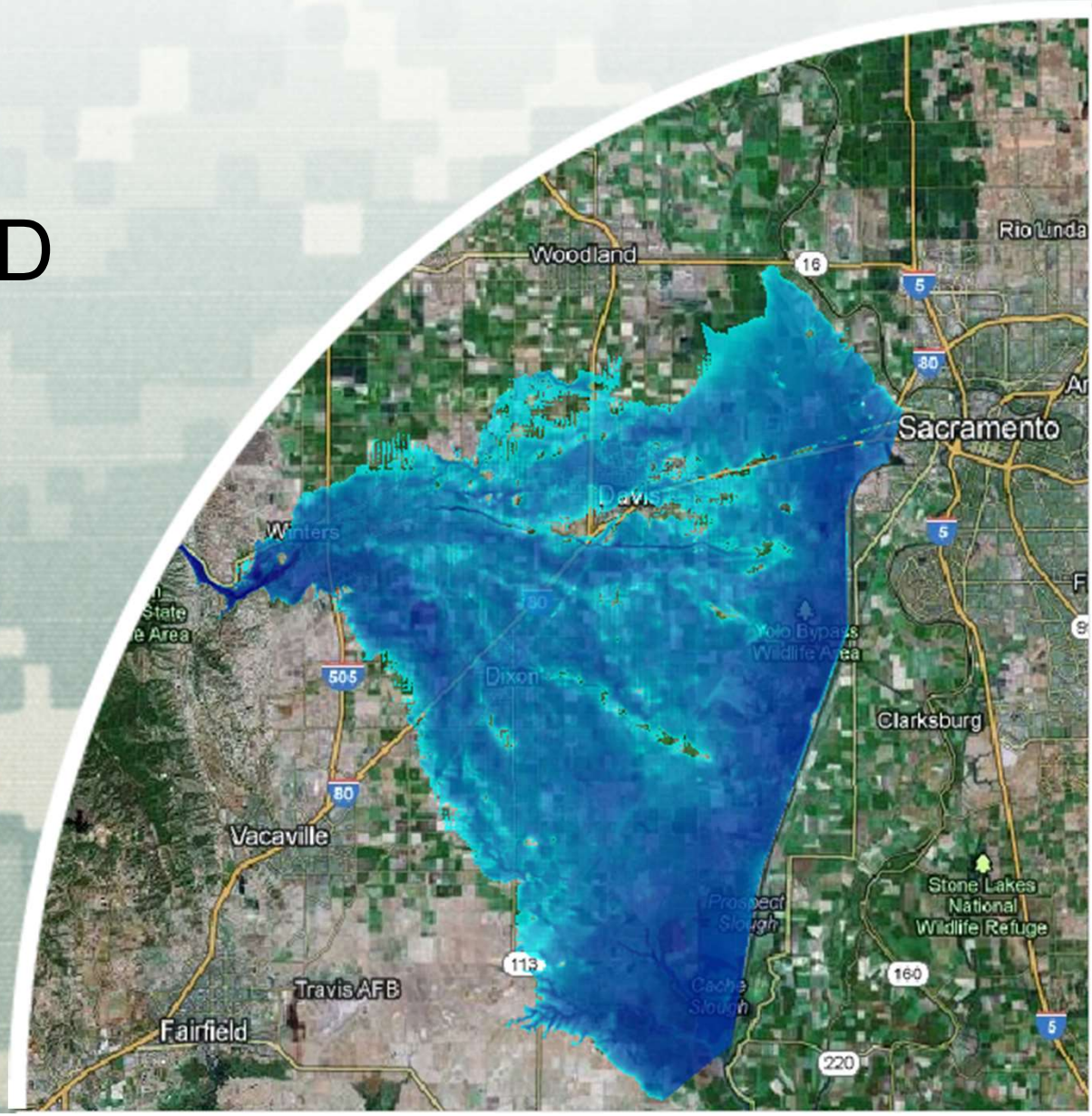
Dam Breaching Analysis with Combined 1D and 2D Elements

Stanford Gibson, PhD

Includes slides by

Gary Brunner, P.E.



US Army Corps of Engineers

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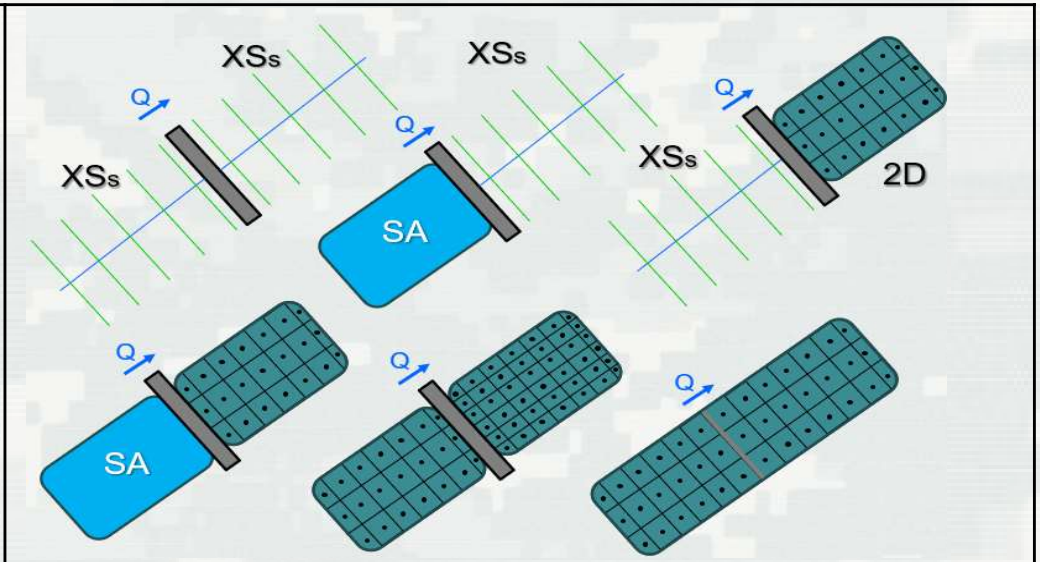
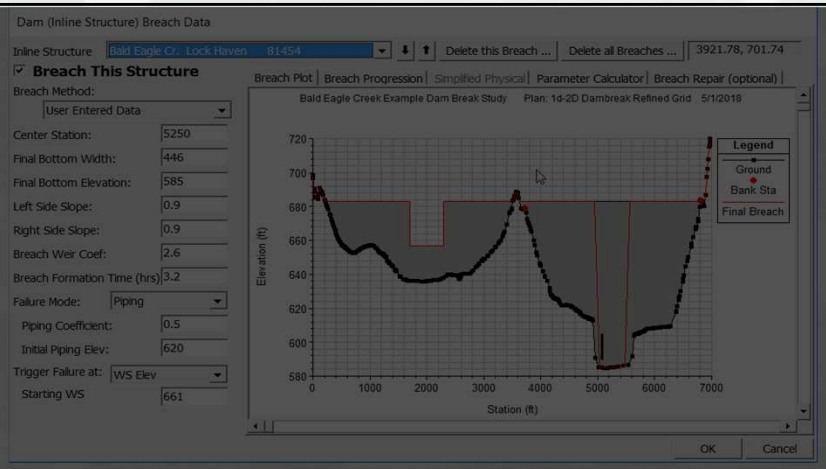
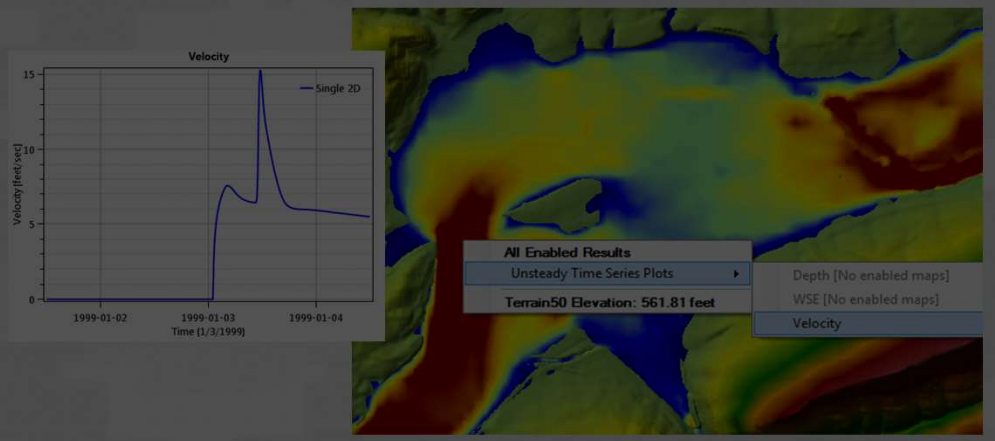
1. Six Dam Breach Model Configurations



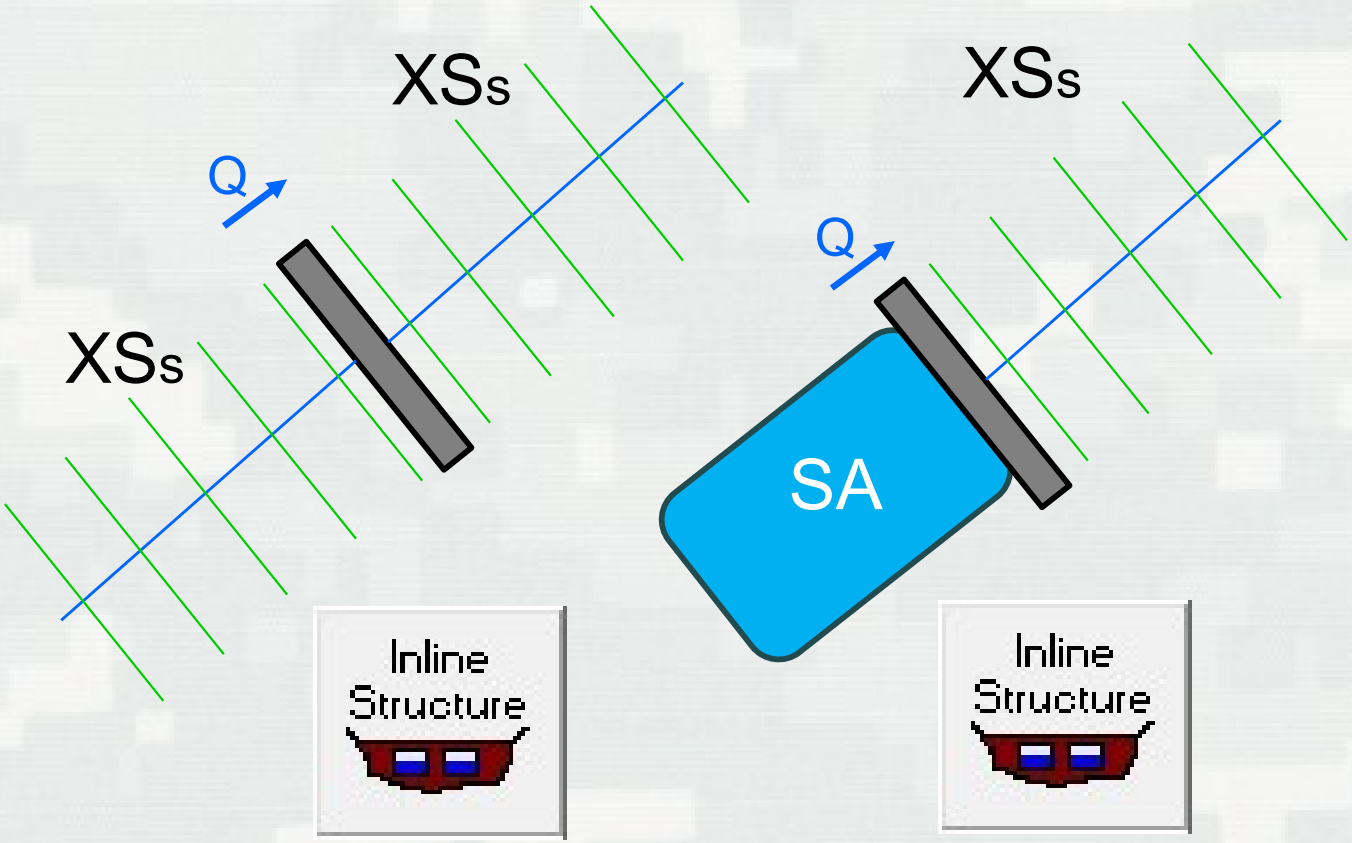
2. Breaching Options and Parameters



3. Breach Results and Visualization

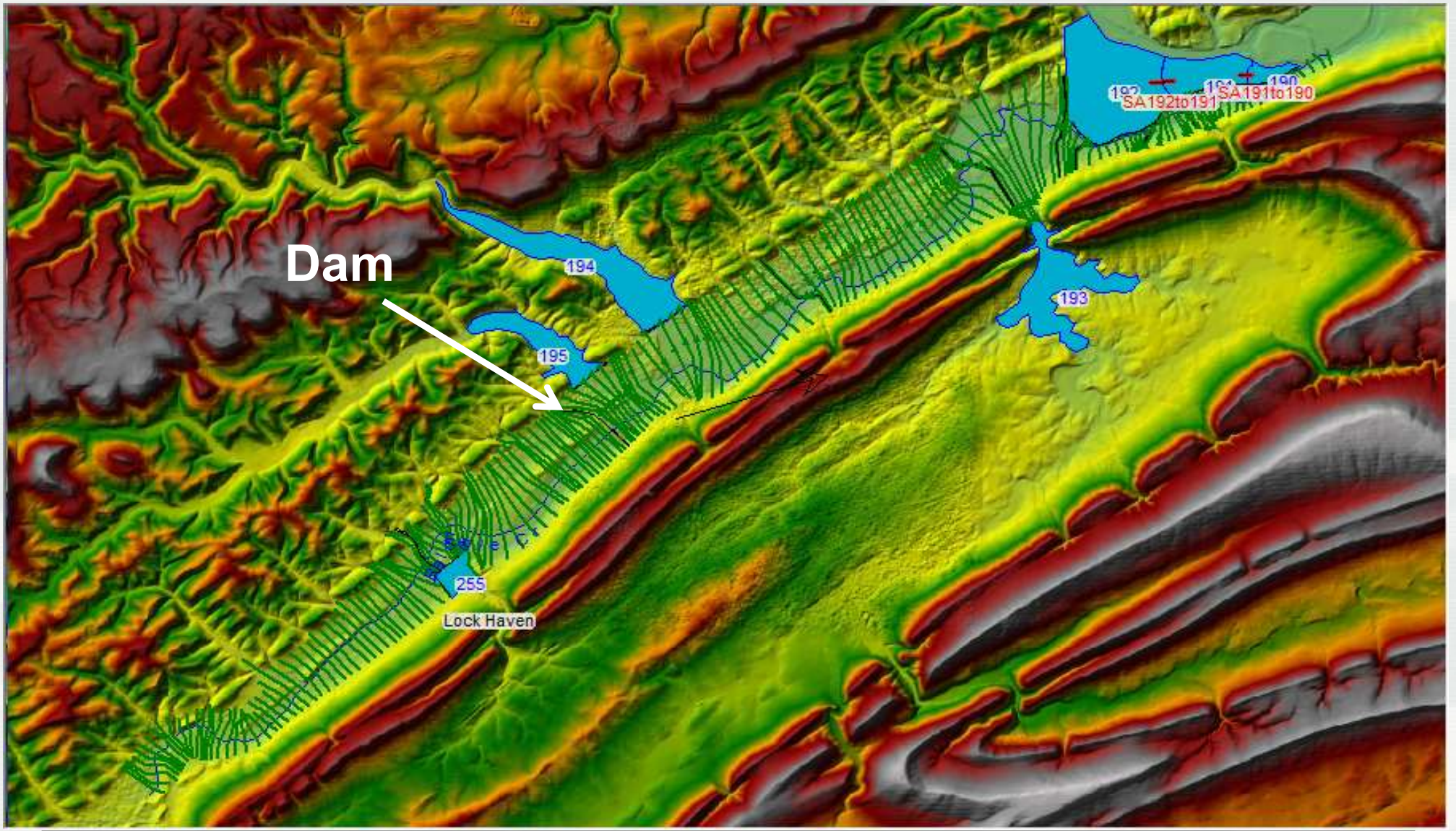


Breach Model Configuration Options



Pre-2D Options

1D Dam Breaching Analysis
Cross Section for Pool and Downstream



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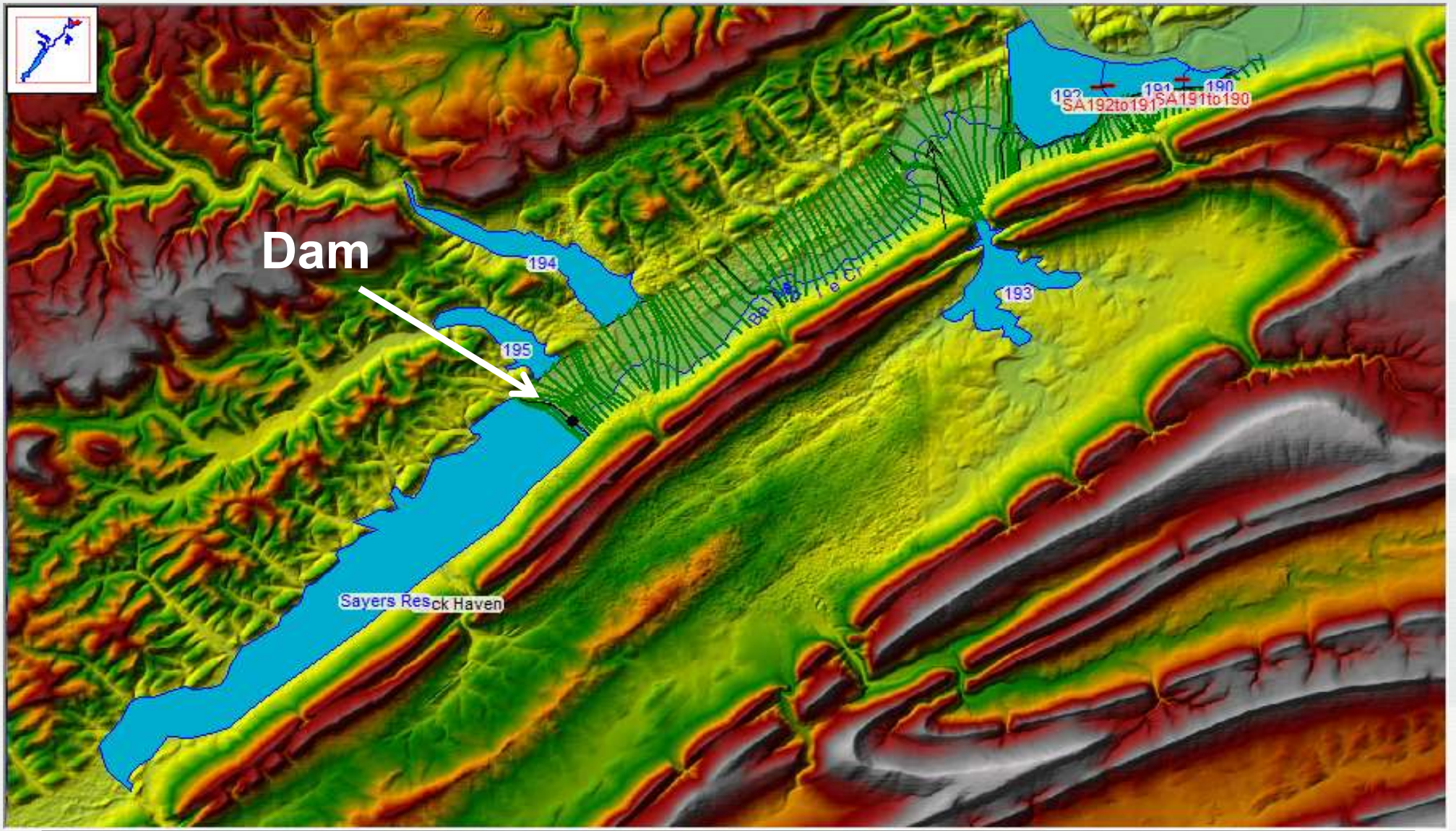
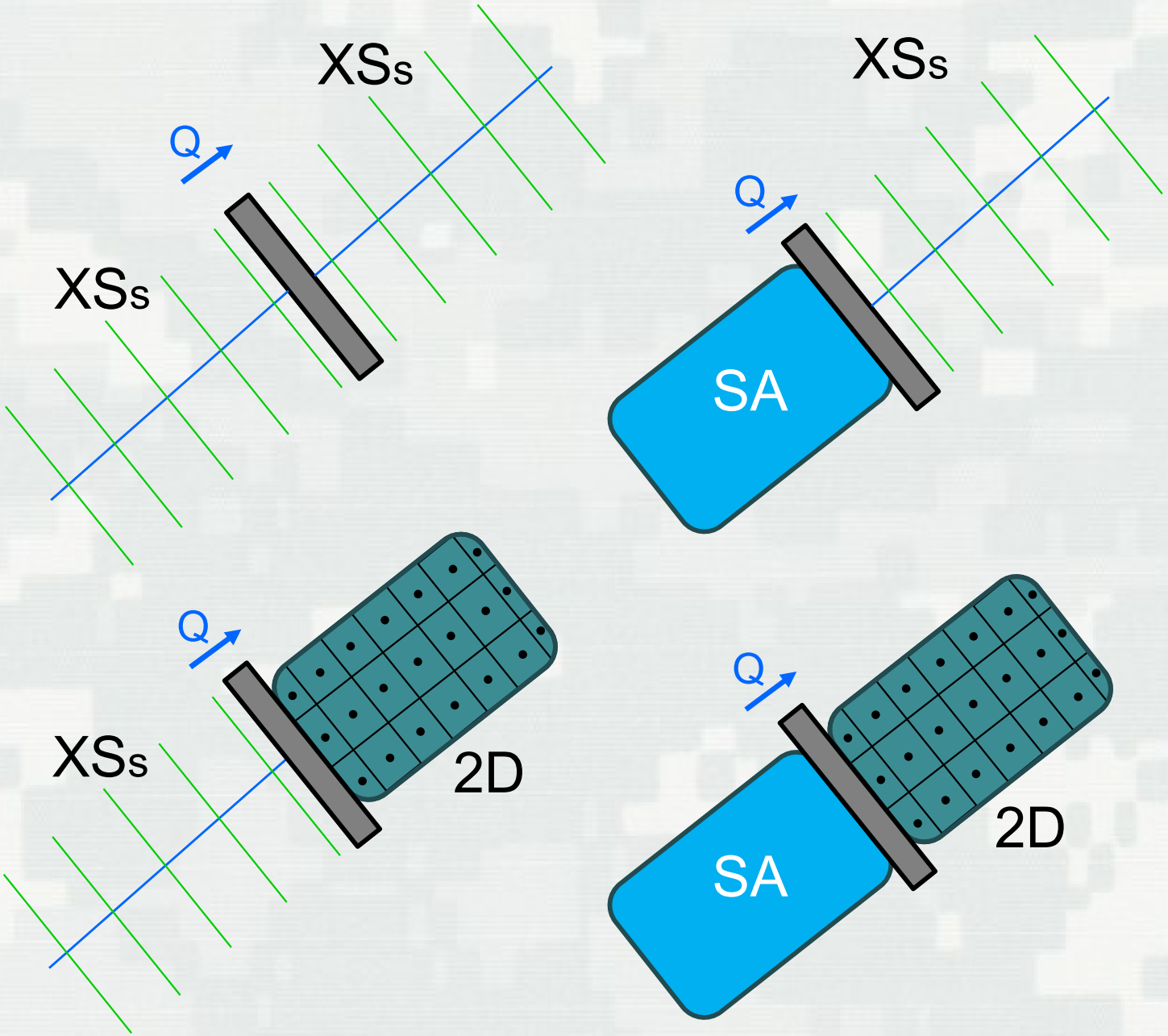
1D Dam Breaching Analysis
Storage Area Pool and XS Downstream



Breach Model Configuration Options



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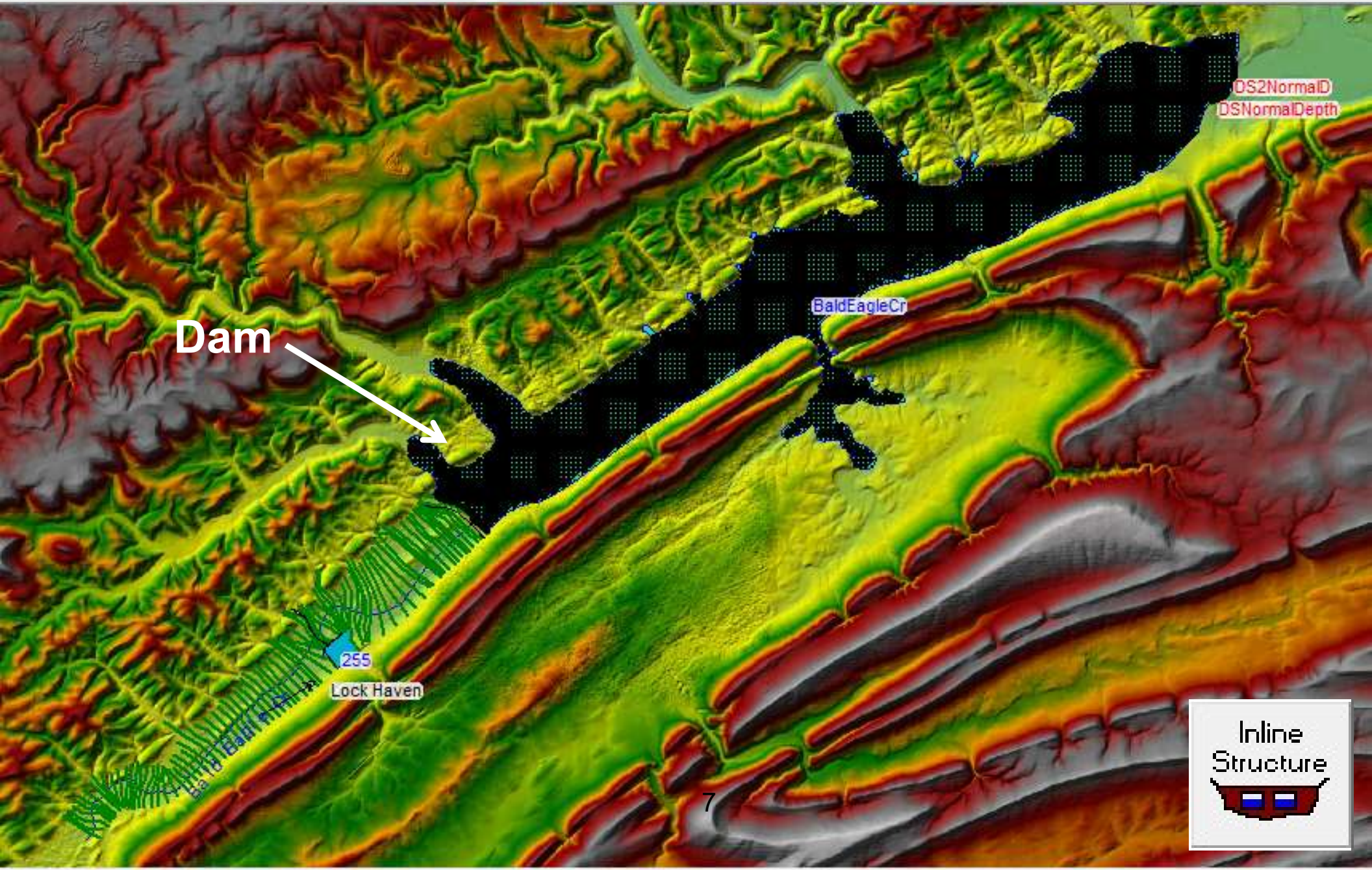
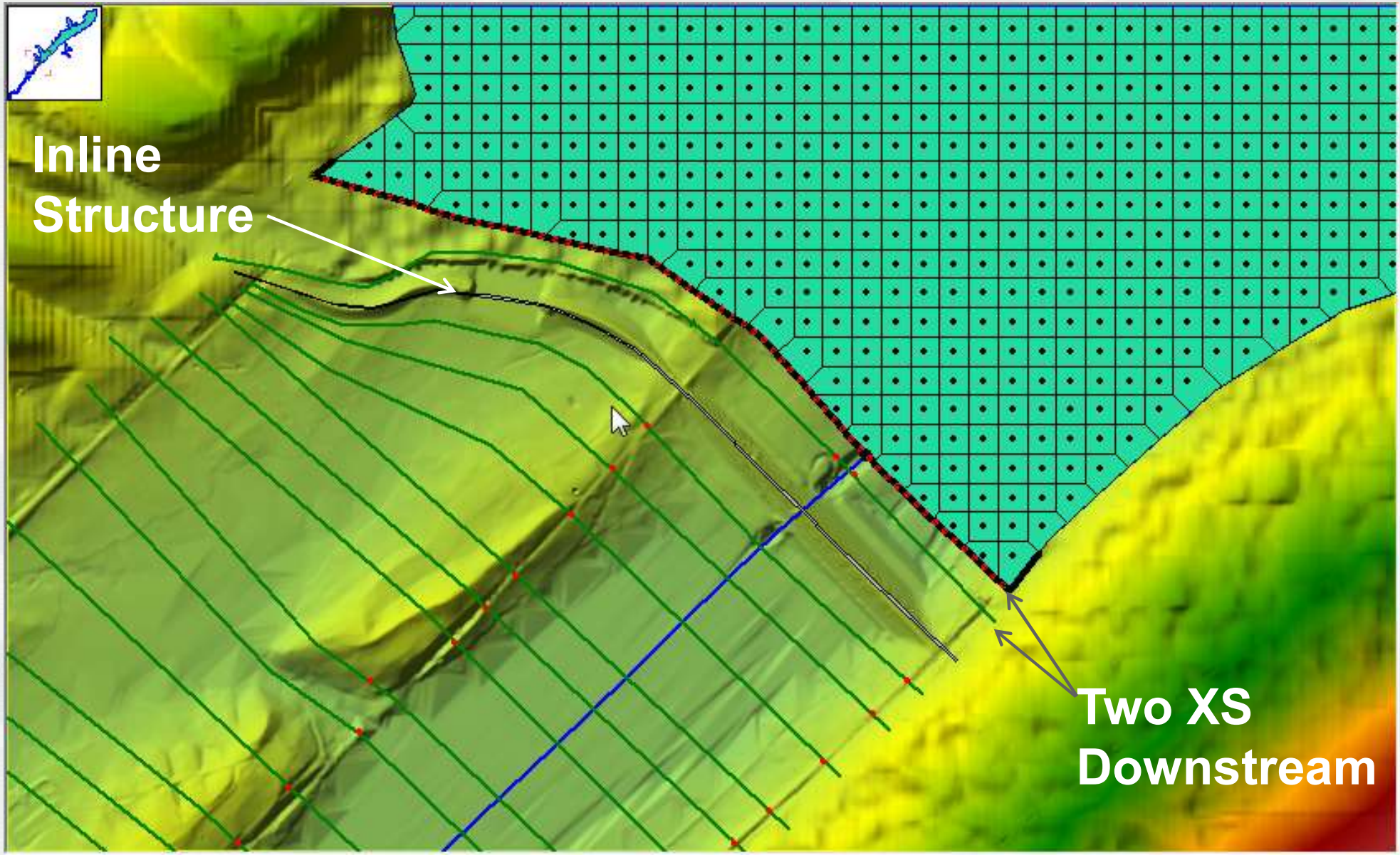
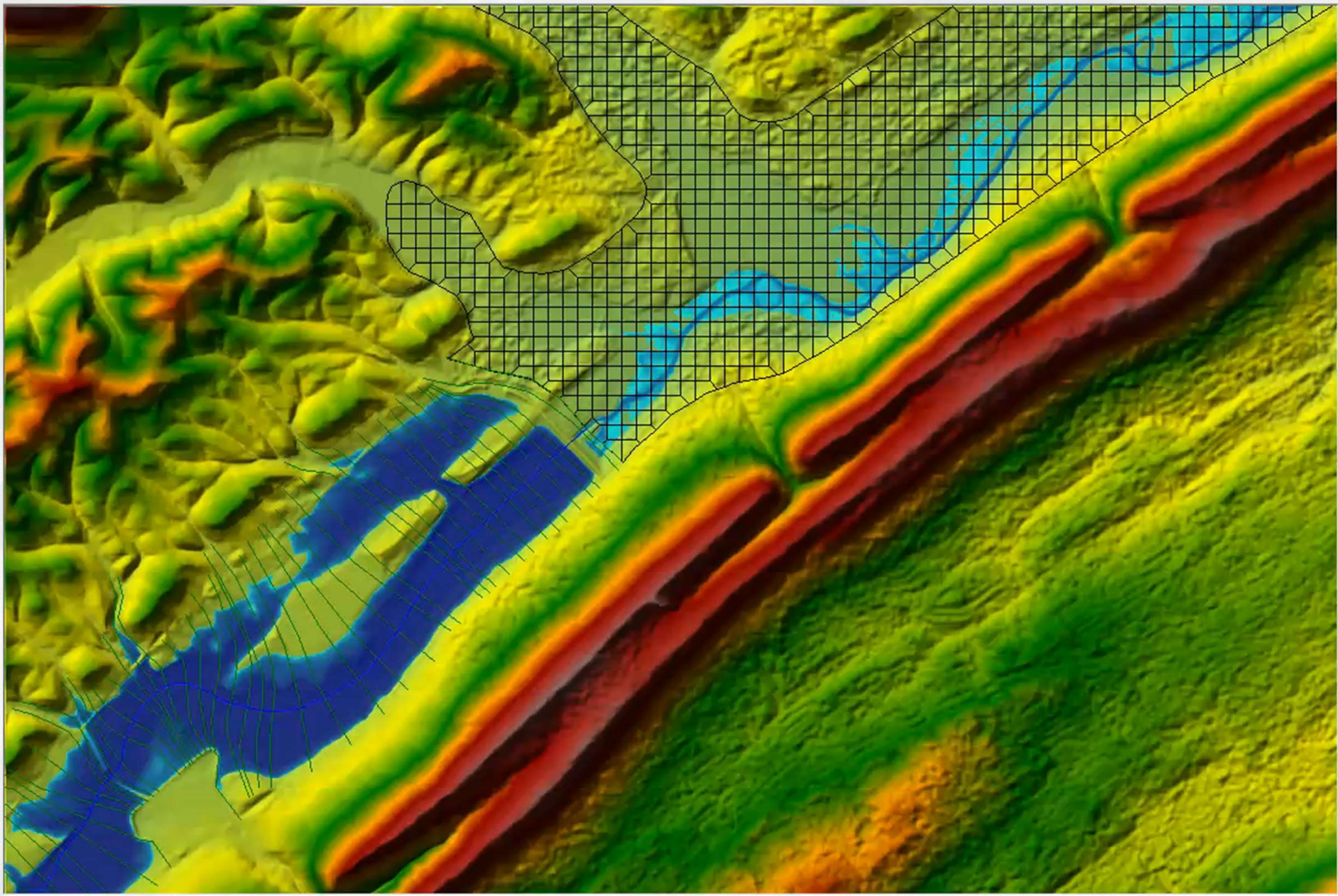
1D River Reach Pool and 2D Downstream



1D River Reach Pool and 2D Downstream



Animation 1D River Reach Pool and 2D Downstream



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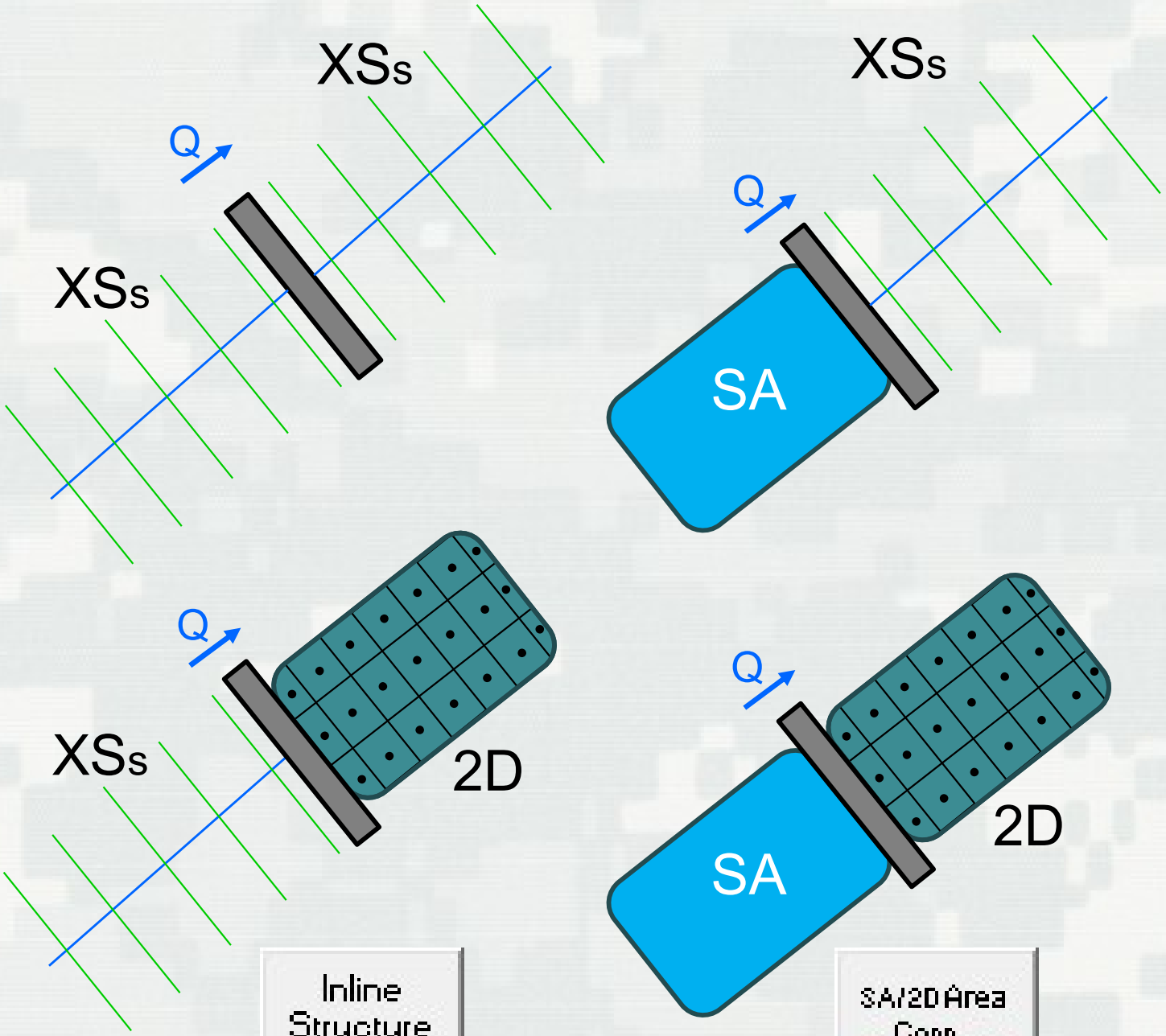
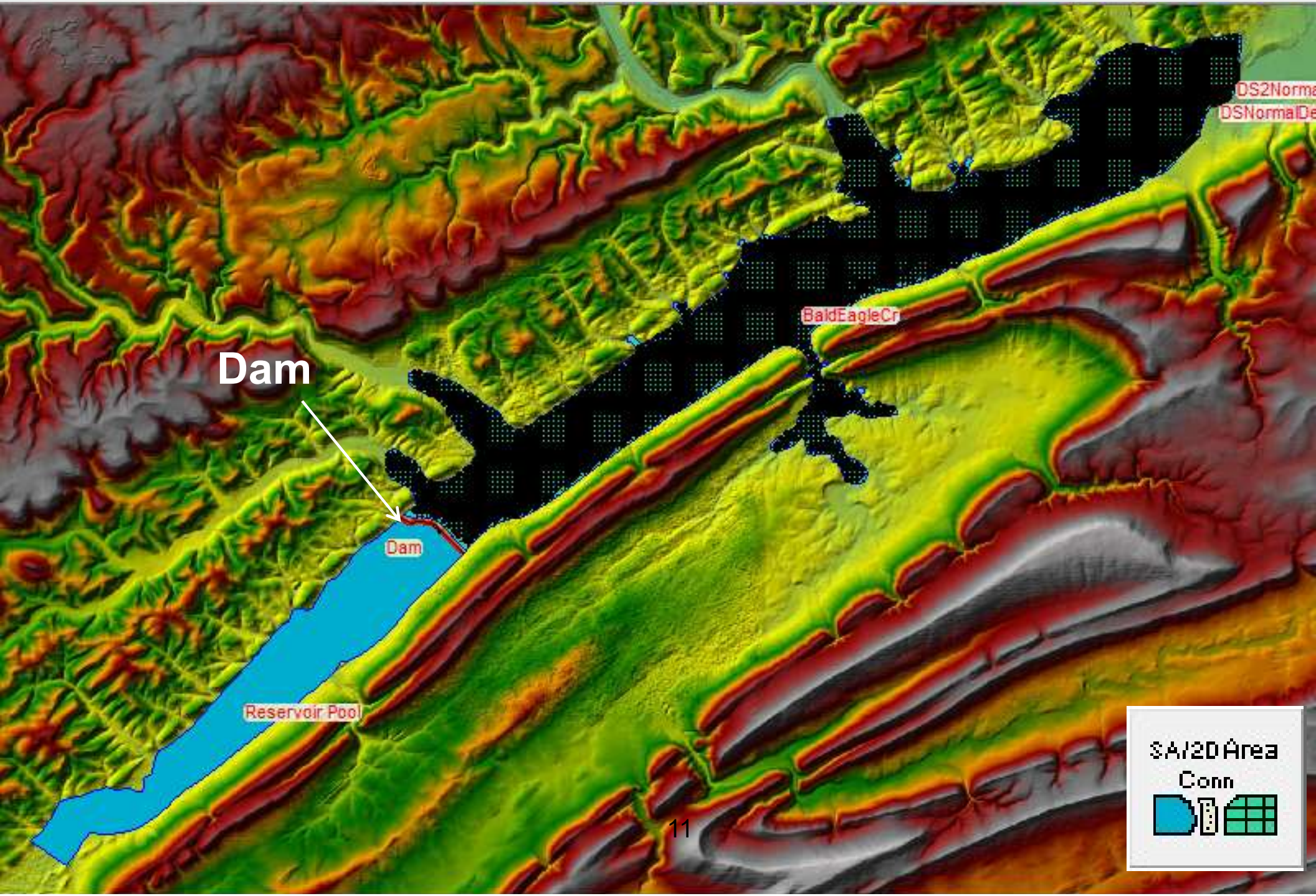


Inline Structure

SA/2D Area Conn

1D Storage Area Pool and 2D Downstream



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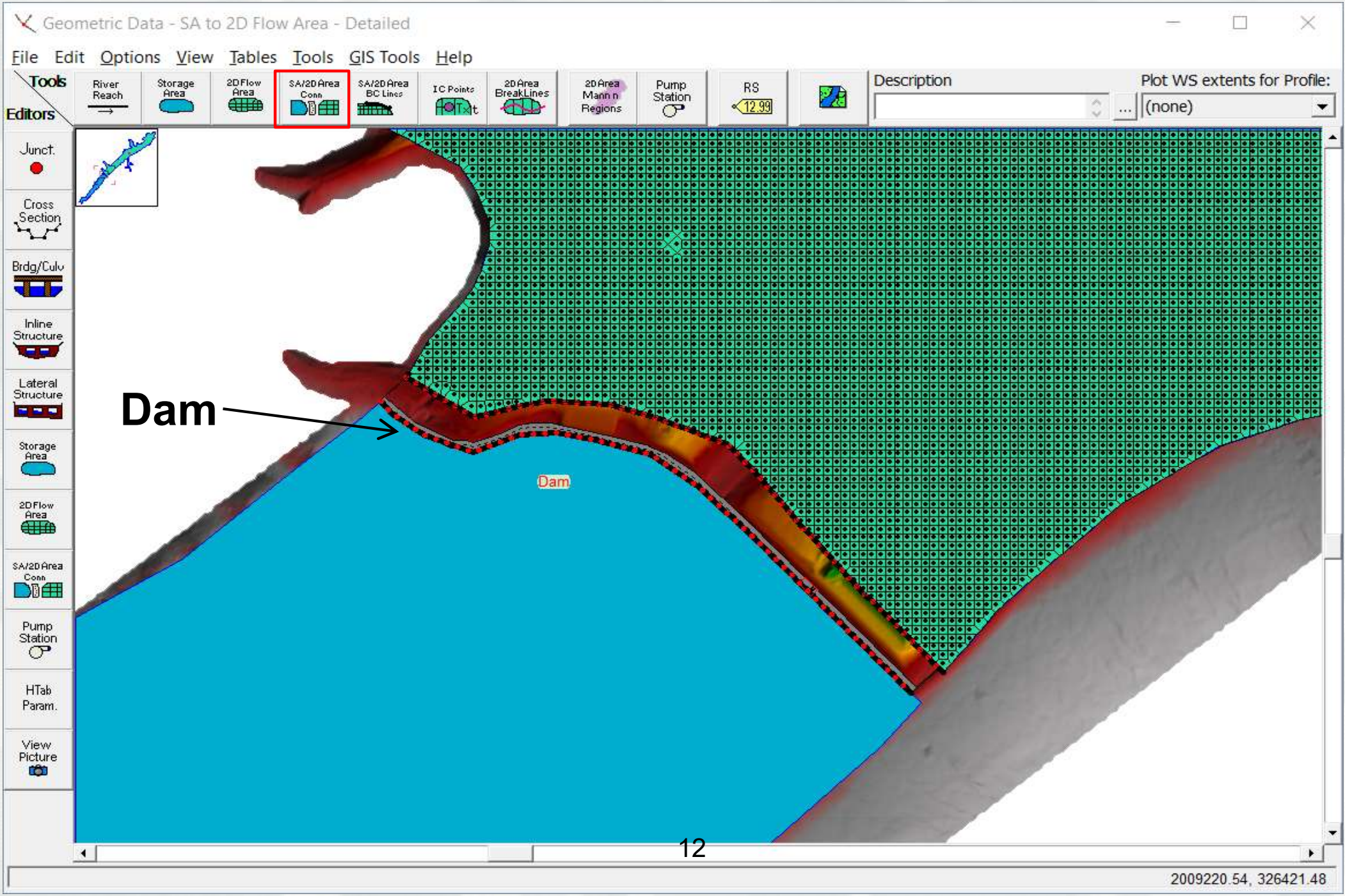
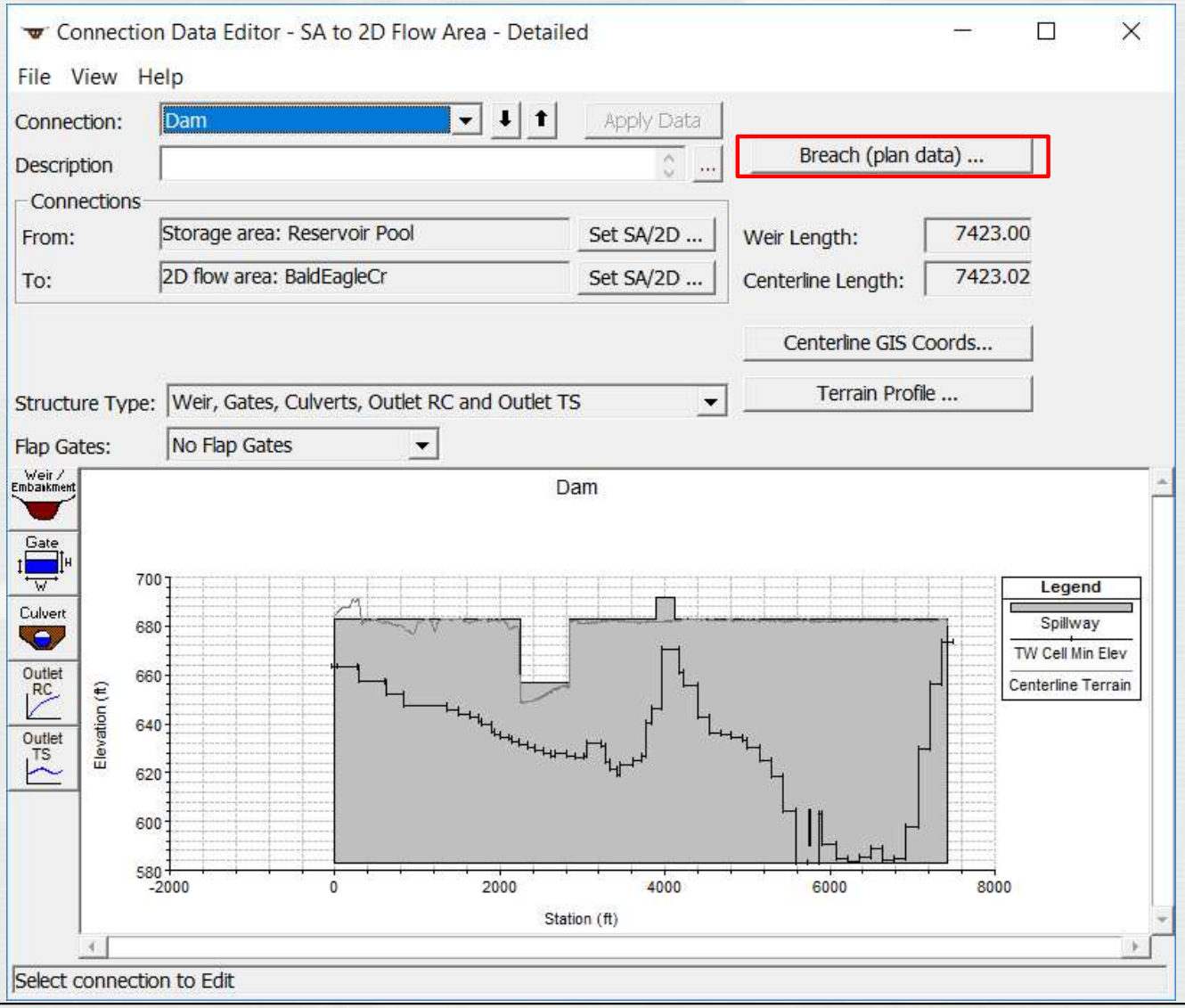


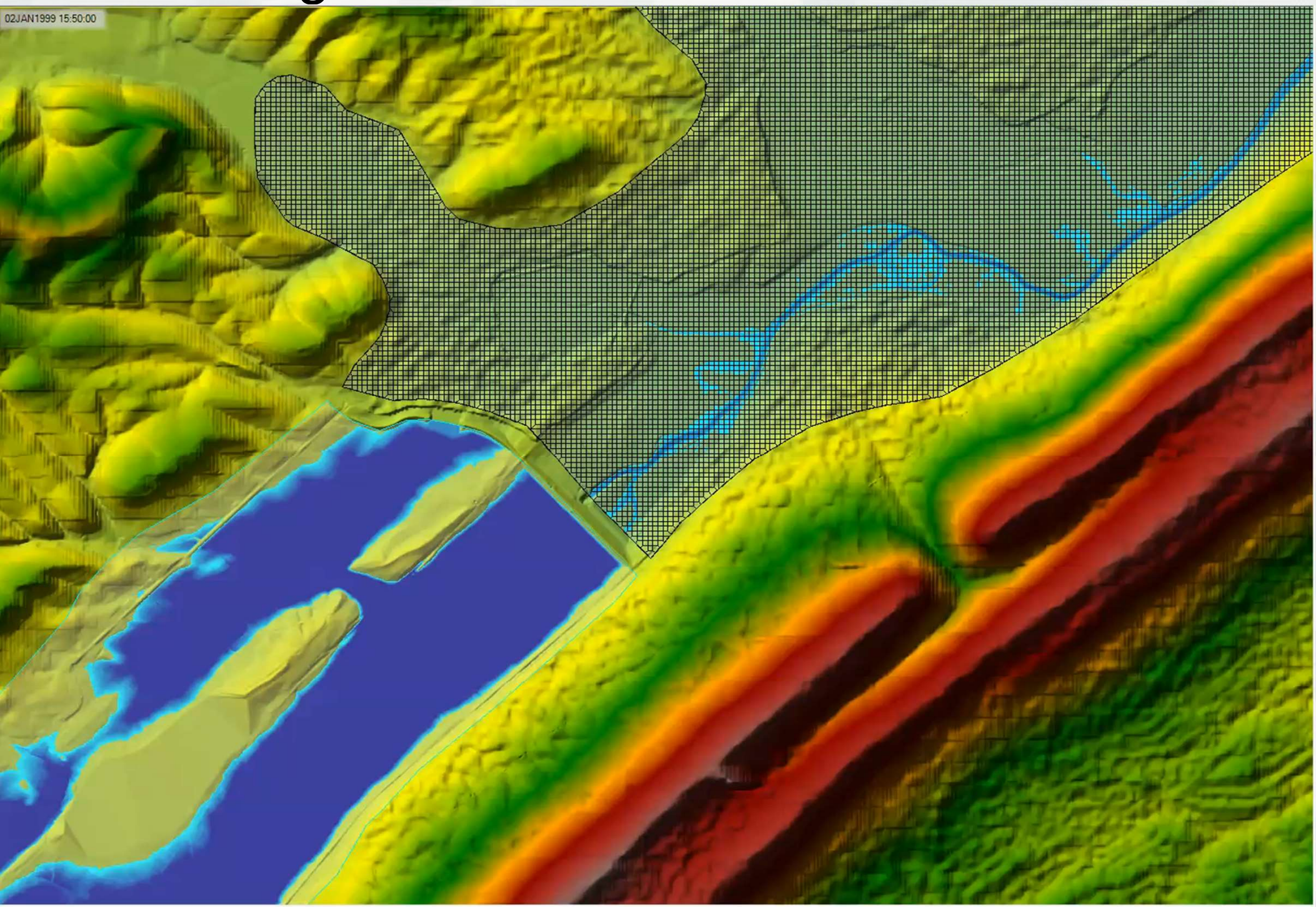
Steps to Connect a SA to a 2D Flow Area with a SA/2D Area Hydraulic Connection

- Draw the Storage Area and enter its data
- Draw the 2D Flow Area and create Mesh
- Using the **SA/2D Area Conn** drawing tool
  - draw the line that represents the hydraulic Structure from left to right looking downstream
- Select the **SA/2d Area Conn** data editor
  - Enter the “From” and “To” connections
  - Enter the top of dam and spillway profile
  - Enter any gate data, etc…

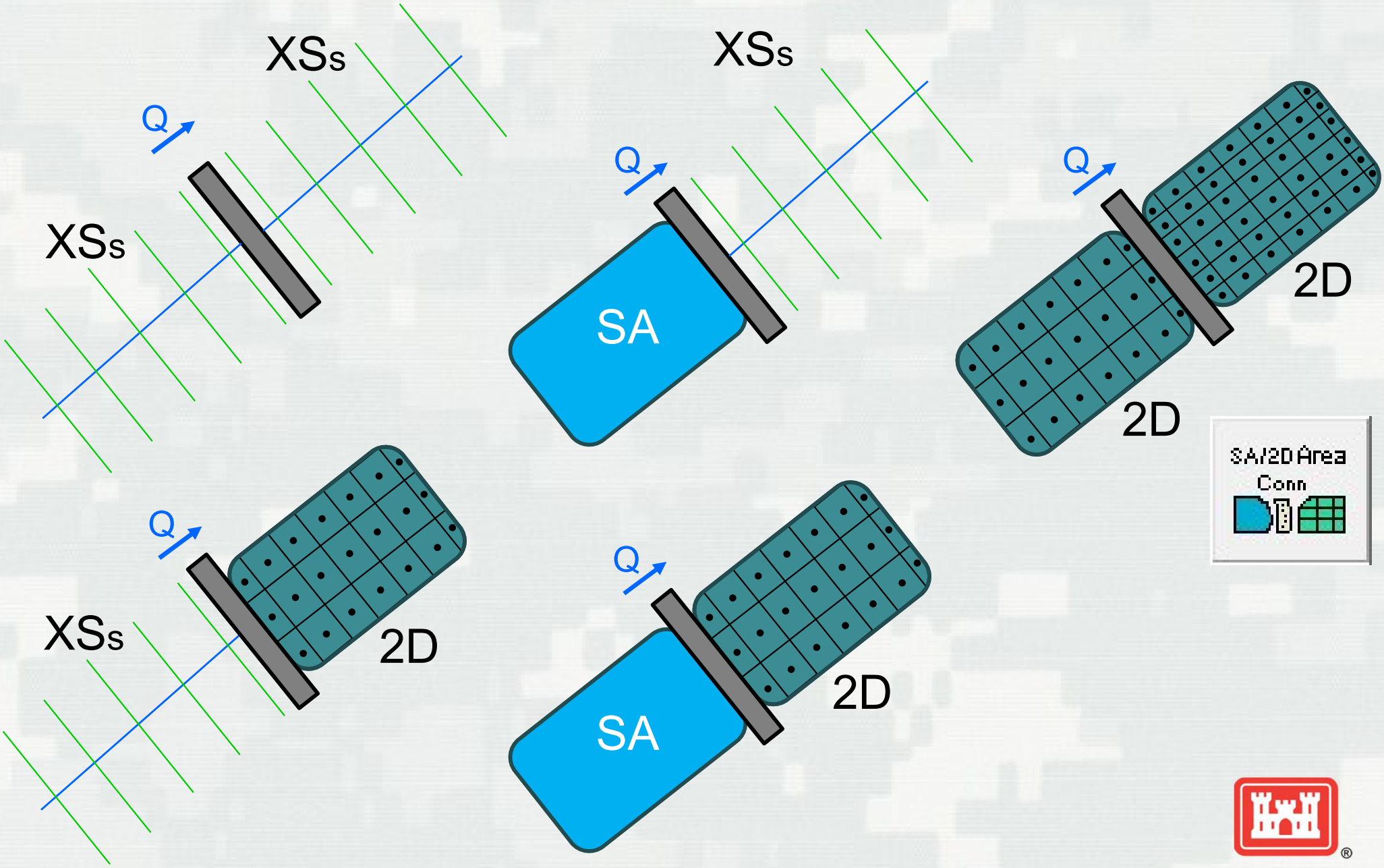
Modeling the Dam with a SA/2D Area Hydraulic Connection



1D Storage Area Pool→2D Area Downstream



Breach Model Configuration Options



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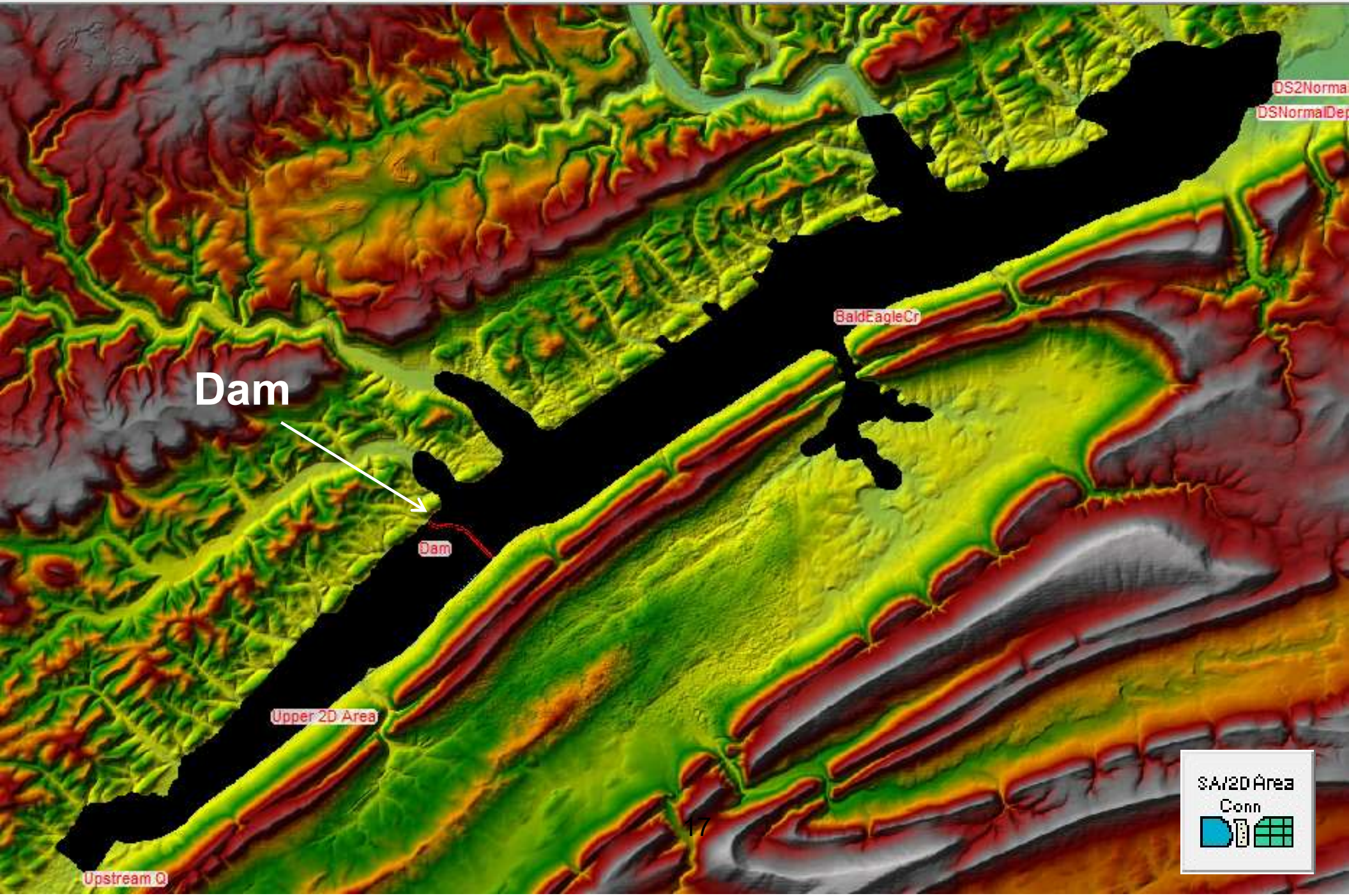
2D Reservoir Pool and 2D Downstream



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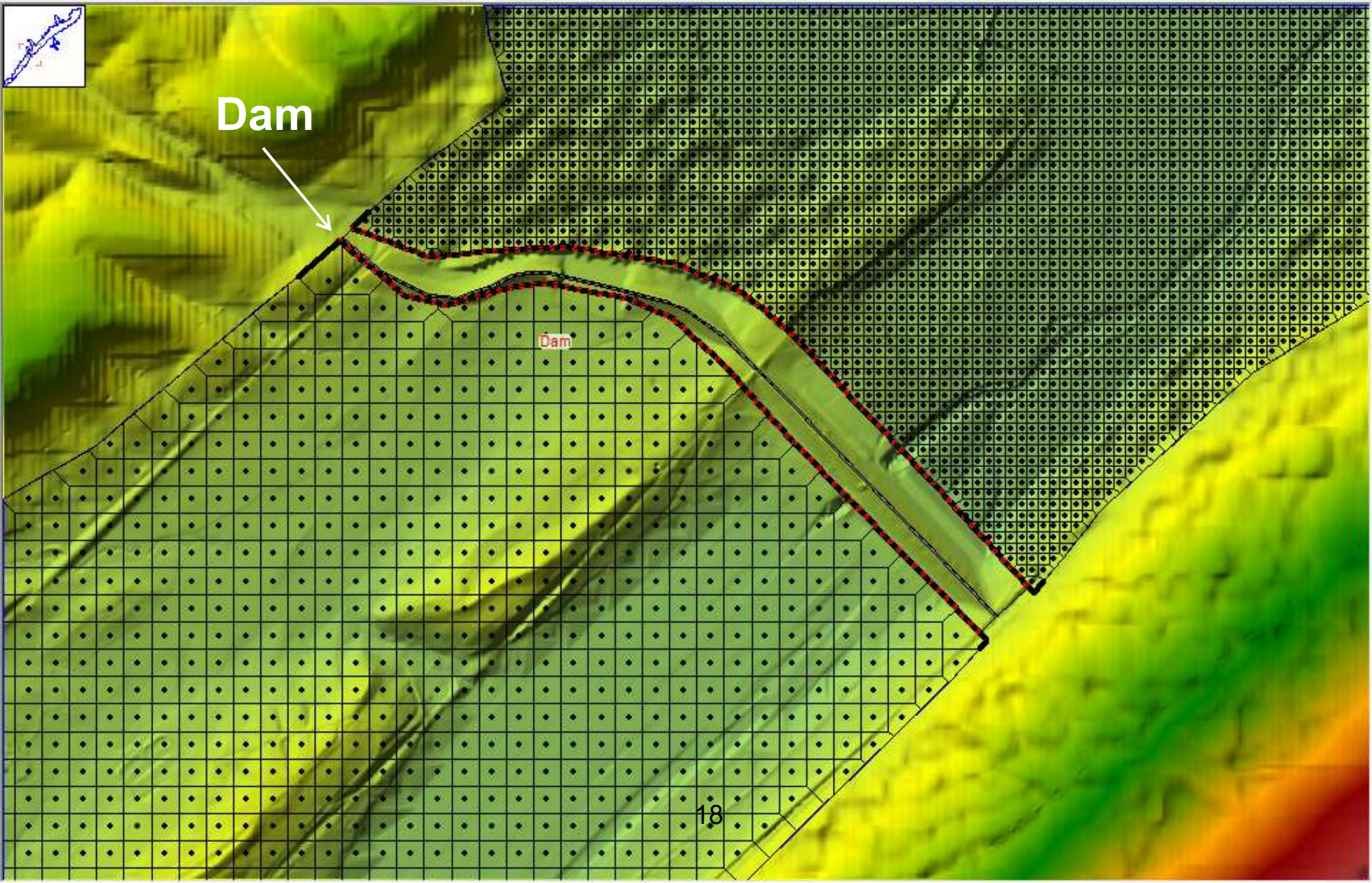
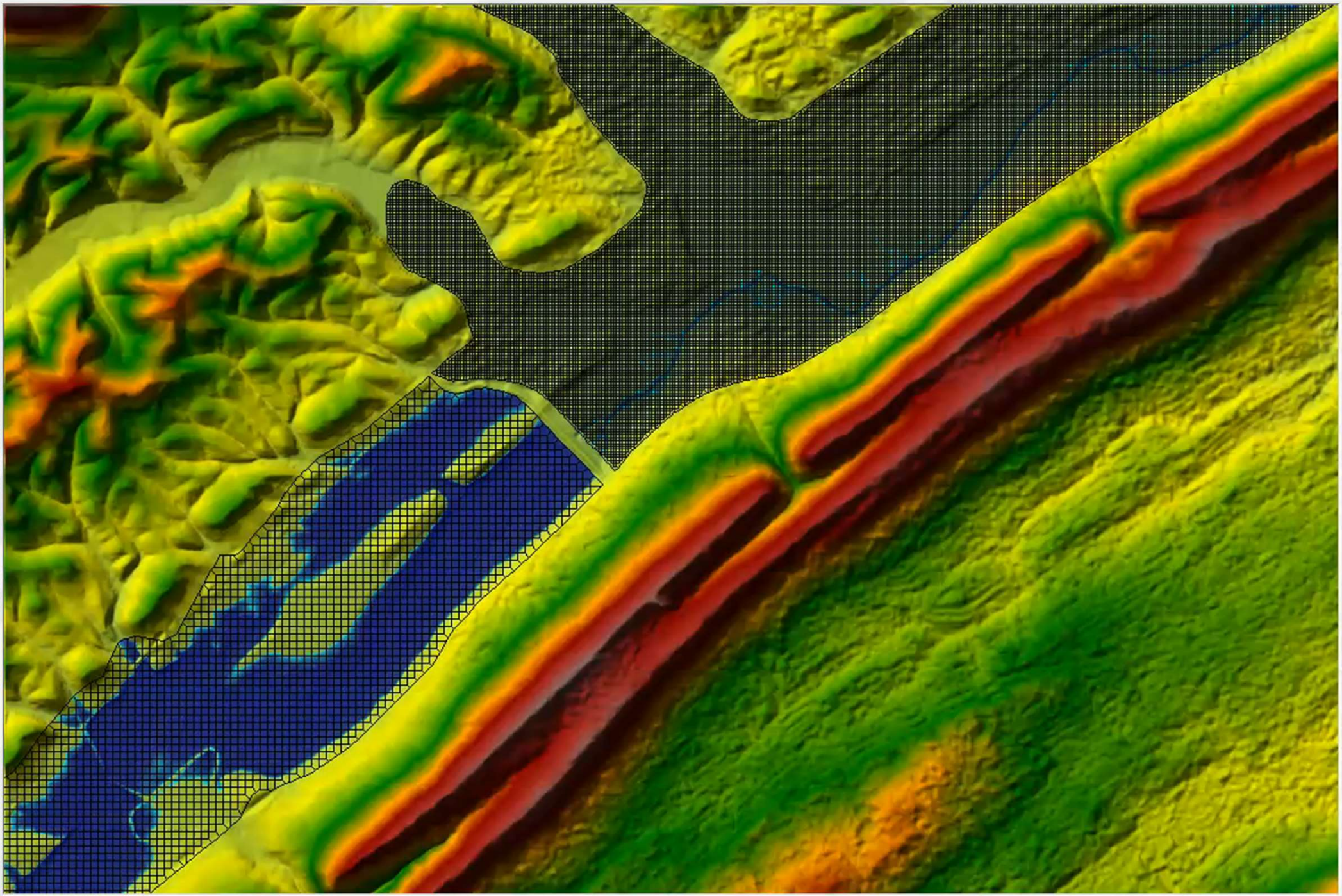
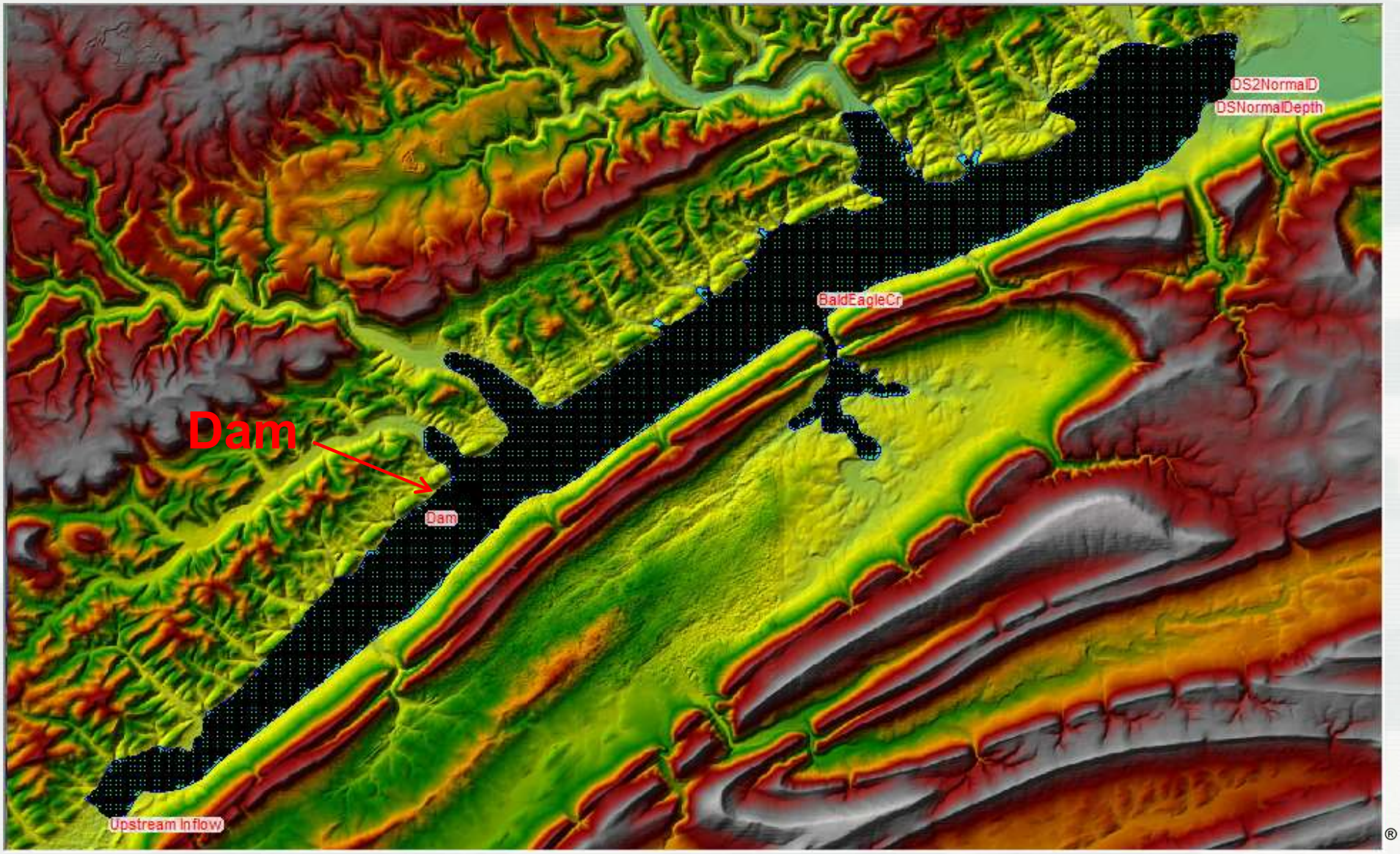


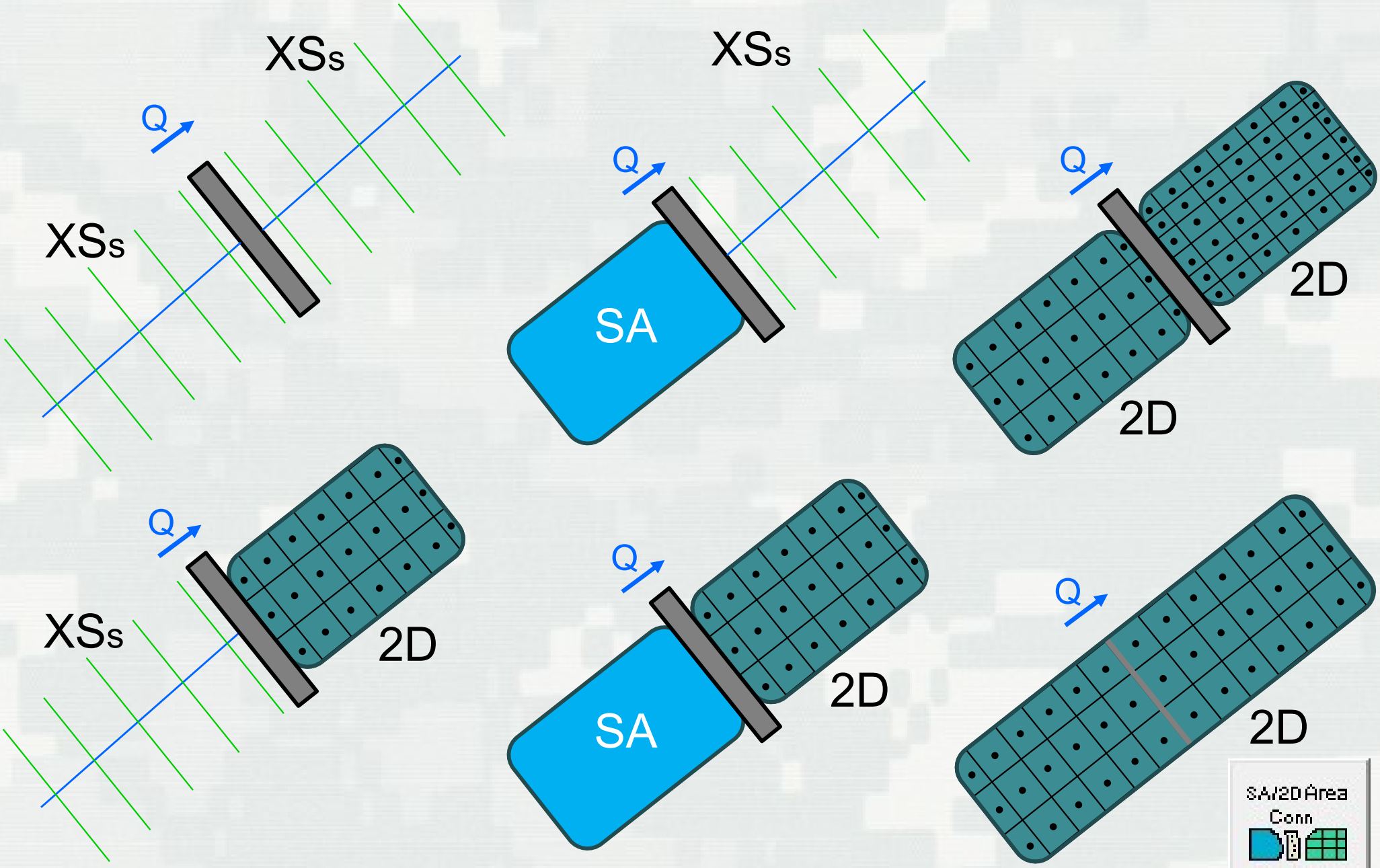
Animation of 2D Reservoir Pool and 2D Downstream



Single 2D Flow Area with Internal Hydraulic Structure for the Dam

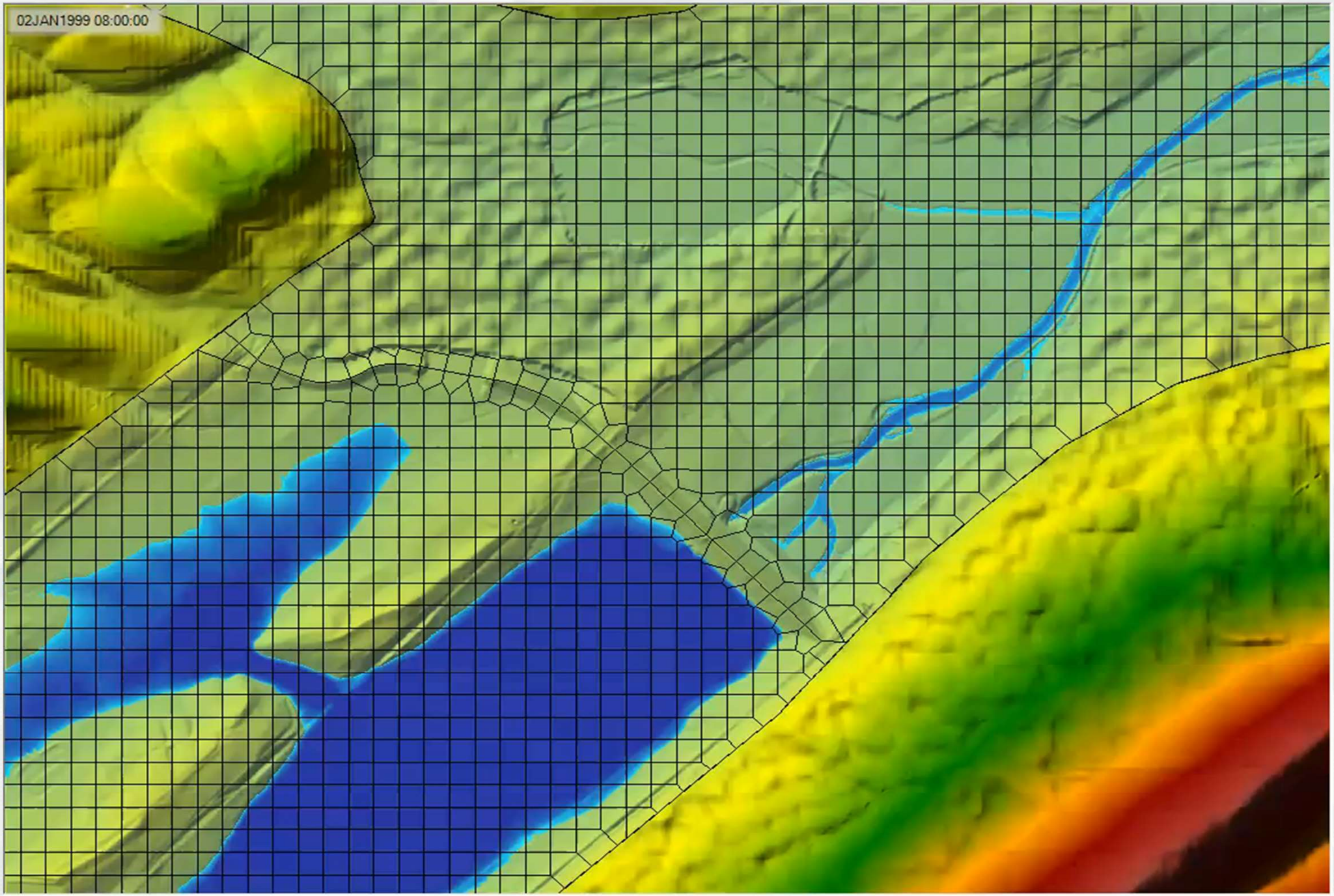


Breach Model Configuration Options

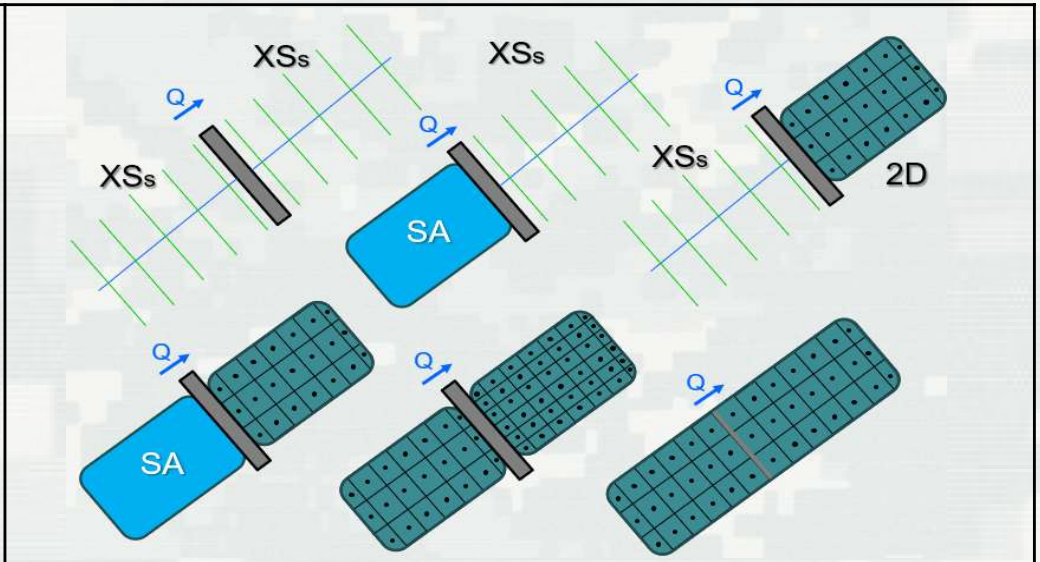


Single 2D Flow Area with Internal Hydraulic Structure for the Dam

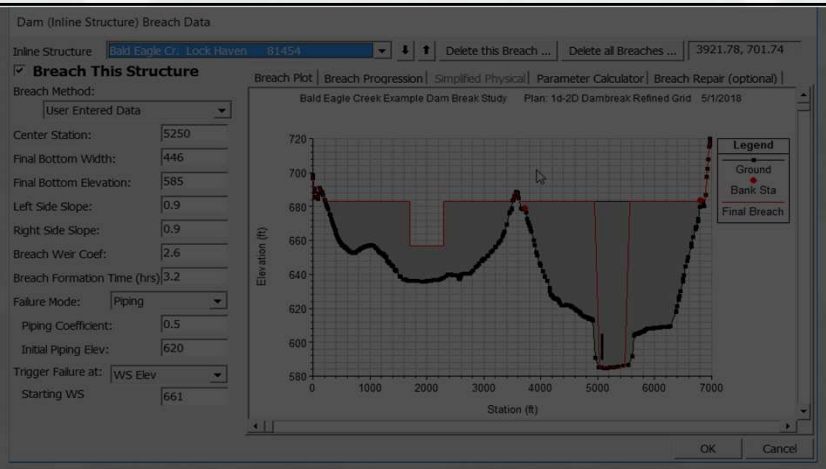
Animation of Single 2D Flow Area with Internal Hydraulic Structure for the Dam



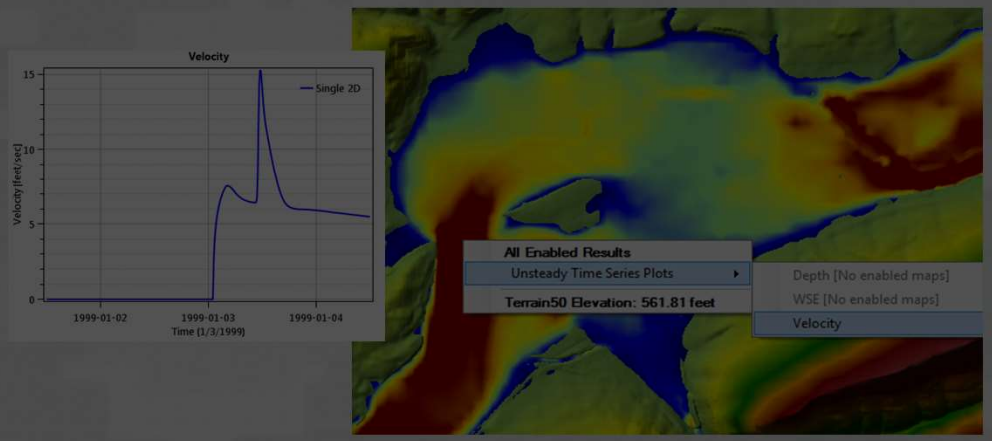
1. Six Dam Breach Model Configurations



2. Breaching Options and Parameters



3. Breach Results and Visualization



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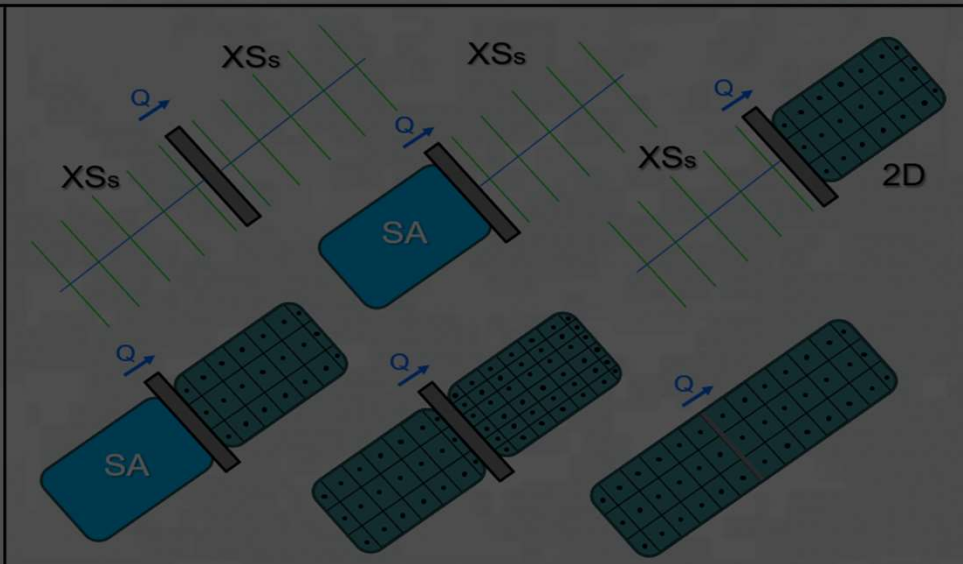

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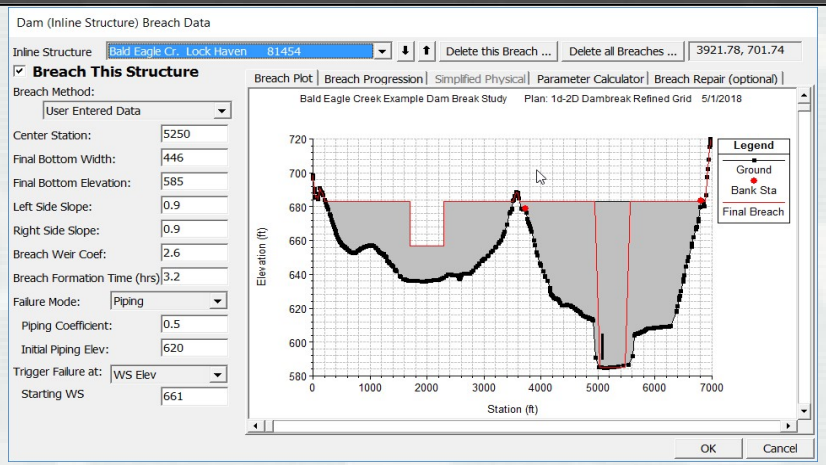

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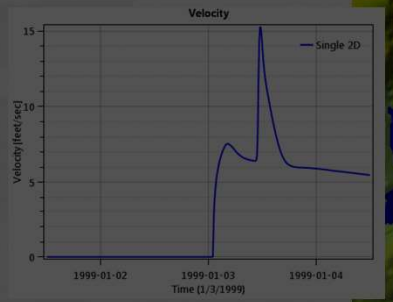
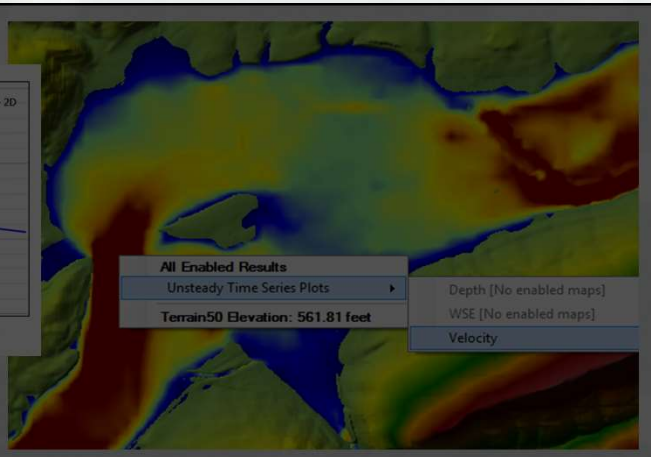
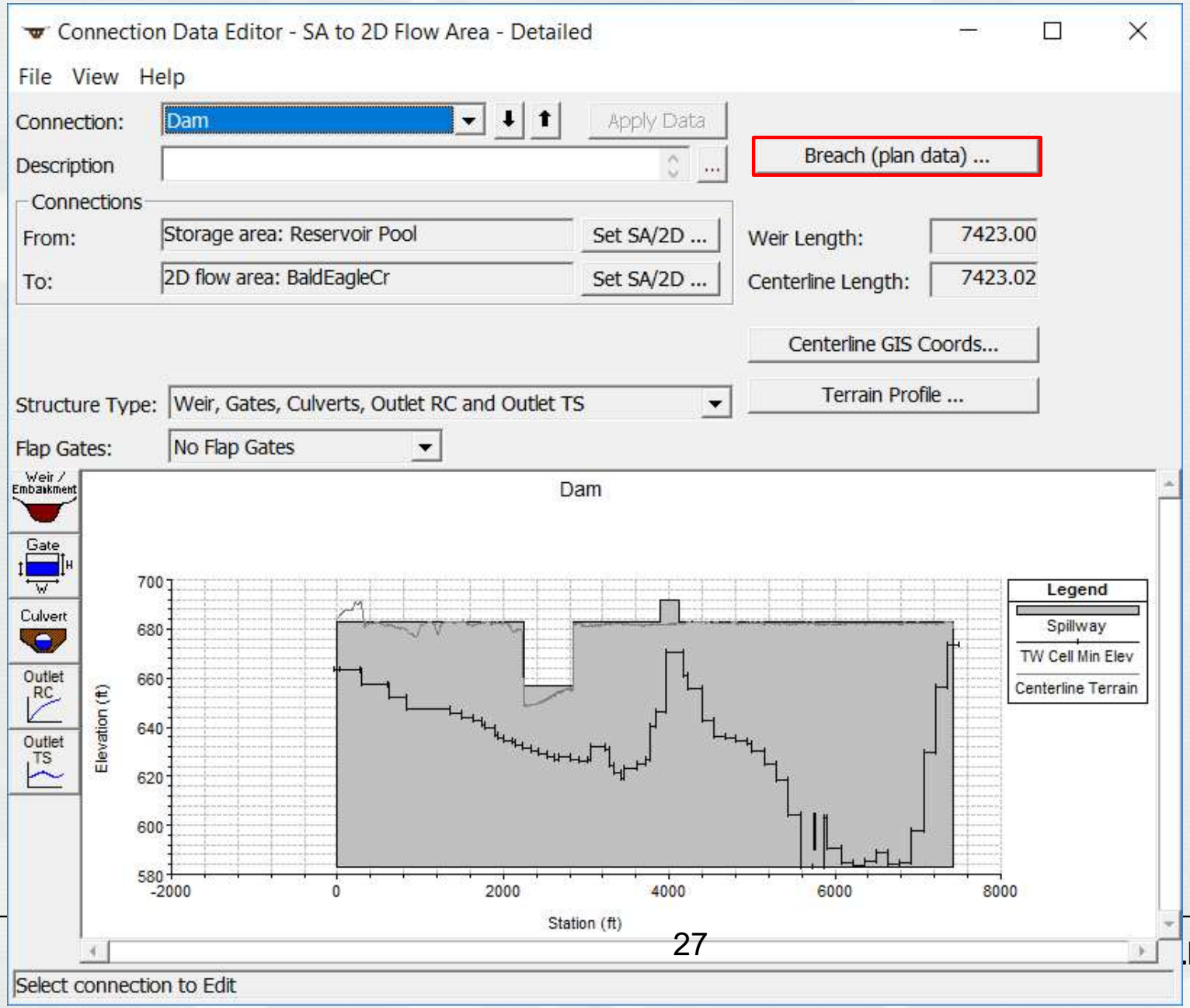




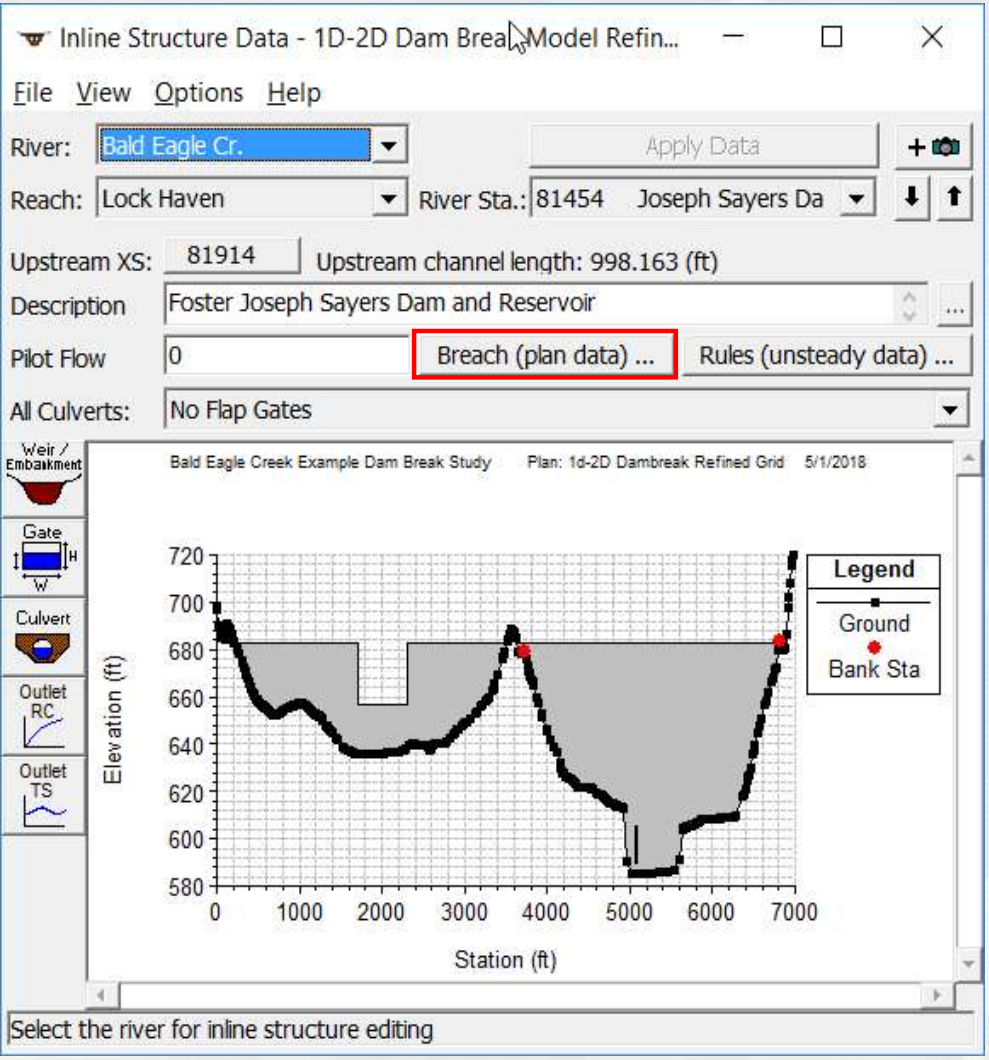
Dam Break Analysis in HEC-RAS

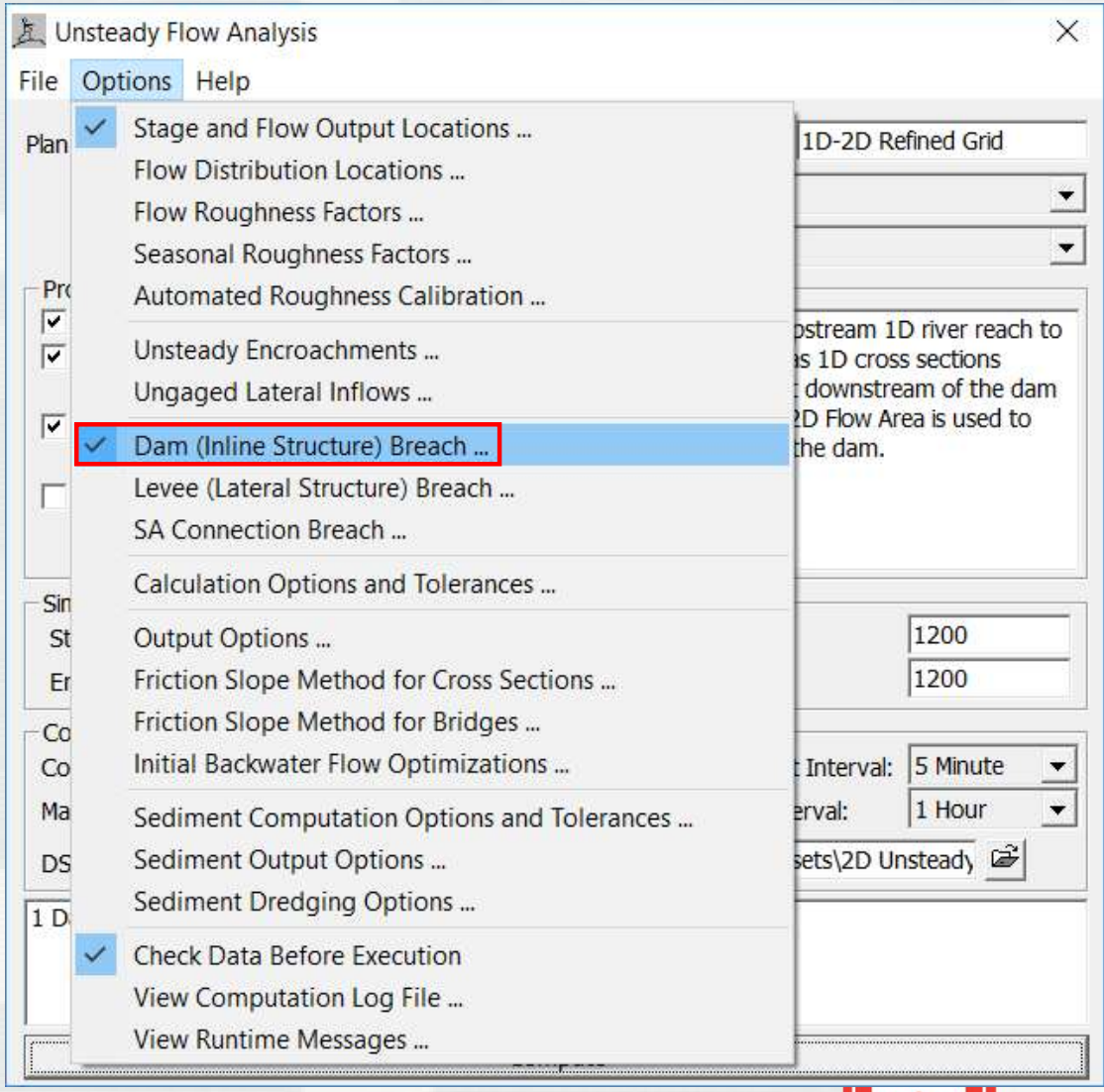
- Failure Modes
  - Overtopping and Piping
- Failure Initiation based on:
  - stage
  - simulation time
  - stage + duration, and immediate initiation stage.
- Breach progression
  - linear or nonlinear (user specified)
  - Simplified Physical Breaching Option
  - DL Breach

Modeling the Dam with a SA/2D Area Hydraulic Connection



Inline Structure Dam Break Control





Dam Breach Data

Dam (Inline Structure) Breach Data

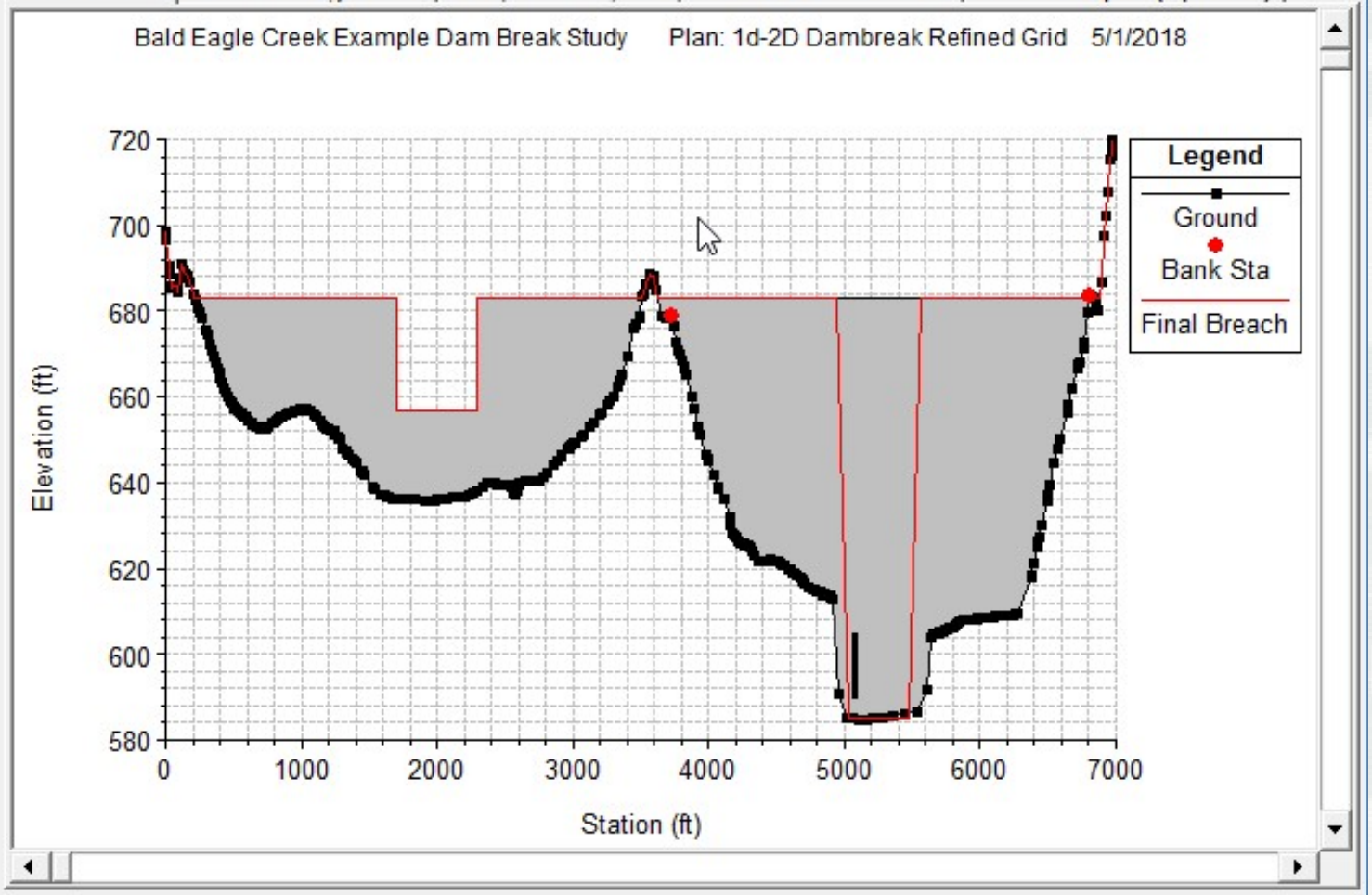
Inline Structure: Bald Eagle Cr. Lock Haven 81454 | Delete this Breach ... | Delete all Breaches ... | 3921.78, 701.74

Breach This Structure

Breach Method: User Entered Data

Center Station:	5250
Final Bottom Width:	446
Final Bottom Elevation:	585
Left Side Slope:	0.9
Right Side Slope:	0.9
Breach Weir Coef:	2.6
Breach Formation Time (hrs)	3.2
Failure Mode:	Piping
Piping Coefficient:	0.5
Initial Piping Elev:	620
Trigger Failure at:	WS Elev
Starting WS	661

Breach Plot | Breach Progression | Simplified Physical | Parameter Calculator | Breach Repair (optional)



OK | Cancel

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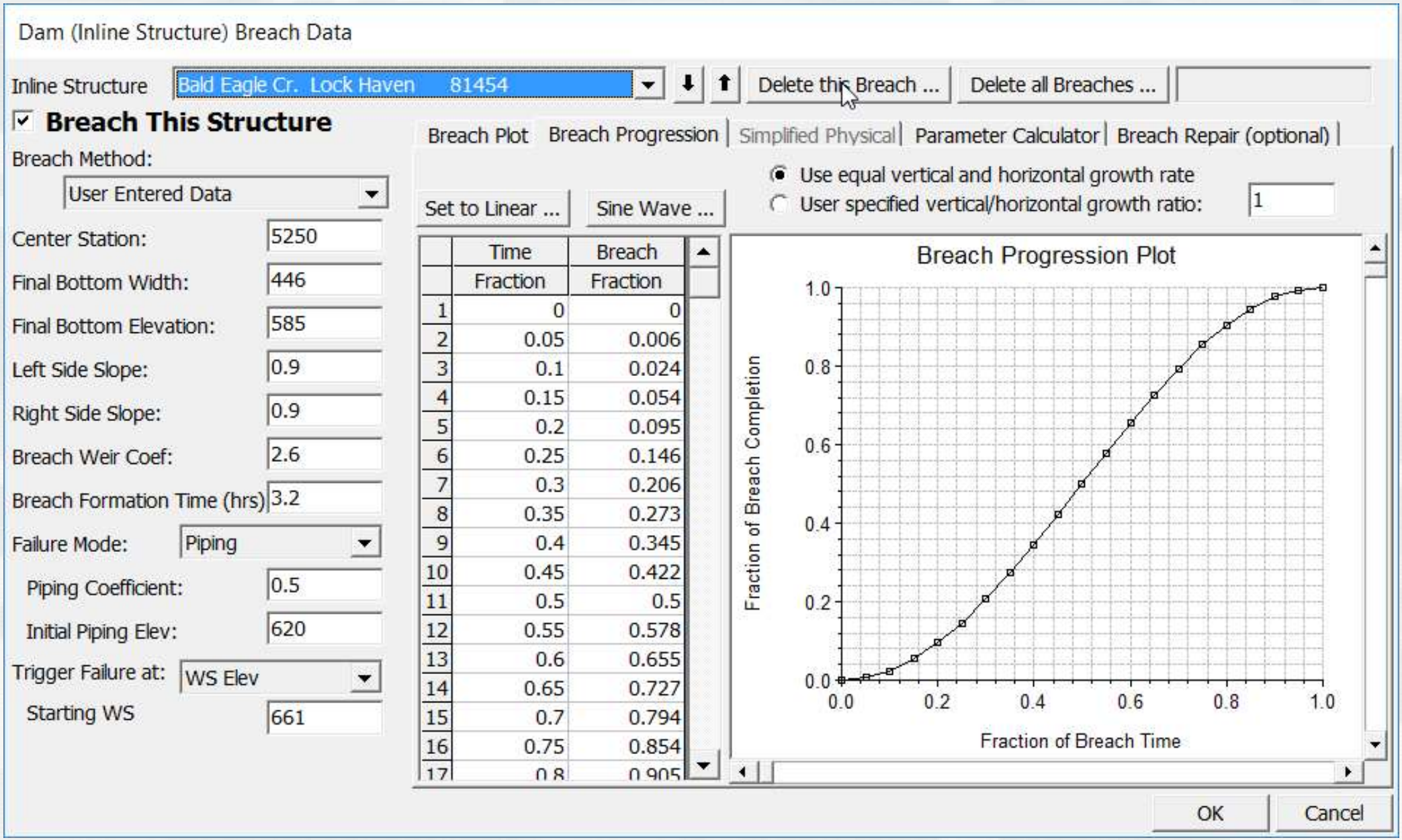
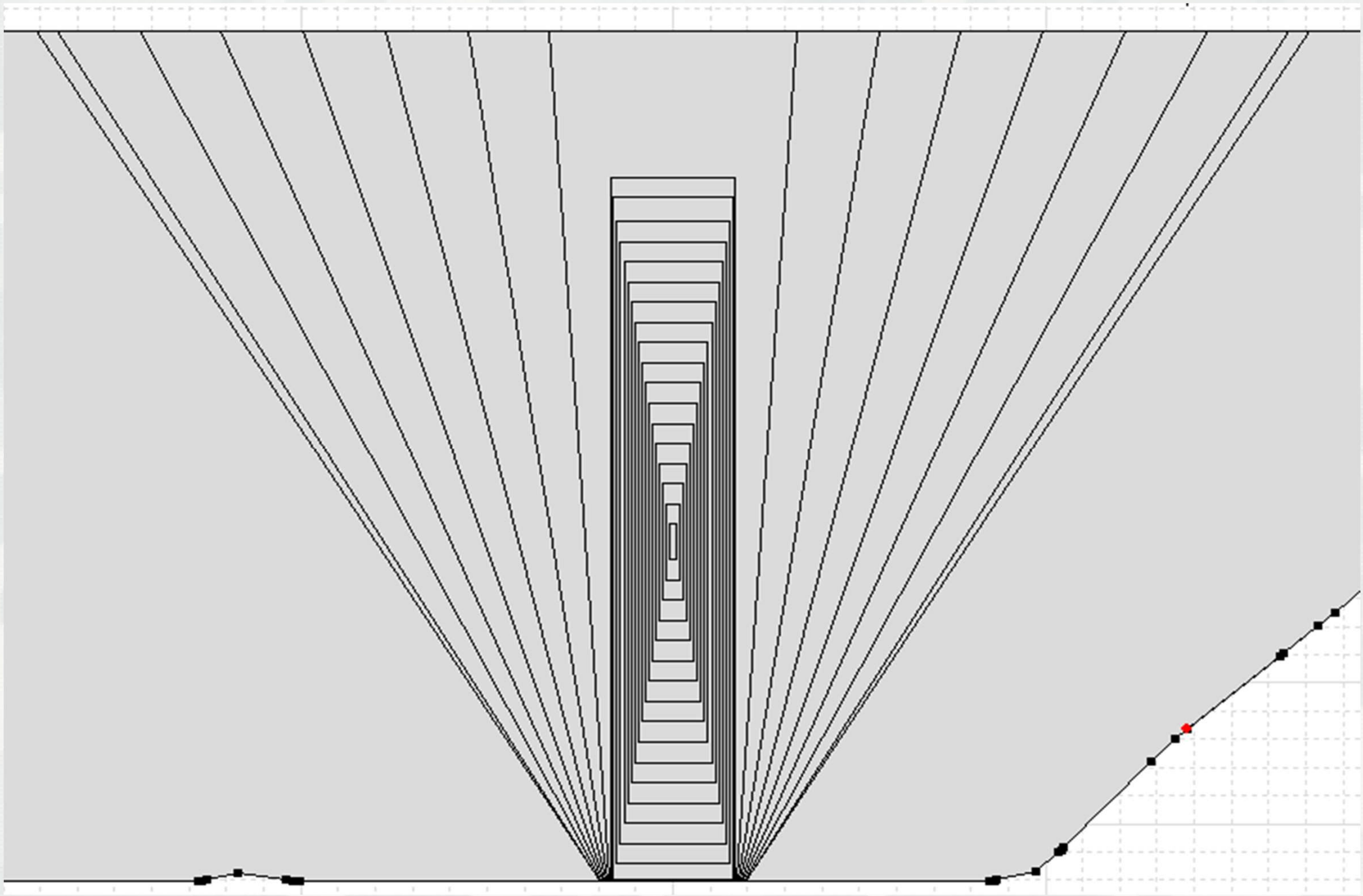
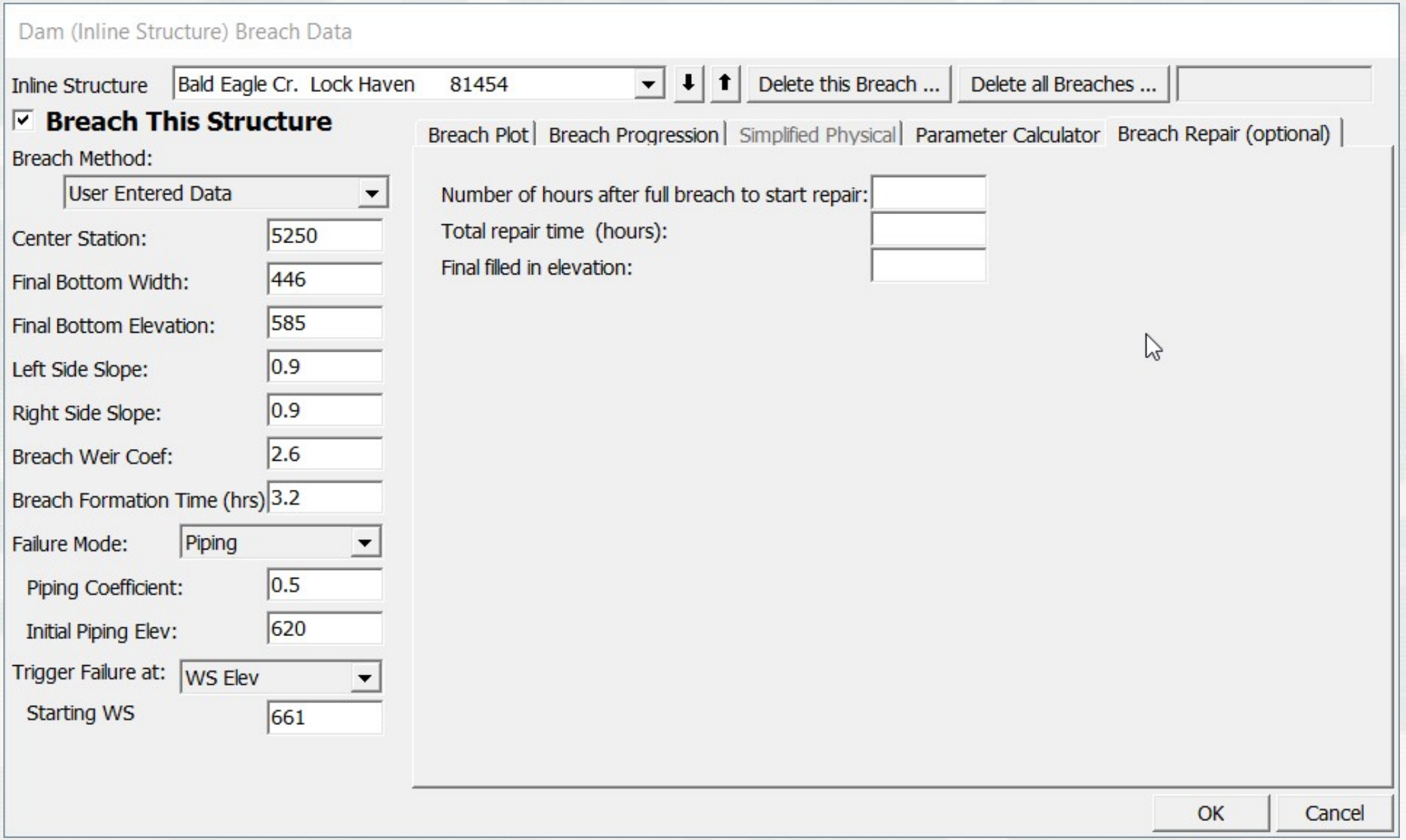
Non-Linear Breach Growth



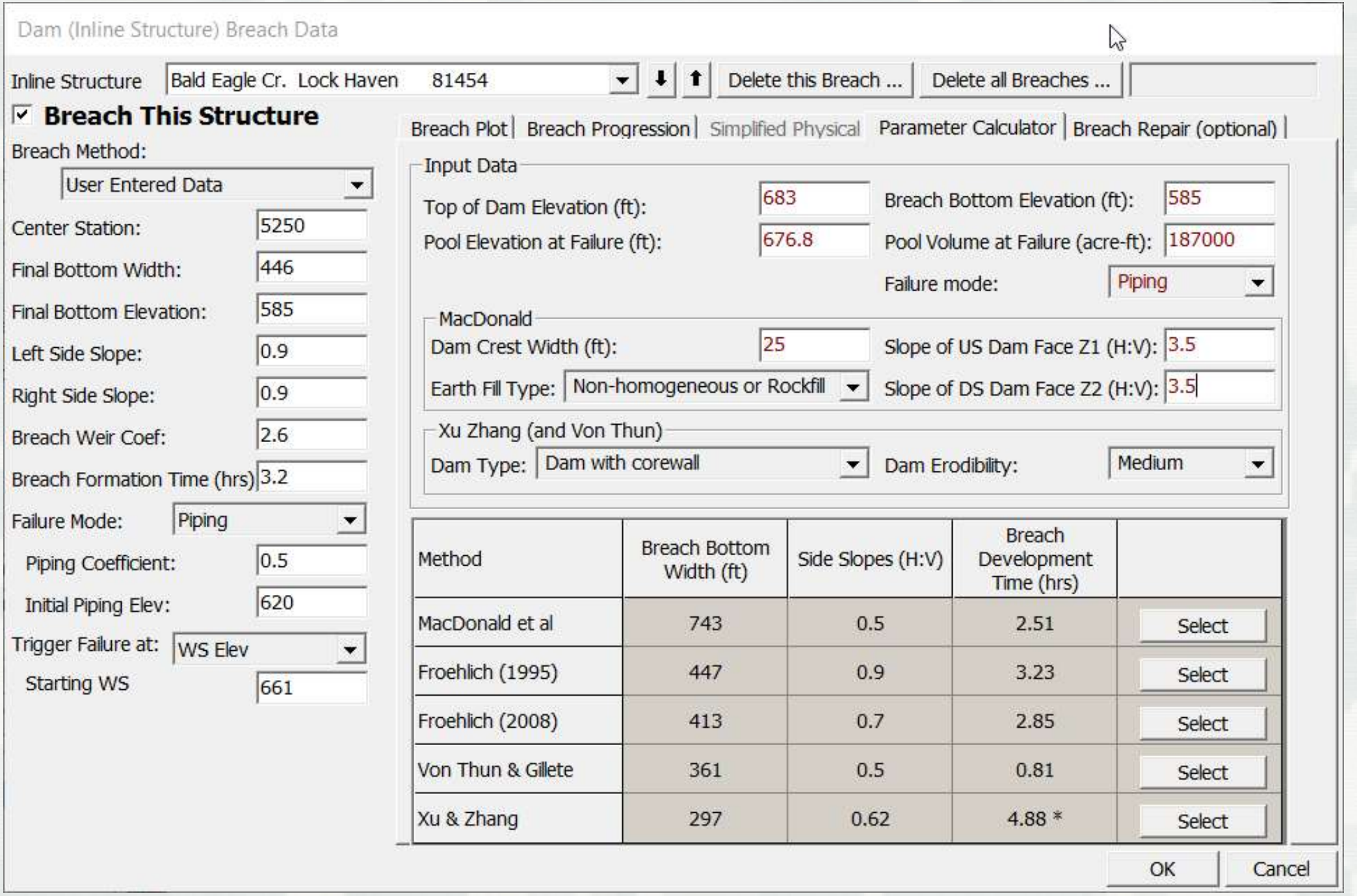
Piping Failure Breach Growth Geometry



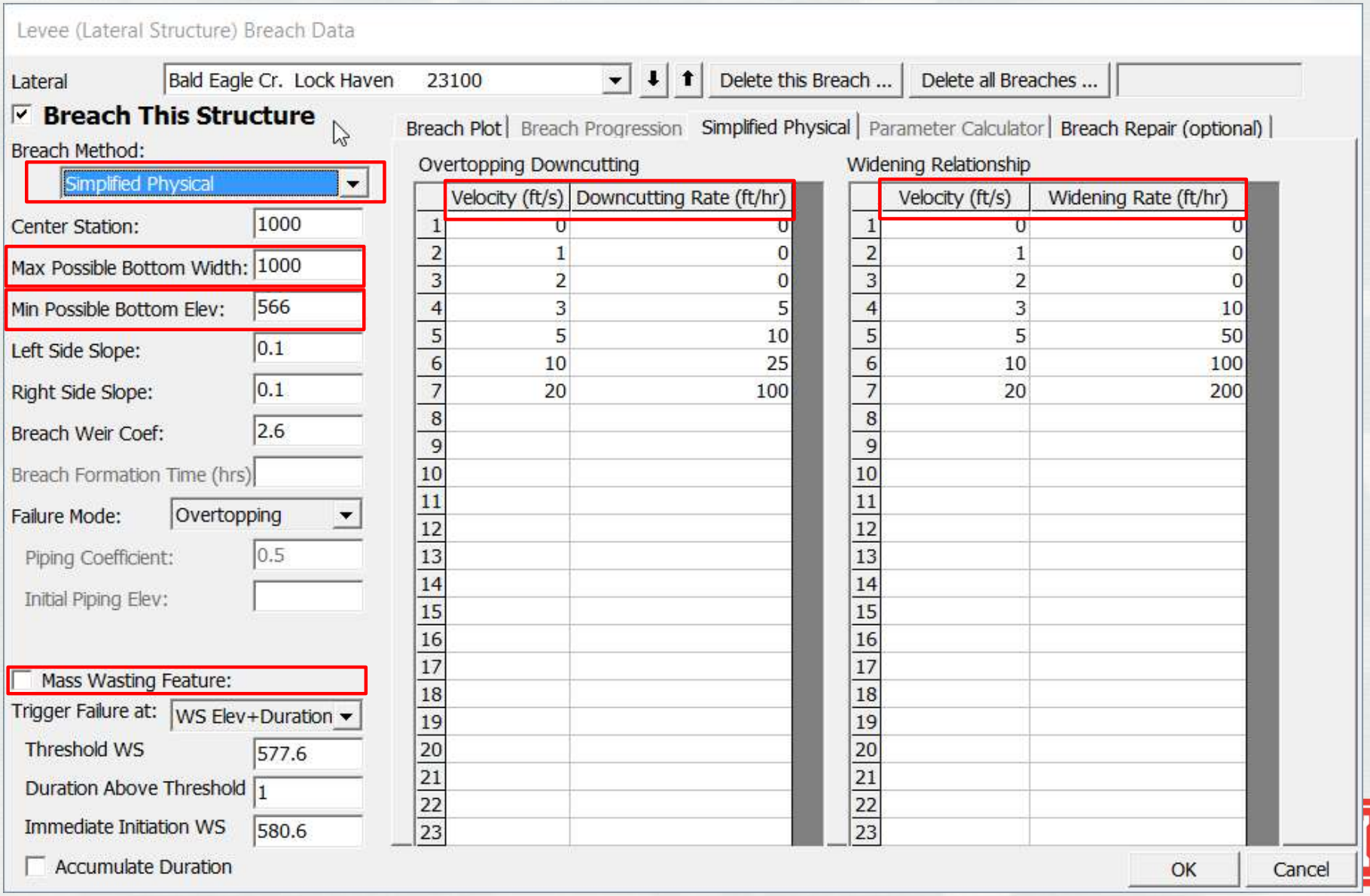
Breach Repair Option



Breach Regression Equation Calculator



Simplified Physical Breaching



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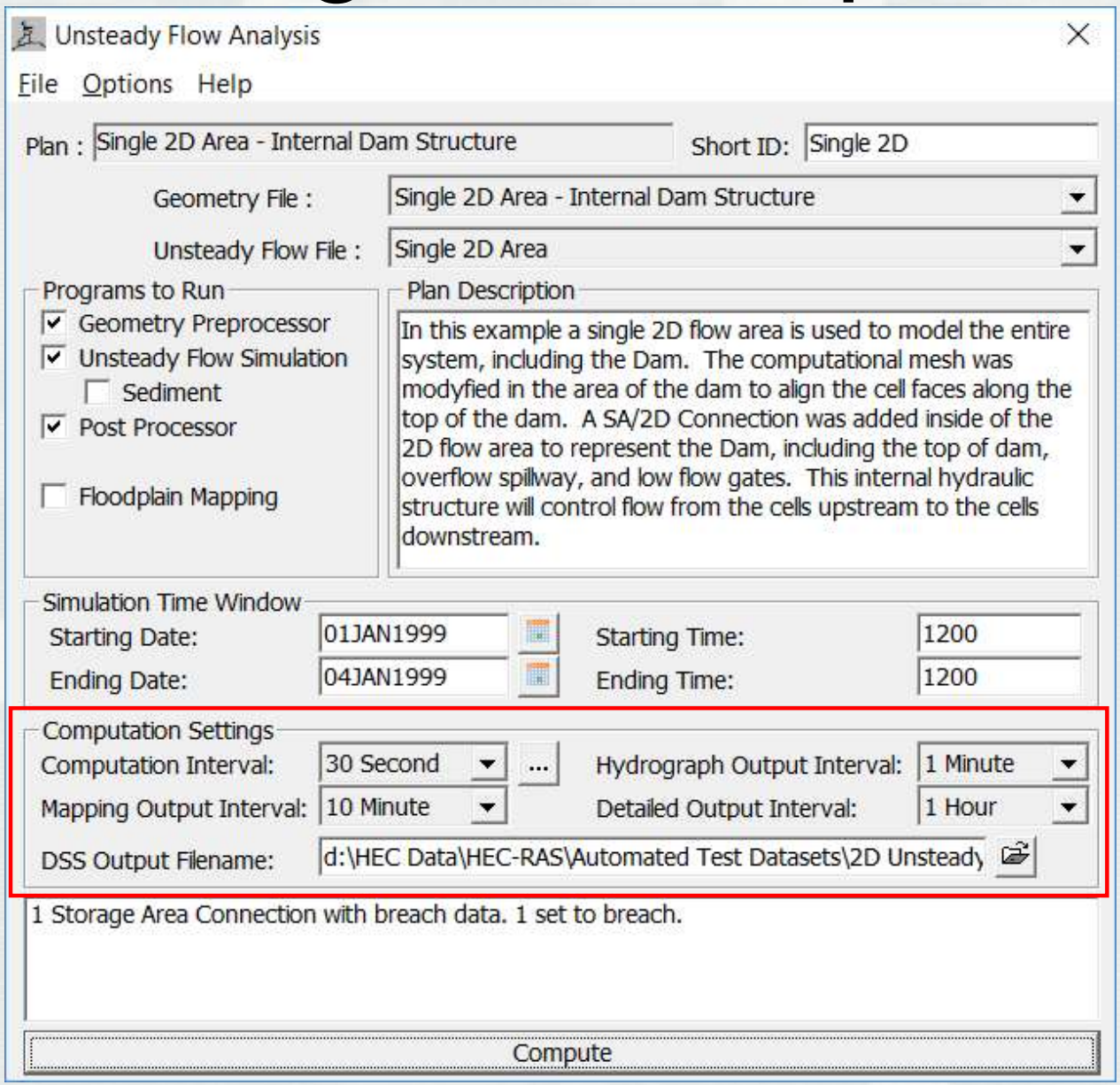
Performing the Computations

Important Computational Settings



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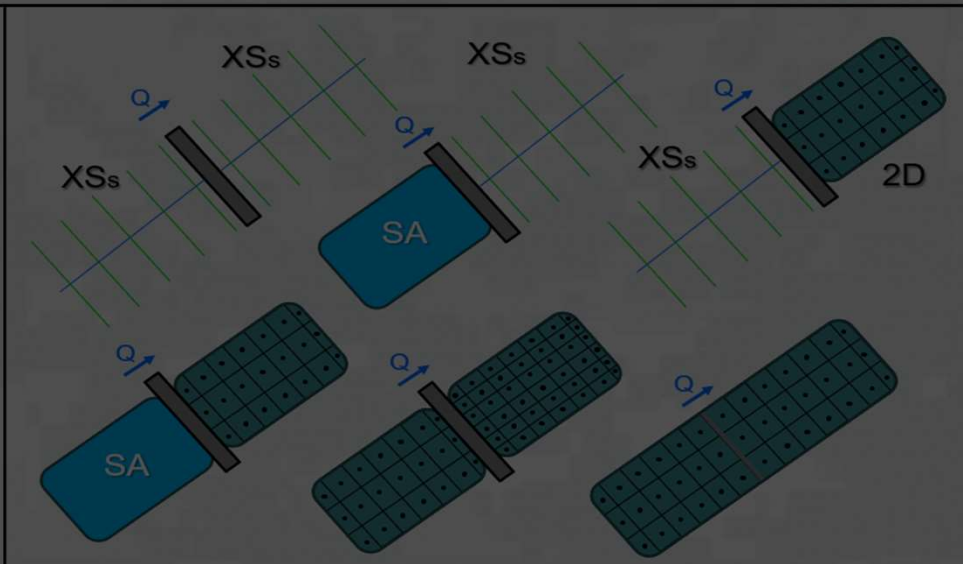

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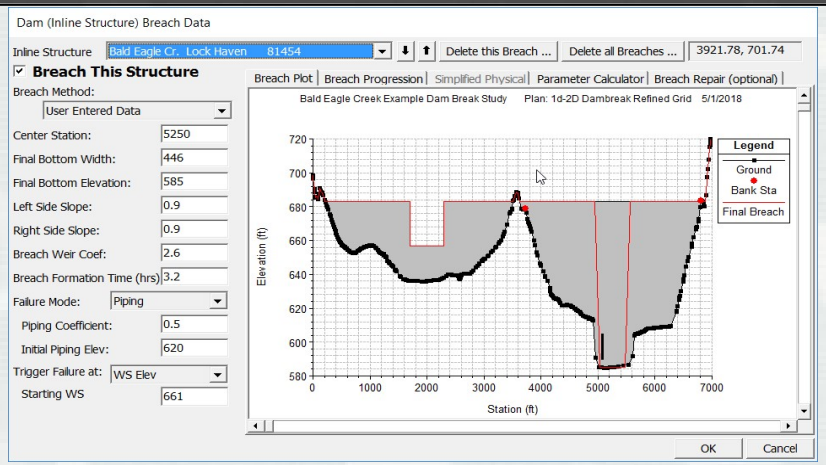

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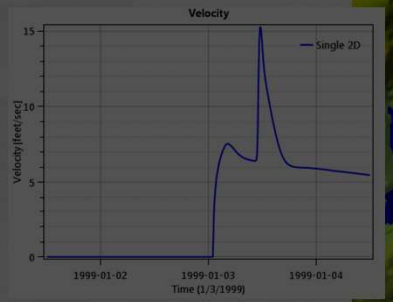

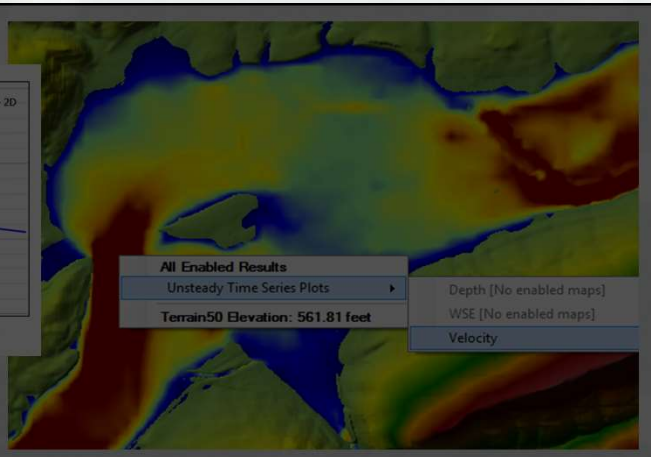

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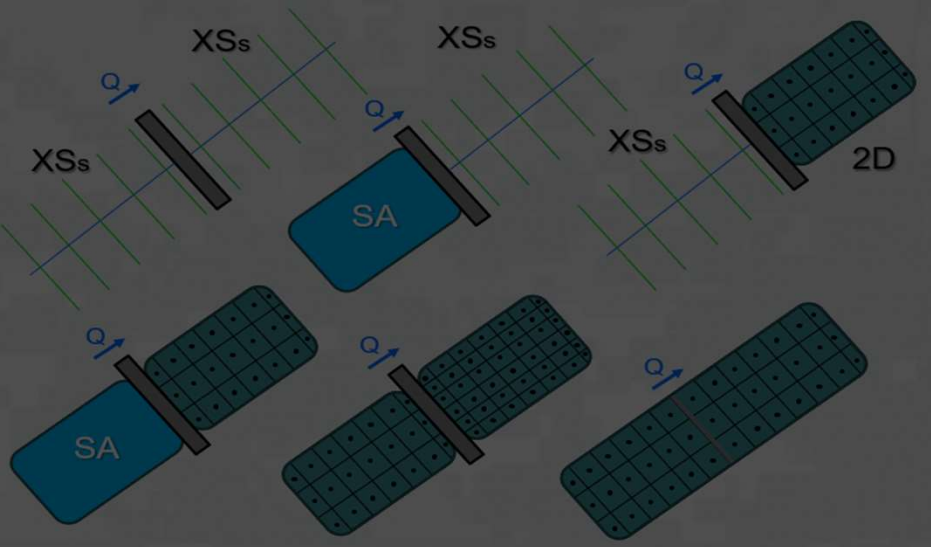

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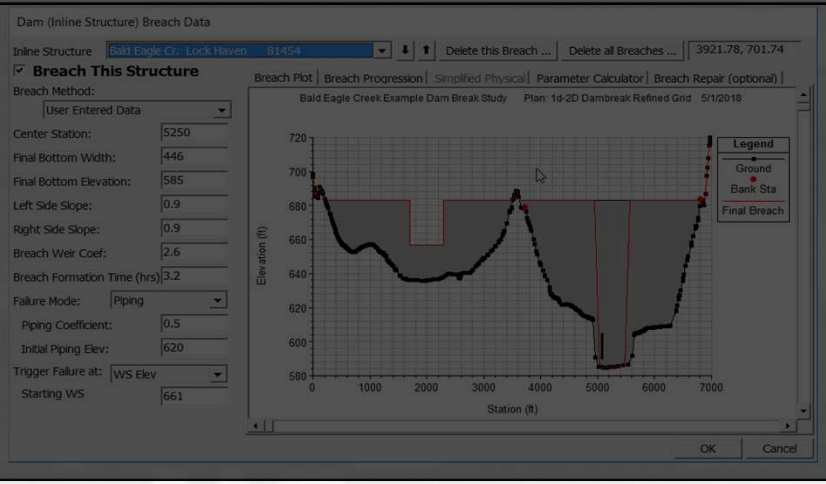

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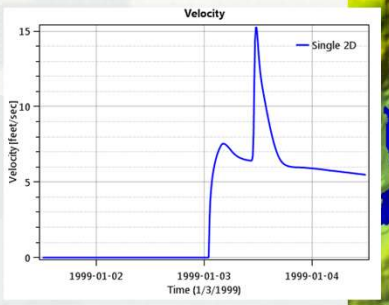
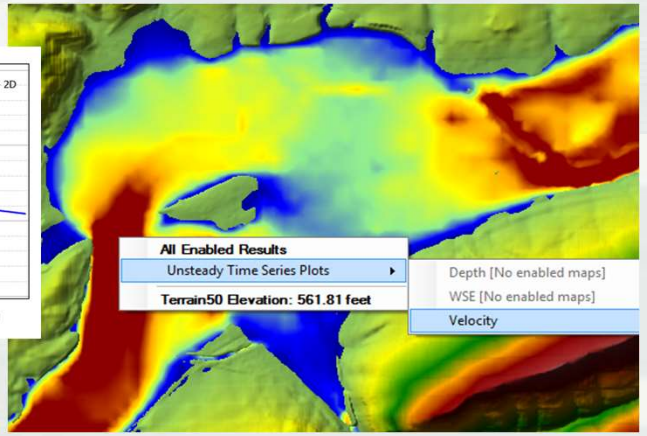
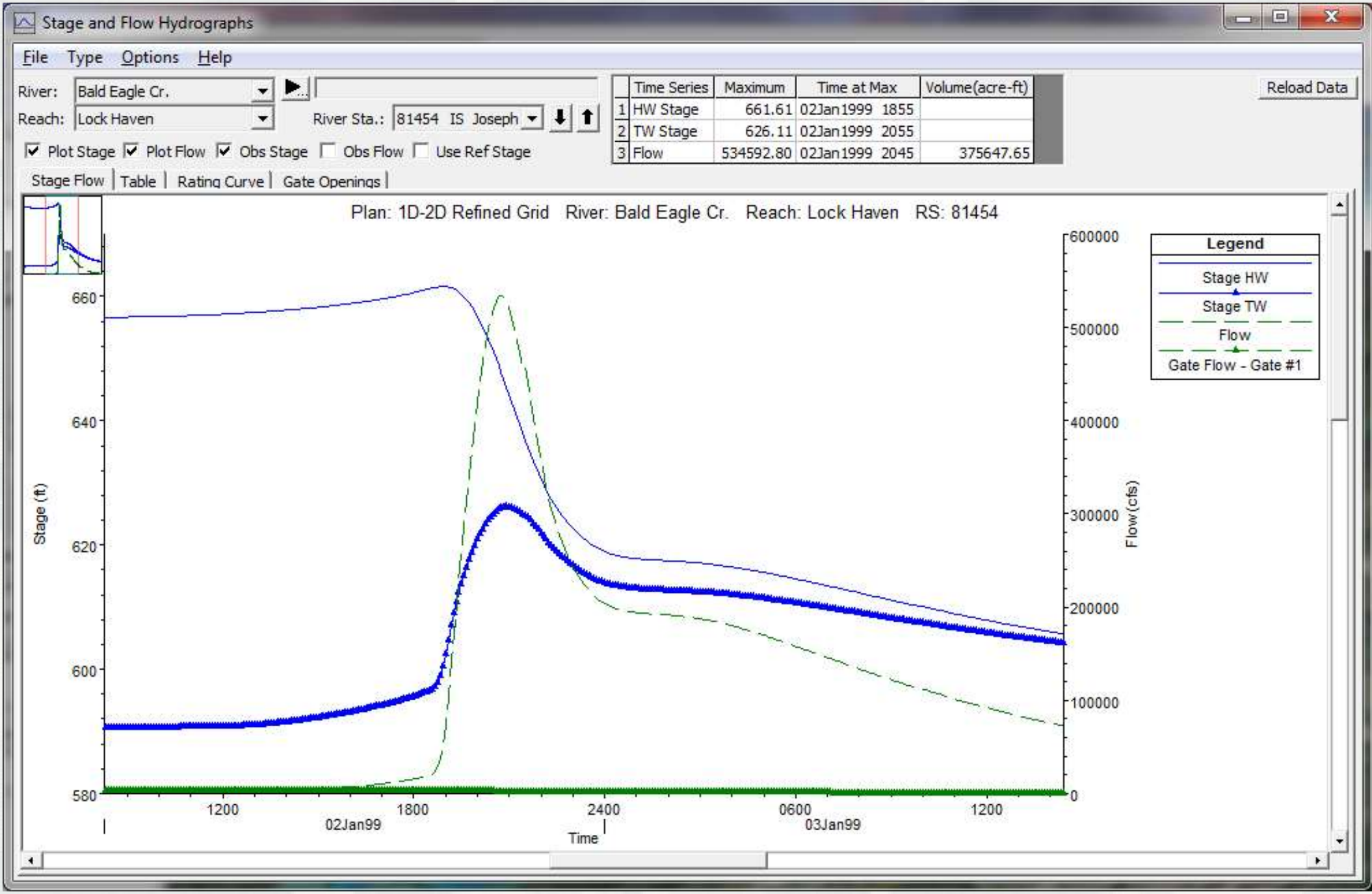




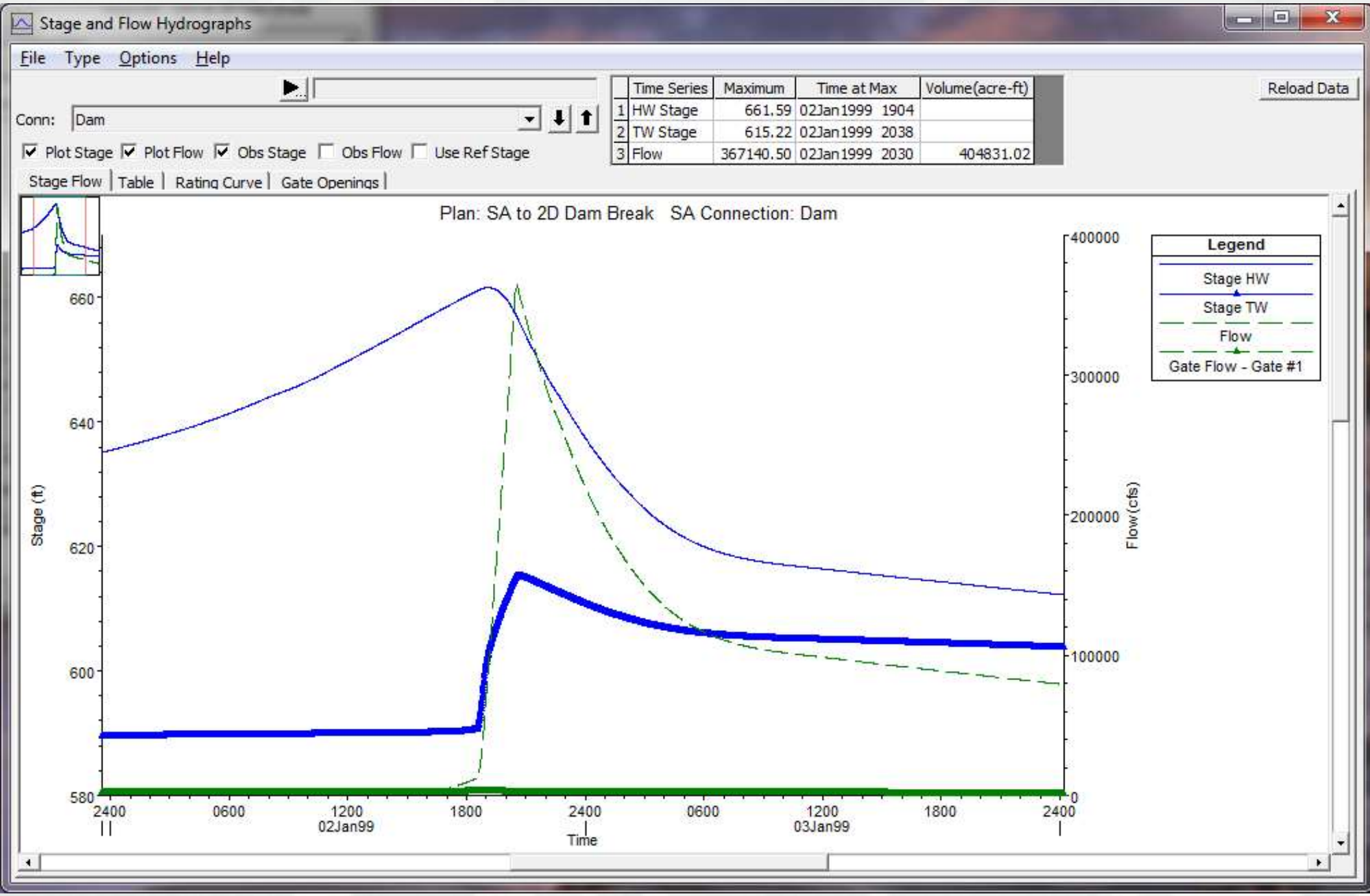
Breach Results and Visualization

- Hydrographs at Inline Structures, SA/2D Hydraulic Connections, and Storage Areas
- Profile Plots for 1D Reaches
- Flow Hydrographs at 2D Area Boundaries
- Inundation Maps/Animations in RAS-Mapper
- Stage Hydrograph Plots in RAS-Mapper
- Velocity Time Series in RAS-Mapper

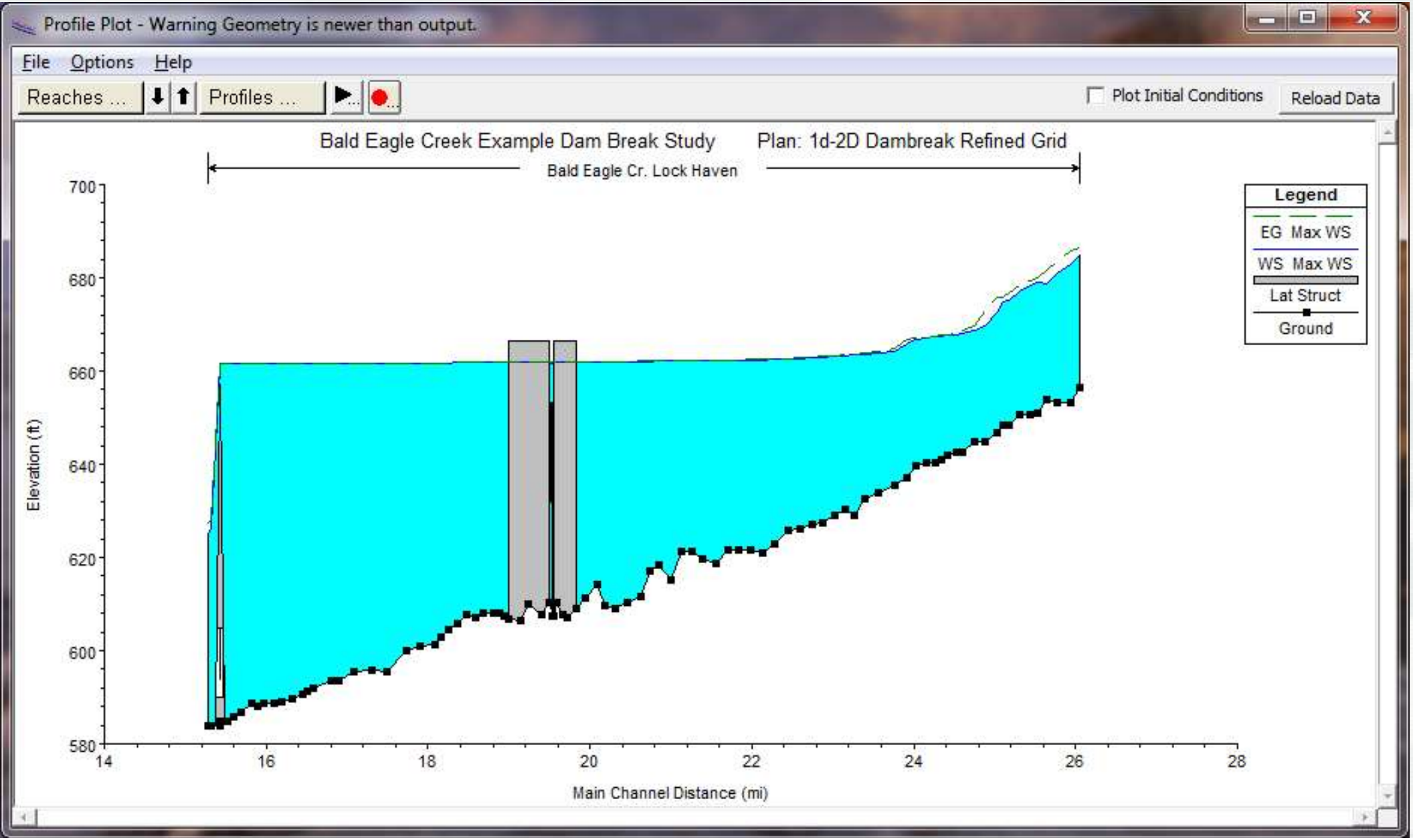
Inline Structure Hydrograph



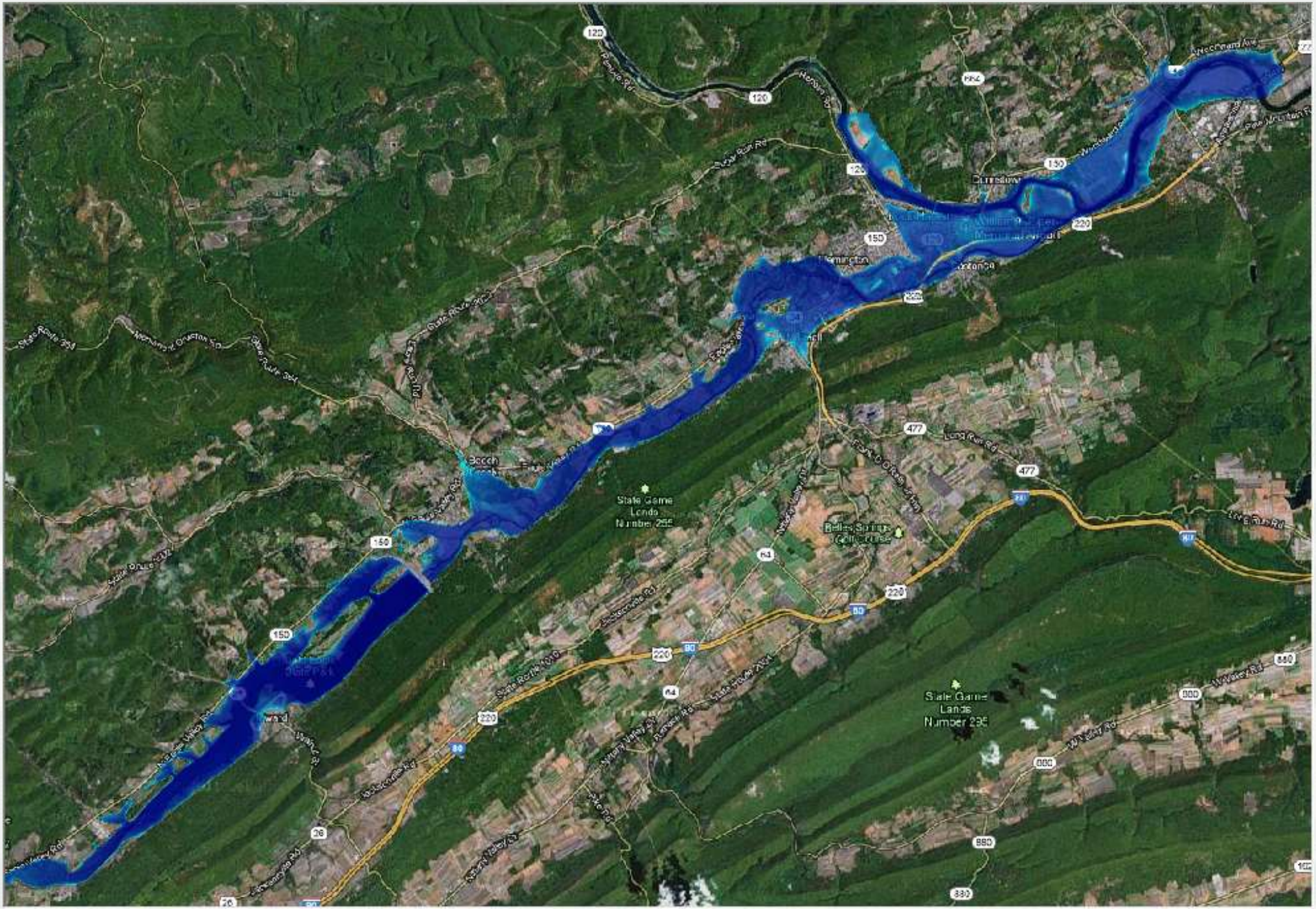
SA/2D Conn Hydrograph



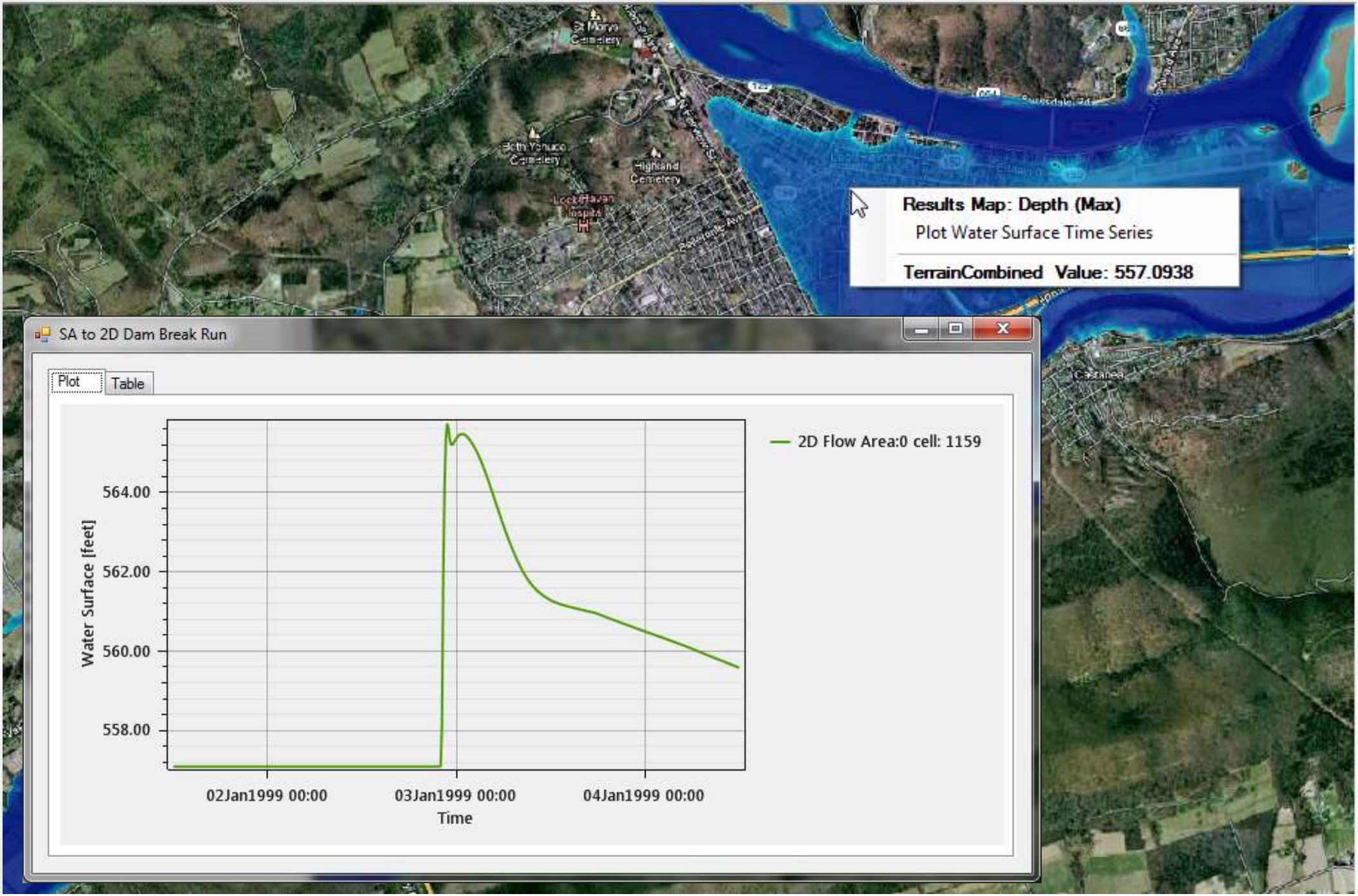
1D River Reach W.S Profile Plots



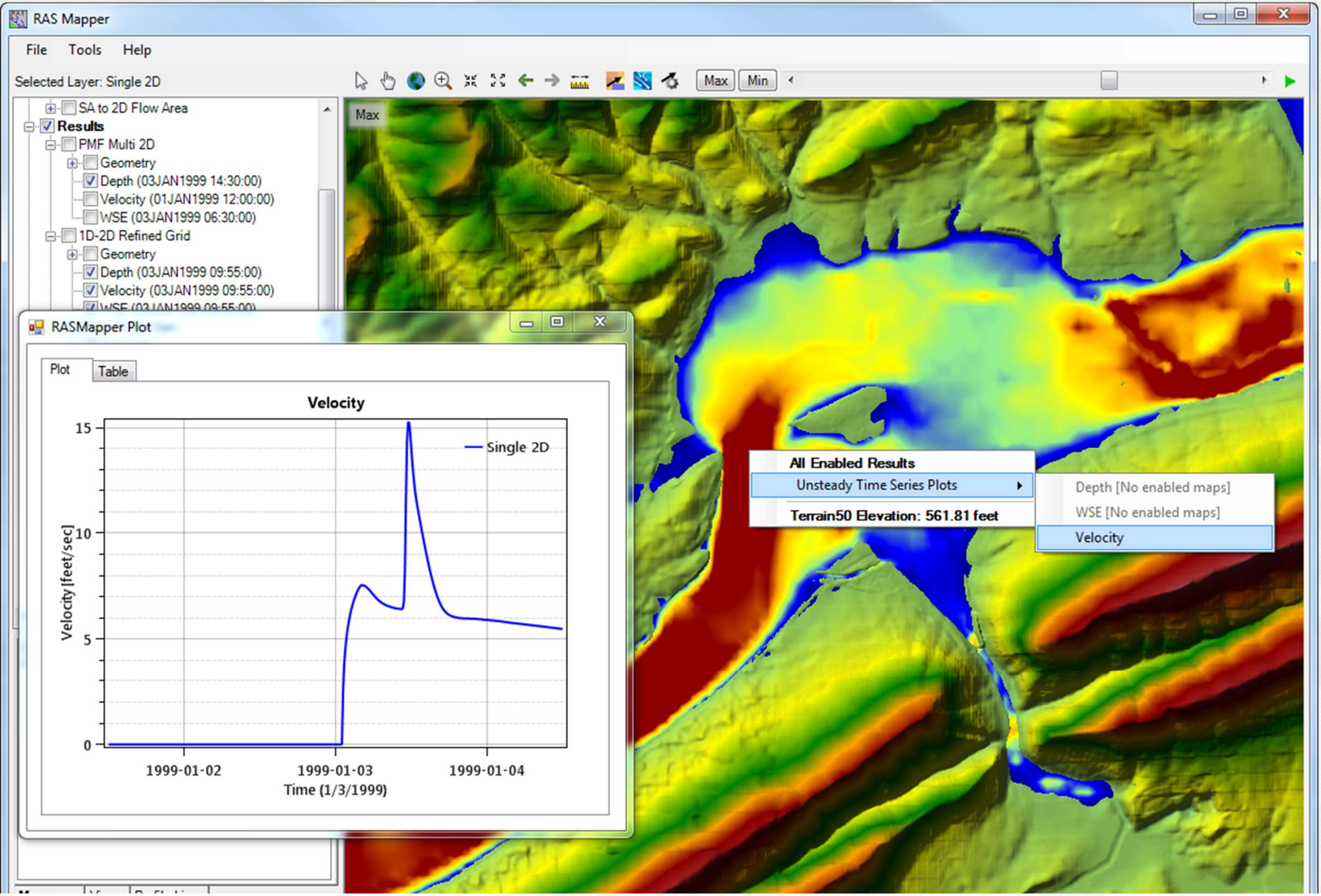
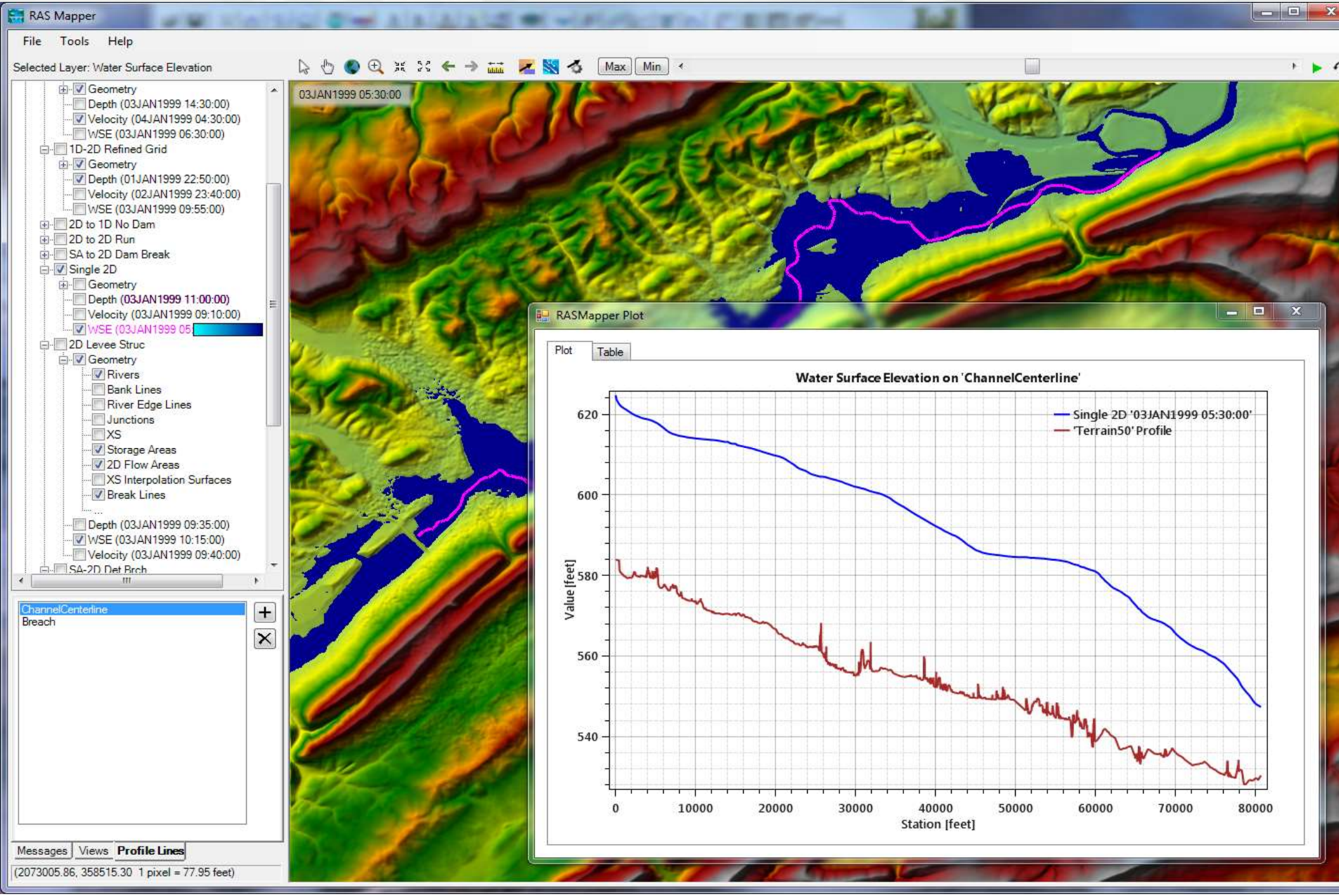
Inundation Maps



Stage Hydrographs – RAS-Mapper



Velocity Time Series – RAS-Mapper



Profile Lines – RAS-Mapper