SA/2D Connections

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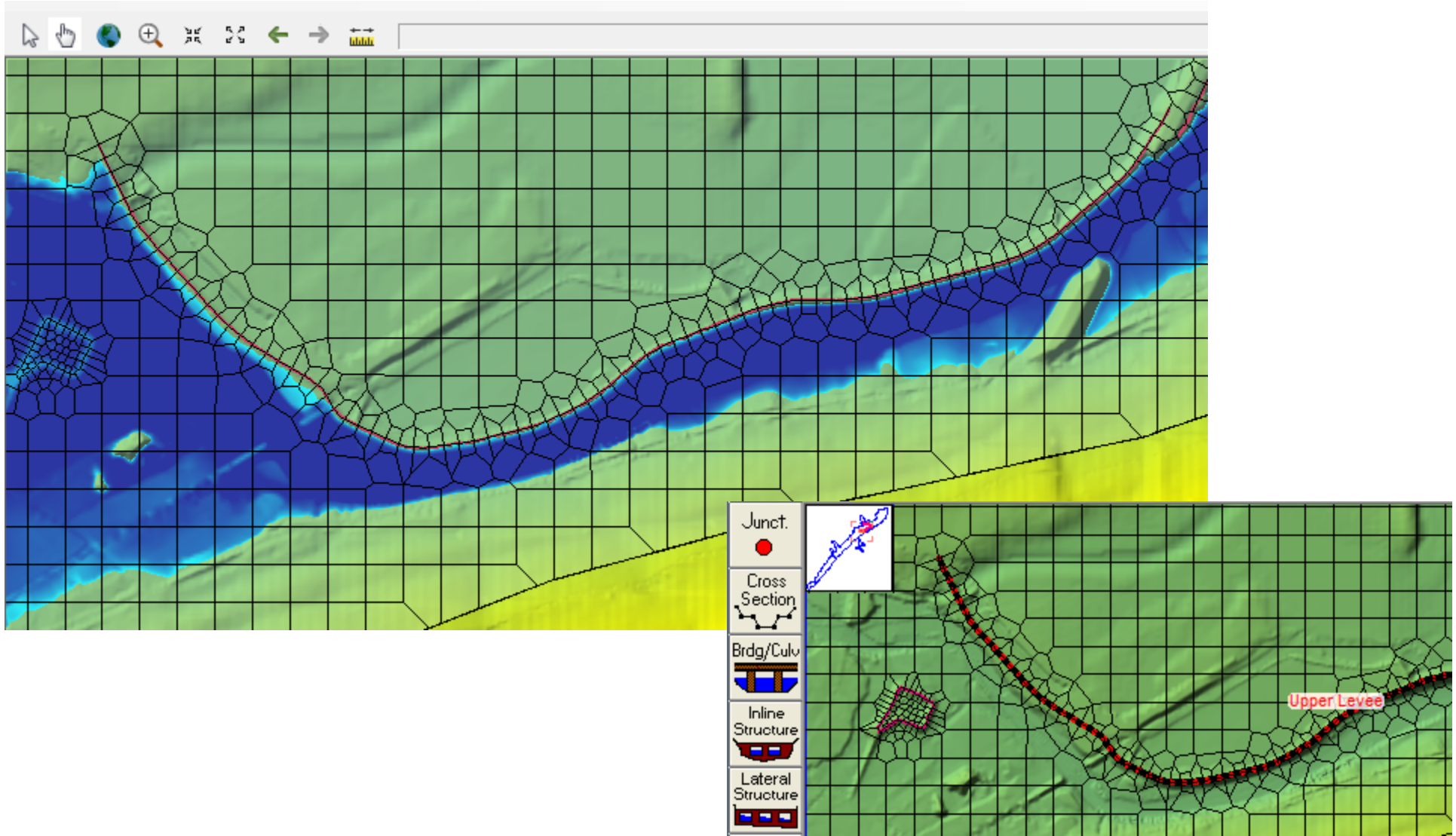
Internal SA/2D Area Conn

- Discuss using SA/2D Area Conn inside of 2D areas
  - **aka Hydraulic Structures (HS)**

Hydraulic Structure Example



Hydraulic Structures (HS)

- User entered station/elevation data overrides terrain data
- Can add breaches
- Can add culverts and gates
  - Culvert/Gates can be georeferenced
- Can model with weir equation or 2D equation
- HS centerline is also a breakline

Levees With HS

- When:
  - Bad Terrain data
  - Structure too high for 2D equations (i.e. water fall), Weir equation is a better solution
  - Need Culverts, Gates, or Breaching
- Create the HS and enter the Station/Elevation (SE) data
- The user entered SE data controls the flow over the structure

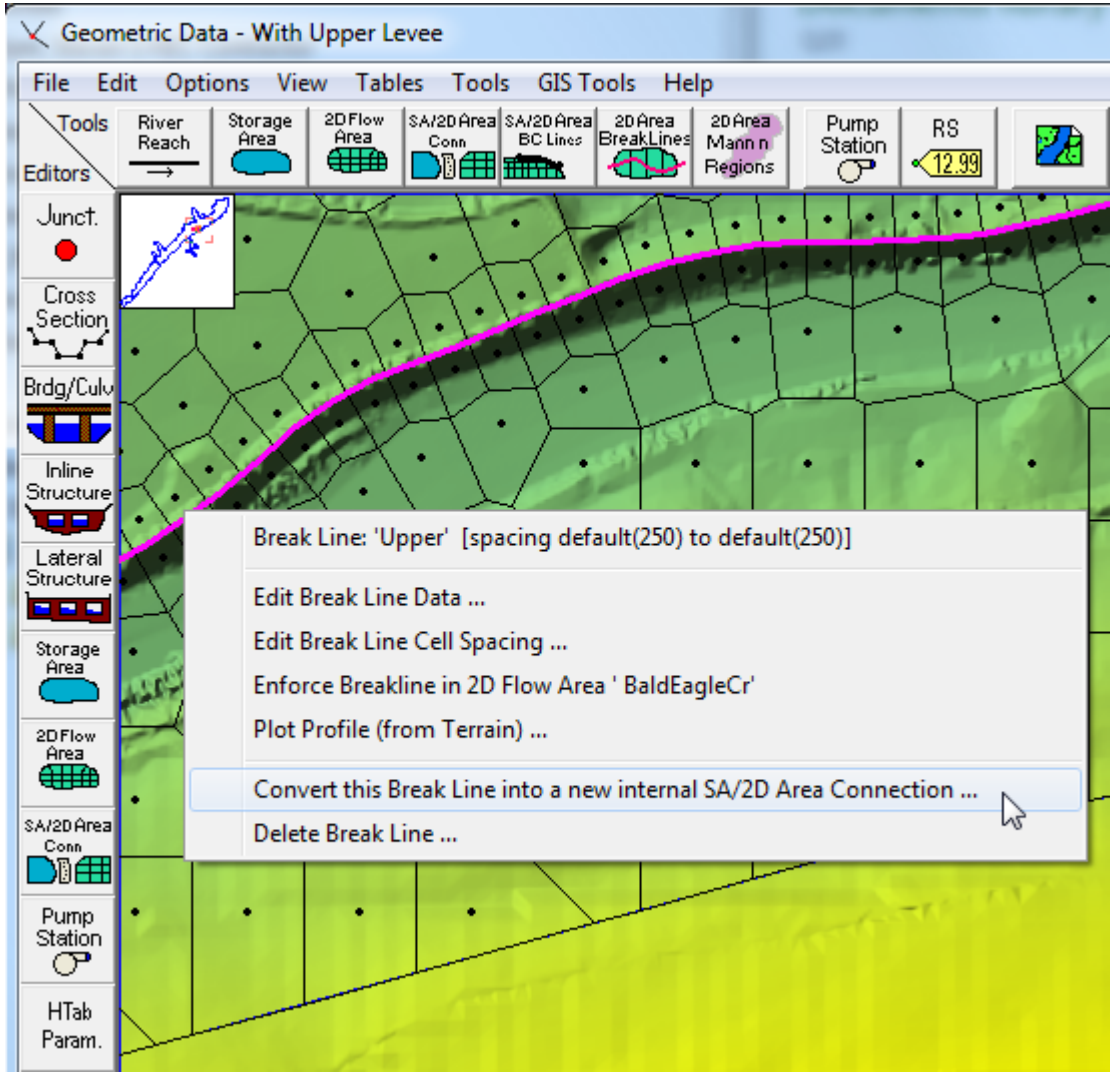
“Levees” Without HS

- Breaklines may be all that is needed!
- IF
  - The terrain data is good enough
  - The Faces line up accurately
  - Normal 2D Equation is appropriate
  - No culverts, gates, breaches, etc.
- THEN
  - No HS required!

Overview Data Entry

- Create HS Centerline
  - Convert existing breakline (if breakline already exists)
  - Download centerline (if available)
  - Or draw by hand
- HS goes left to right looking downstream (for positive flow convention)
- Edit Centerline/Breakline and Cell Mesh, as needed (the centerline is also a breakline)
- Enter station/elevation of weir
- Enter culverts, gates, breach, etc.
- Select 2D Domain or Weir Eq.

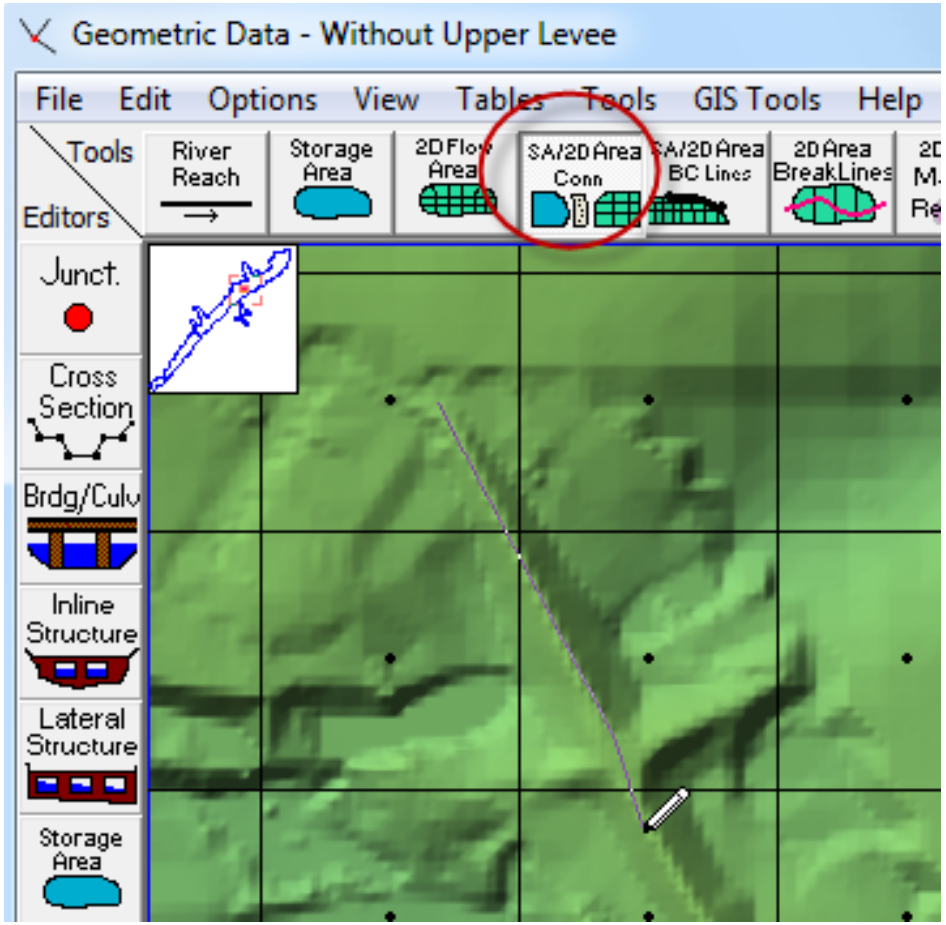
Converting a Breakline



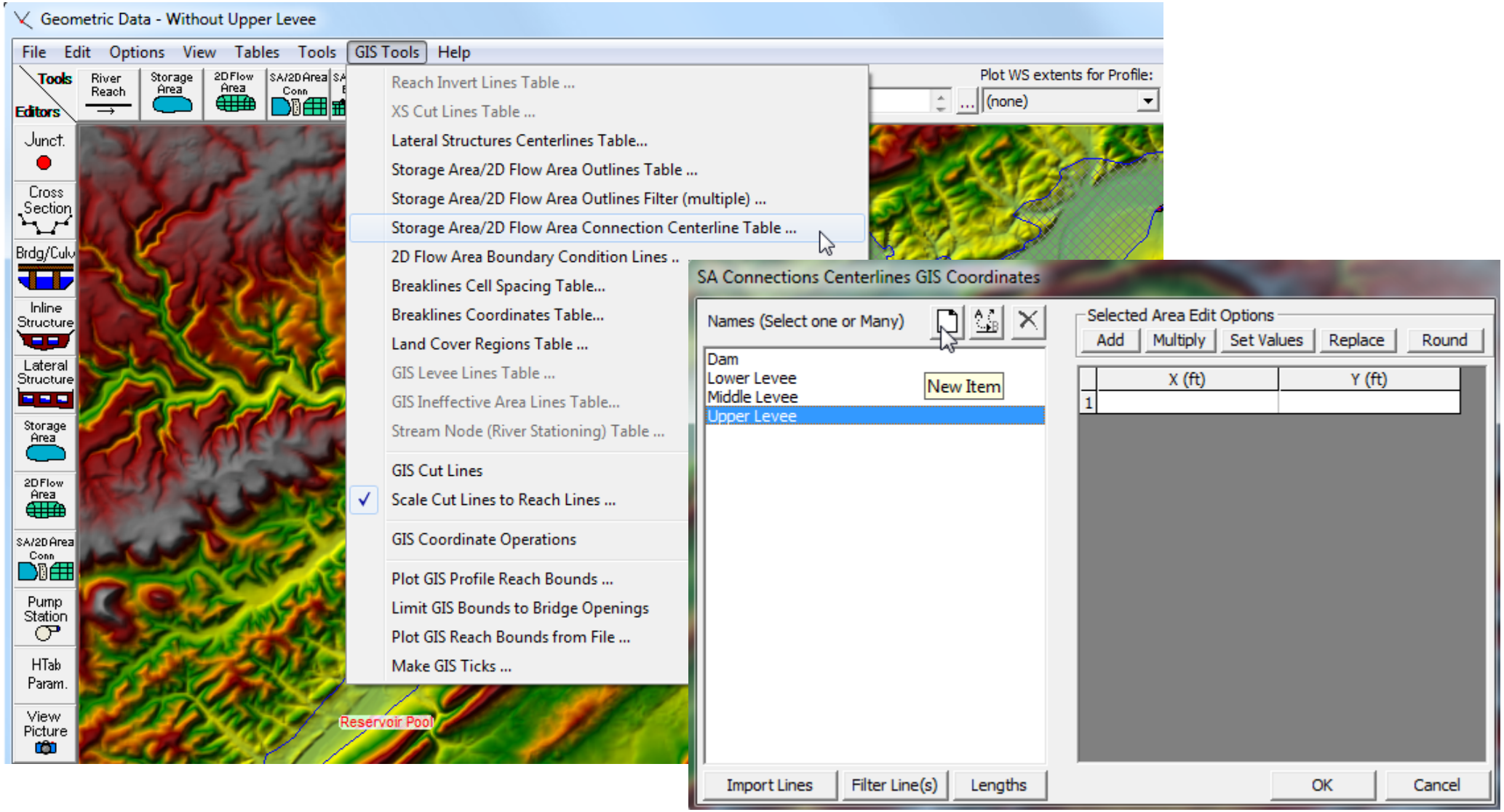
- If a Breakline has already been created, then it can be converted to a hydraulic structure.
- Left-click on the Breakline and select **Convert…**

Drawing HS Centerline

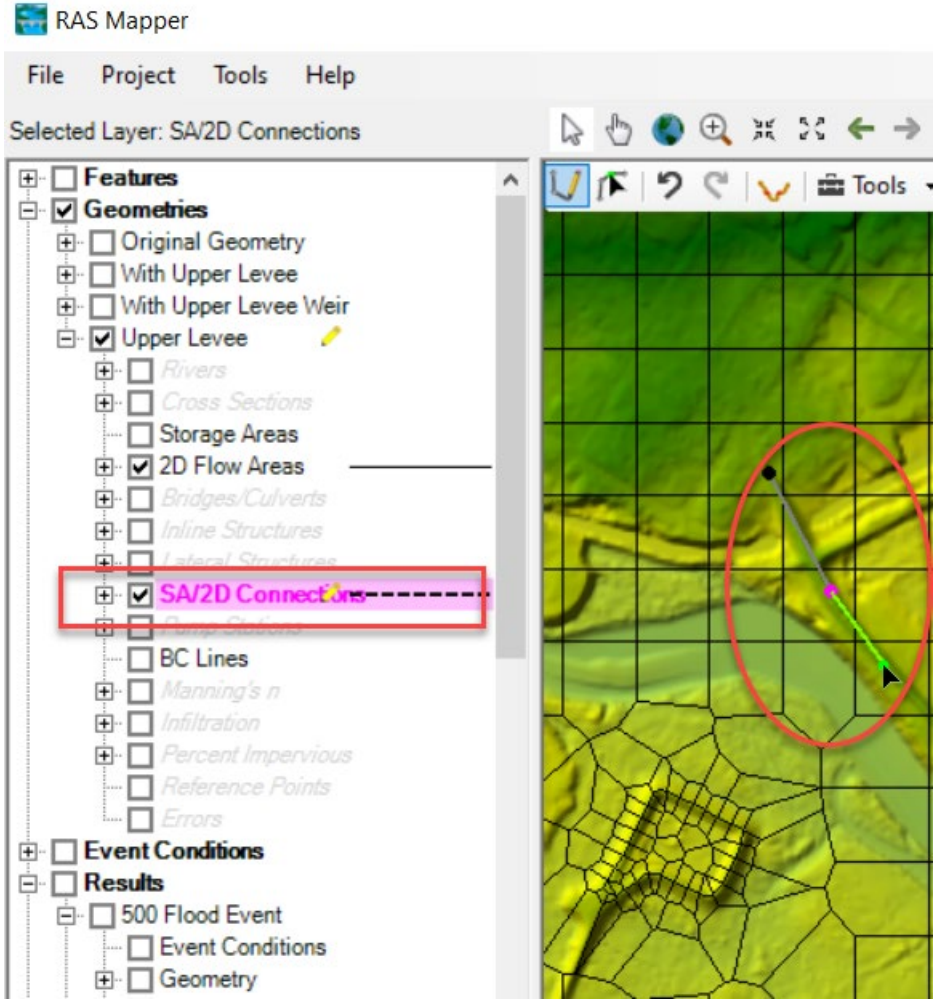
- Click **SA/2D Conn** and draw the location of the HS
- Double-click to finish drawing and name the HS
- Copy coordinates from Excel



HS Centerline Table

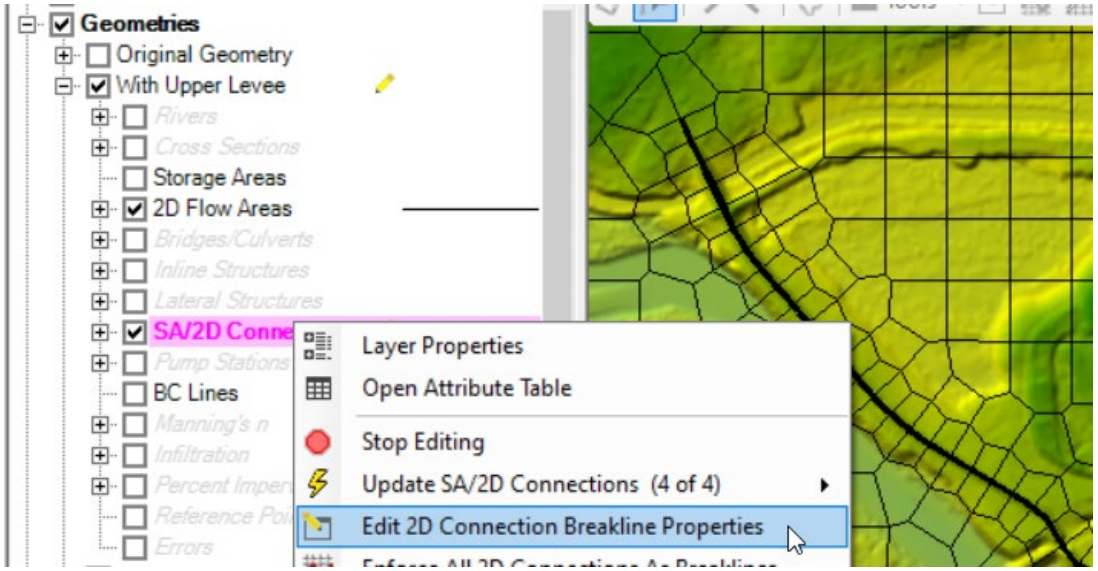


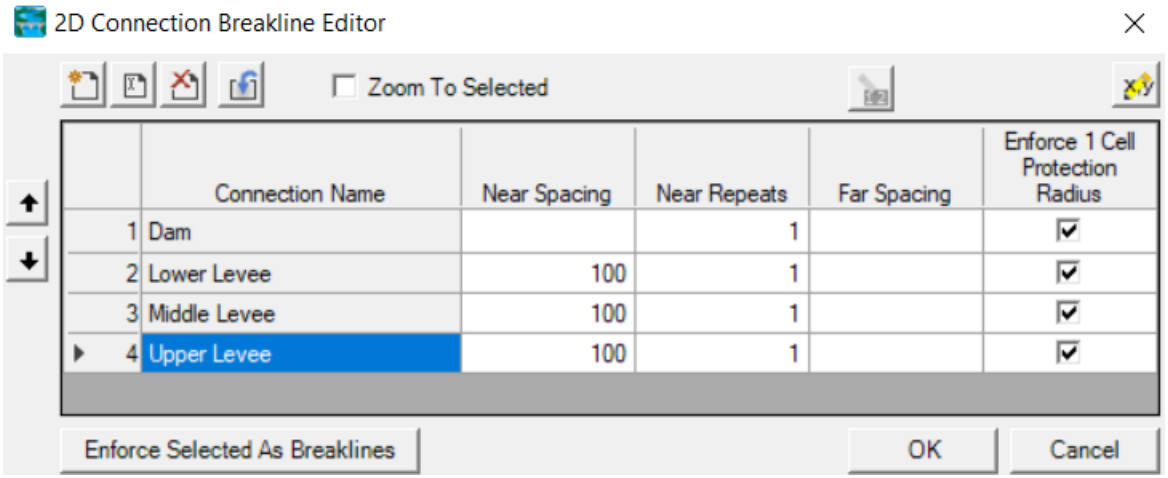
HS Centerline w/ Editing Tools



- CL can also be added from RASMapper
- Click **SA/2D Conn** and draw the location of the HS
- Double-click to finish drawing and name the HS
- Or CL can be imported as shapefile
- Weir SE data still on 2D Conn Editor/Geom Editor

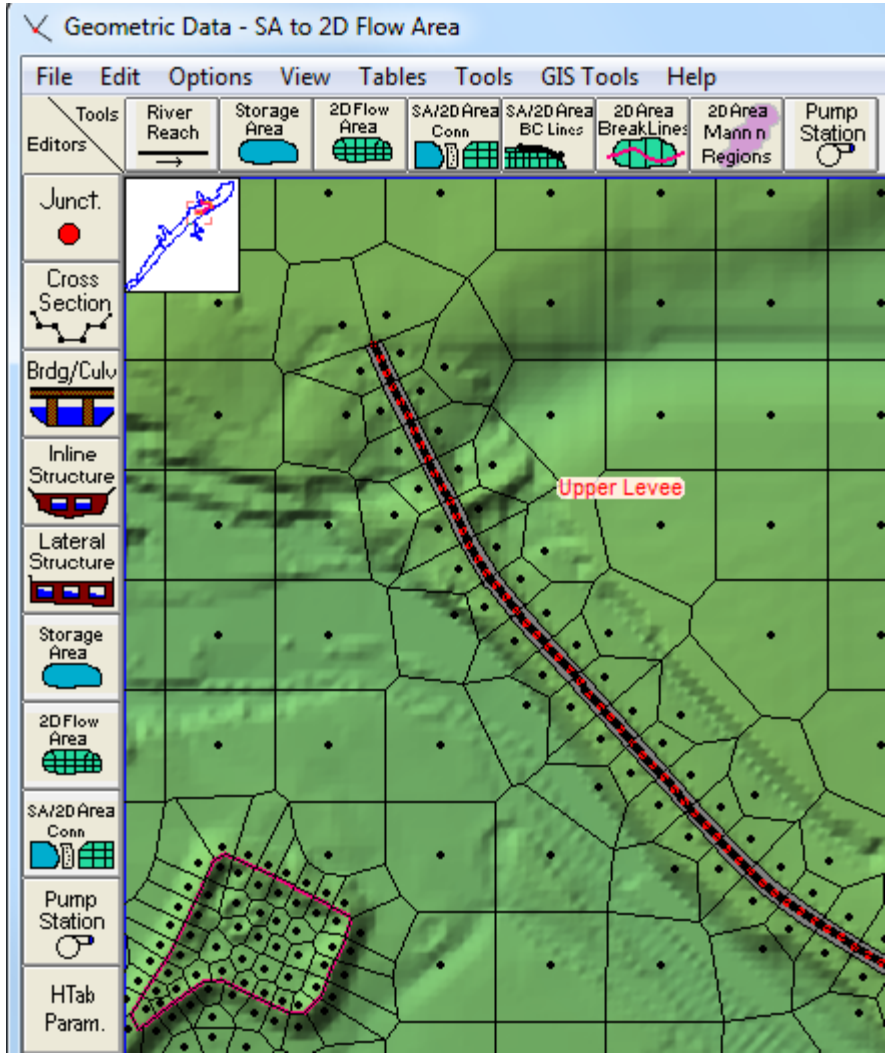
HS Cell Spacing



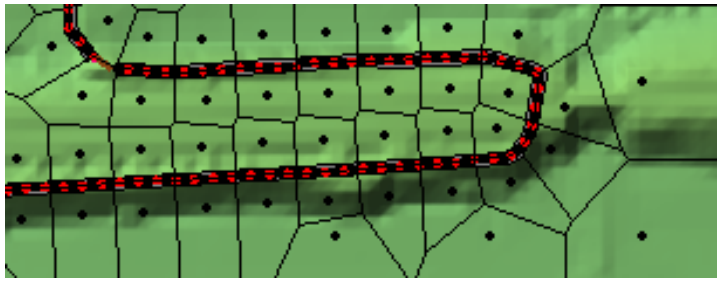


- HS/Breakline can be enforced while still in Edit mode
- Additional Cells can be added along the HS centerline
- Cell spacing should not be made too small!

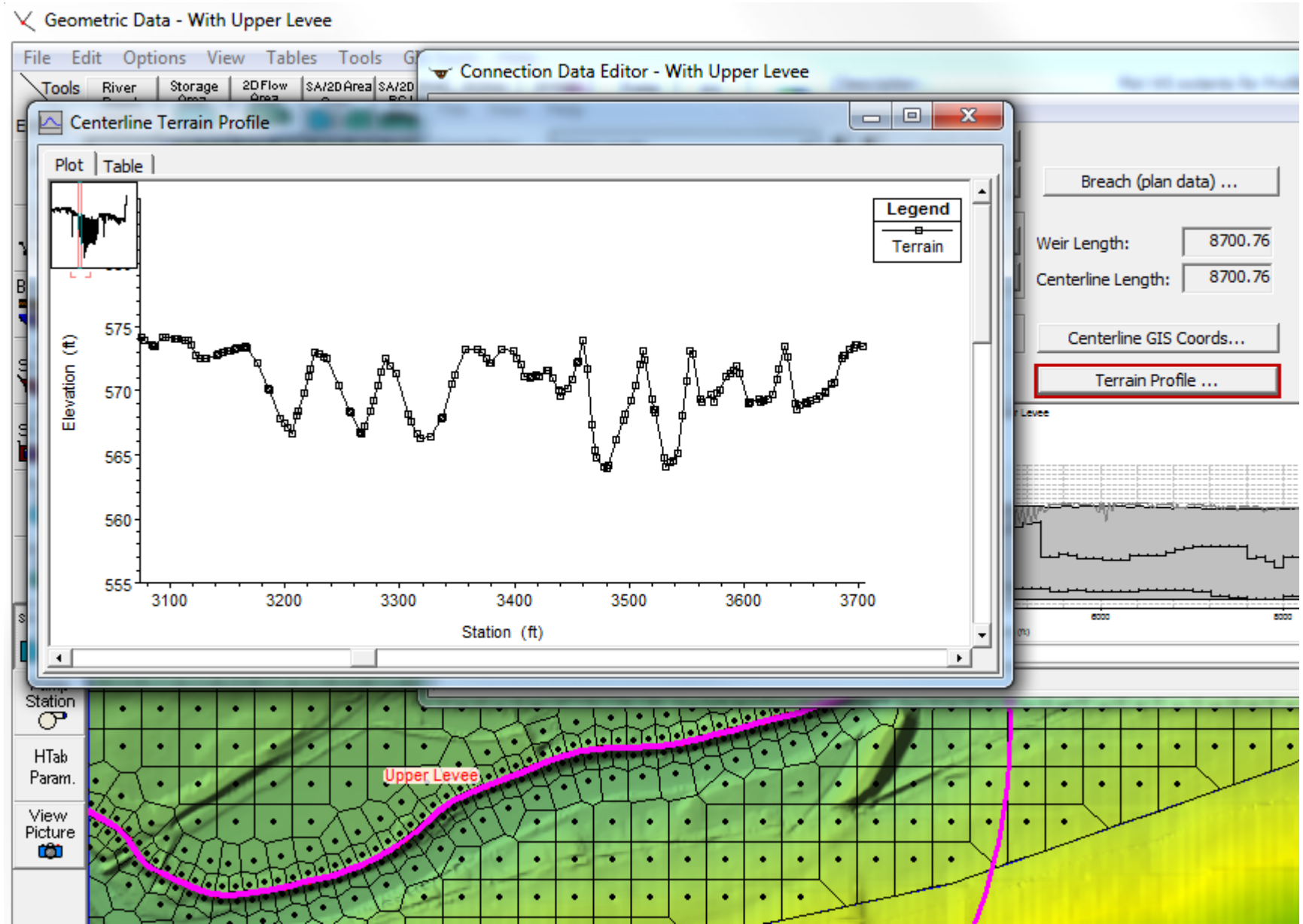
Inspect Cells Around HS

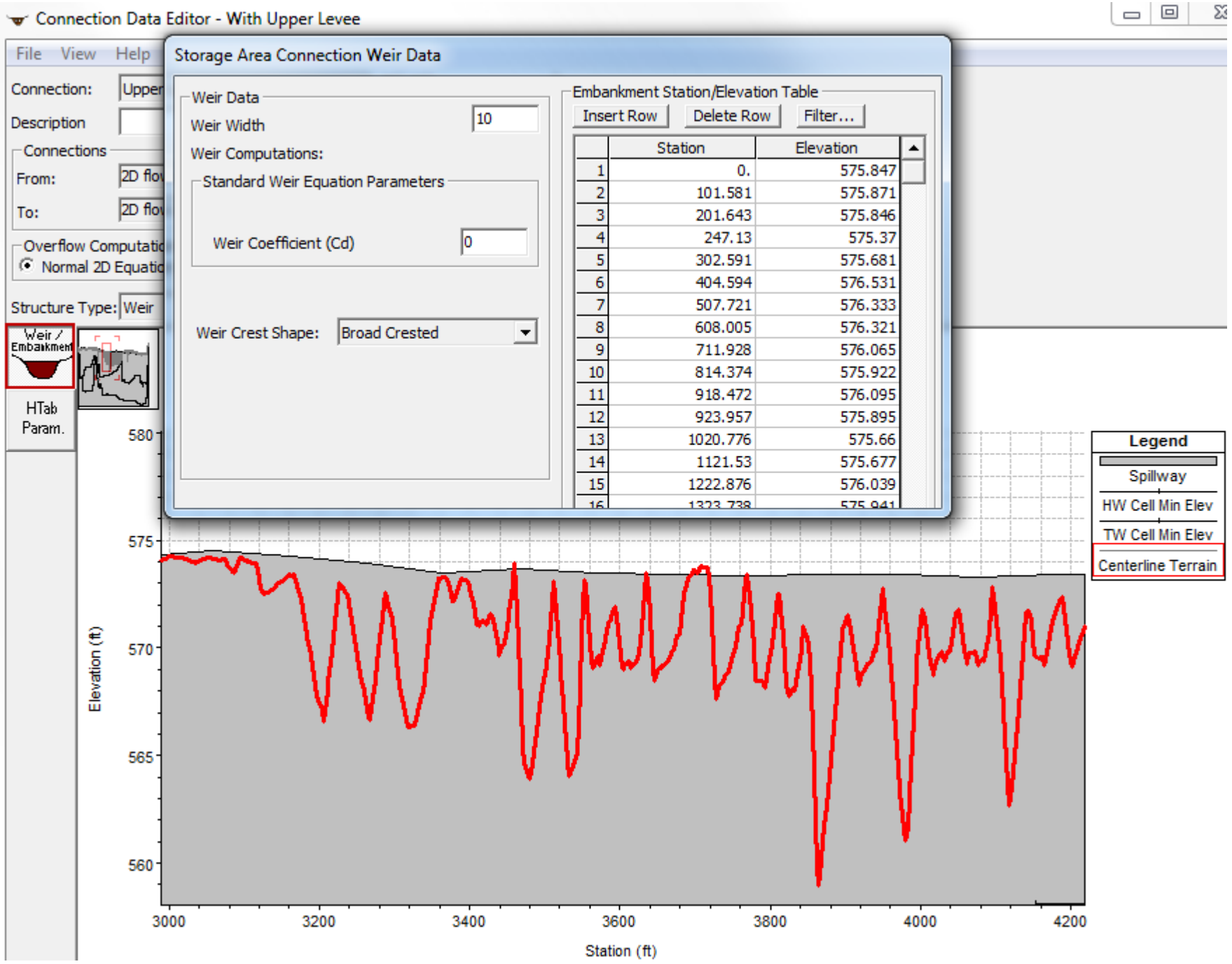


- RAS will show the HS as a black line w/ red dots
- Inspect the line for problems
  - Start/End of HS!
  - Tight Curves

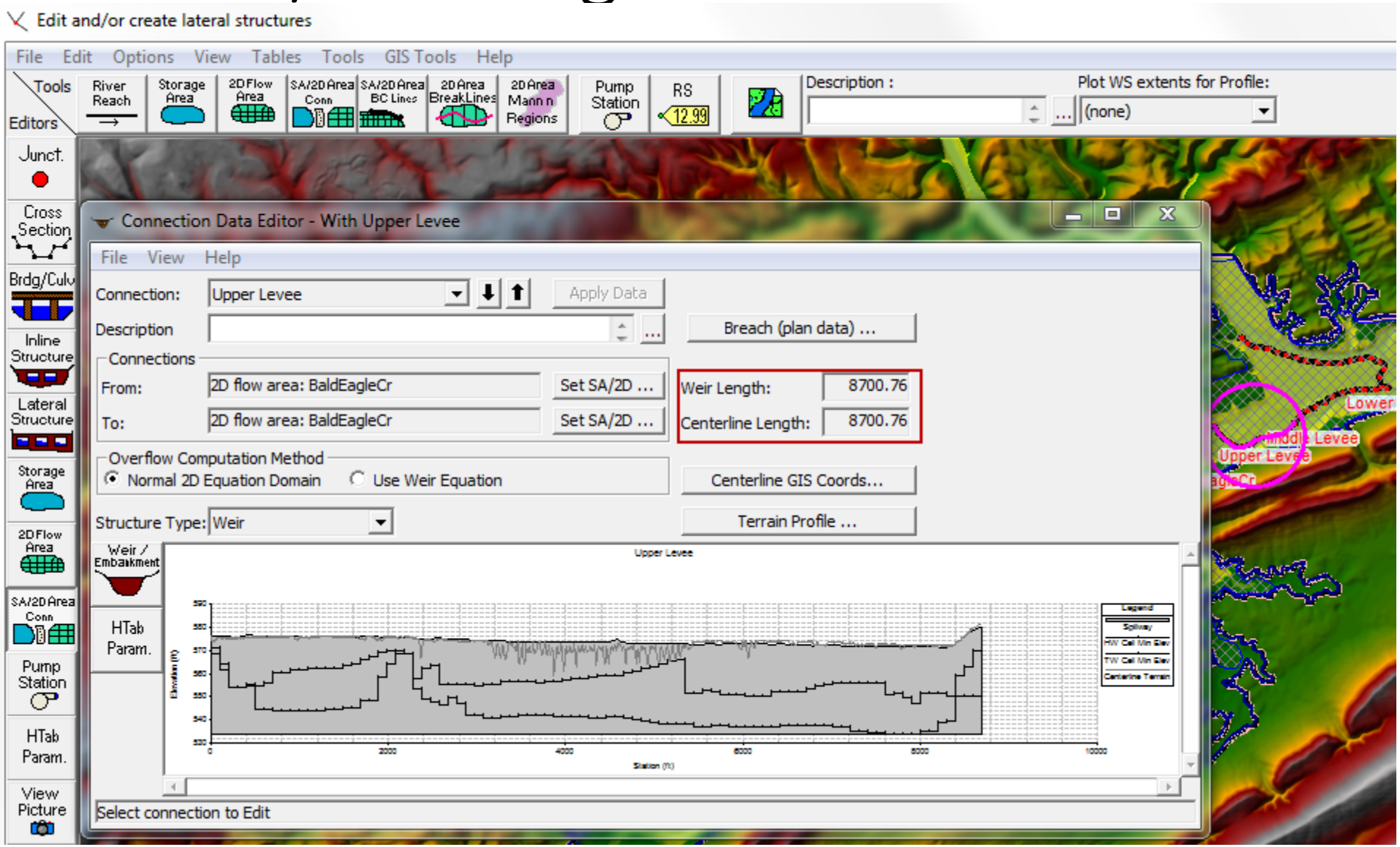


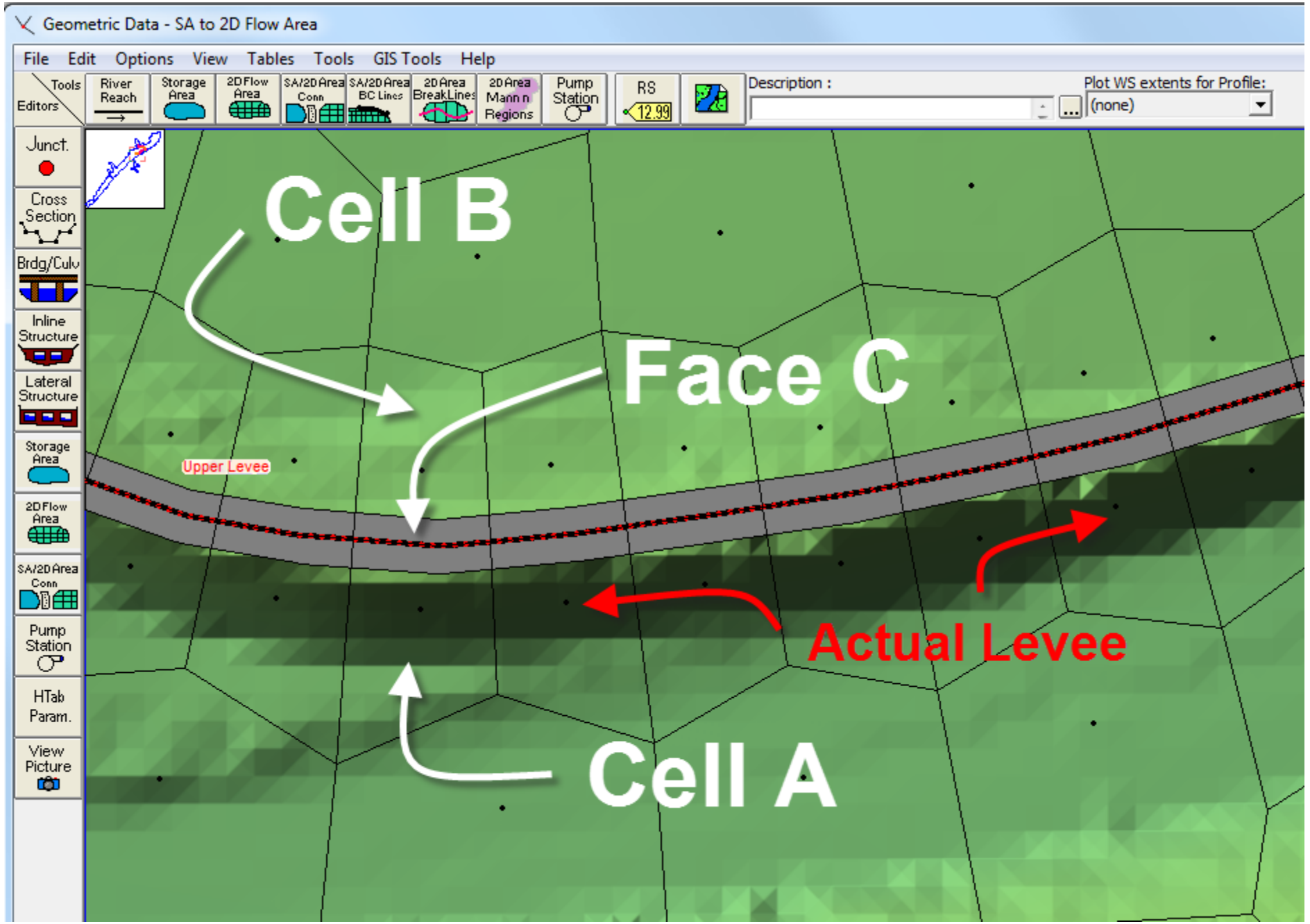
Terrain CL Profile Missing Levee

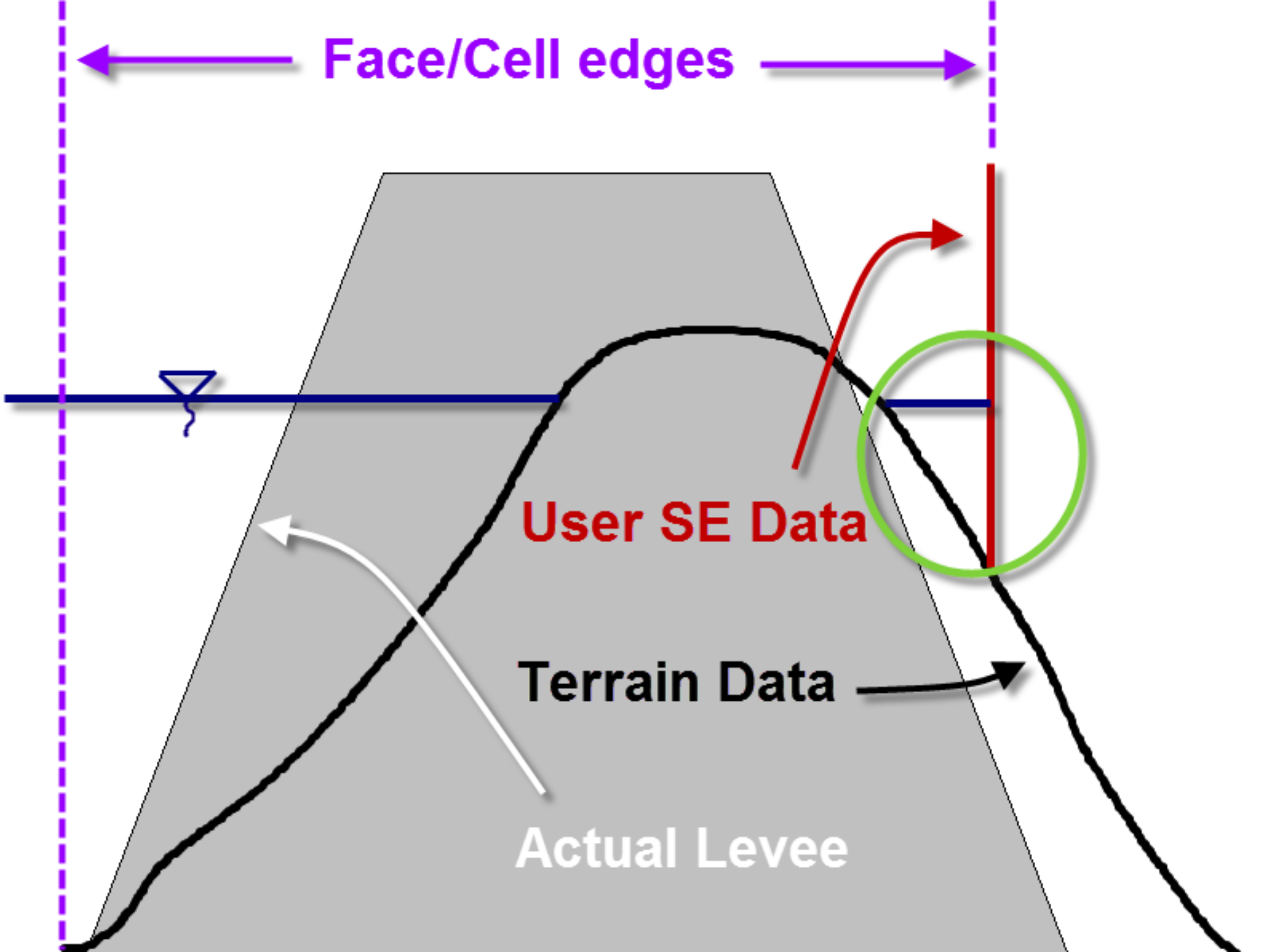



Connection Data Editor - With Upper Levee
File View Help
Connection:
Description
Connections
From:
To:
Overflow Computatio
Normal 2D Equatio
Structure Type: Weir
Weir / Embankment
HTab Param.
Storage Area Connection Weir Data
Weir Data
Weir Width 10
Weir Computations:
Standard Weir Equation Parameters
Weir Coefficient (Cd) 0
Weir Crest Shape: Broad Crested
Embankment Station/Elevation Table
Insert Row
Delete Row
Filter...
Station Elevation
1 0. 575.847
2 101.581 575.871
3 201.643 575.846
4 247.13 575.37
5 302.591 575.681
6 404.594 576.531
7 507.721 576.333
8 608.005 576.321
9 711.928 576.065
10 814.374 575.922
11 918.472 576.095
12 923.957 575.895
13 1020.776 575.66
14 1121.53 575.677
15 1222.876 576.039
Legend
Spillway
HW Cell Min Elev
TW Cell Min Elev
Centerline Terrain
Elevation (ft)
580
575
570
565
560
3000
3200
3400
3600
3800
4000
4200
Station (ft)

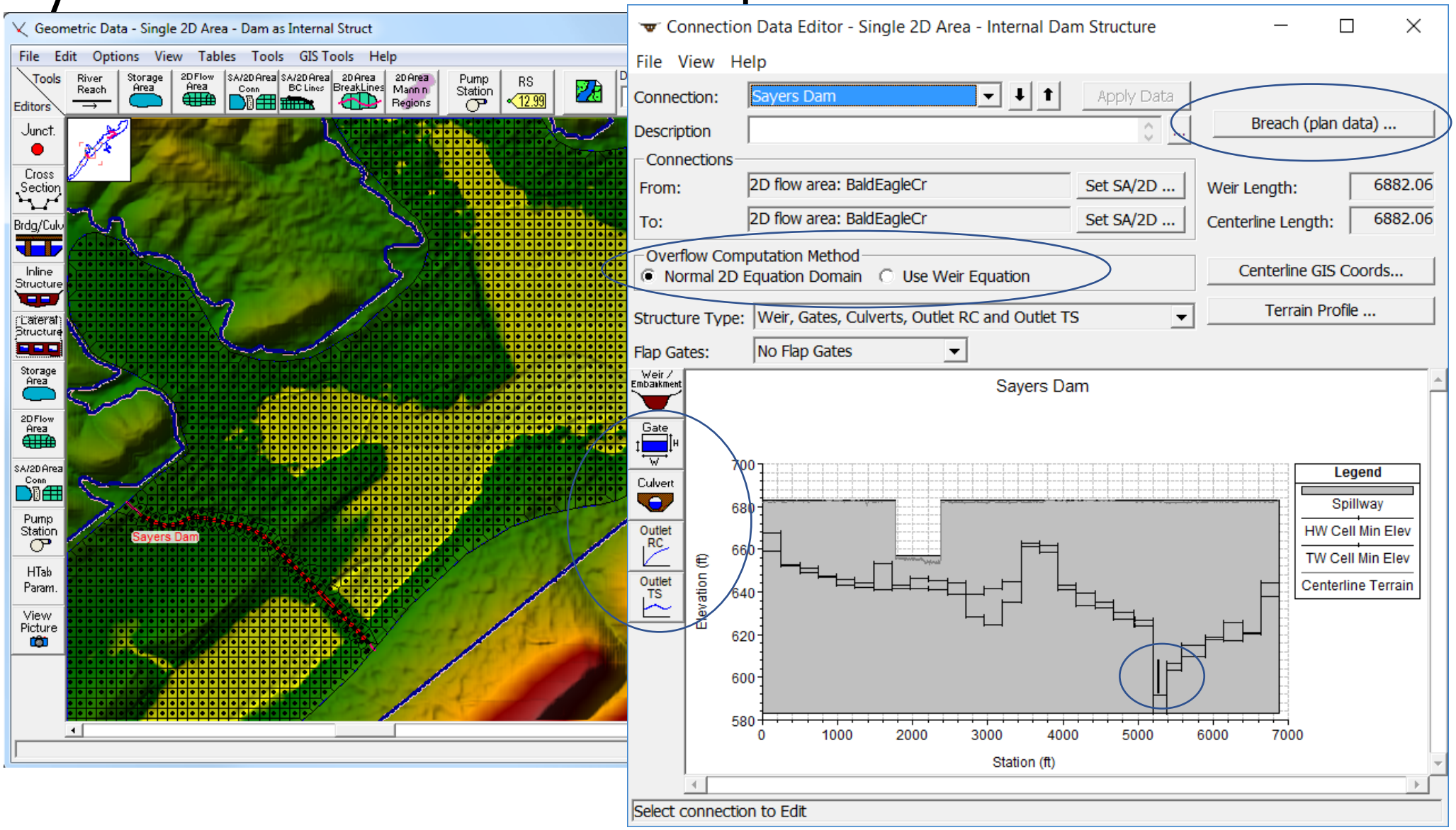
Check Weir/GIS Length



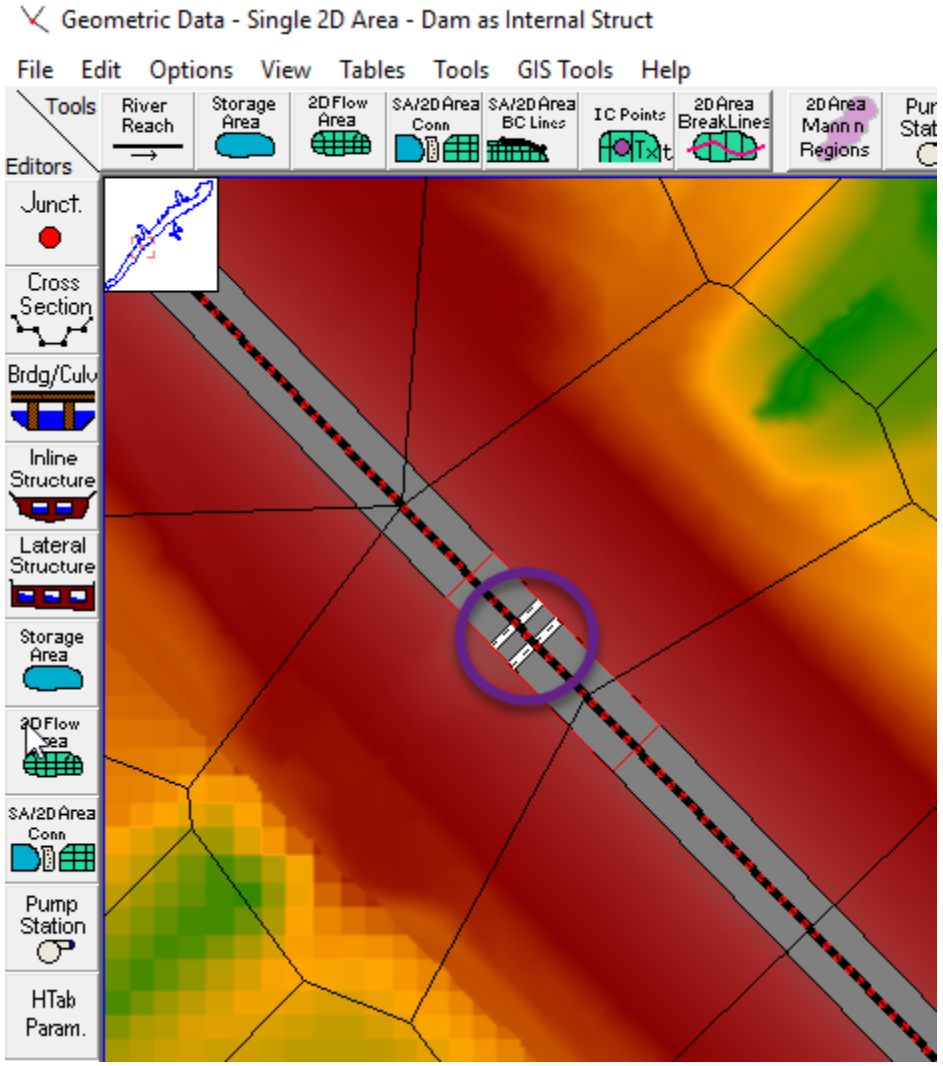

Geometric Data - SA to 2D Flow Area
File Edit Options View Tables Tools GIS Tools Help
Tools Editors
River Reach
Storage Area
2D Flow Area
SA/2D Area Conn
SA/2D Area BC Lines
2D Area BreakLines
2D Area Mann n Regions
Pump Station
RS
12.99
Description :
Plot WS extents for Profile:
(none)
Junct.
Cross Section
Brdg/Culv
Inline Structure
Lateral Structure
Storage Area
2D Flow Area
SA/2D Area Conn
Pump Station
HTab Param.
View Picture
Cell B
Face C
Upper Levee
Actual Levee
Cell A


Face/Cell edges
User SE Data
Terrain Data
Actual Levee

Hydraulic Structures Options

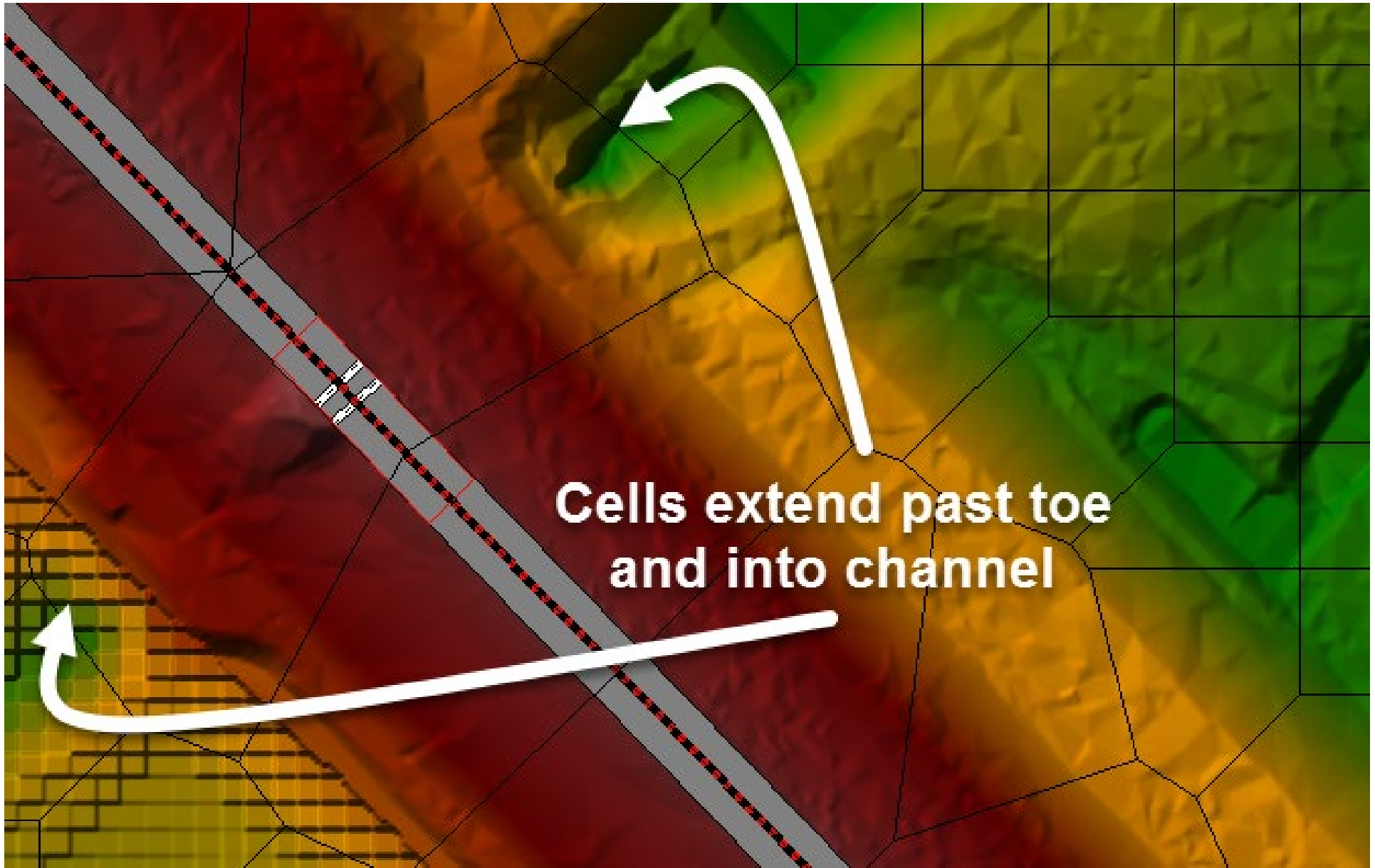


Culverts & Gates inside a HS

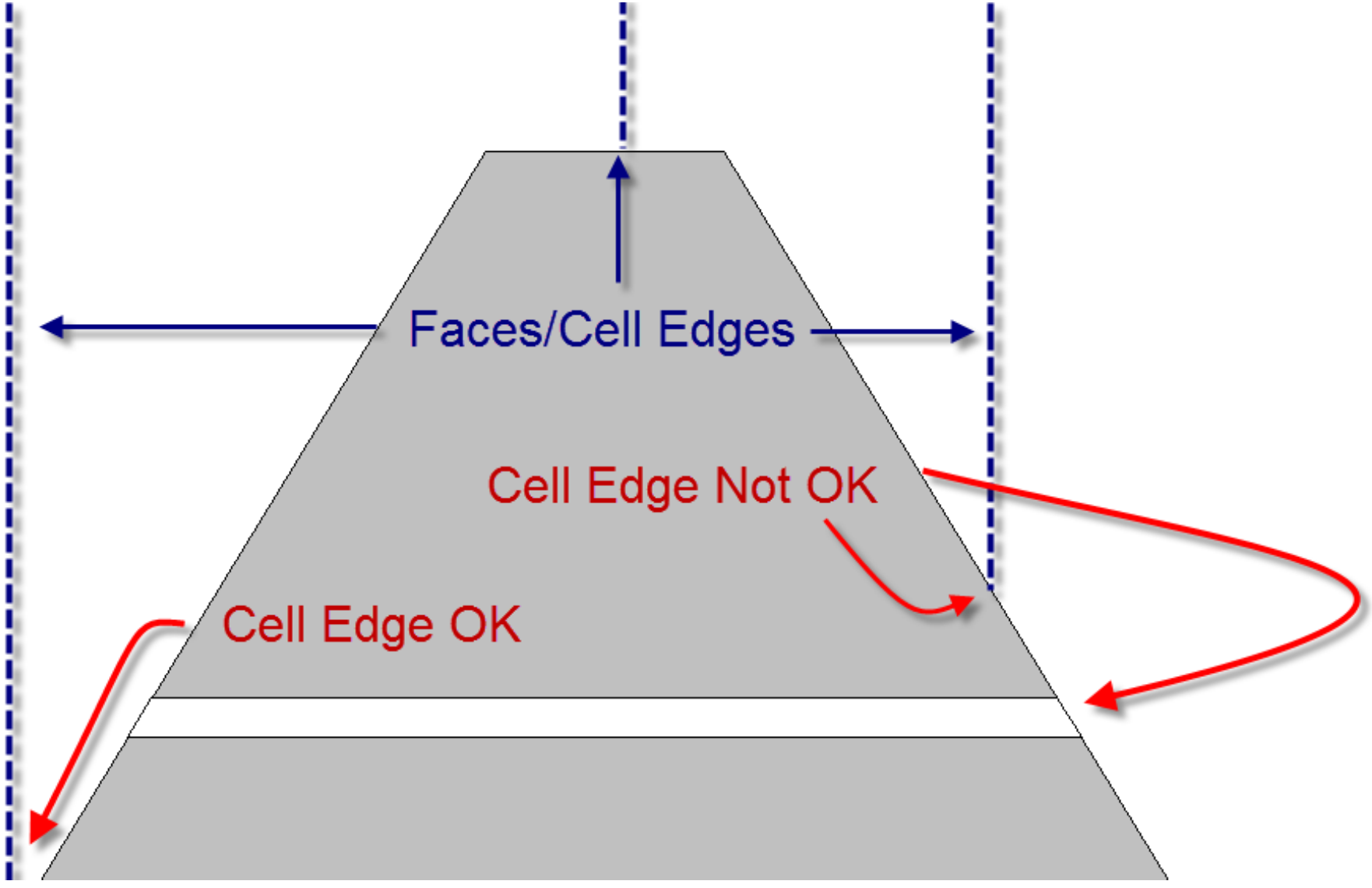


- By default, culverts/gates are not georeferenced and transfer flow from immediately adjacent cells
- In this case, cells need to extend past toe and into channel

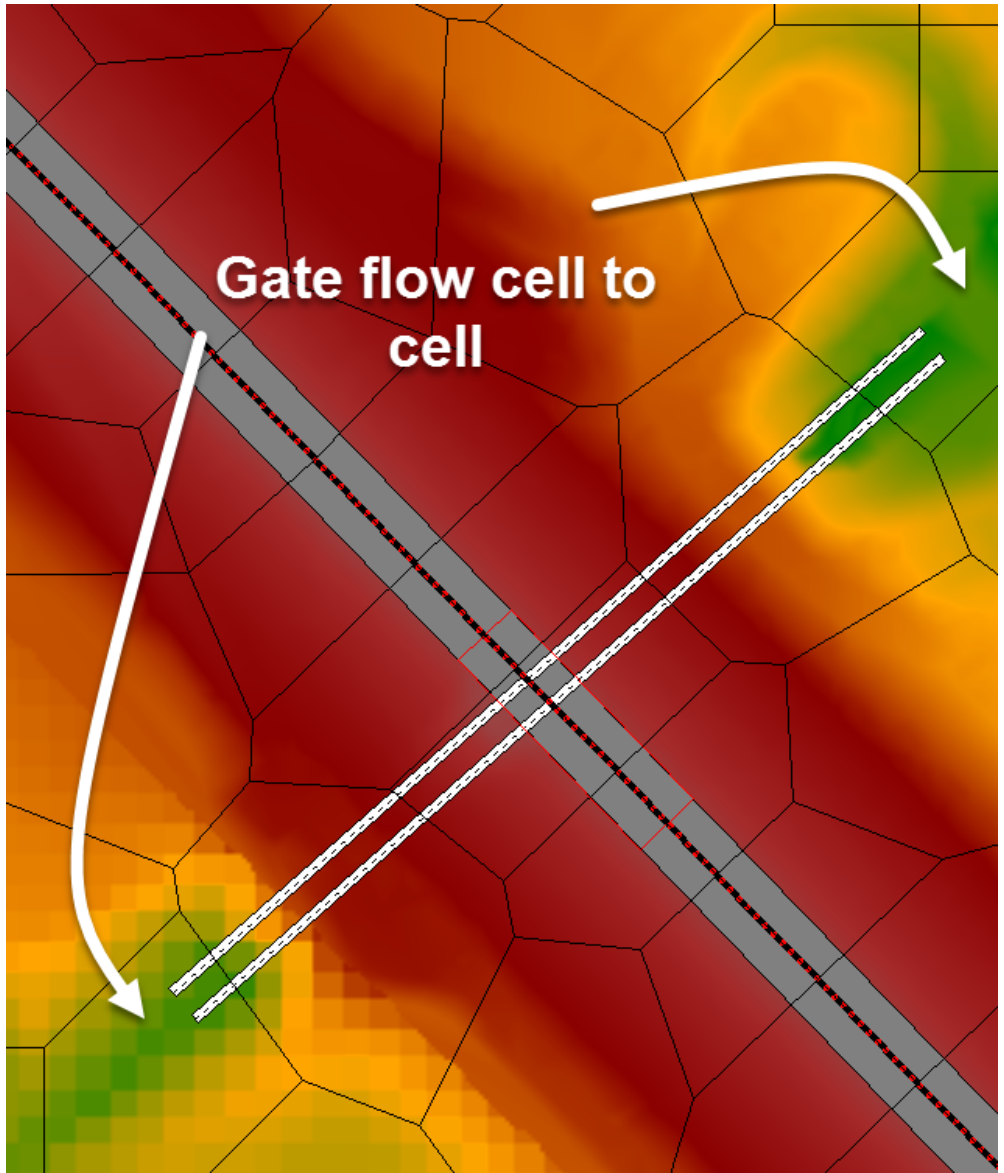
Gates/Culverts and Cell Edges



Cell Edge Location for non-georeferenced culverts/gates

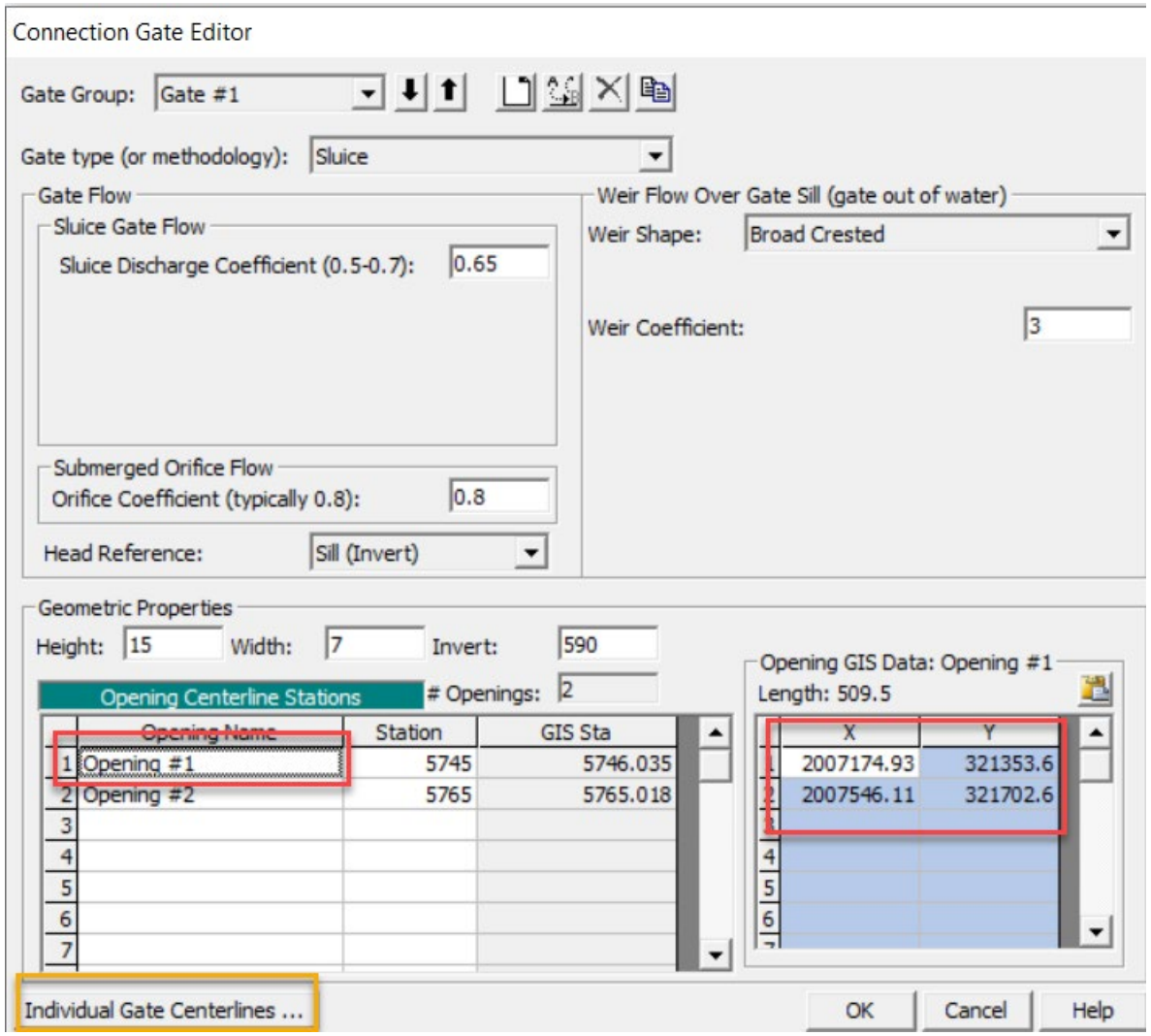


Georeferenced Culverts & Gates



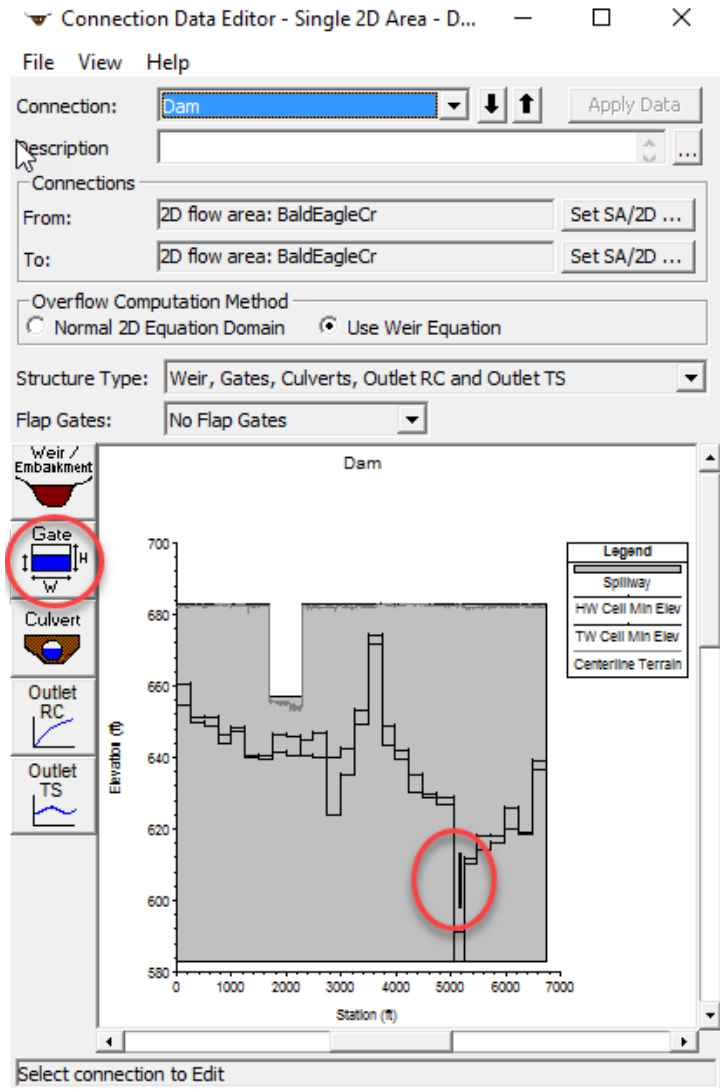
- Georeferenced culverts & gates transfer flow from distant cells
- In this case, cells do not need to extend past toe and into channel
- Small cells can still cause problems for 1D weir flow!

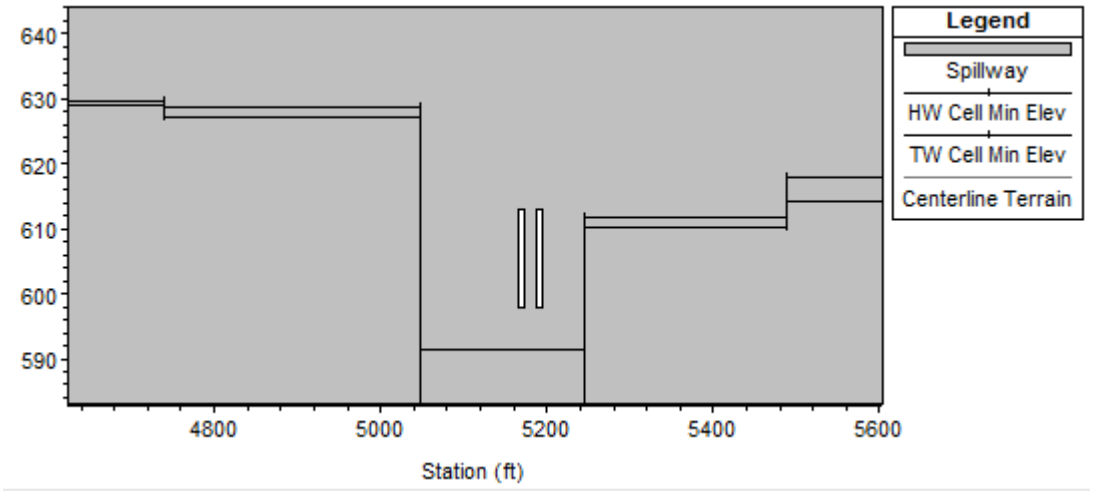
Georeference Culverts & Gates



- Draw the centerline with the mouse pointer and then and paste GIS coordinates for the appropriate opening
- Clicking on Individual Gate Centerlines will bring up a table that shows all of the openings

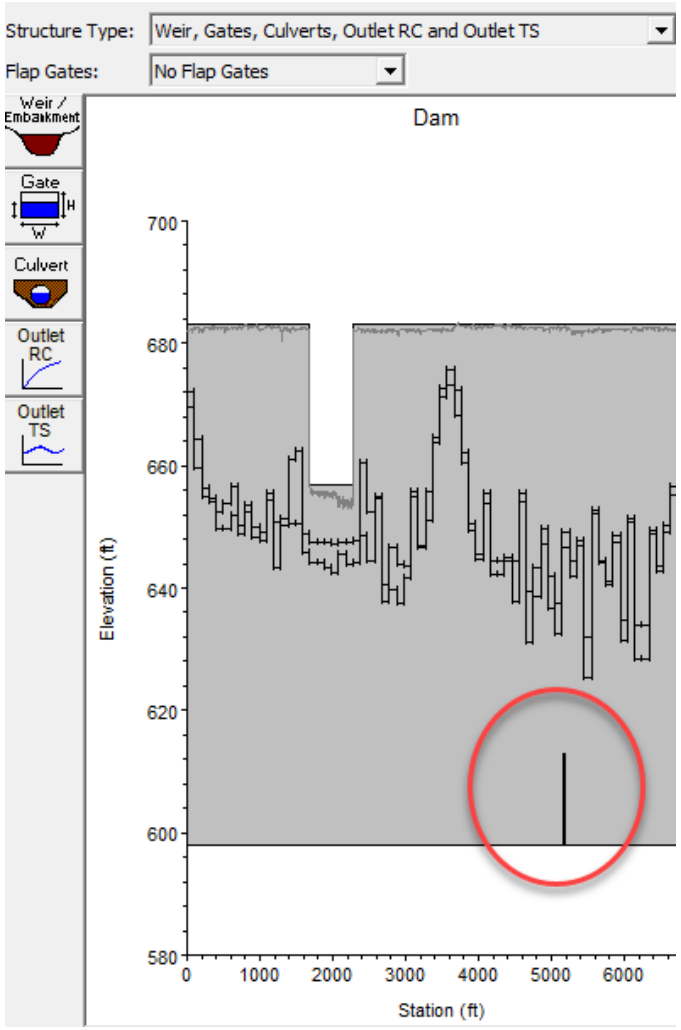
Gate in channel above Cell Invert





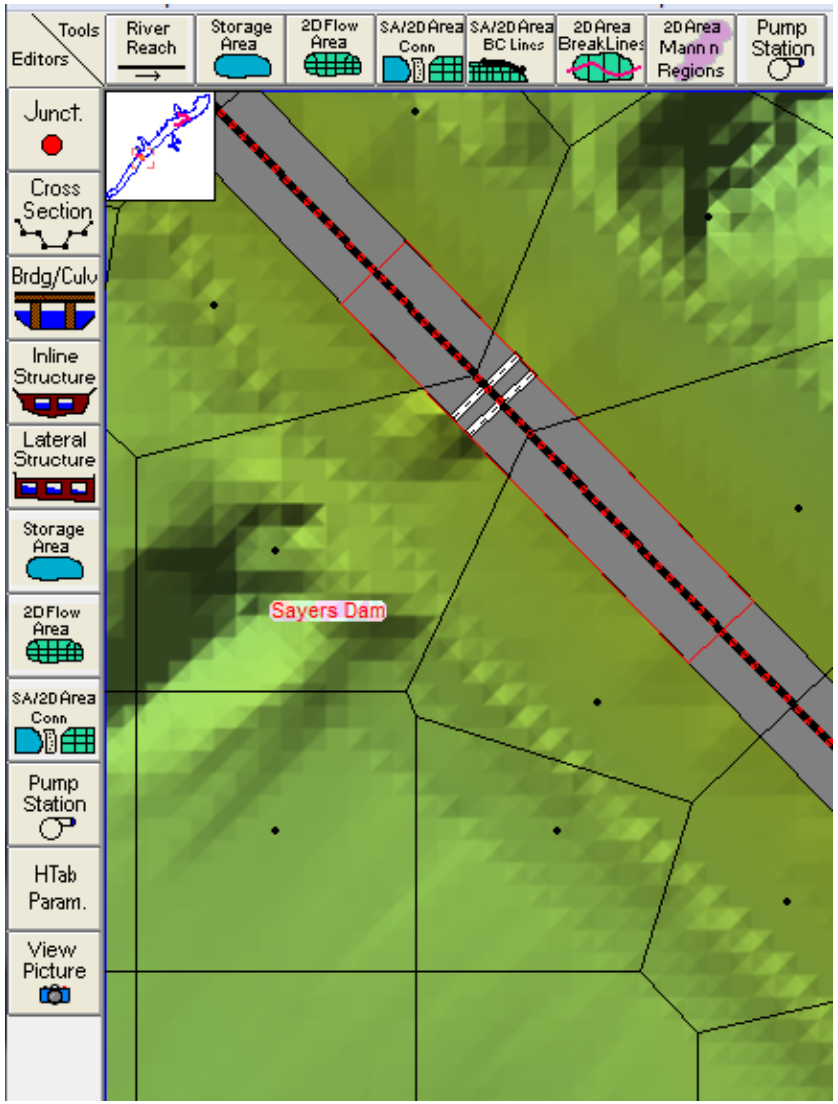
- Non-georeferenced gate in channel above adjacent cell minimum

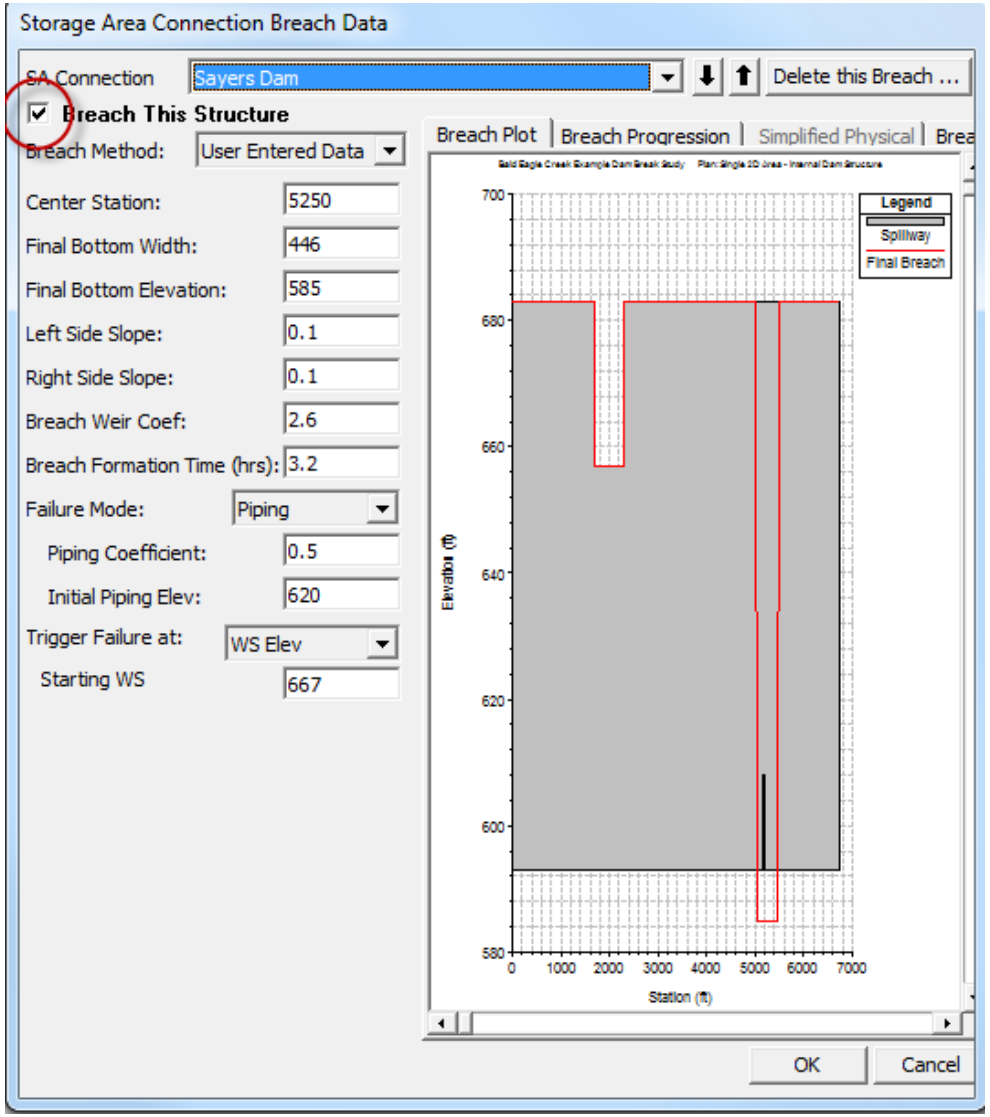
Georeferenced Gate below adjacent cell Invert



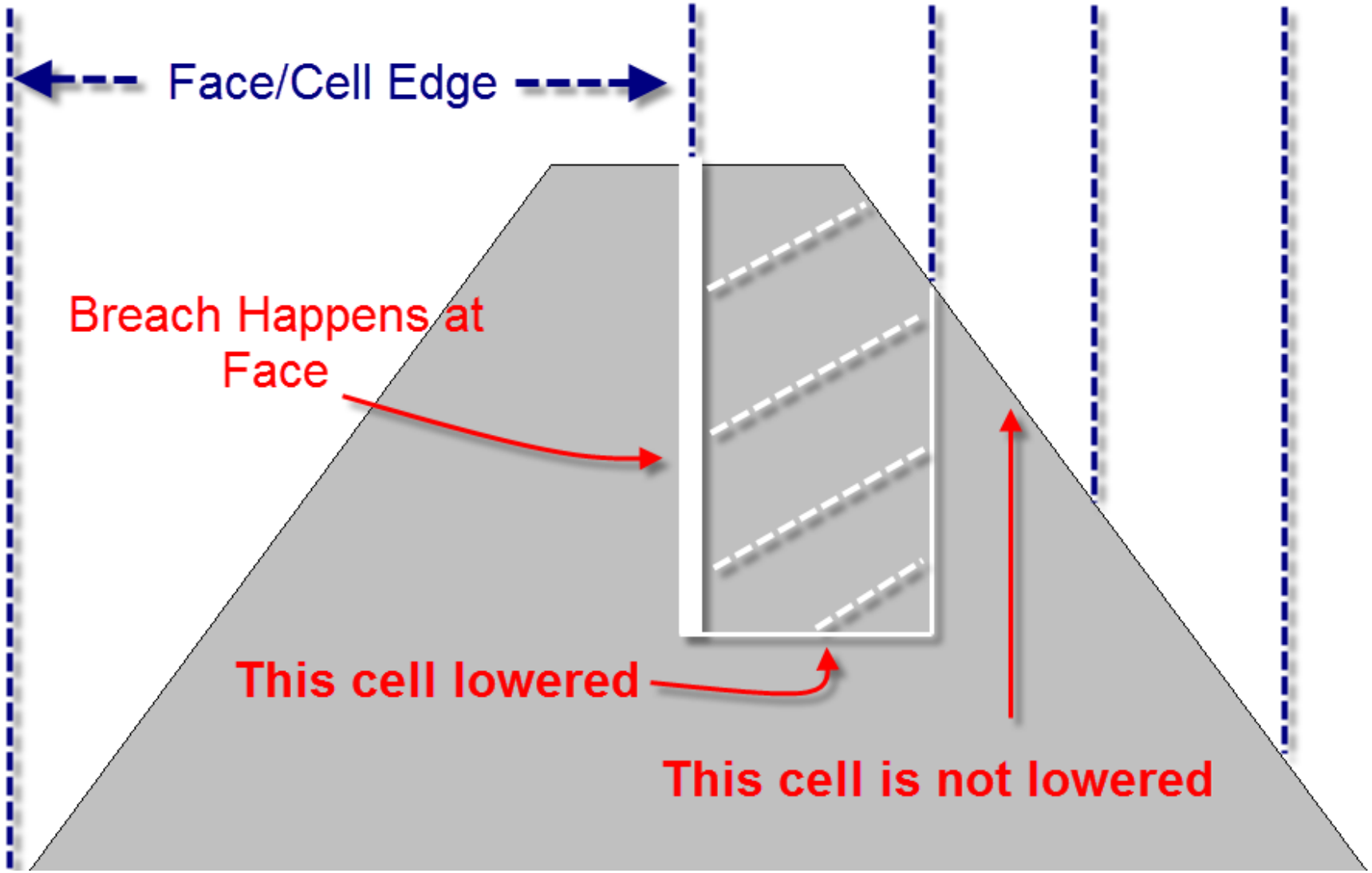
- Small HW/TW cells on abutment next to HS do not show channel location
- This plot does not show whether the georeferenced gate centerline has been properly entered or not

Breach for HS

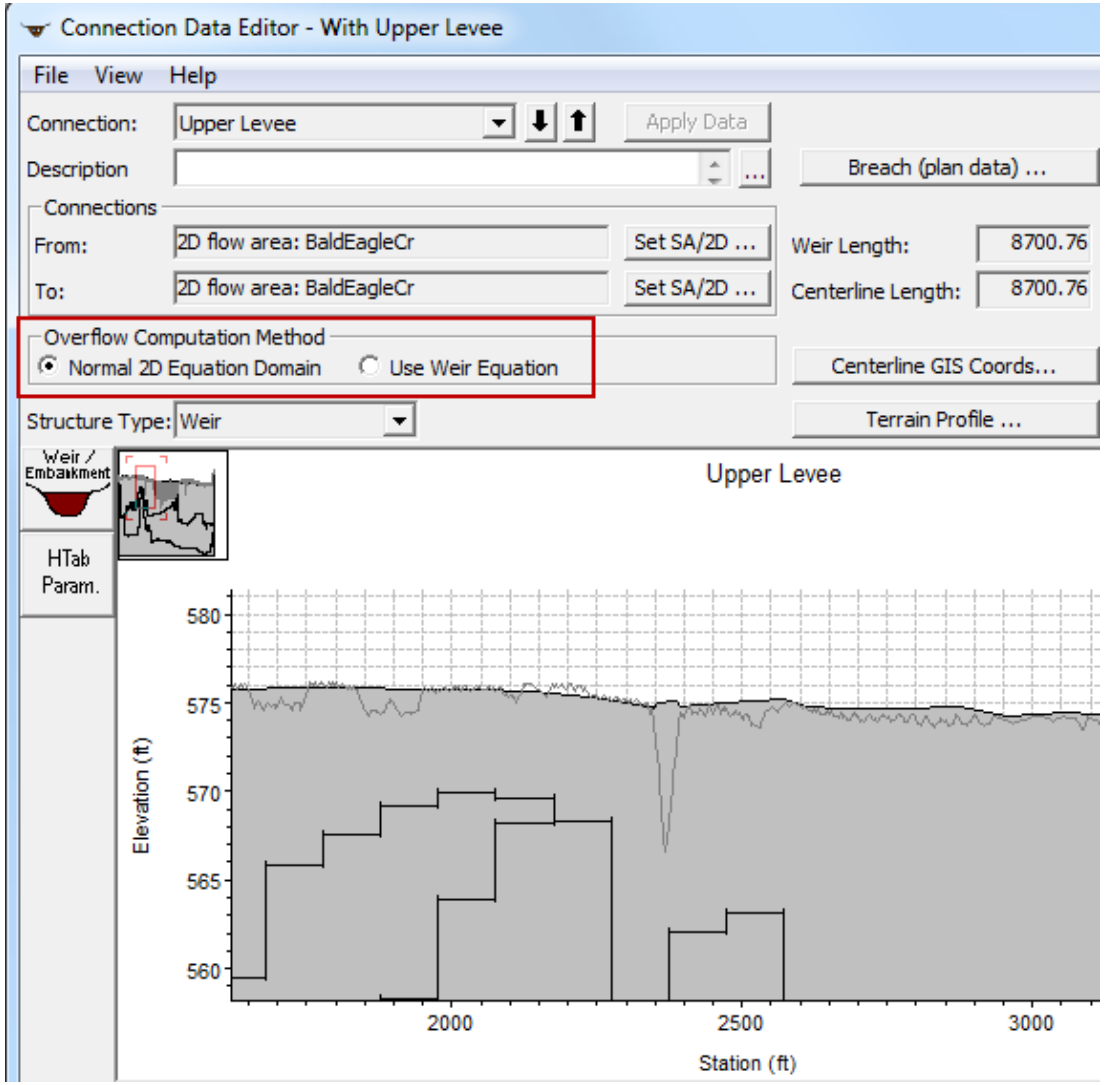




HS Breach and Cell



HS Equation Choice



- Normal 2D Equation Domain
  - flow across face computed with 2D flow equations
- Use Weir Equation
  - Q = CLH^1.5

Normal 2D Equation Domain

- Face properties are adjusted for user entered SE Data, but 2D Area is solved in the normal manner
- Generally, faster, more accurate
- But not good for true weir type
- HS with culverts/gates can still use 2D for overflow
  - culvert/gate flow is computed separately

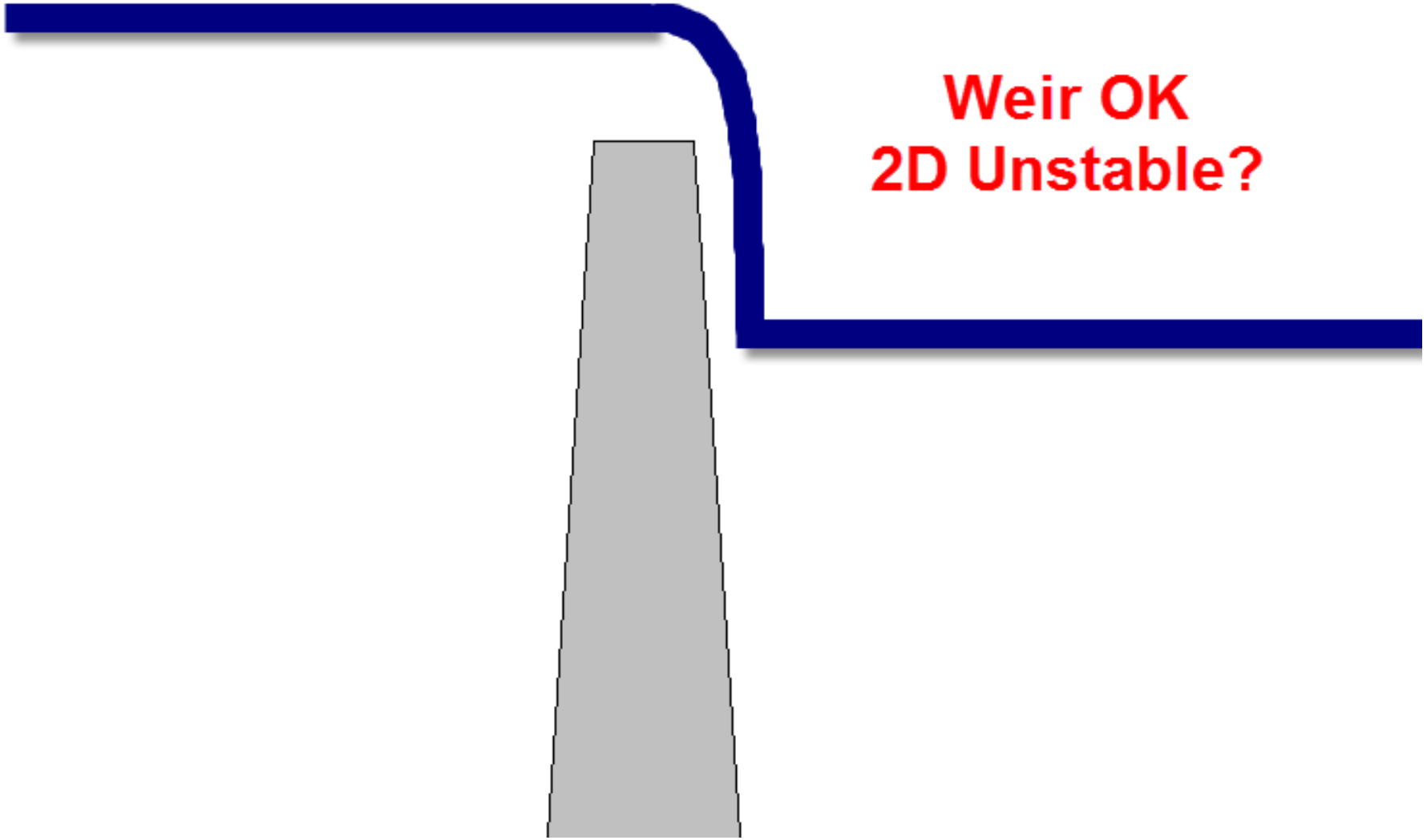
Weir Equation

- Weir flow computed using [1D] weir equation and user SE Data
- Flow computed “just prior” to each iteration of 2D
- More appropriate for [non-submerged] weir flow

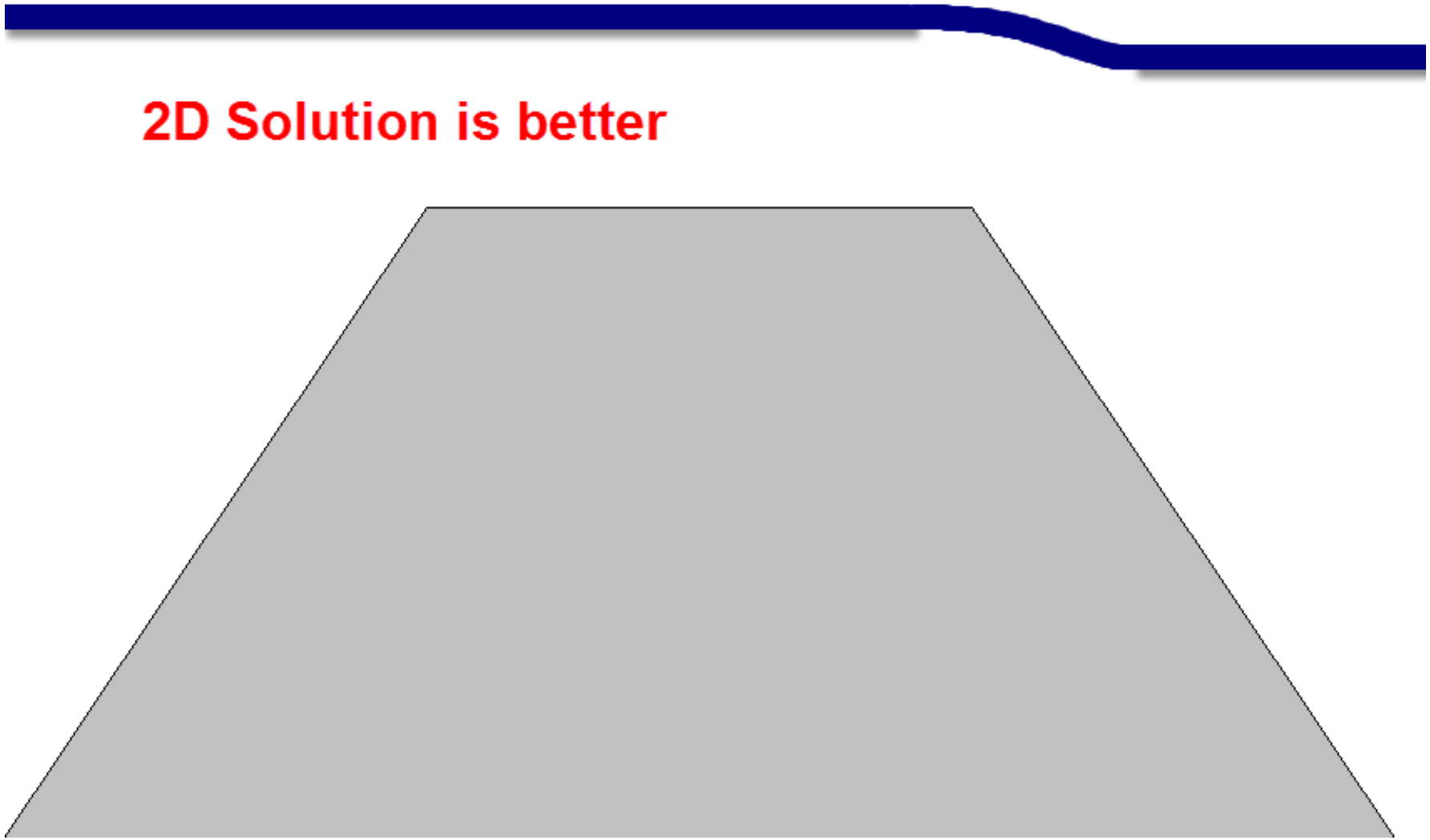
Weir Equation continued

- Less desirable for submerged conditions
  - Turn on Weir Submergence Decay Exponent!
- May require “trial and error” solution causing 2D to iterate
- Gate and culvert flow are always computed “just prior” to 2D

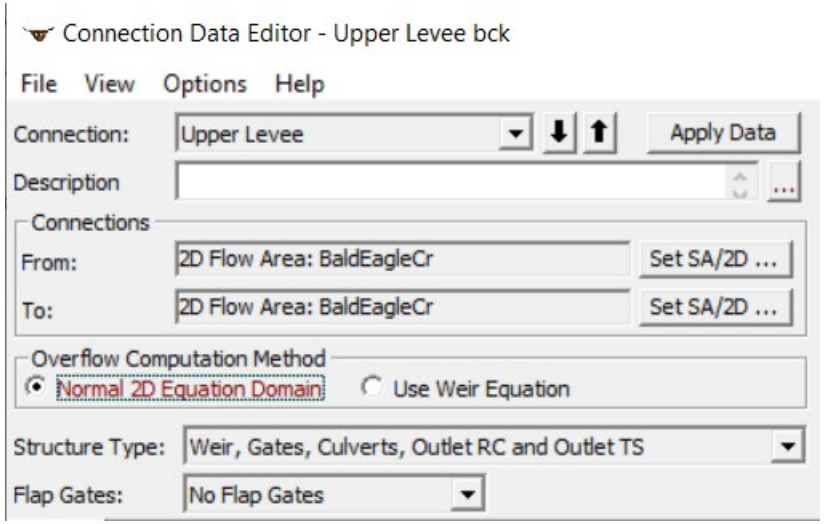
HS Weir Flow

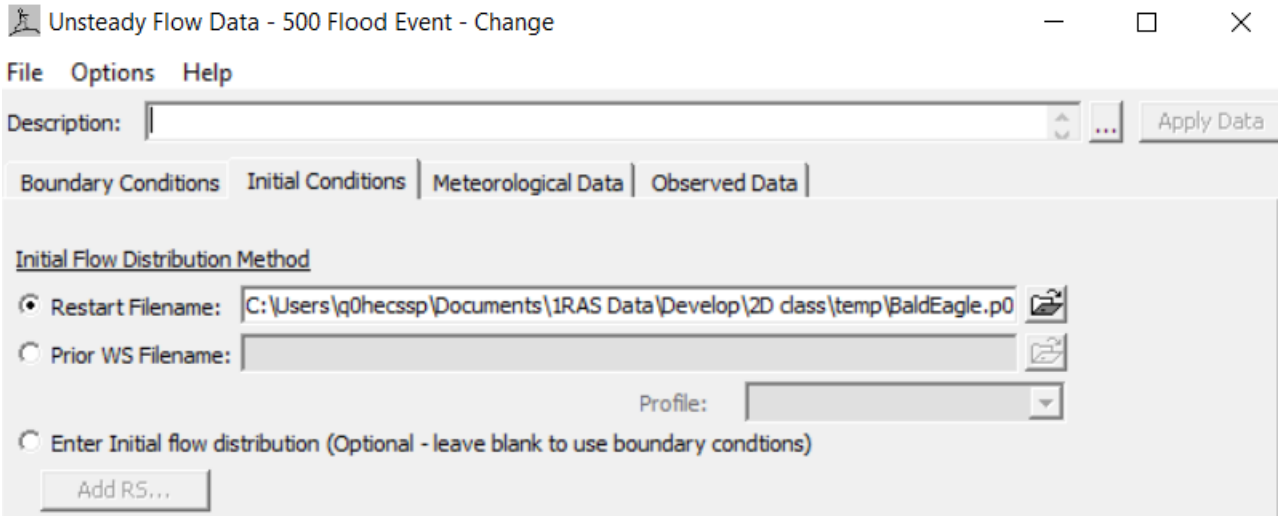


HS 2D Flow



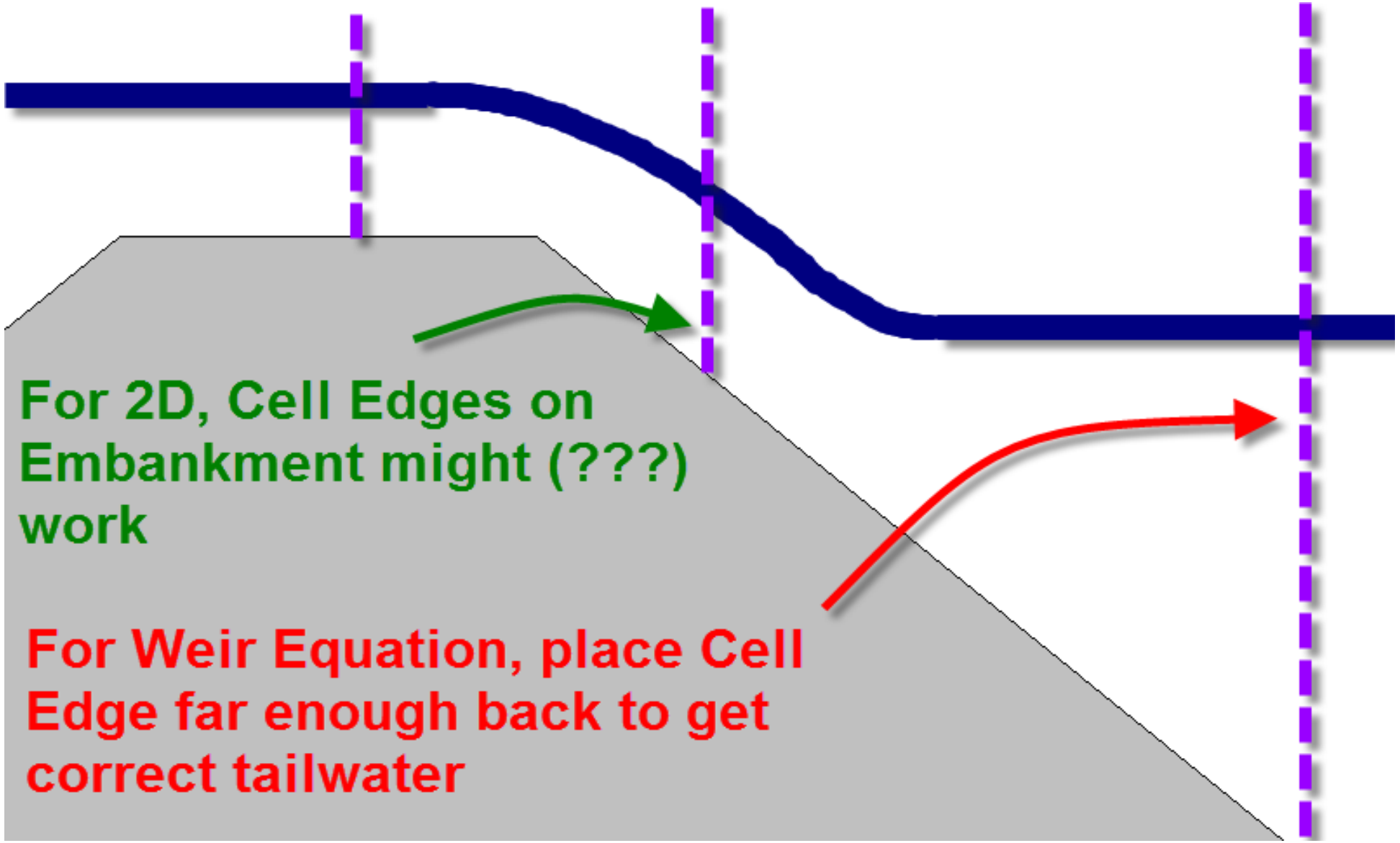
Use Restart/Prior to Switch





- Can switch methods while when using a restart/prior WS method
- Really only viable for a single location such as a levee breach

HS Tailwater Considerations



Questions?

US Army Corps of Engineers