Case Study: Predicted Sediment Transport for Operations at Nolichucky Dam

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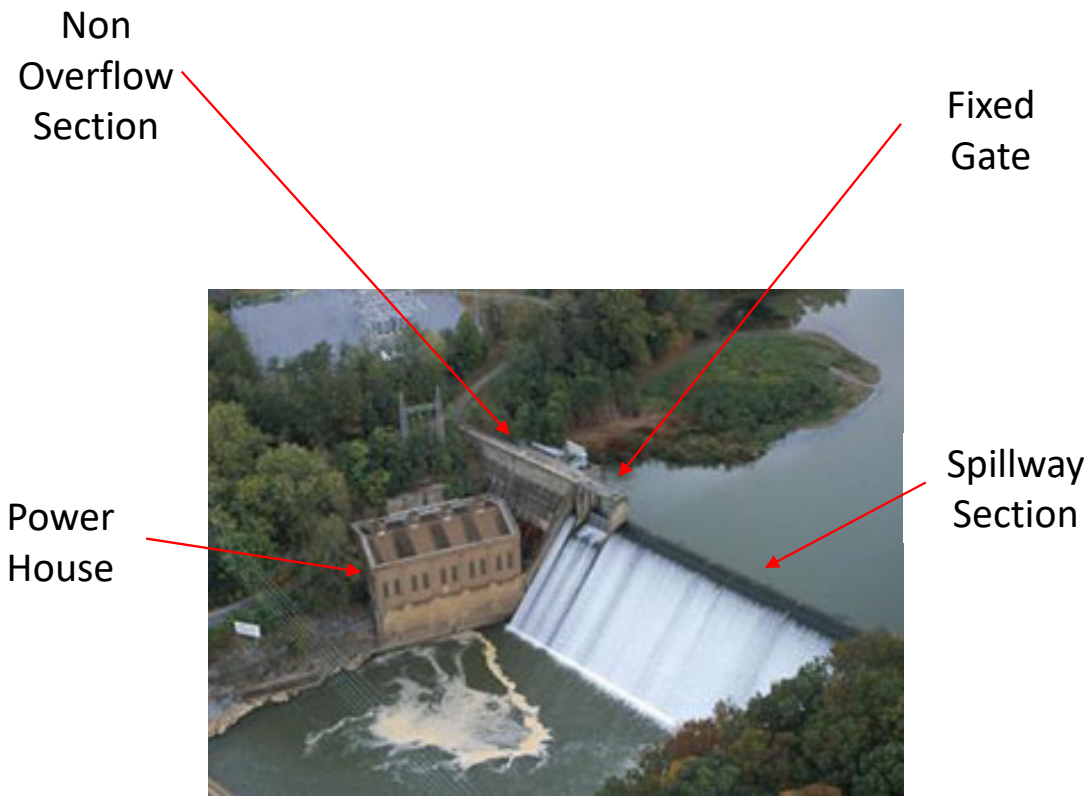
Background and Purpose

- Ogee Spillway with one vertical lift gate, built 1913
- Reservoir mostly filled in
- Power House decommissioned
- Gate permanently closed, all flow over spillway



Source: TVA

Background and Purpose

- New removable gate needed in order to perform periodic dam inspections without overflow
- Extraction of old fixed gate expected to release sediment downstream
- Need to dredge upstream sediments to avoid high concentration releases?

➔ Inform environmental impact assessment

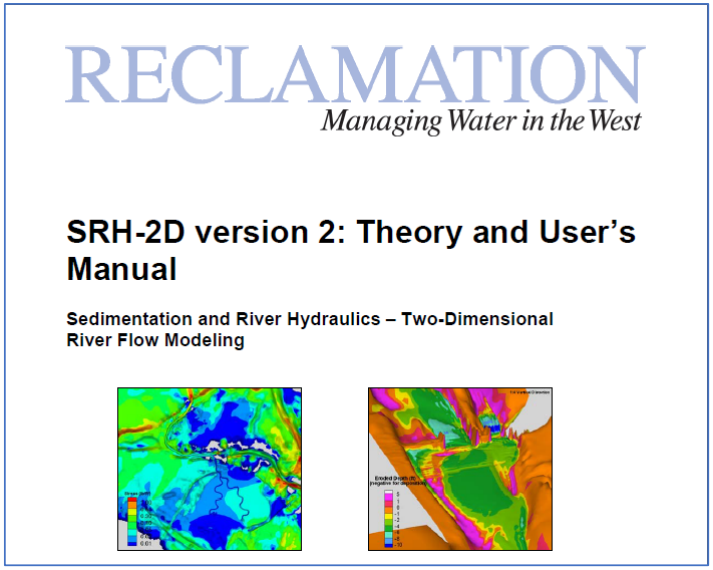
Approach

- Sediment transport modeling to examine mobilization and concentrations when gate removed:
  - Maximum concentrations and duration?
  - Predicted concentrations versus those at natural high flows under existing conditions?
  - Can avoid dredging?


Deposits

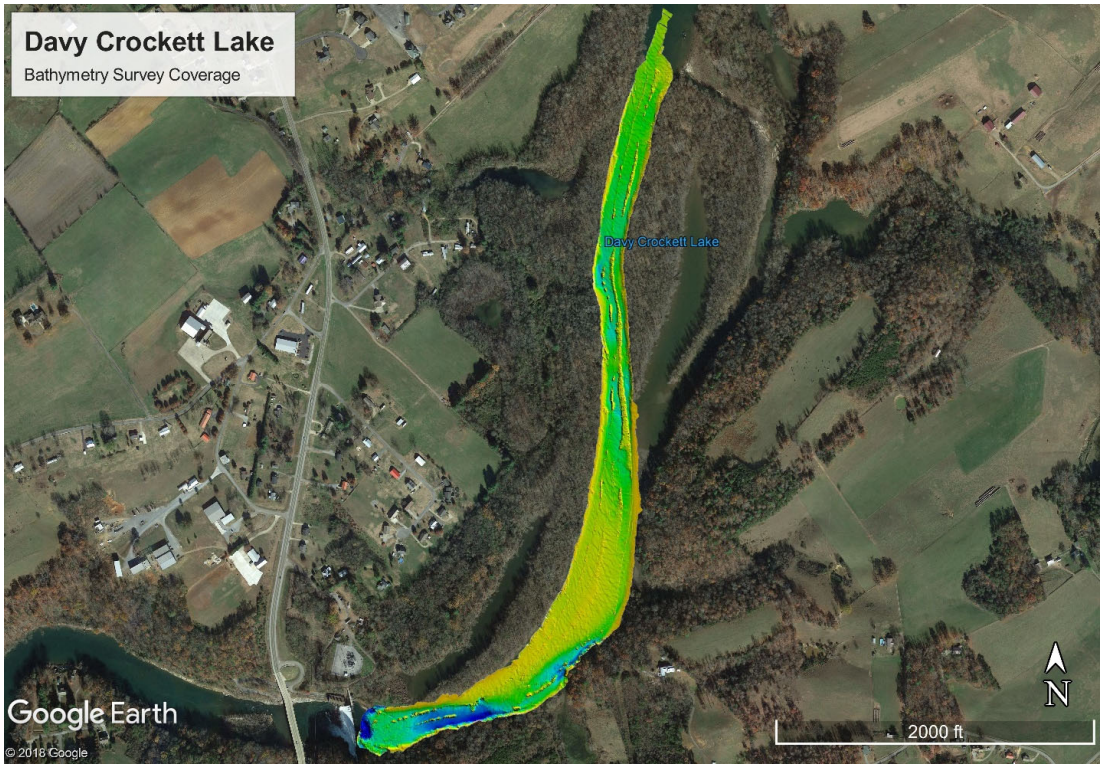
Approach

- SRH-2D Model Selected (Bureau of Reclamation, 2017)
  - 2D depth-averaged St. Venant equations
  - Coupled non-equilibrium sediment transport



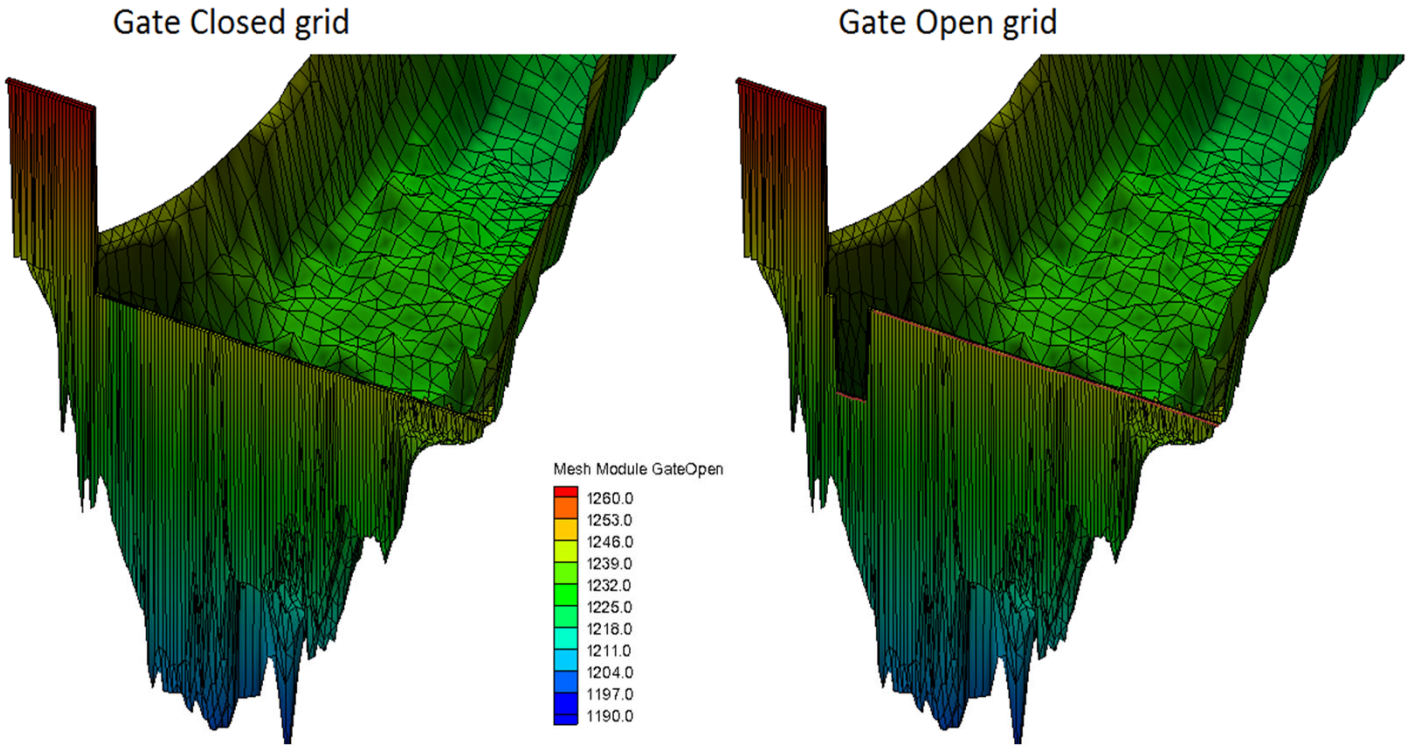
Model Development

- Bathymetry



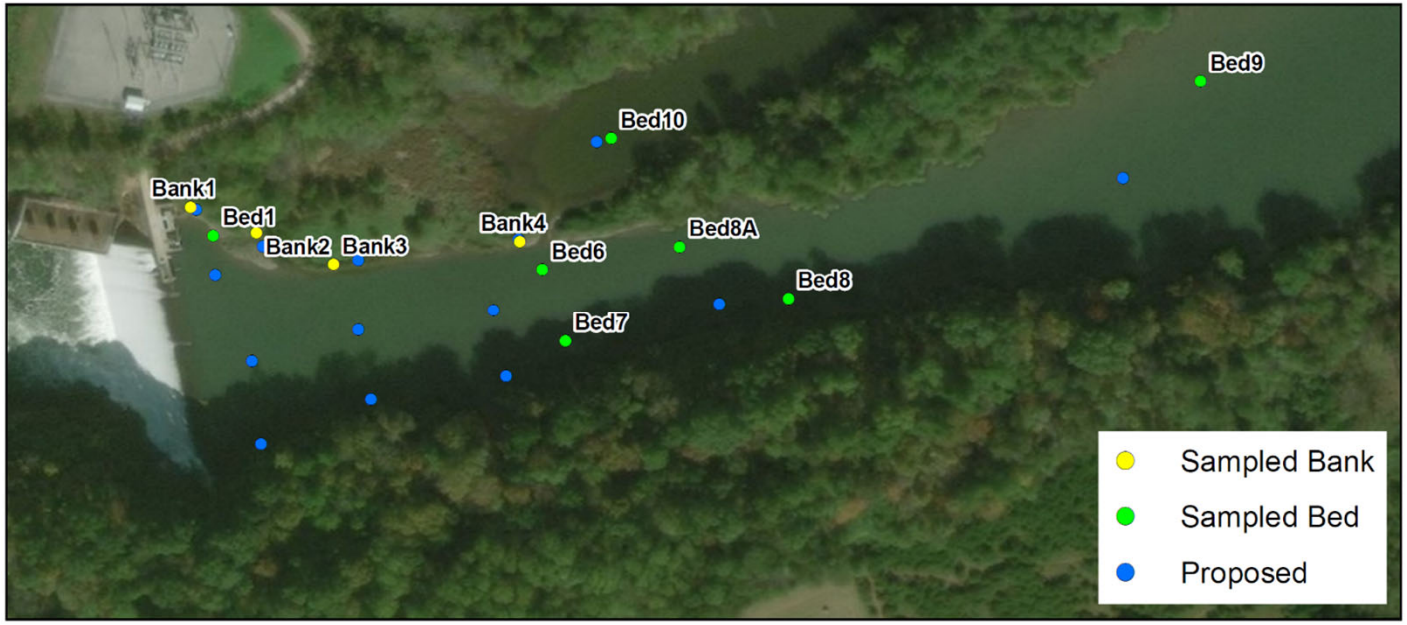
Model Development

- Computational Mesh



Model Development

- Bed and Bank Sediment



Model Development

- Bed and Bank Sediment

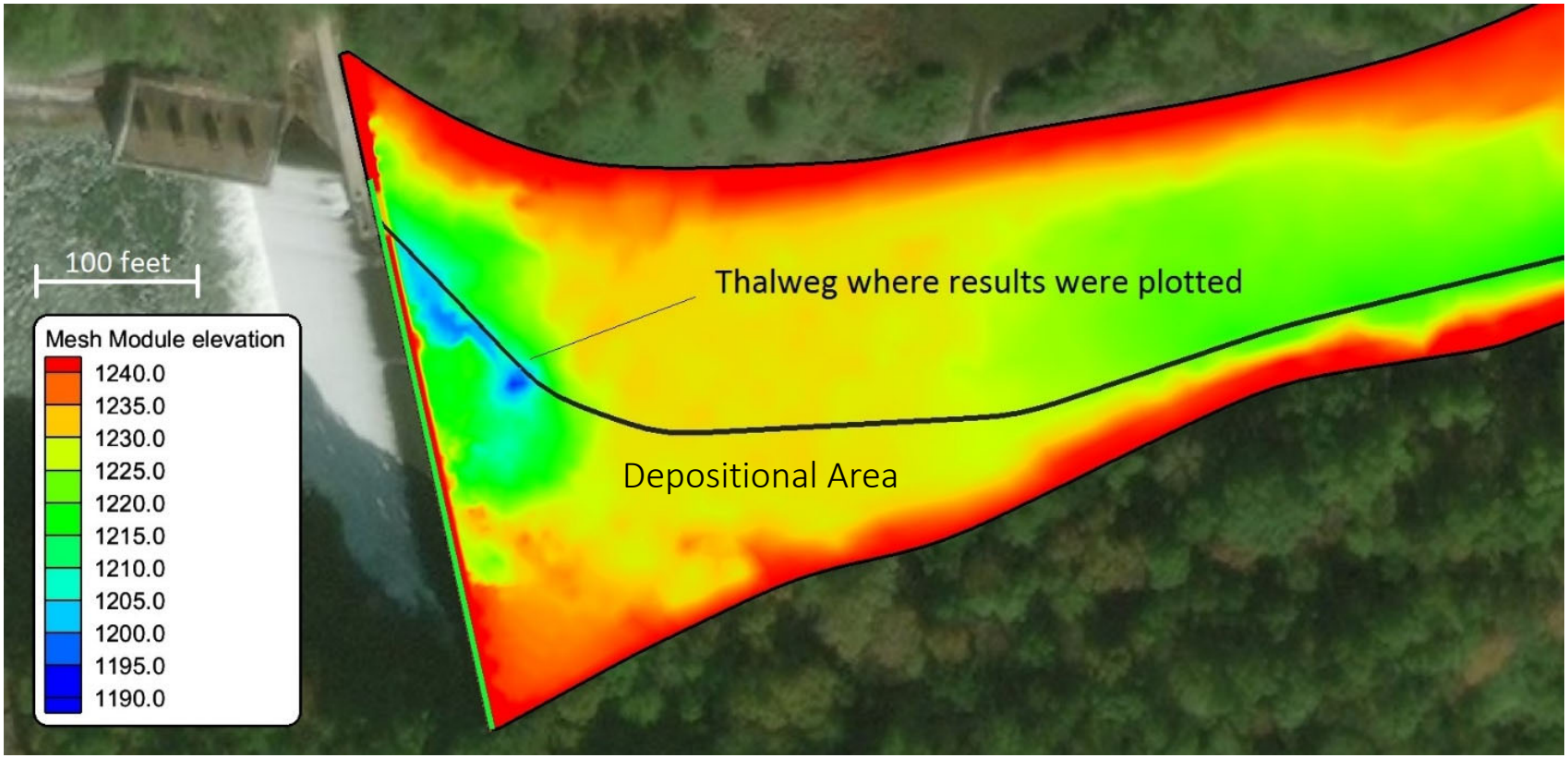
Model Development

- Upstream BC: inflows of 1,900 ft^3/s (54 m^3/s) low flow and 13,000 ft^3/s (371 m^3/s), ~yearly flow.
- Downstream BC: rating curves from TVA
- Surface model to characterize the hydraulic roughness of surface materials of the lake bed and bank.
- Subsurface model to characterize the different sediment types in the lake bed and banks, such as non-cohesive sand and cohesive silt and clay.

Model Results

- Closed Gate – Q = 1,900 cfs low flow
  - Existing conditions with a constant upstream flow of 1,900 cfs and the gate closed.
- Closed Gate – Q = 13,000 cfs yearly flow
  - Existing conditions with a constant upstream flow of 13,000 cfs and the gate closed.
- Open Gate - Surveyed bathymetry
  - Conditions during spillway operation with the gate fully open and a constant upstream flow of 1,900 cfs. Surveyed bathymetry used for the entire Nolichucky Reservoir bed.
- Open Gate - Flat bathymetry
  - Conditions during spillway operation with the gate fully open, a constant upstream flow of 1,900 cfs and an artificially flat bathymetry in front of the Dam set equal to the height of the existing sediment accumulation 100 feet upstream of the dam.

Model Results



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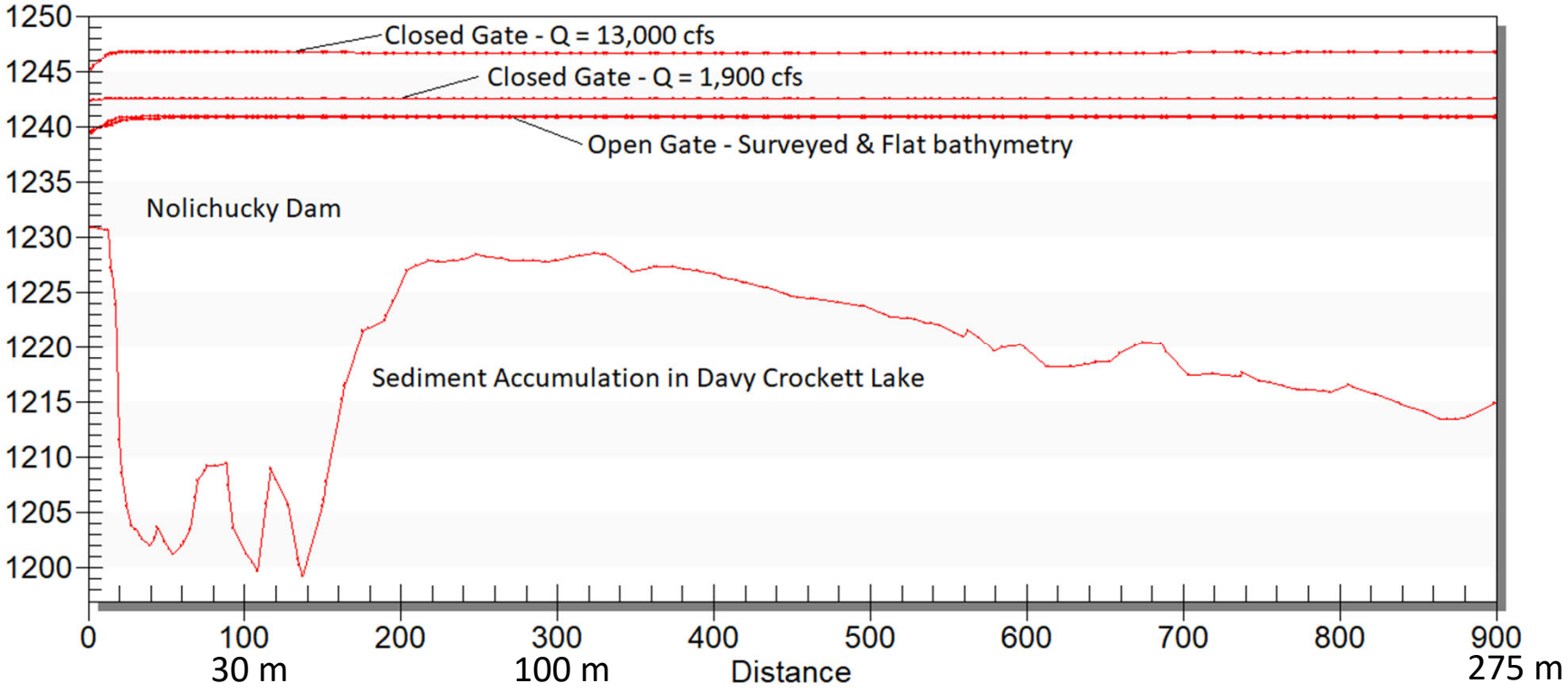

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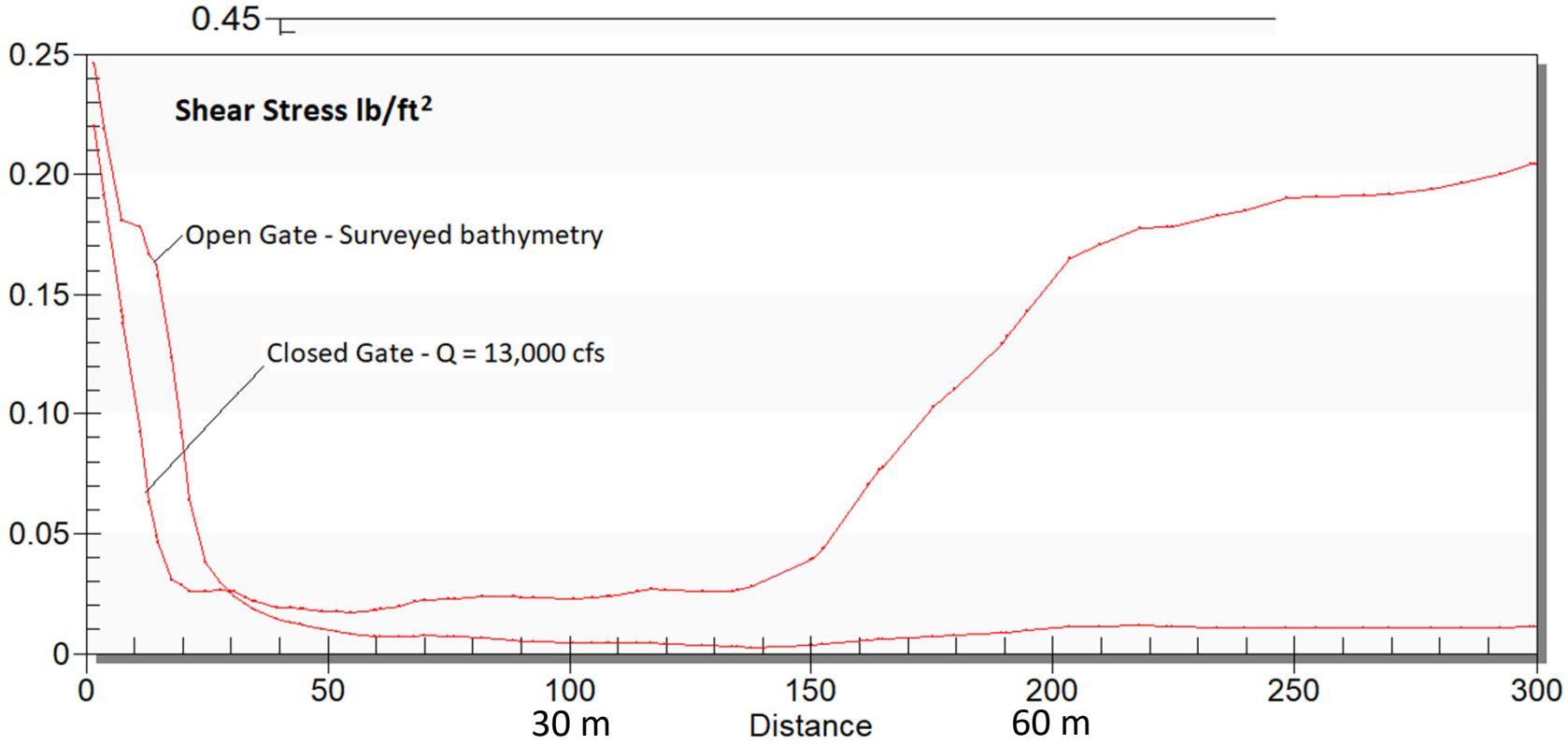
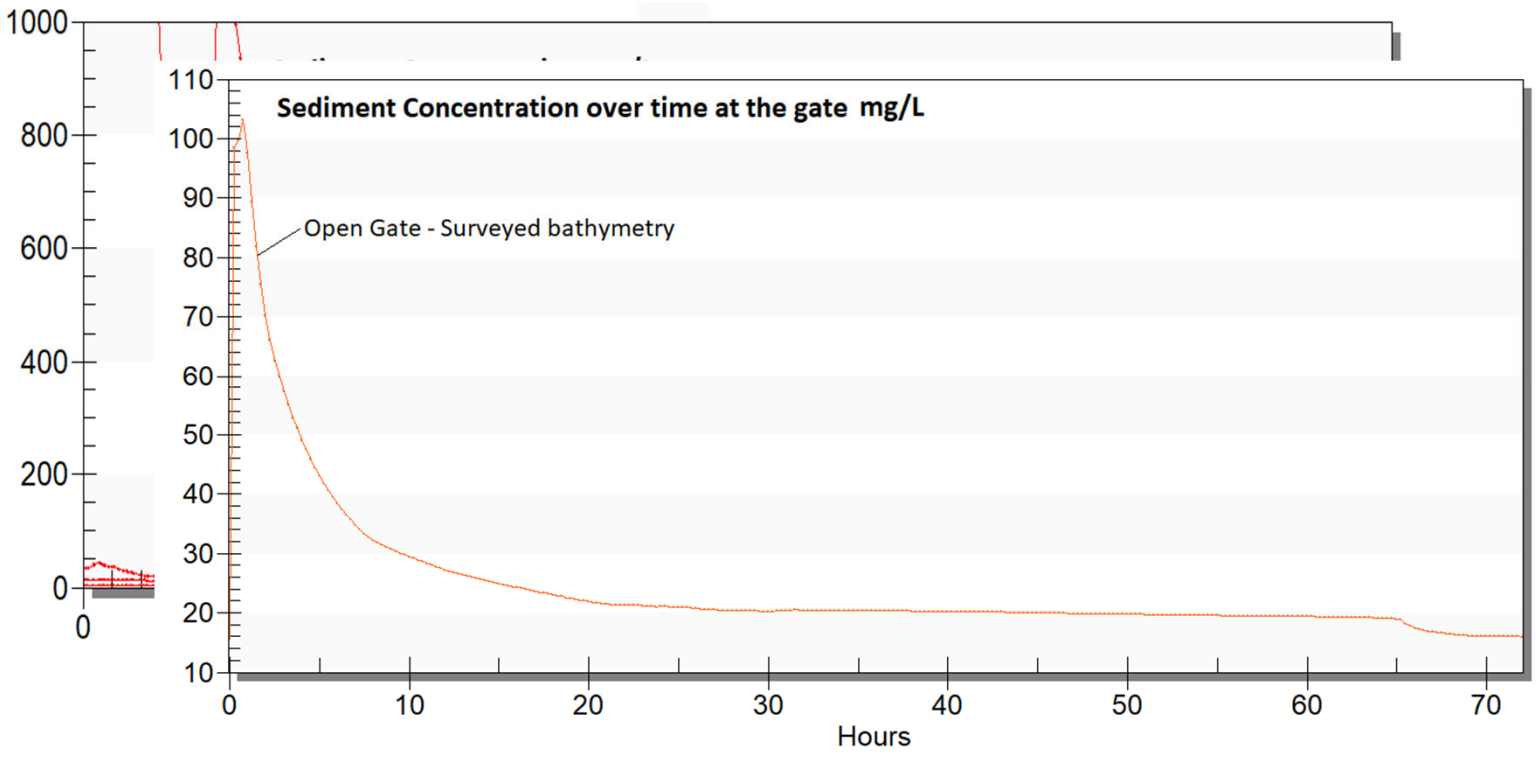
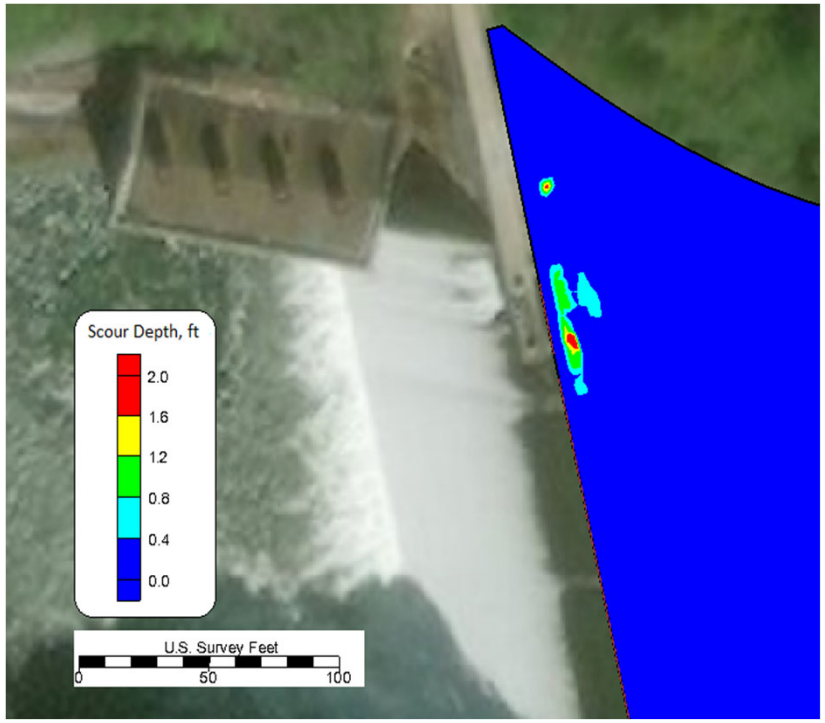


Model Results



Model Results

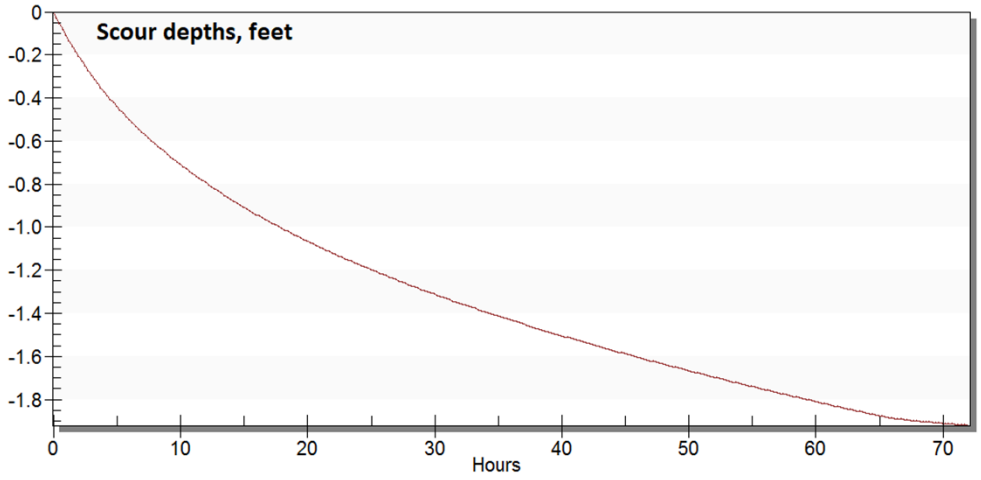


Measured Bathymetry

Max Scour ≈ 2 feet ≈ 60 cm

Volume ≈11 CY ≈ 8.5 m³

Cmax ≈ 105 mg\l



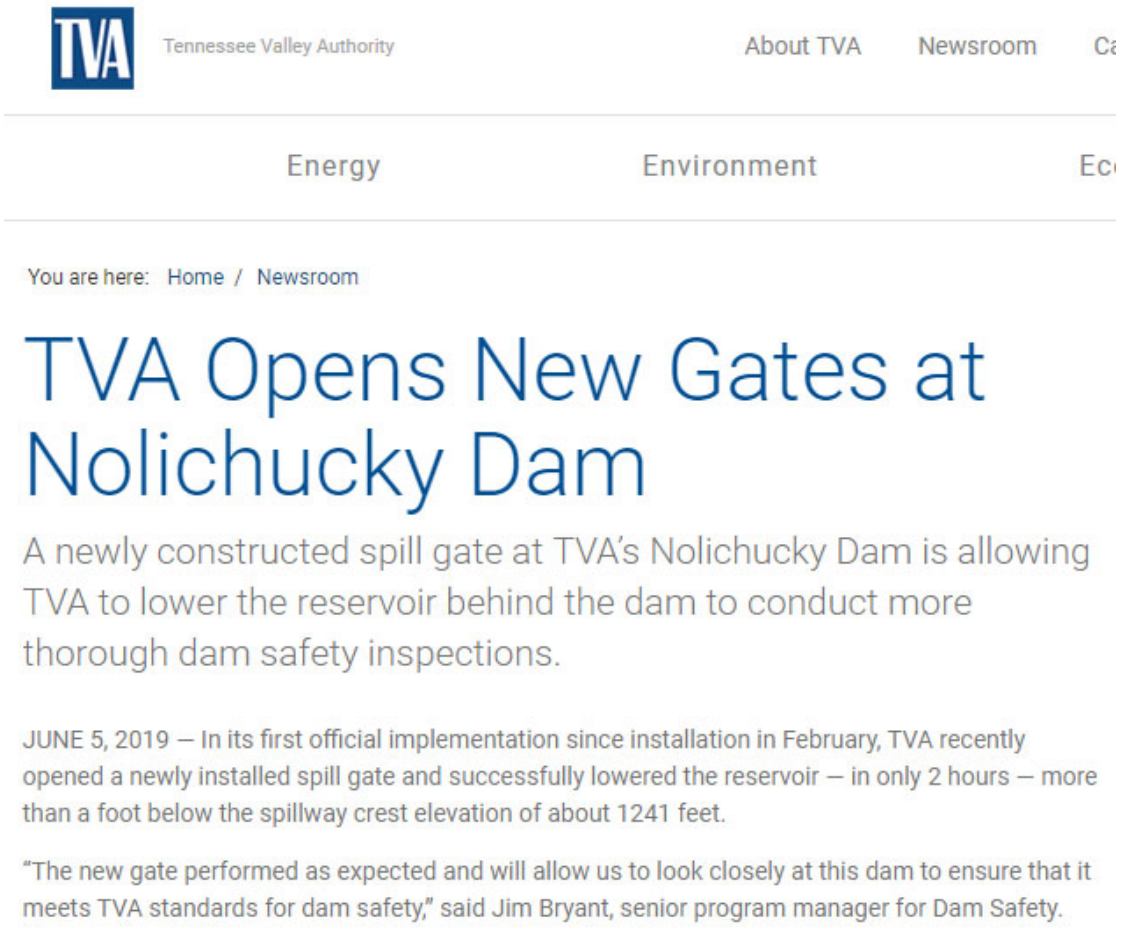
Model Results

	Max Scour (ft/m)	Cmax (mg\l)
Meas. Bathymetry	2.0 / 0.6	105
Flat Bathymetry	6.5 / 2	160
High Flow	-	600

Conclusions

- Sediment transport modeling indicated that opening the gate would probably result in localized scour for a brief period.
- The temporary increase in concentration would be much less than existing conditions at natural higher flows.
- Transport of sediment through the open gate is expected to be minimal.
- Dredging therefore not required, avoiding additional environmental impacts and costs.

- Project Status
  - WEST work completed
    - ⬇
  - Final EA/ FONSI
    - ⬇
  - Gate replacement



Tennessee Valley Authority

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TVA Opens New Gates at Nolichucky Dam

A newly constructed spill gate at TVA's Nolichucky Dam is allowing TVA to lower the reservoir behind the dam to conduct more thorough dam safety inspections.

JUNE 5, 2019 — In its first official implementation since installation in February, TVA recently opened a newly installed spill gate and successfully lowered the reservoir — in only 2 hours — more than a foot below the spillway crest elevation of about 1241 feet.

"The new gate performed as expected and will allow us to look closely at this dam to ensure that it meets TVA standards for dam safety," said Jim Bryant, senior program manager for Dam Safety.