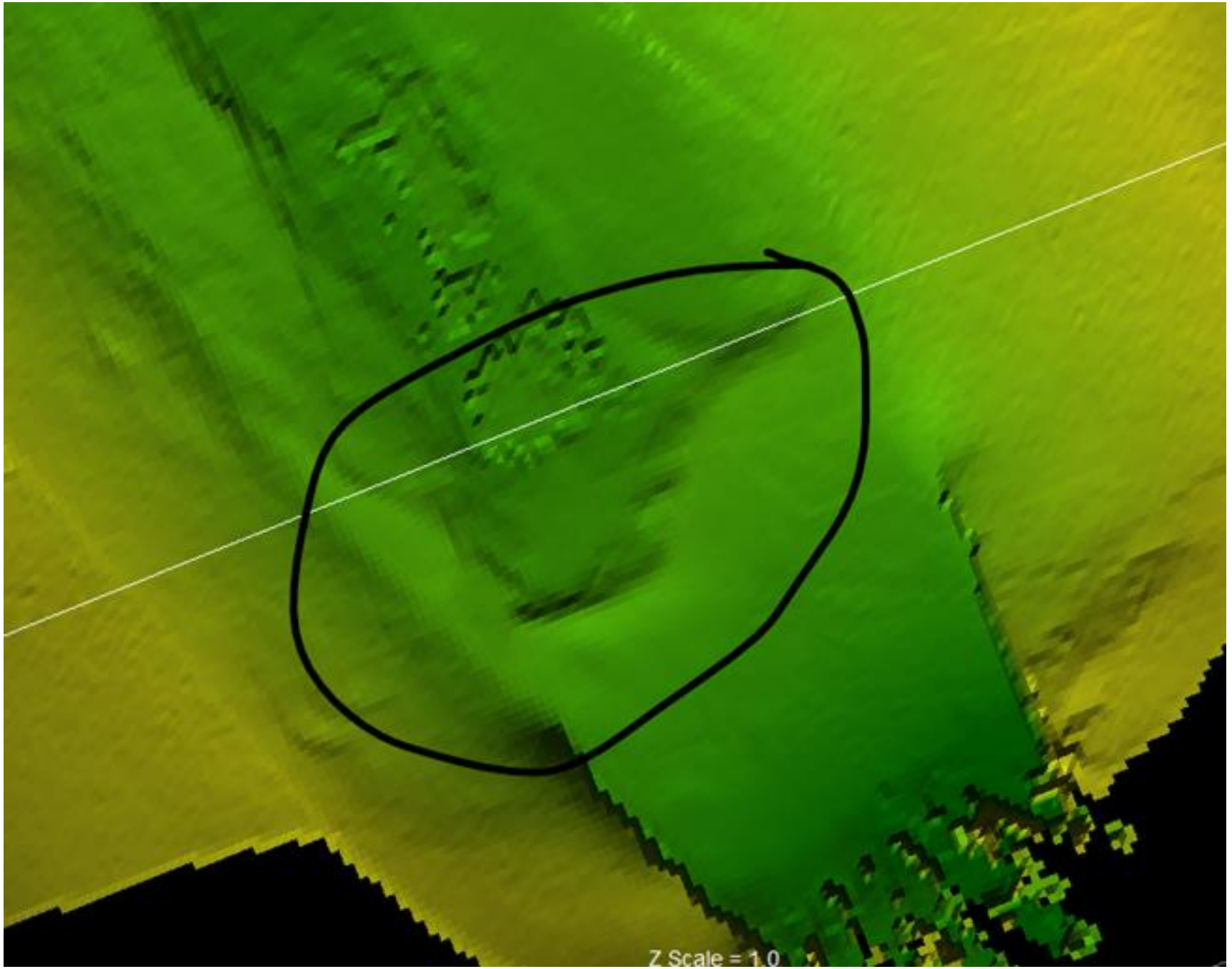
Diesel fuel leak confirmed at Tuttle Creek, dredging project delayed

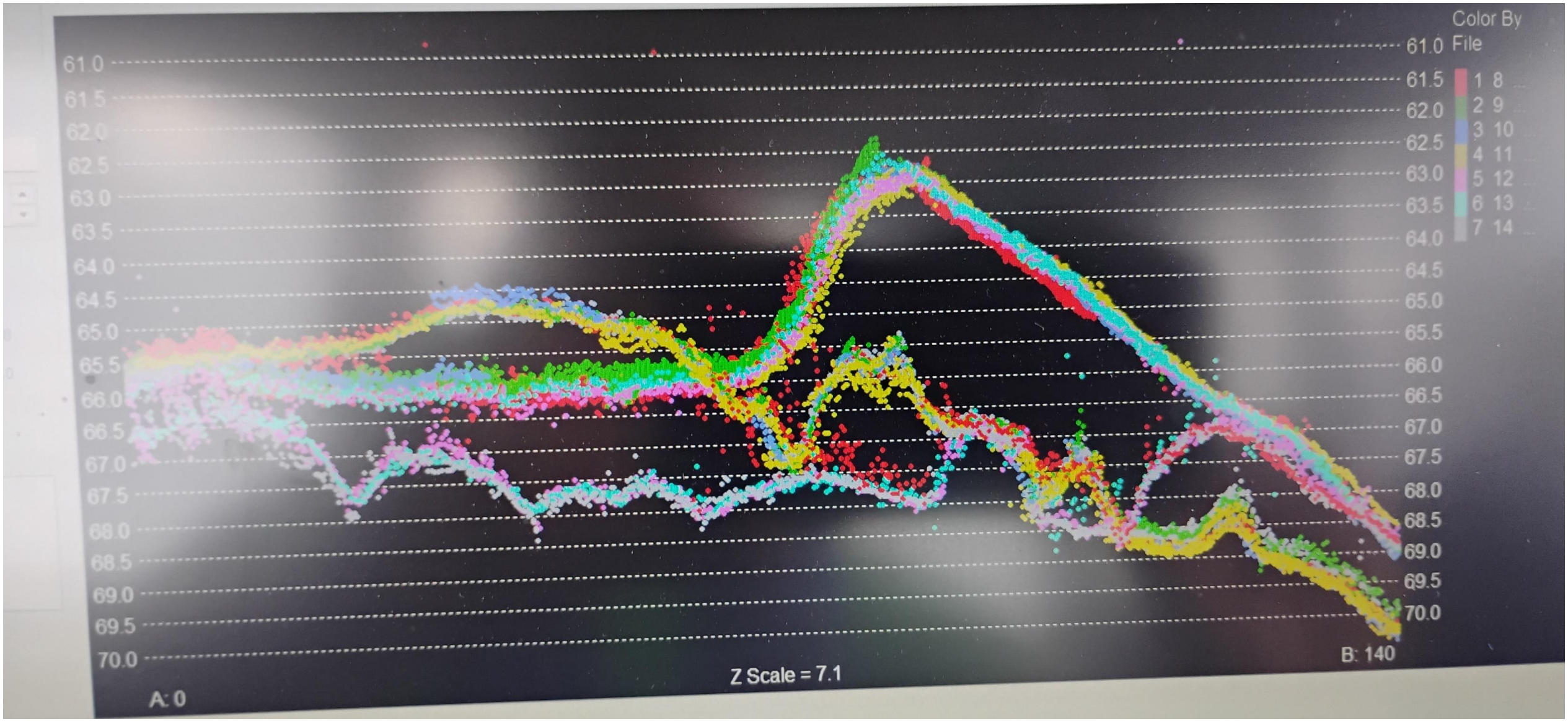
Brandon Peoples brandon@1350kman.com Mar 17, 2026 Updated Mar 18, 2026

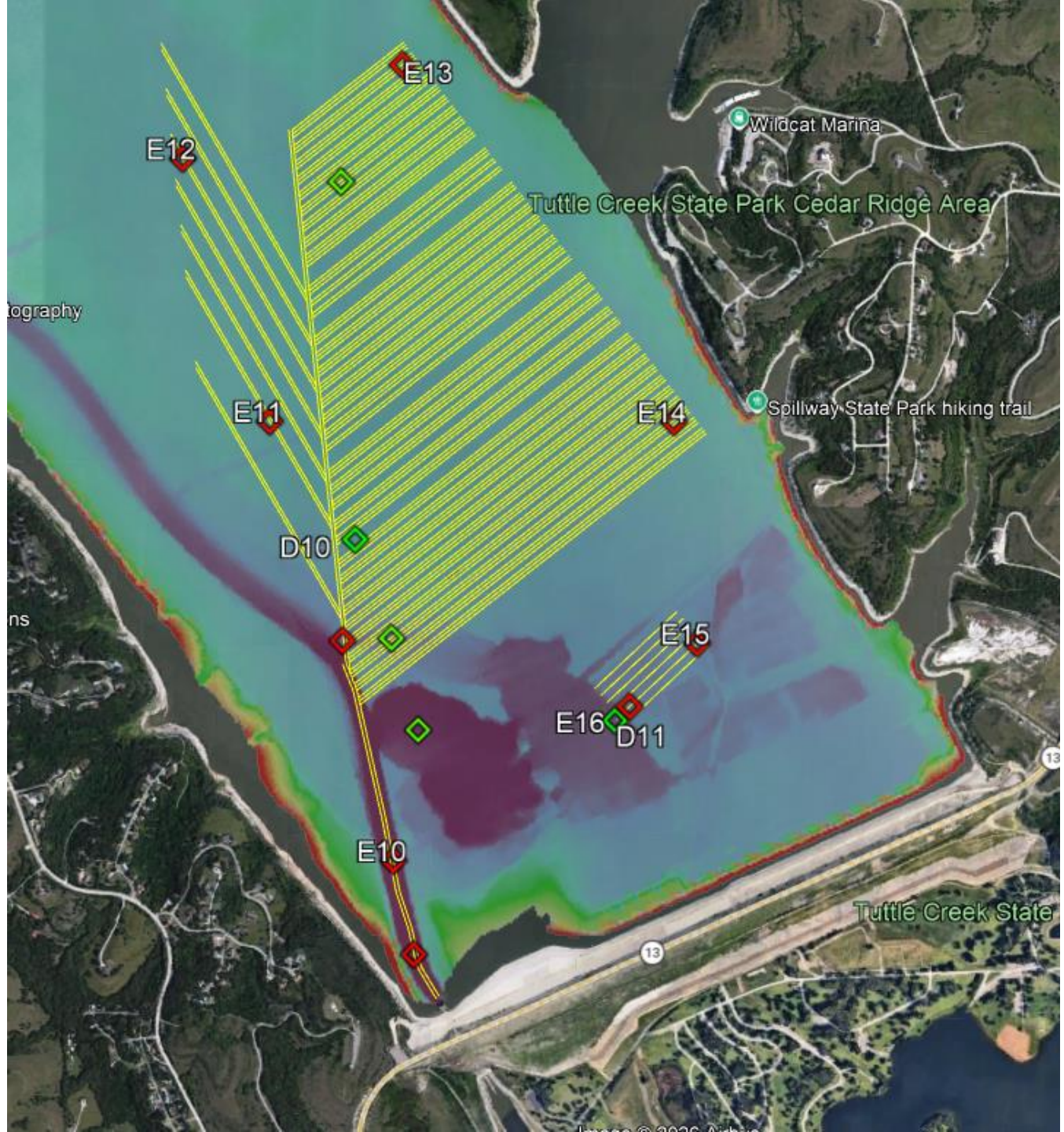
Latest News

- Police investigating Walmart
- K-State baseball tak State
- MHS girls' T&F take Relays
- Area softball roundu Wabaunsee records
- Area baseball round sweeps, Council Gr
- Former Riley County contraband into facil
- Manhattan baseball
- MHS girls' soccer d

Mound of sediment left over from Fall

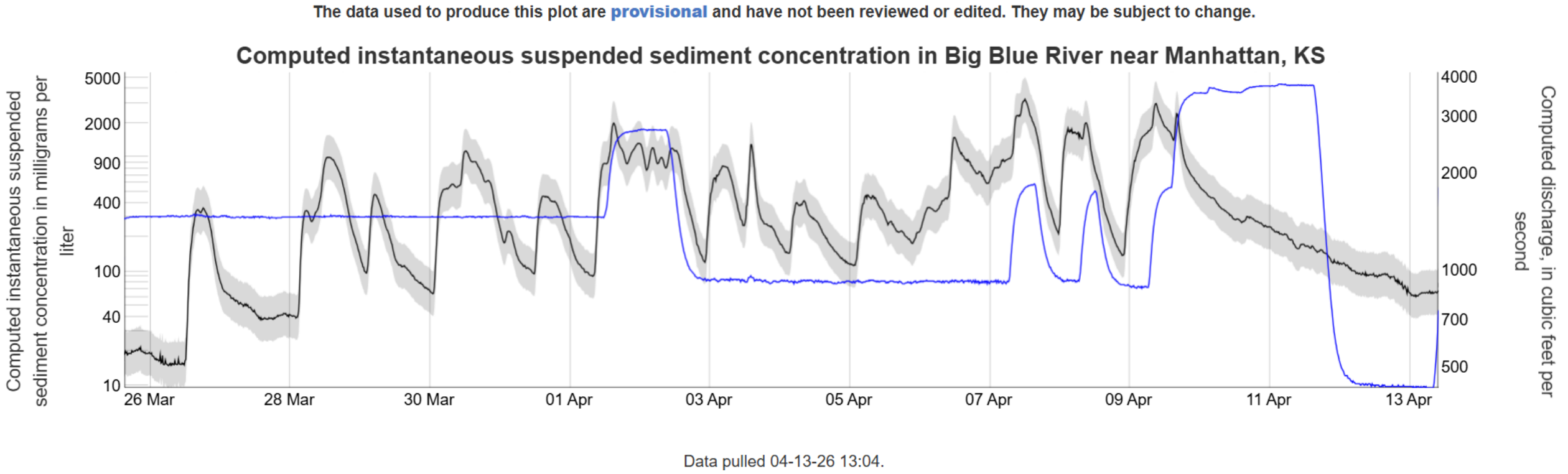



Color By
File
1 8
2 9
3 10
4 11
5 12
6 13
7 14
61.0
61.5
62.0
62.5
63.0
63.5
64.0
64.5
65.0
65.5
66.0
66.5
67.0
67.5
68.0
68.5
69.0
69.5
70.0
A: 0
Z Scale = 7.1
B: 140

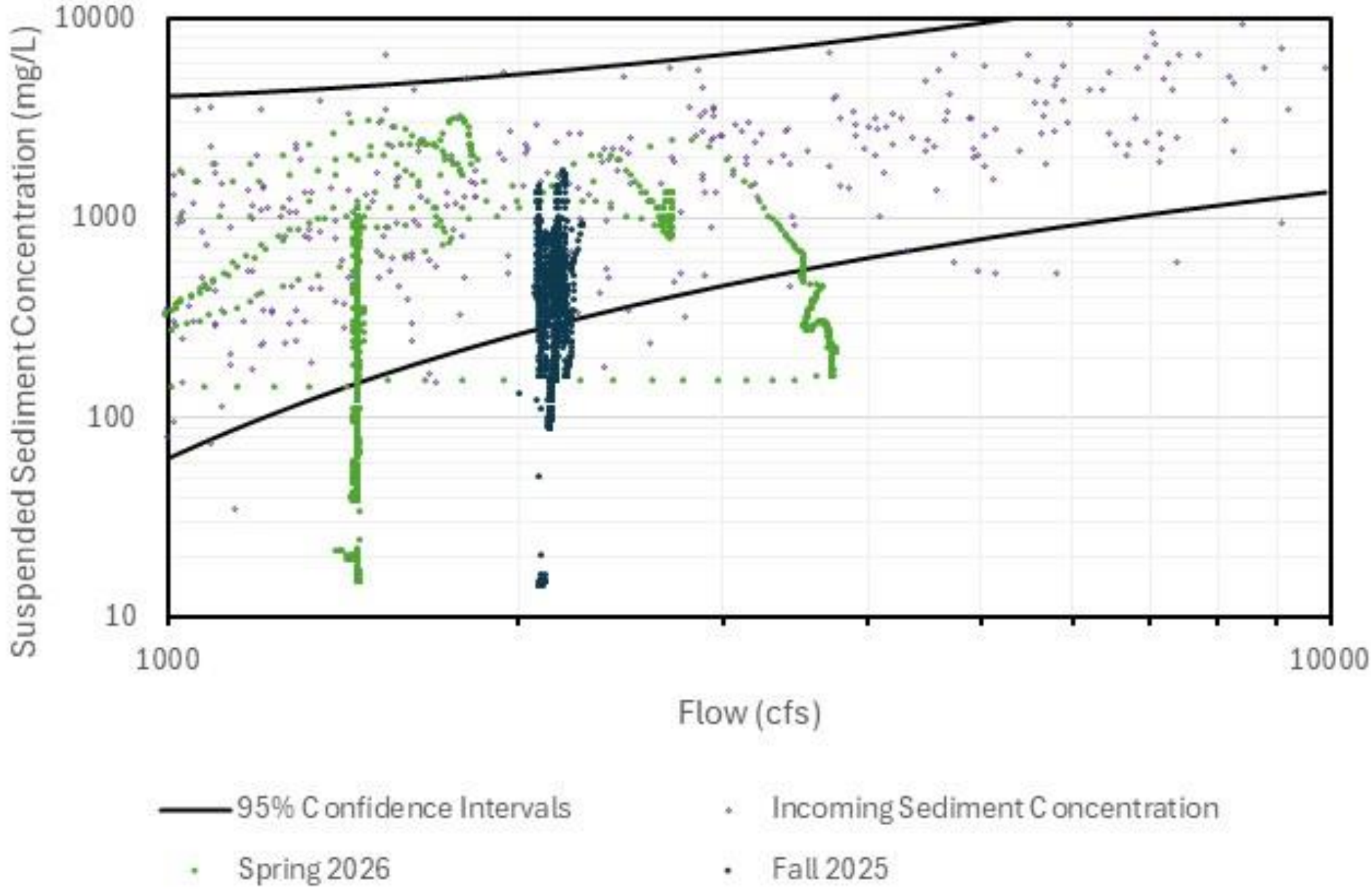

E13
E12
Wildcat Marina
Tuttle Creek State Park Cedar Ridge Area
E11
E14
Spillway State Park hiking trail
D10
E15
E16
D11
E10
13
Tuttle Creek State


Tuttle WID TSS
@3:11pm L6
260326 1m
Tuttle WID TSS
@3:10pm L6
260326 13m
Tuttle WID TSS
@3:08pm L6
260326 14m

Big Blue River near Manhattan



[Effect of Water-Injection Dredging (WID) Operations on Water Quality Downstream from Tuttle Creek Reservoir | U.S. Geological Survey]


10000
1000
100
10
Suspended Sediment Concentration (mg/L)
1000
10000
Flow (cfs)
95% Confidence Intervals
Incoming Sediment Concentration
Spring 2026
Fall 2025

Conclusion

- Sedimentation is an ongoing problem at lakes across Kansas and the United States
- Water Injection Dredging has the potential to be more cost effective
- Fall 2025 and Spring 2026 carried out successfully (though not without problems!)
- Downstream concentrations stayed within permitted limits
- Waiting on USACE for full release of multibeam bathymetry

June* 2026- Final Demonstration Project Dredging Session

June 16-17, Sedimentation Summit

*Weather permitting!

Questions?