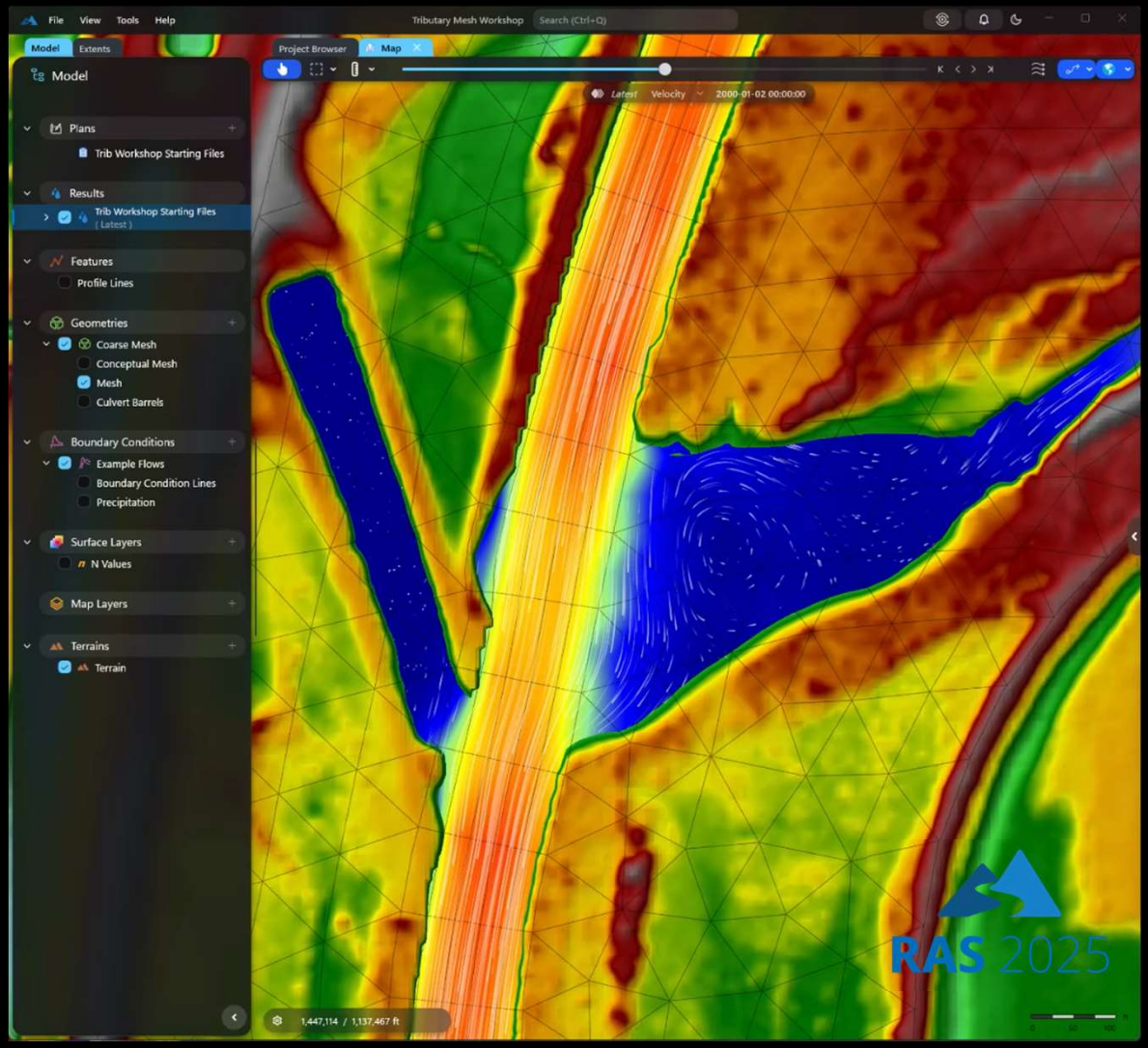
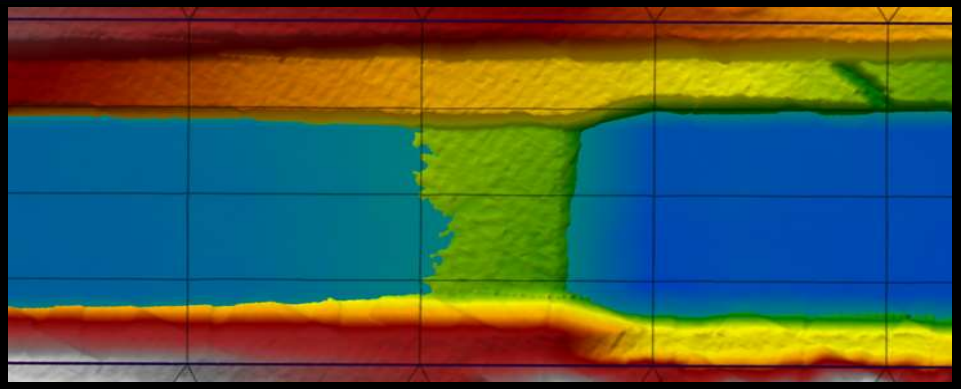
Common Meshing Applications

(Difficult meshing challenges that you WILL encounter)

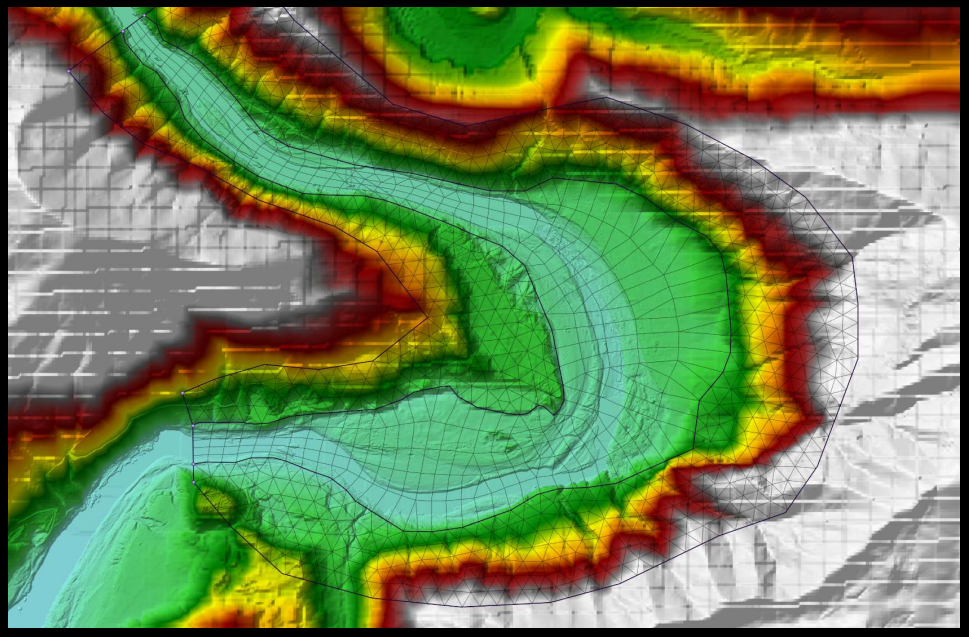
Stanford Gibson, Ph.D
Cameron Ackerman, P.E.



Common Meshing Applications

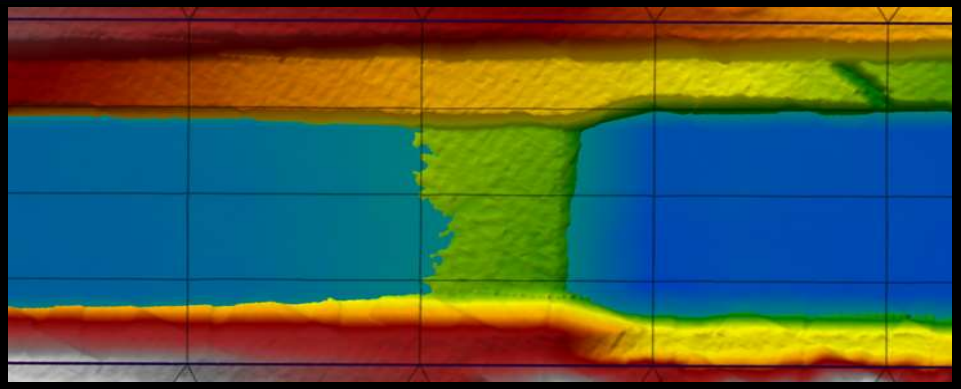


- Subgrid Mesh Principles



- Common Application
  - Meander
  - Tributary Confluence
  - Flow Split/Island
  - Expansion-Contraction
  - Bridge Pier
  - Three-Cell Simplification

Common Meshing Applications



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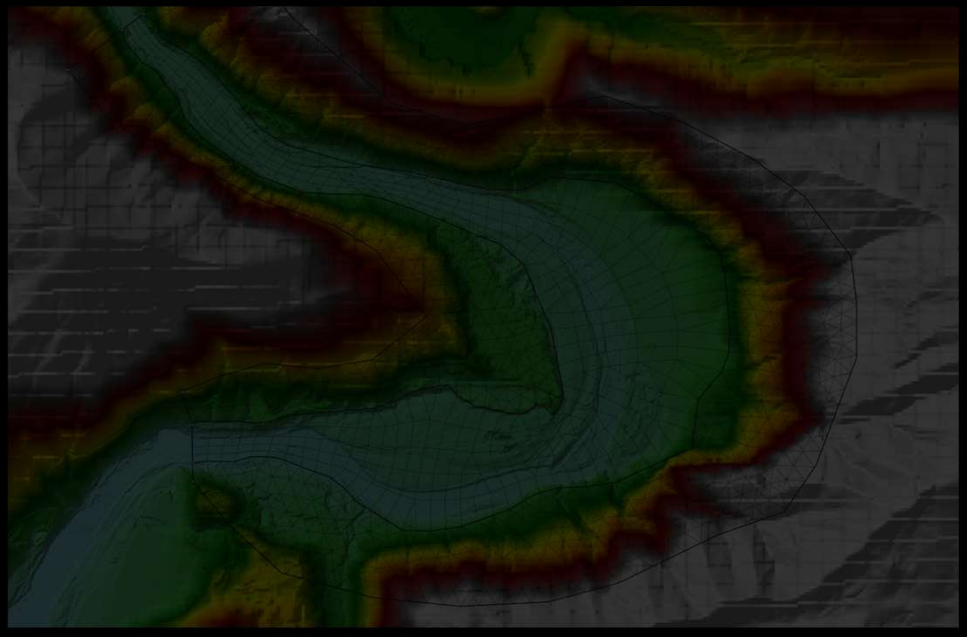

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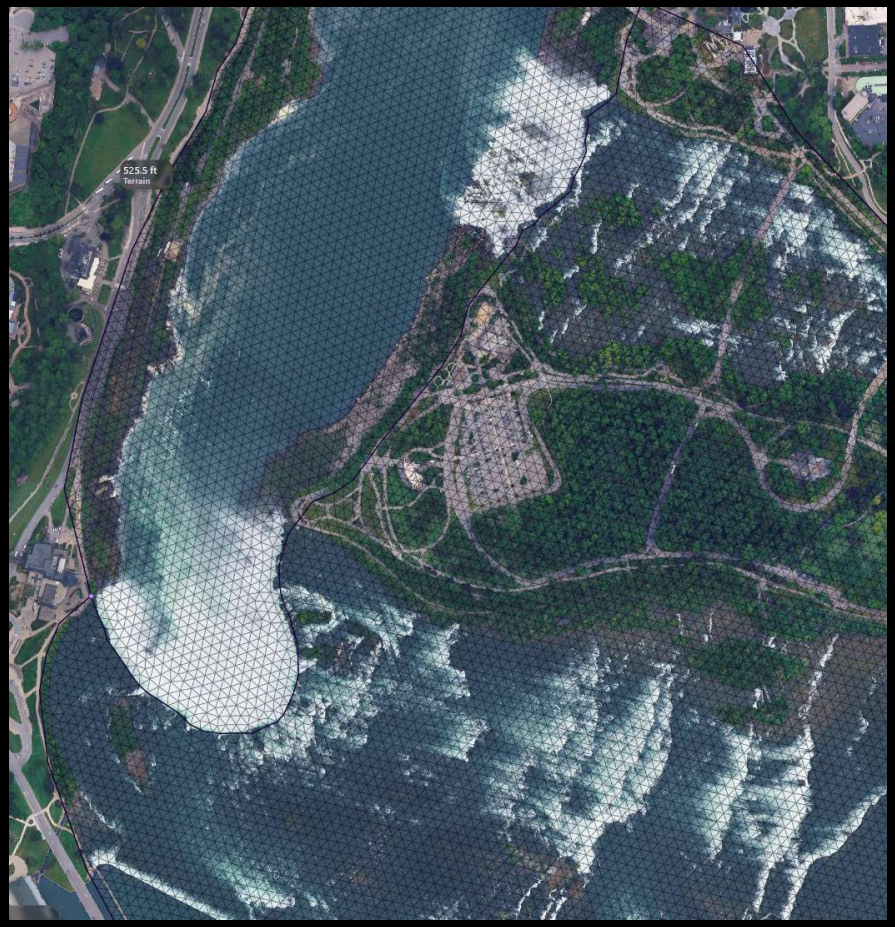
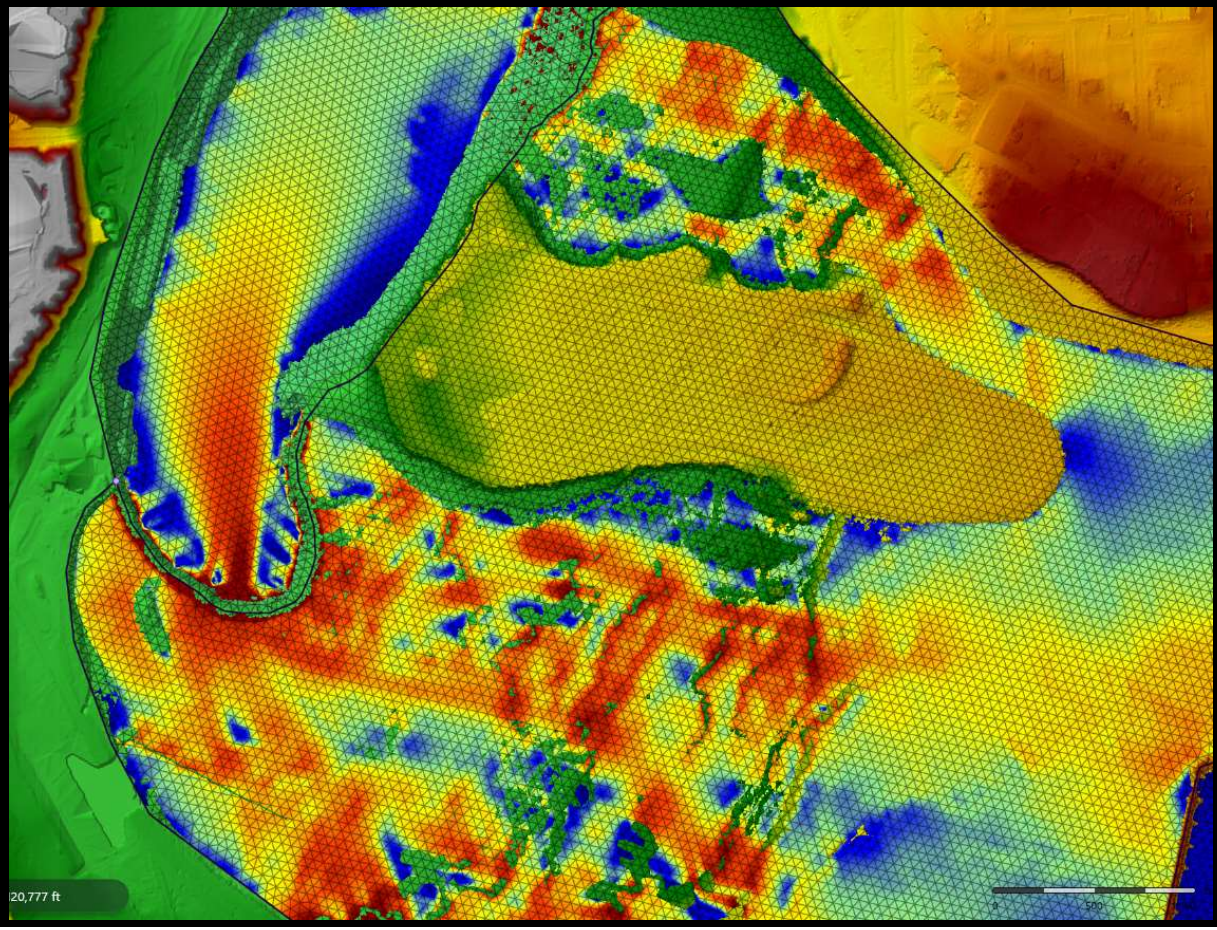
You Still Need to Capture Hydraulic Control

- Standard Subgrid modeling principles still apply





You Still Need to Capture Hydraulic Control

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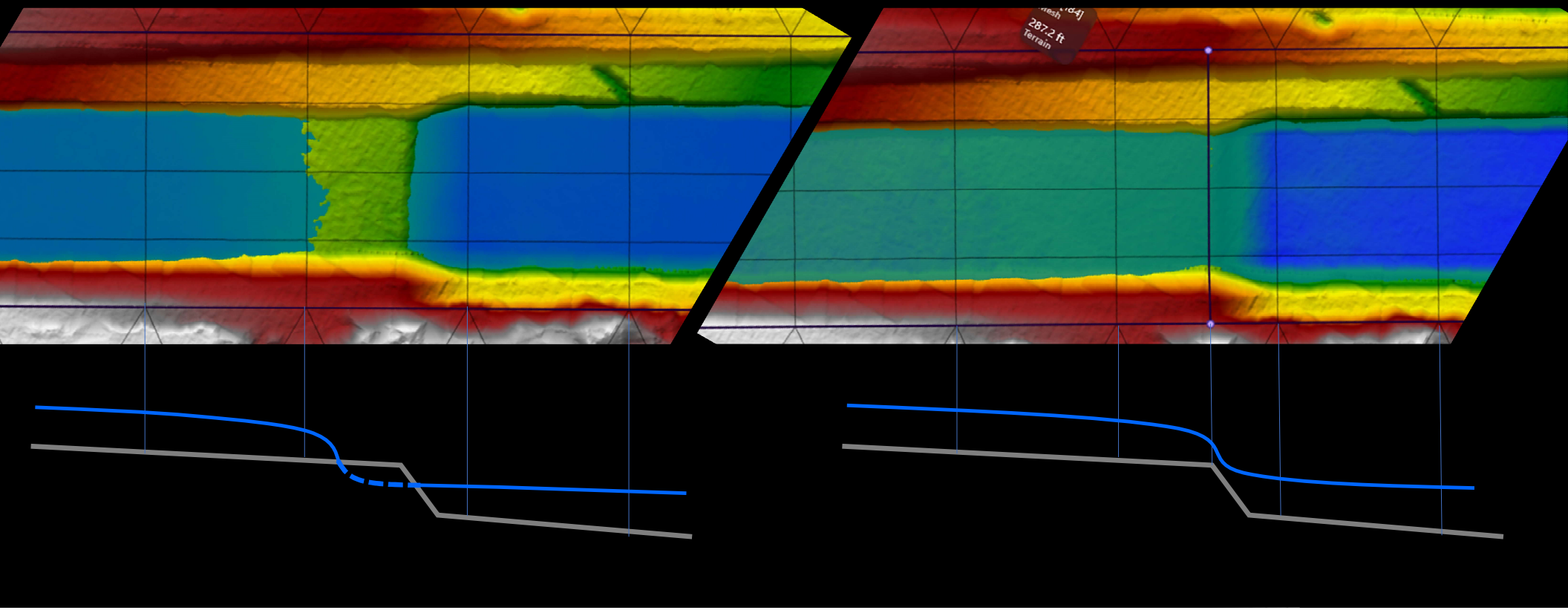
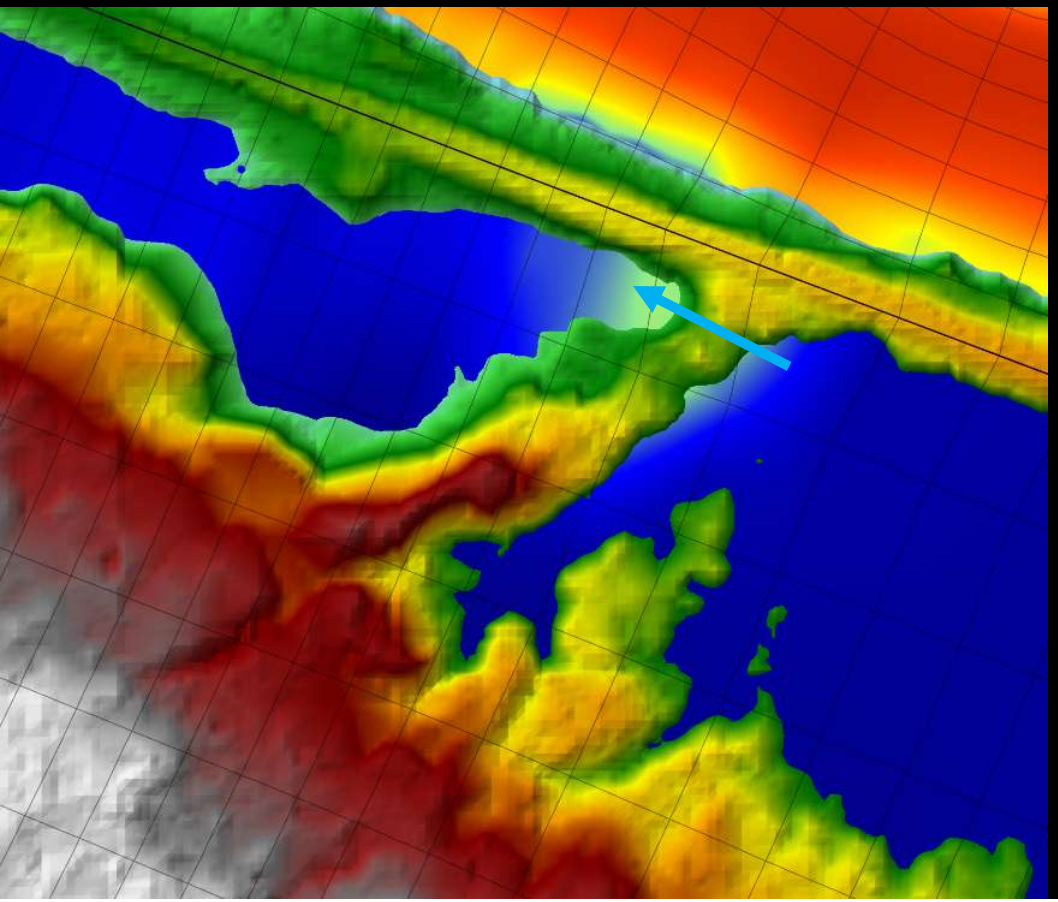
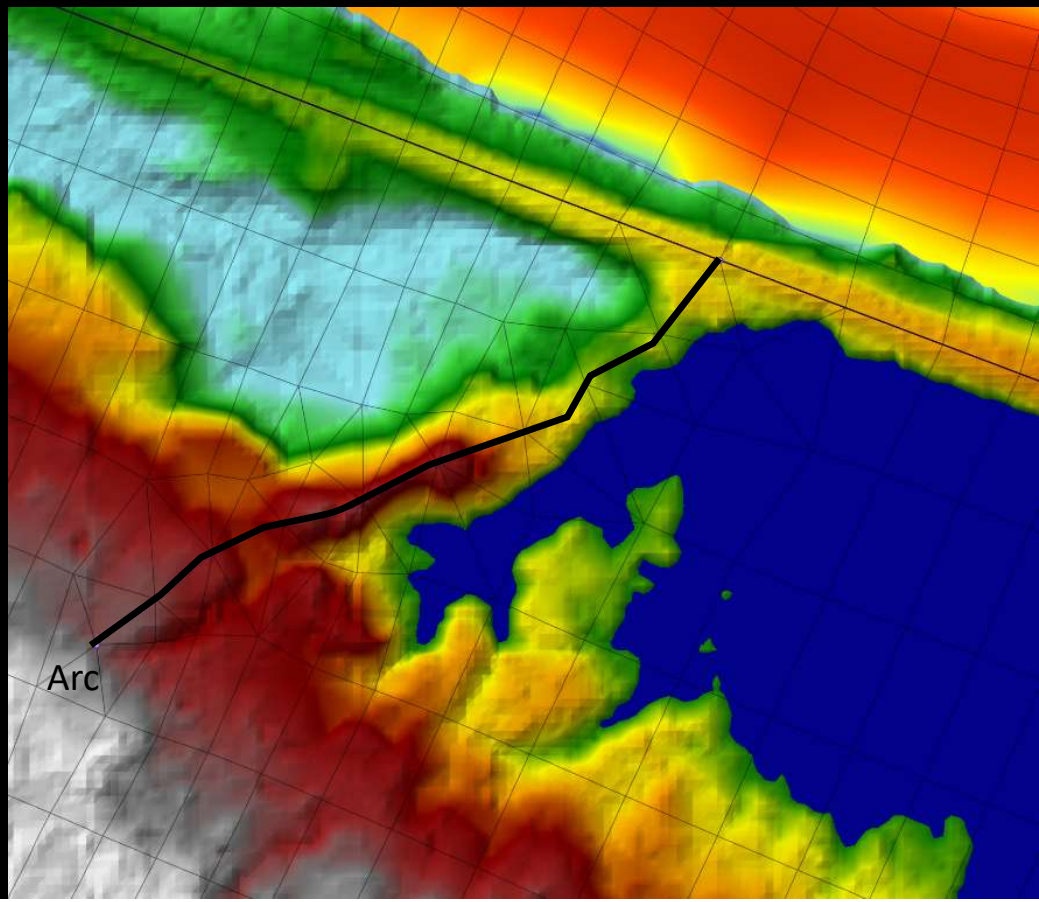


You Still Need to “Breaklines” Along High Ground

- Standard Subgrid modeling principles still apply
- But now “Arcs” do the work of Perimeters and Breaklines





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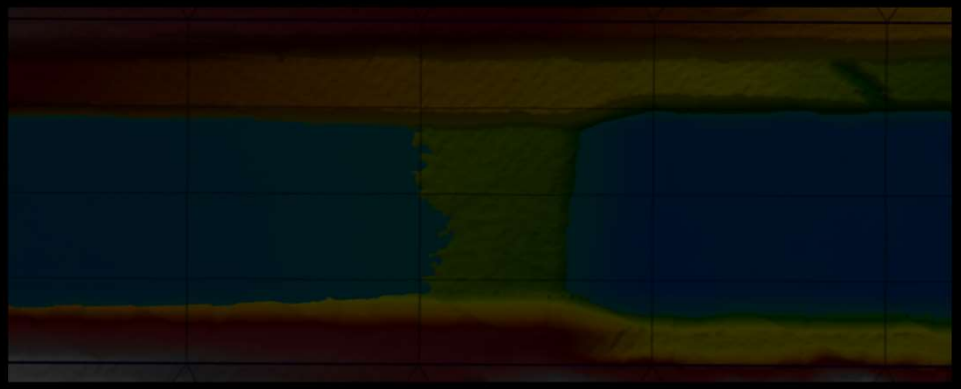

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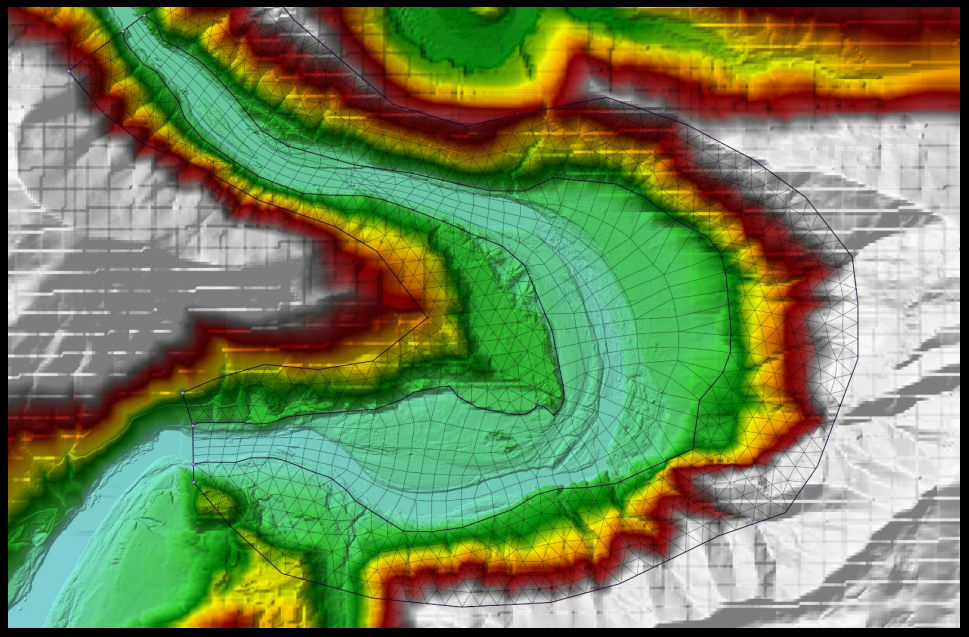

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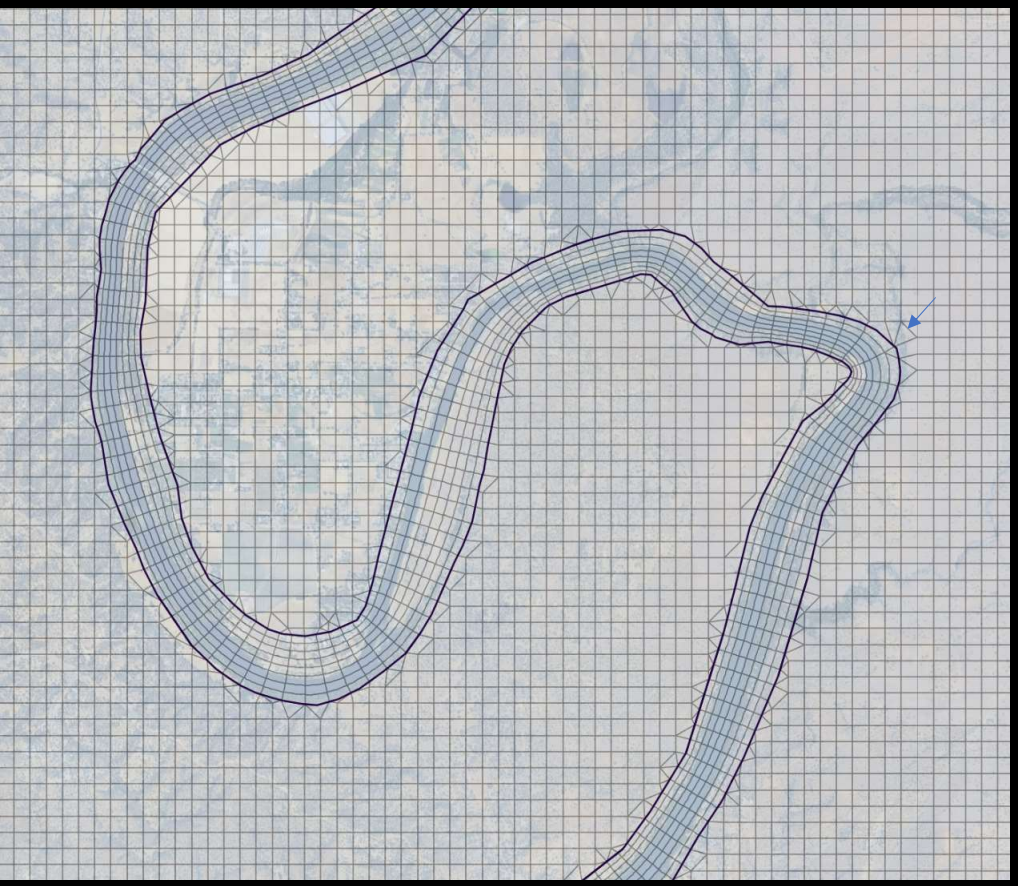
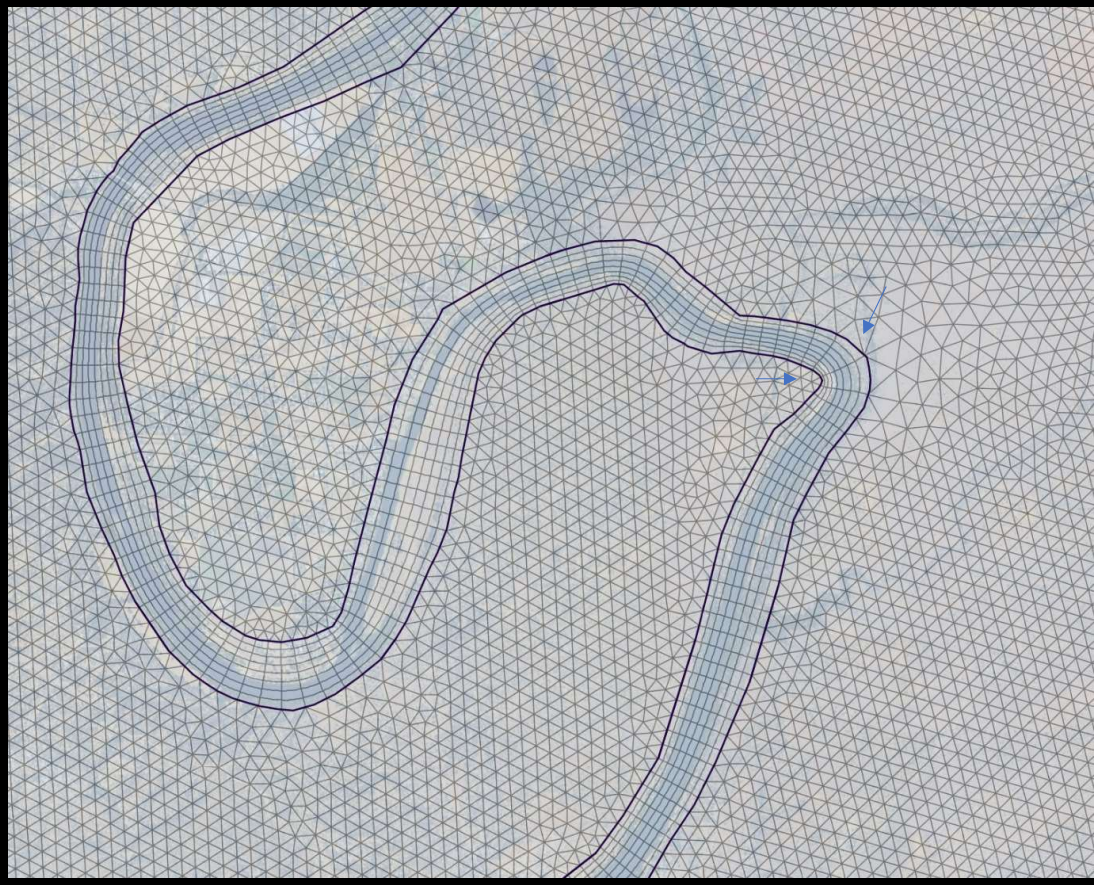
Meander Meshing





Transitions to From Quad Channels
to Cartesian/Triangular Floodplains

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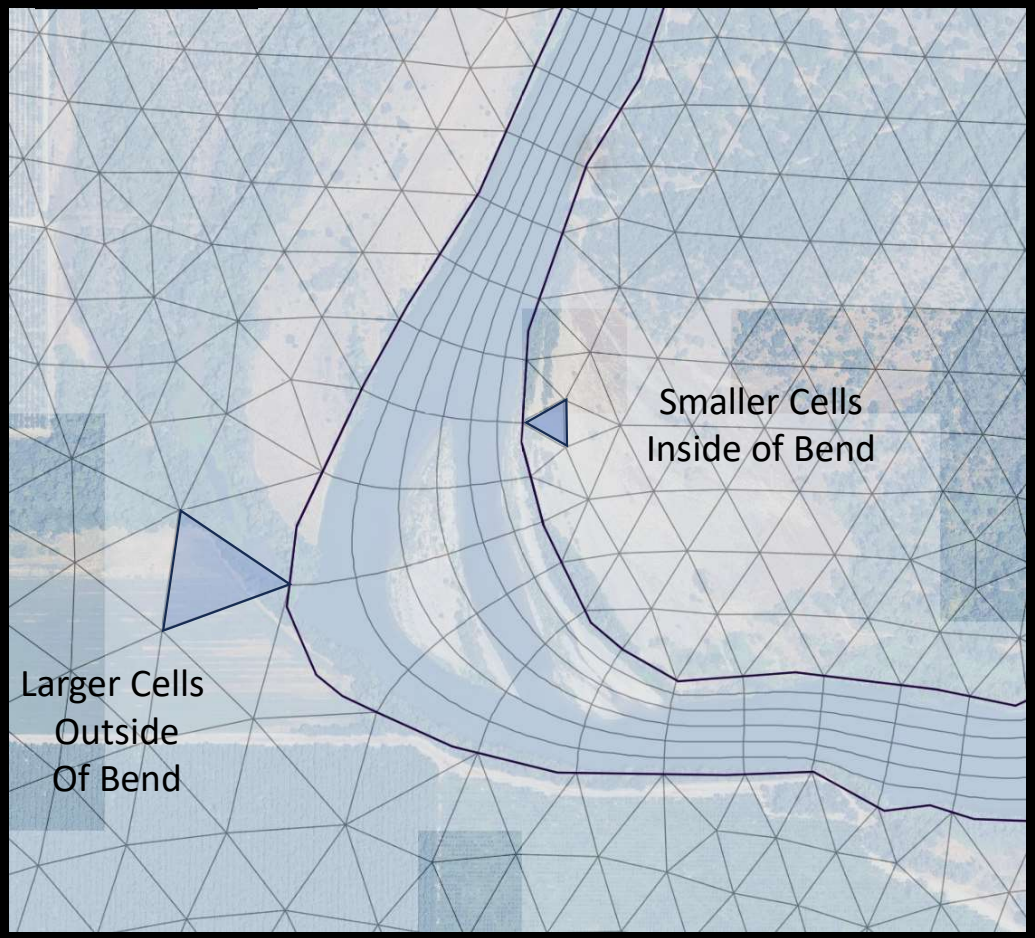
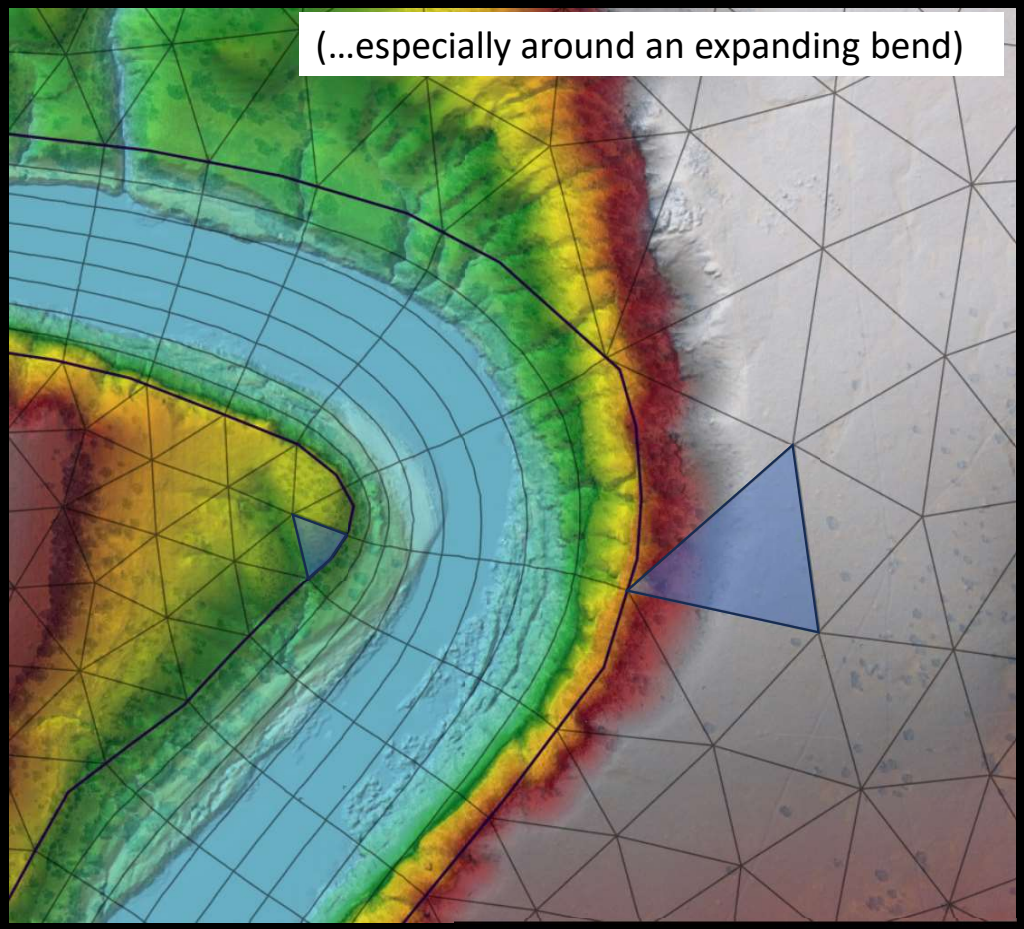
Quads Will Drive Triangle Spacing Around a Bend





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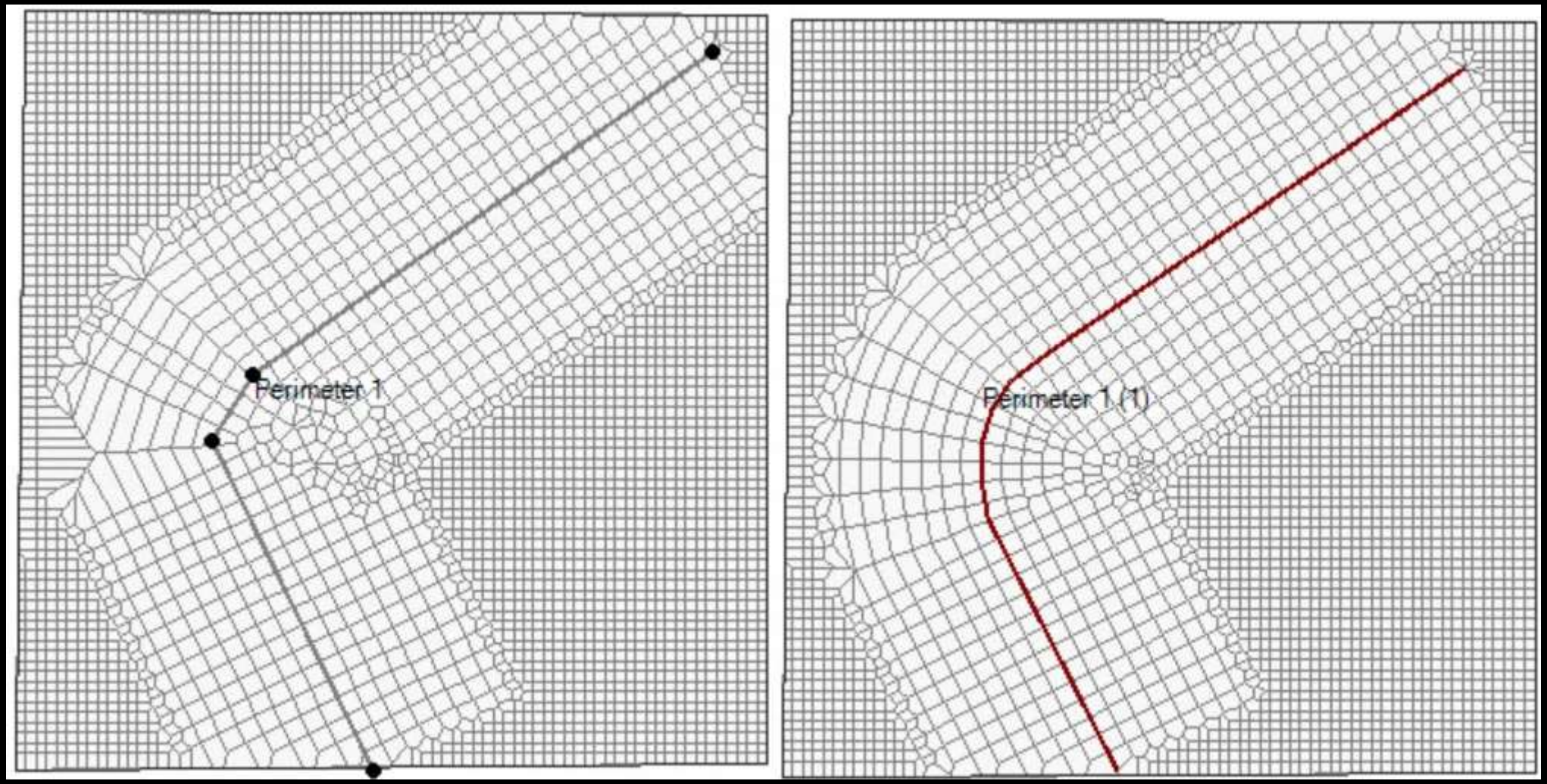
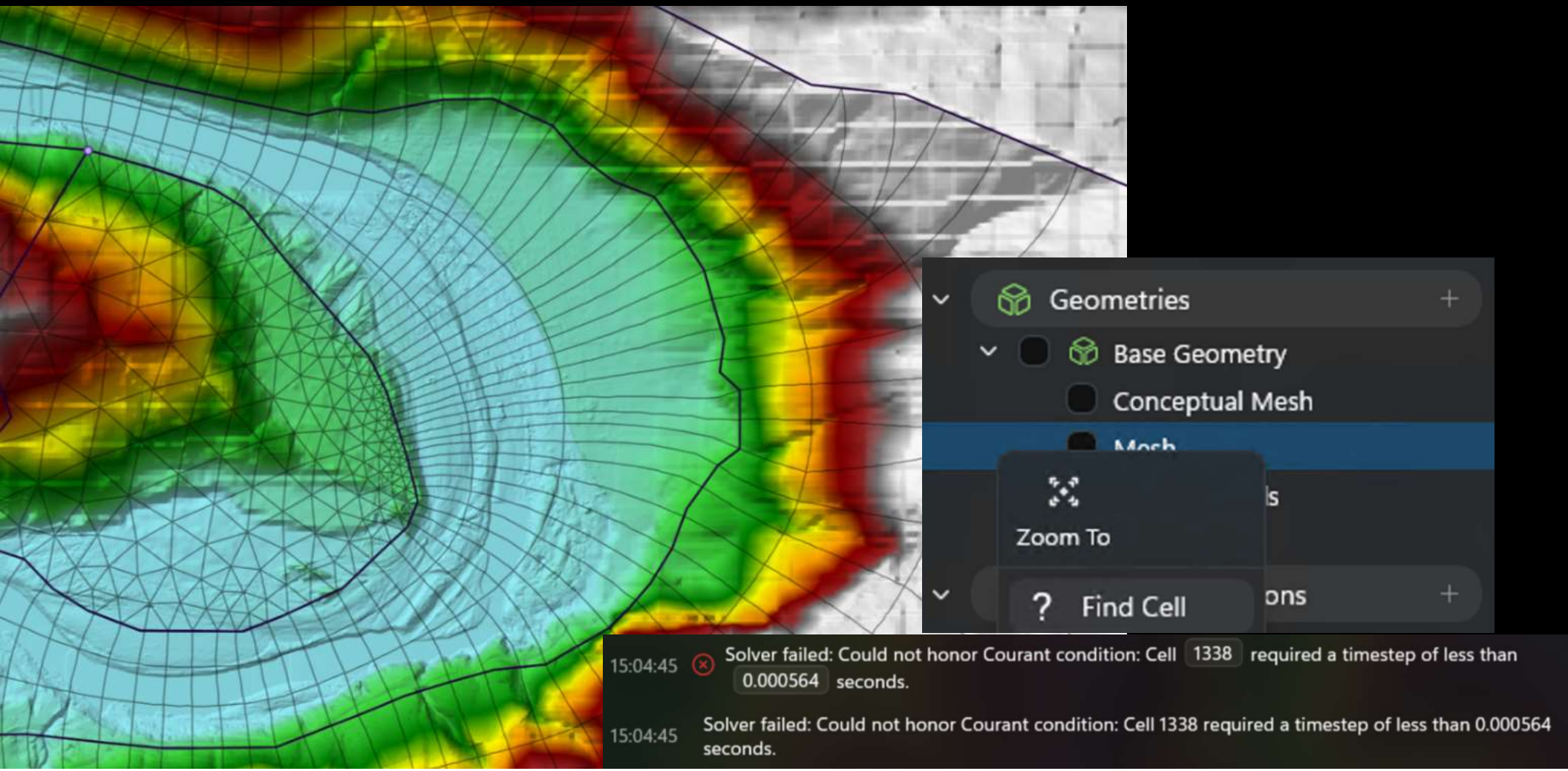
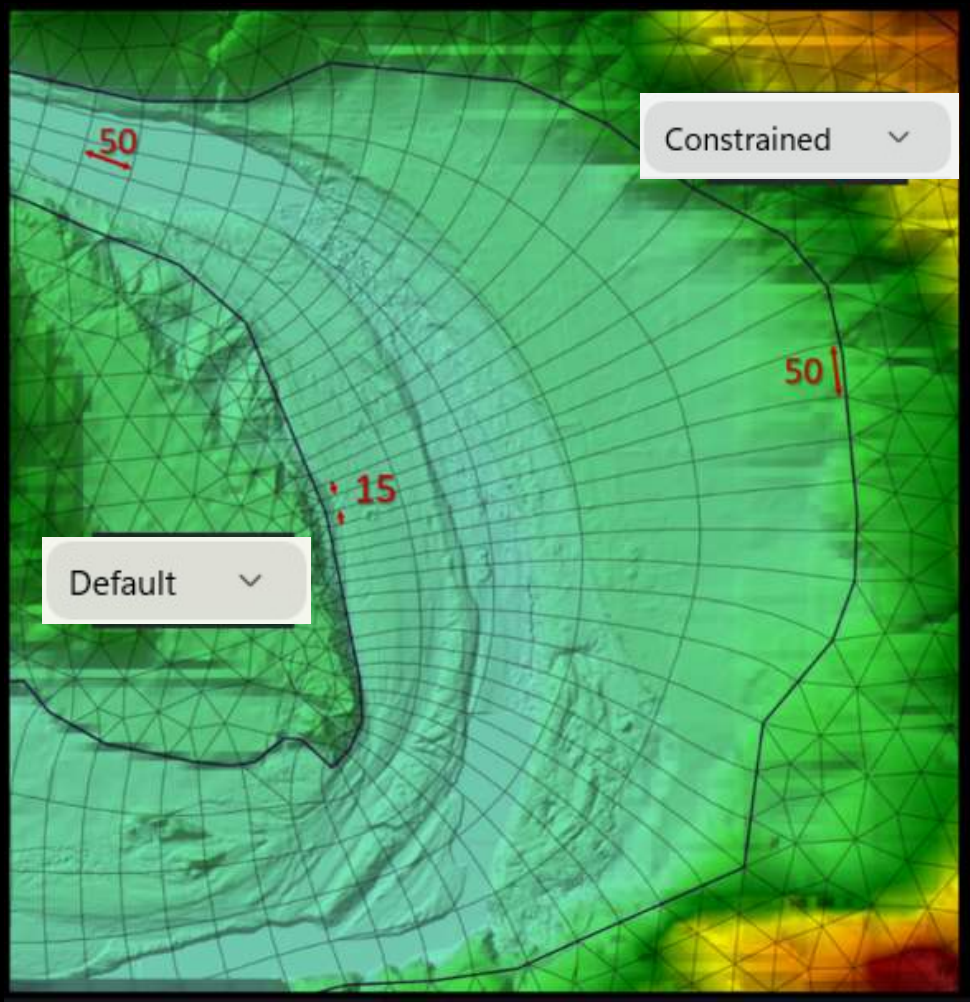
A reminder of how this use to go…

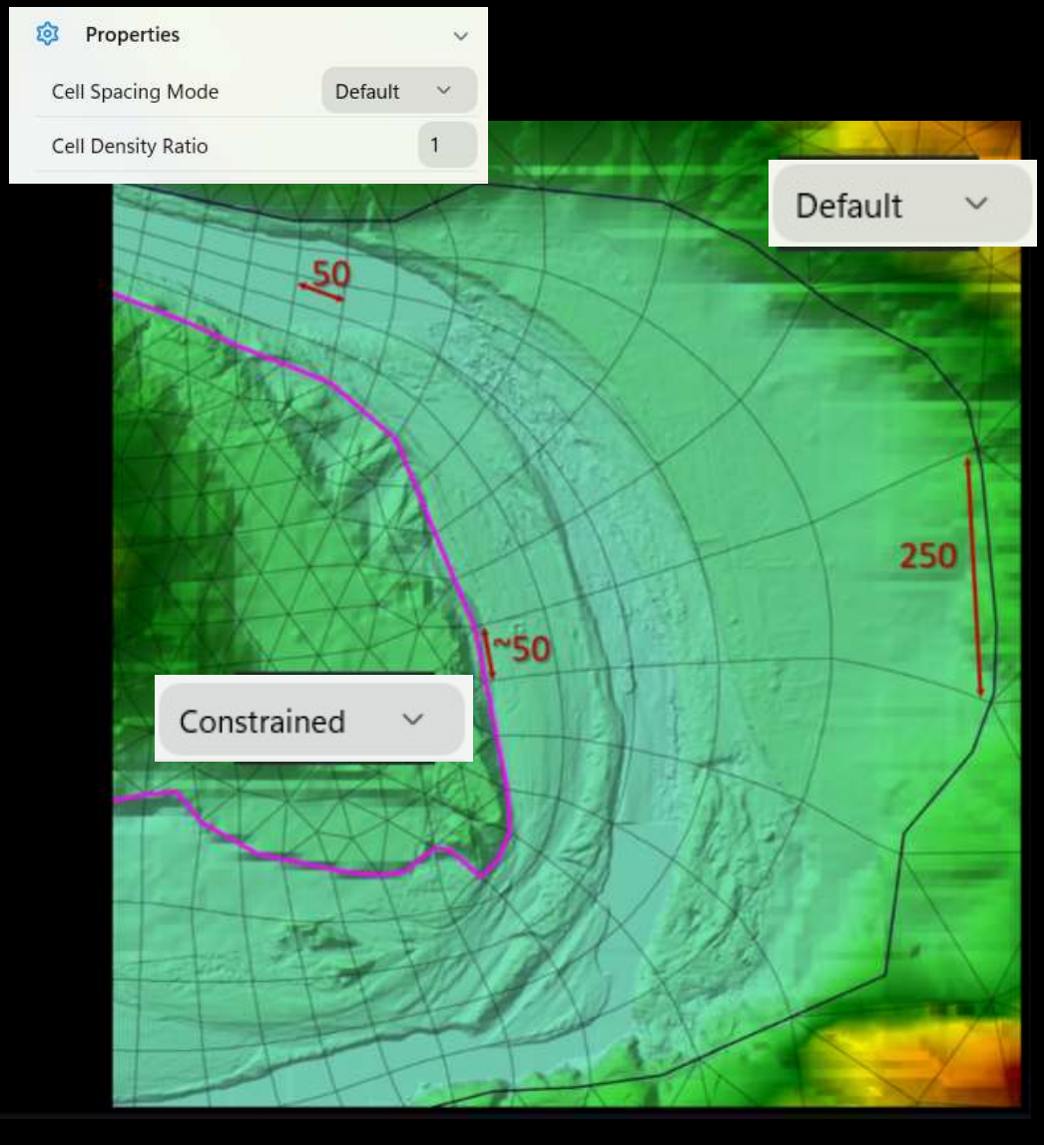


Meander Meshing

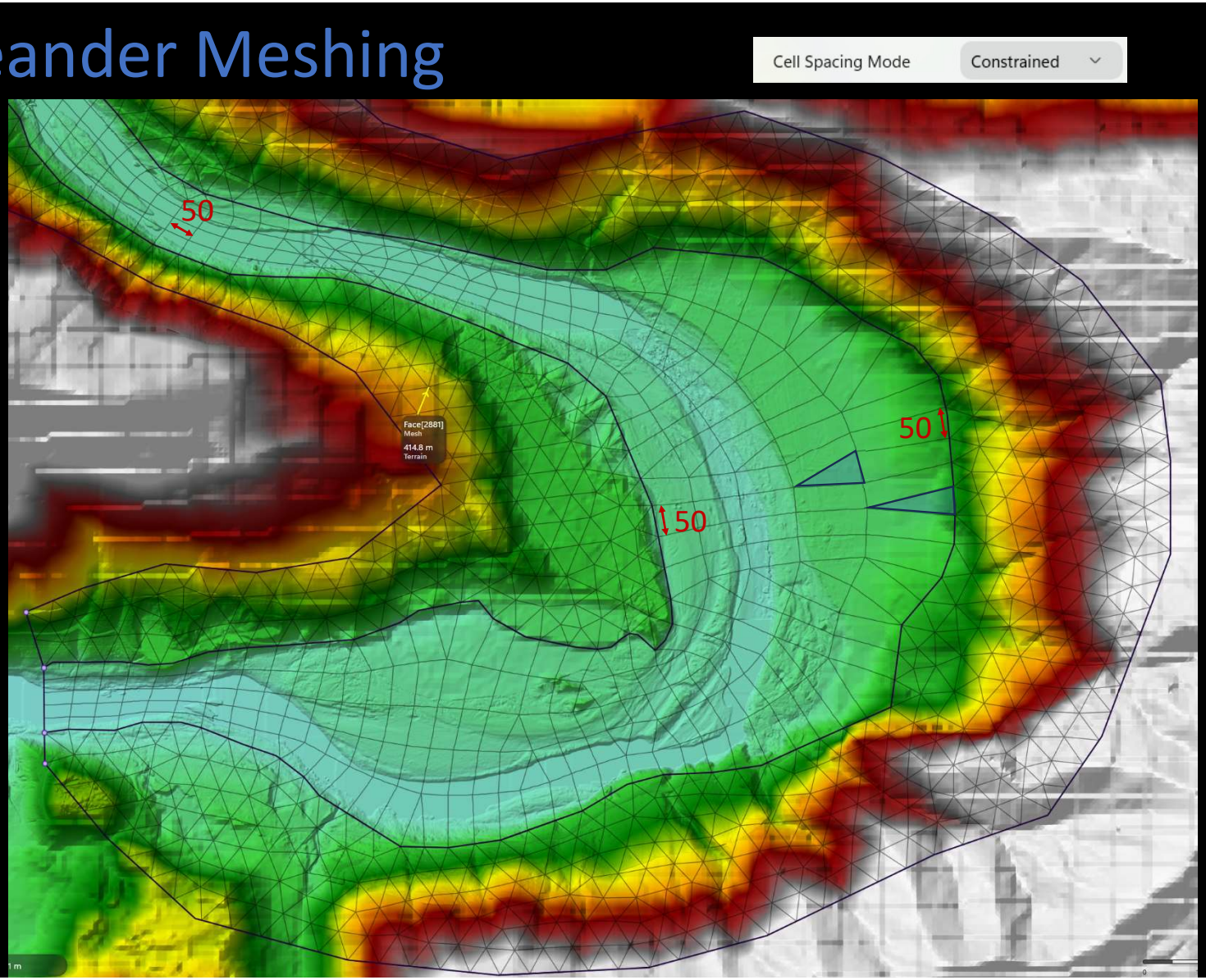


Meander Meshing

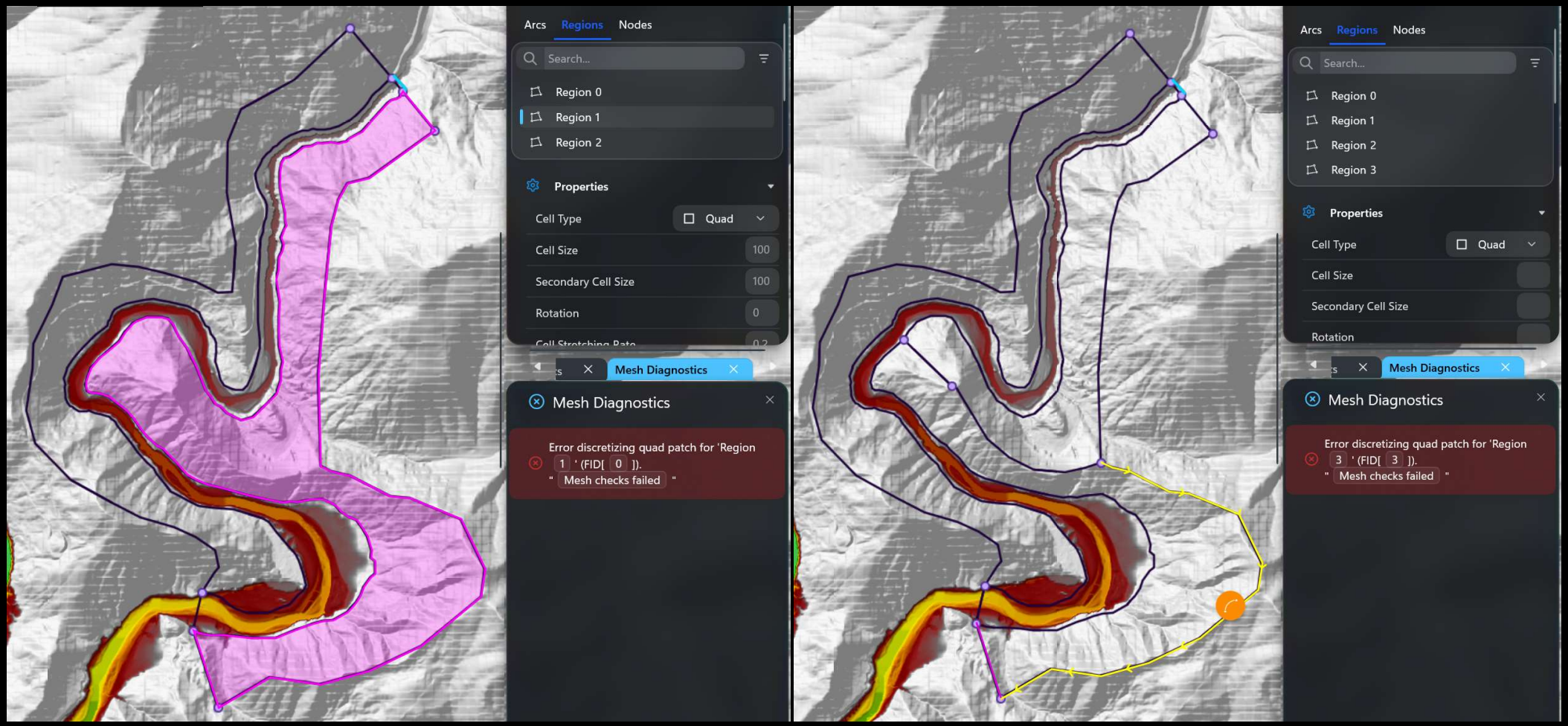




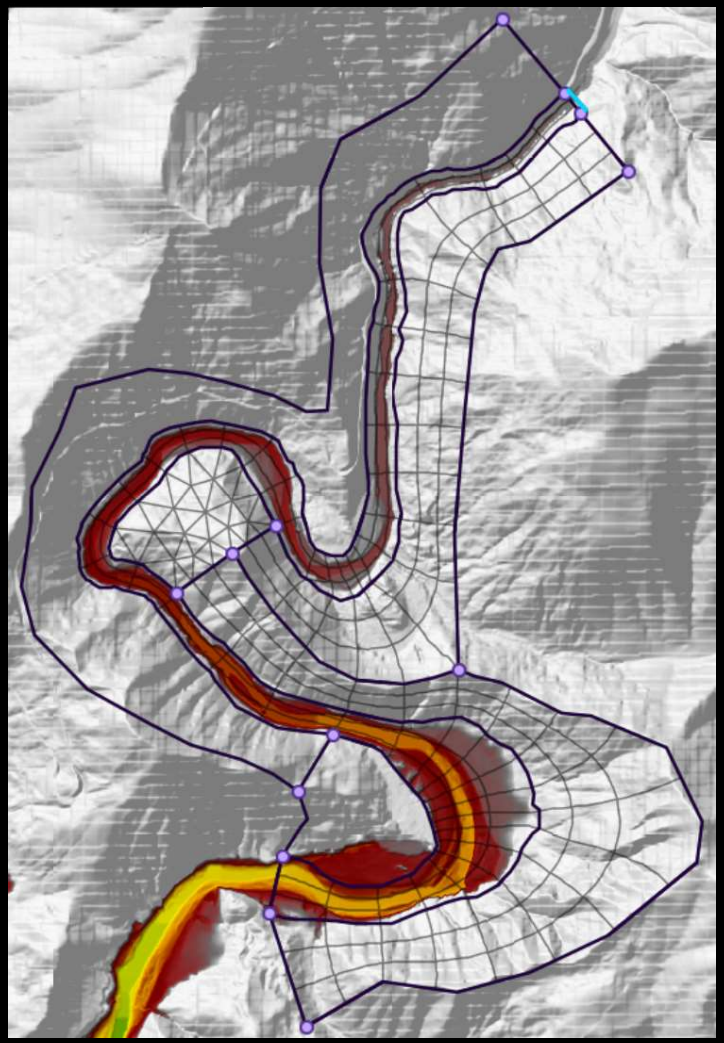
Meander Meshing

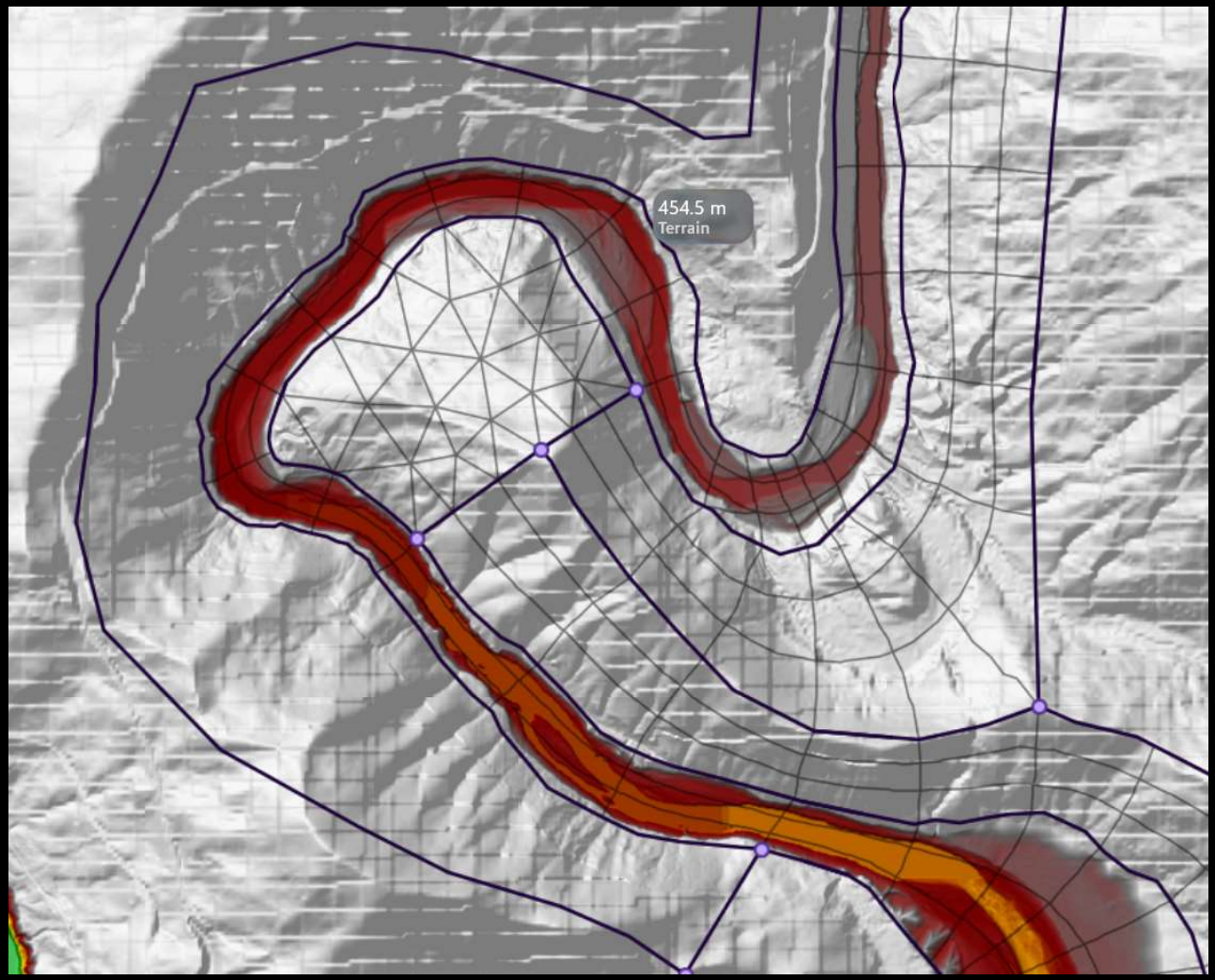


Hairpin Meanders

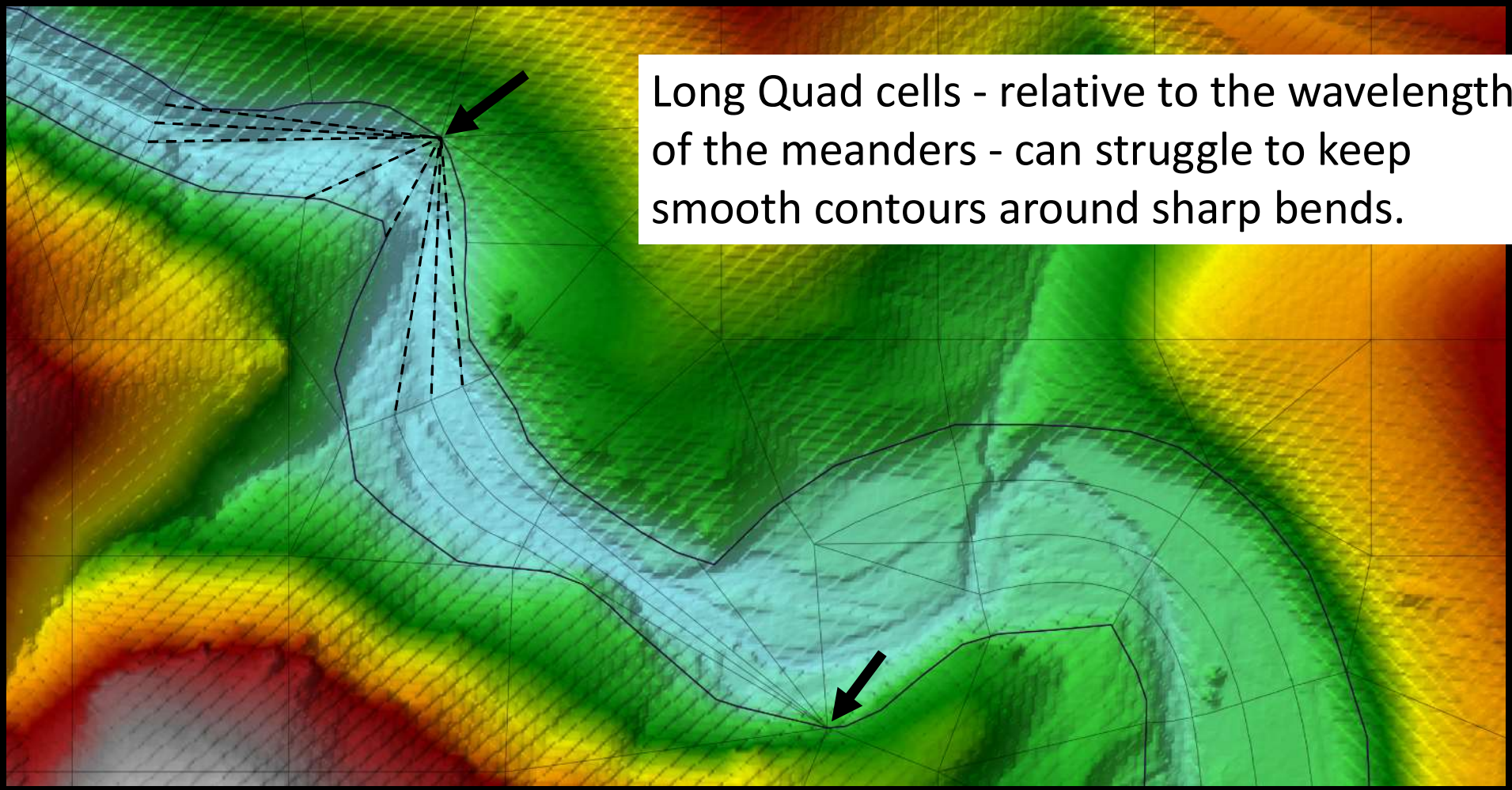


Common Applications: Hairpin Meanders





Meshing Trick: Computational Nodes Force Mesh Nodes



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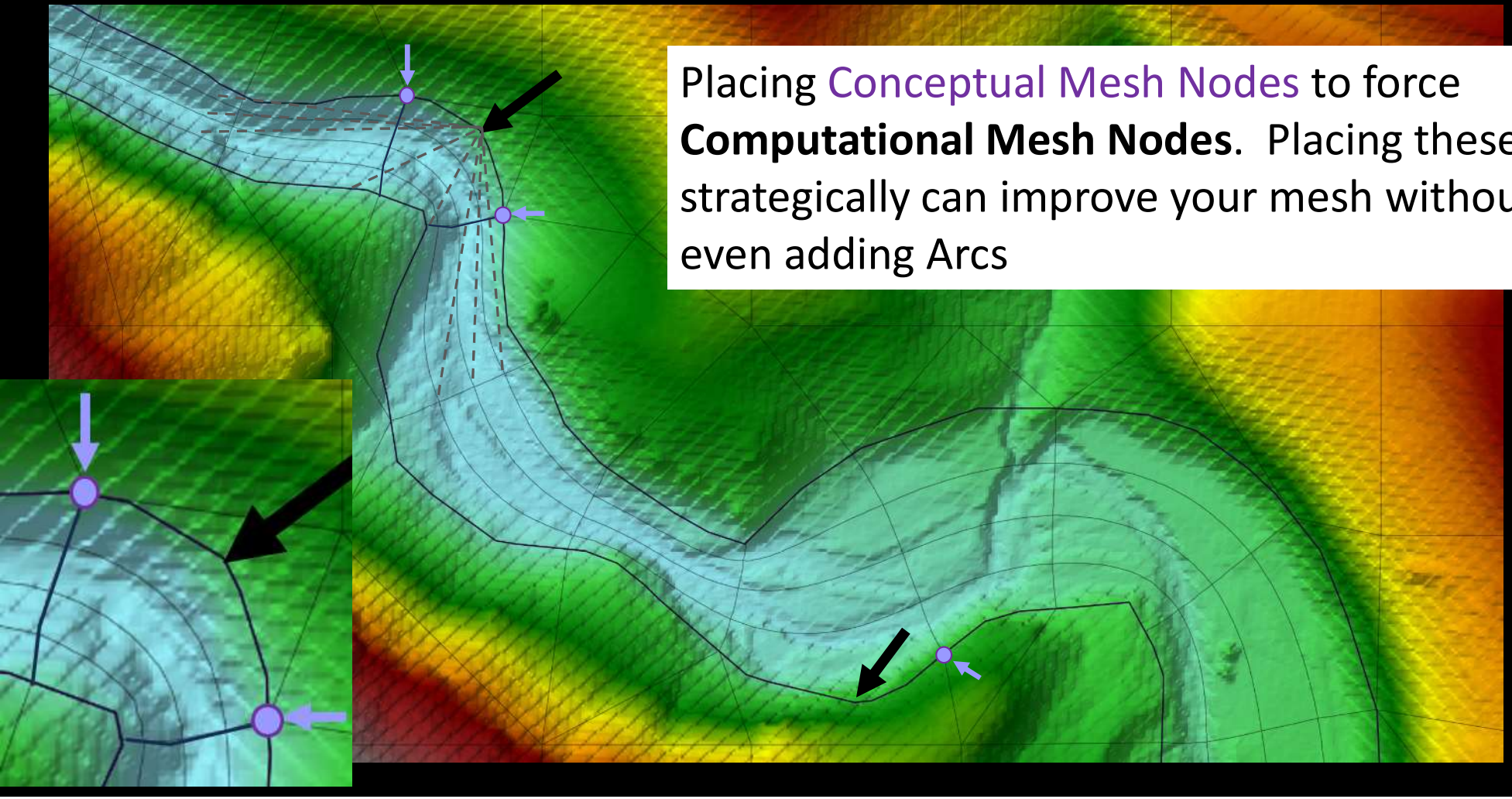
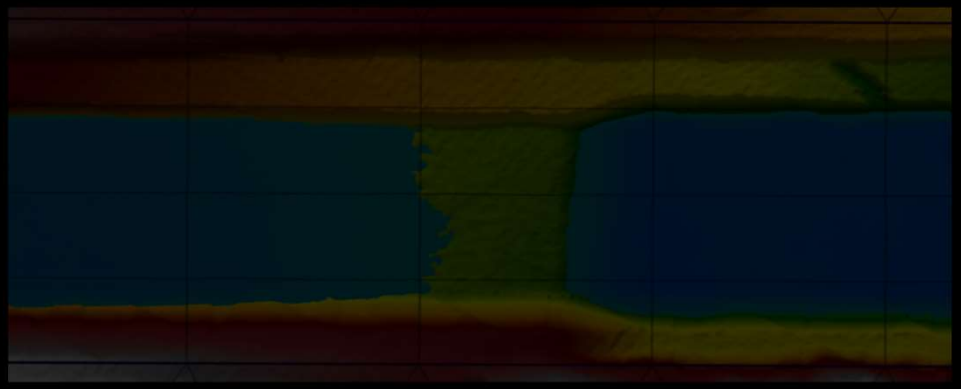


Placing Conceptual Mesh Nodes to force **Computational Mesh Nodes**. Placing these strategically can improve your mesh without even adding Arcs

Common Meshing Applications



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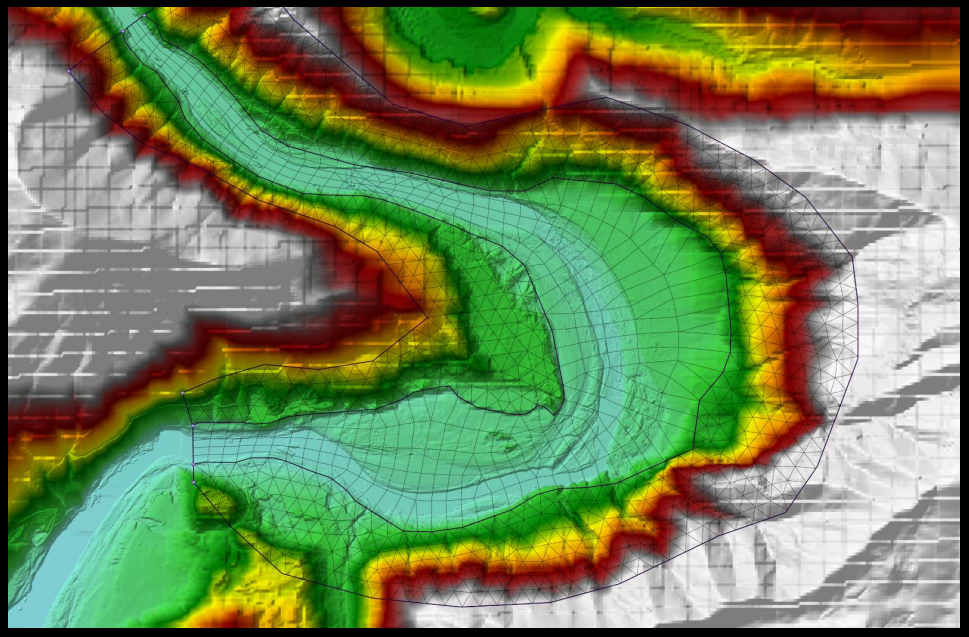

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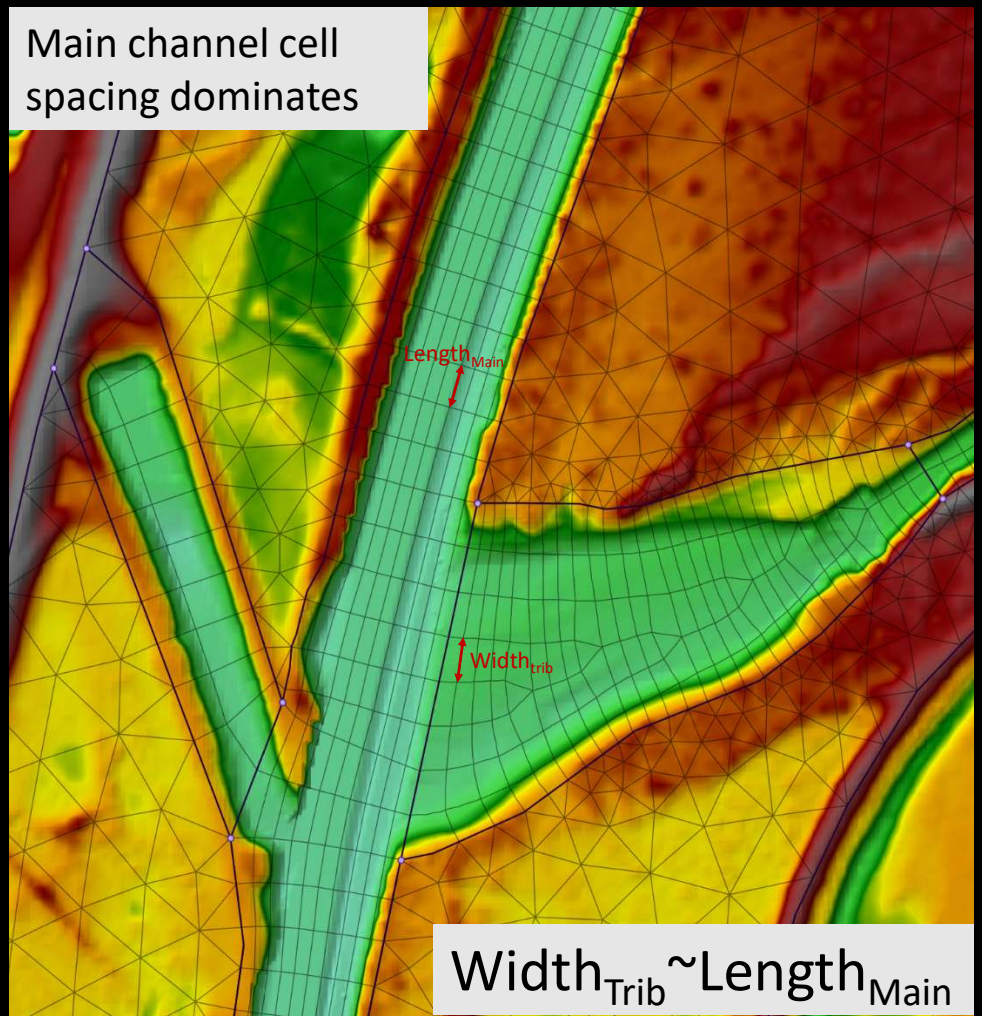
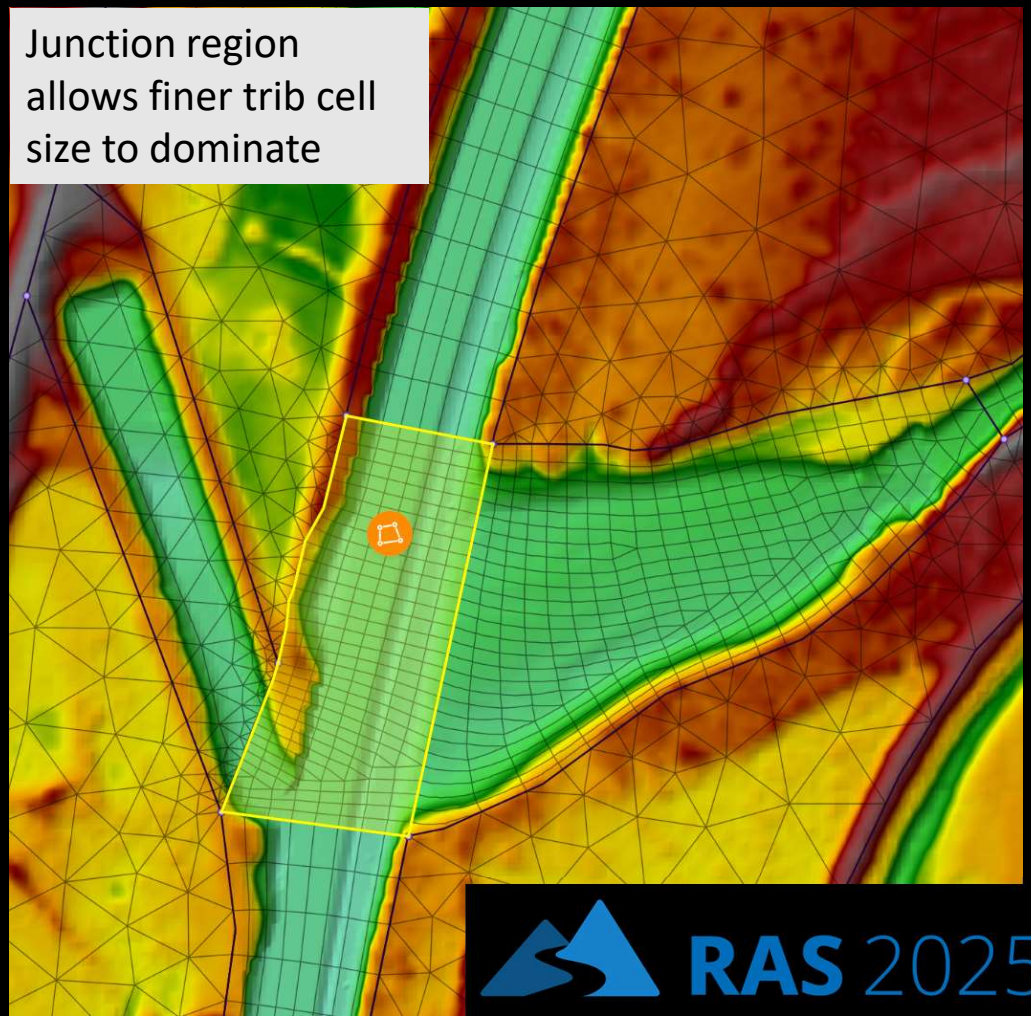
Common Applications: Tributaries

Main channel cell spacing dominates



$Width_{Trib}$~$Length_{Main}$

Junction region allows finer trib cell size to dominate



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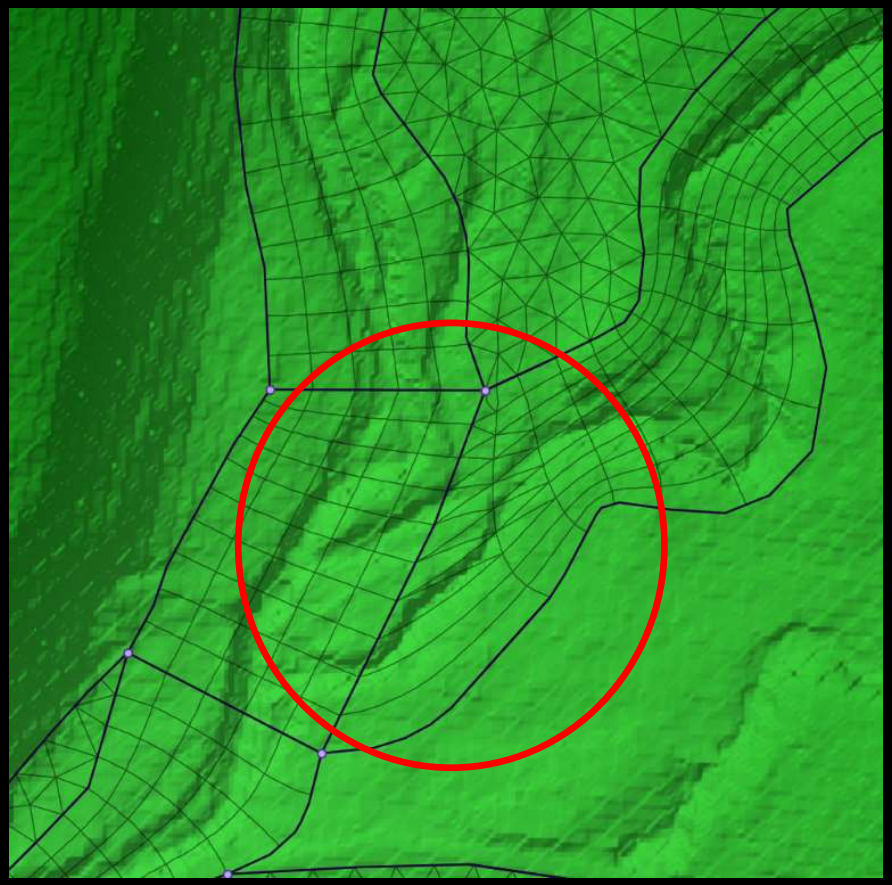
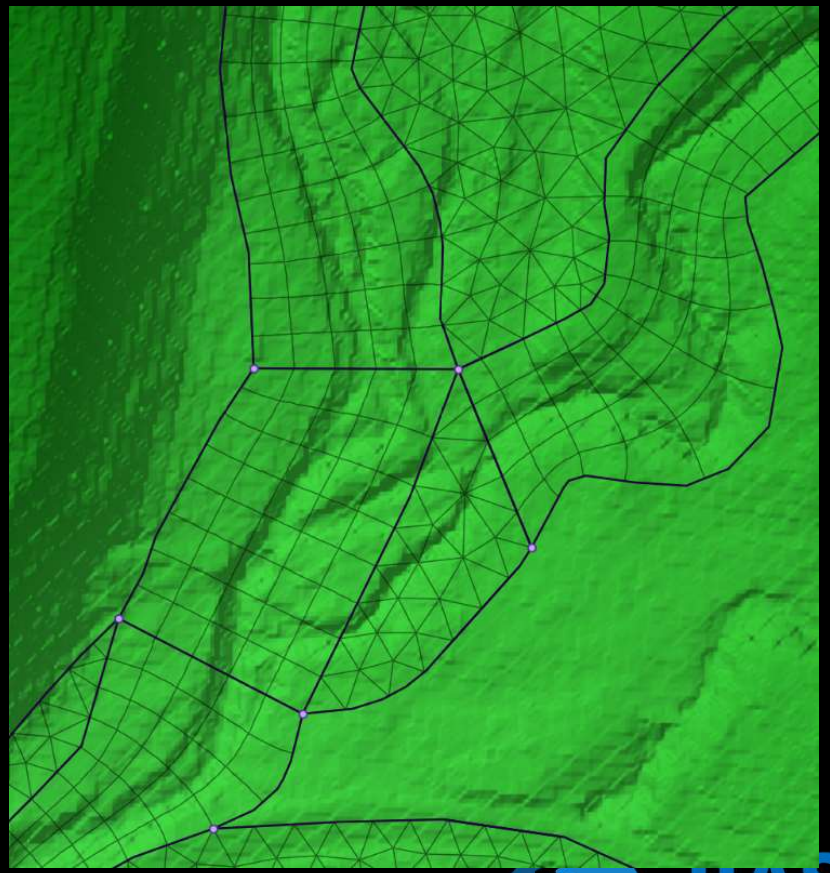
Common Applications: Tributaries

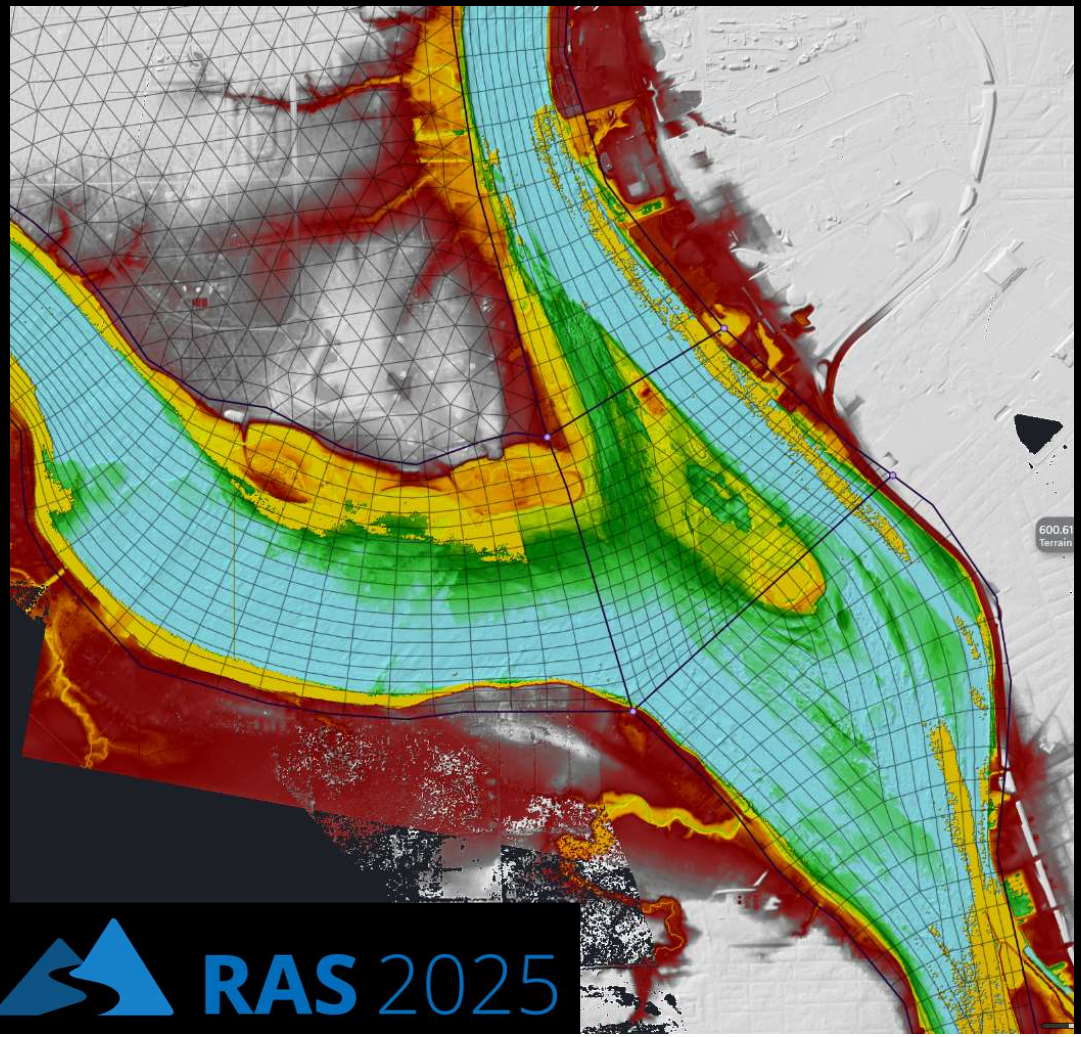
- **Problematic junctions**

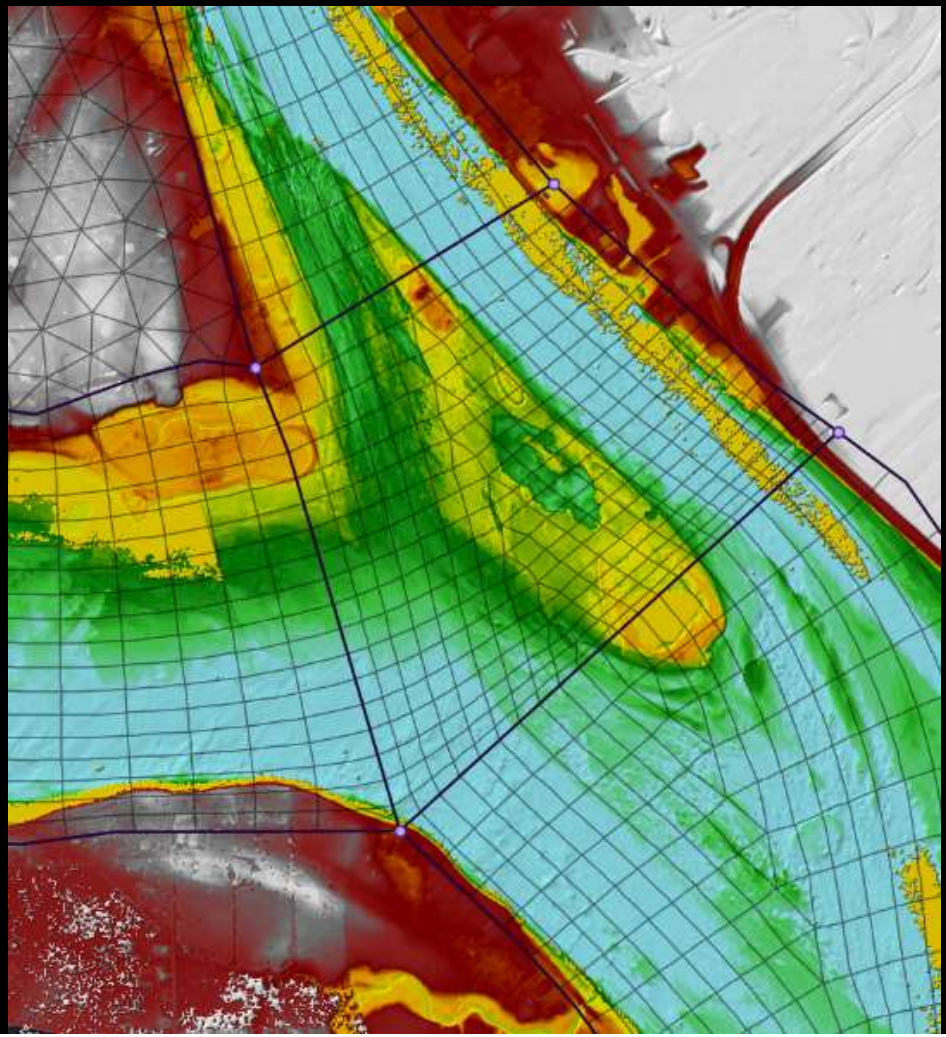


- **Insert triangular transition region**



Common Applications: Tributaries/Splits





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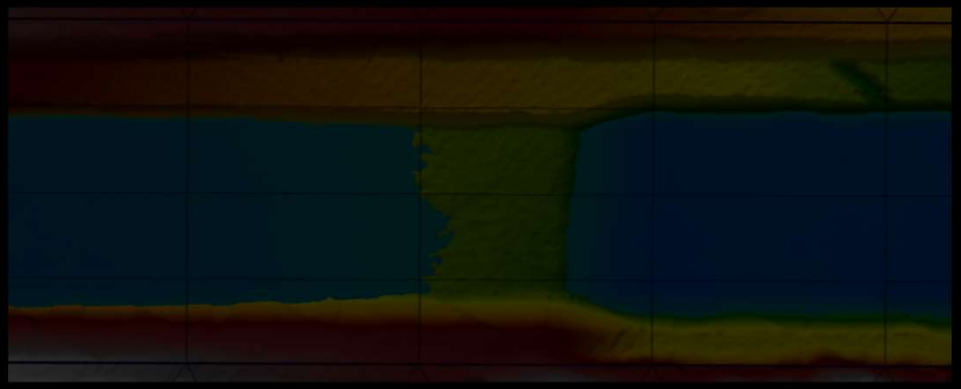

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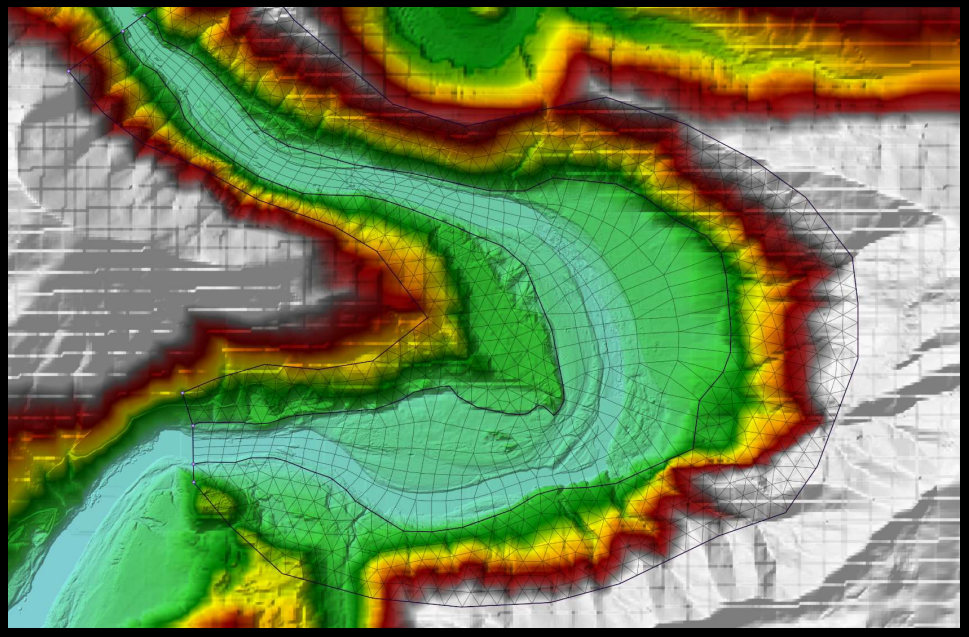

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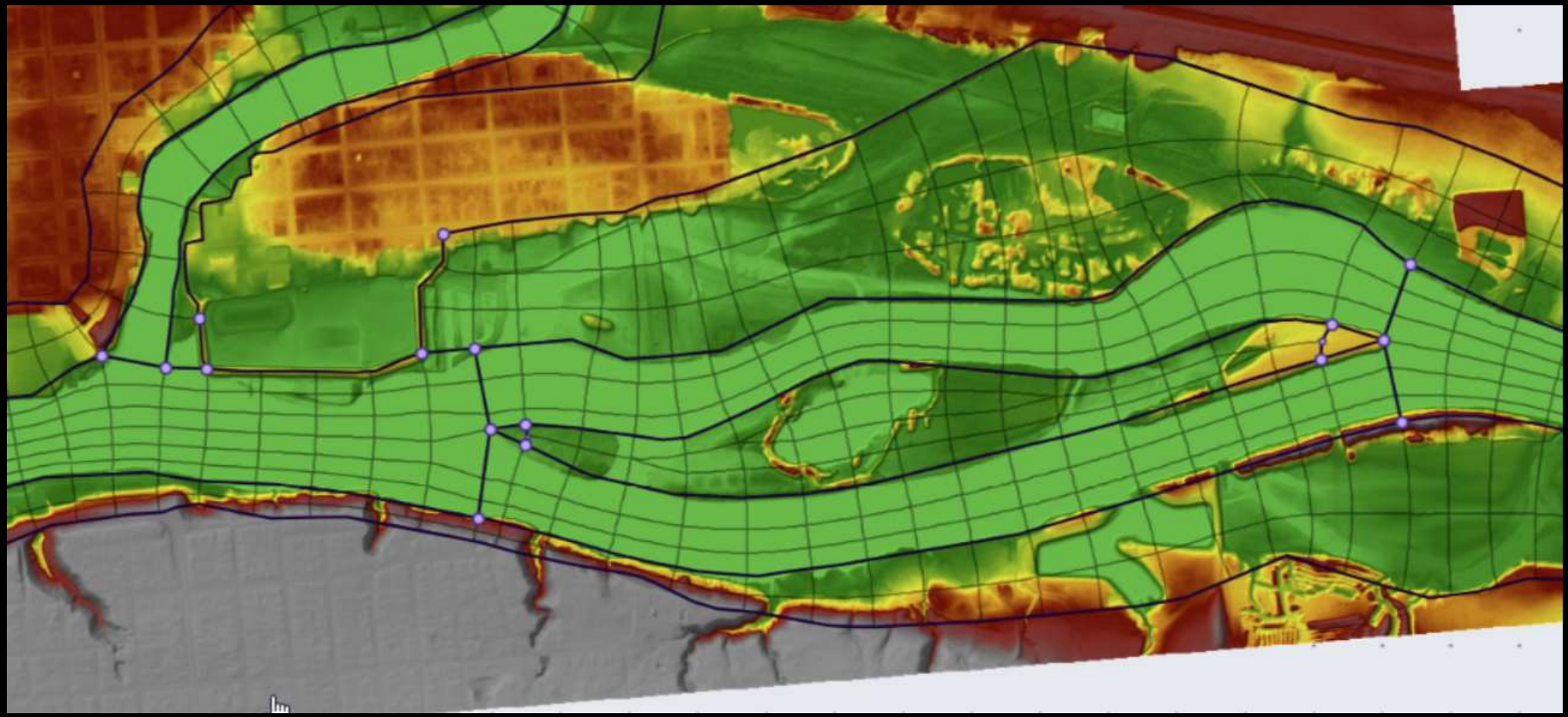
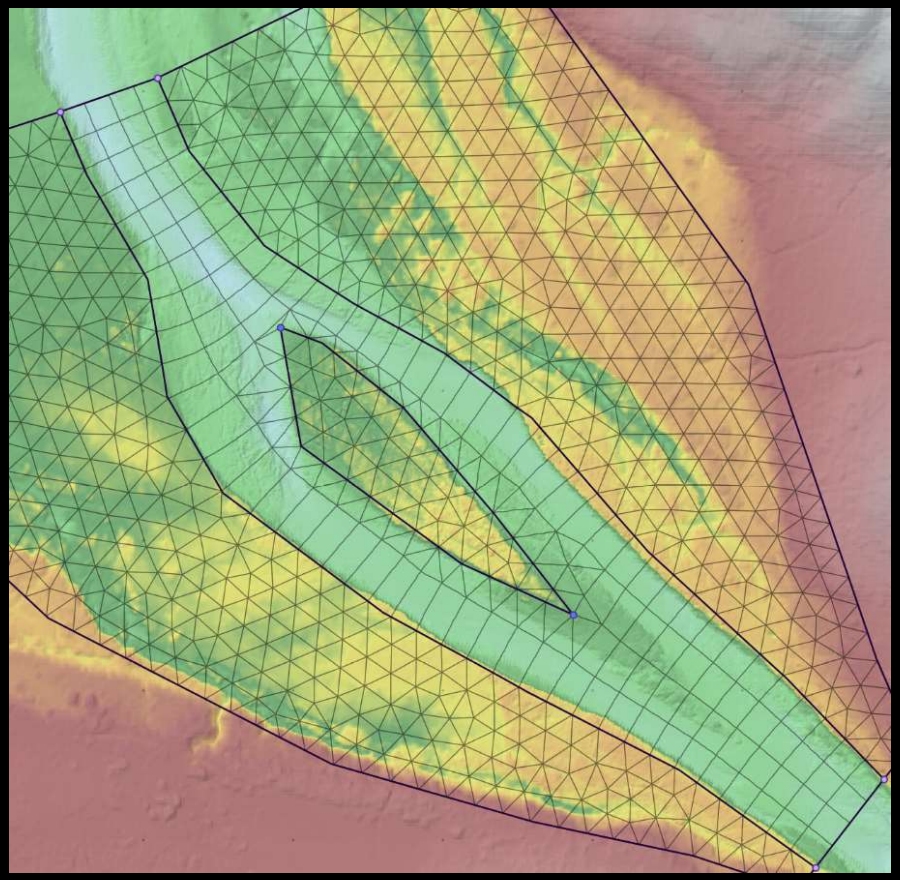
Modeling a Flow Split or Island

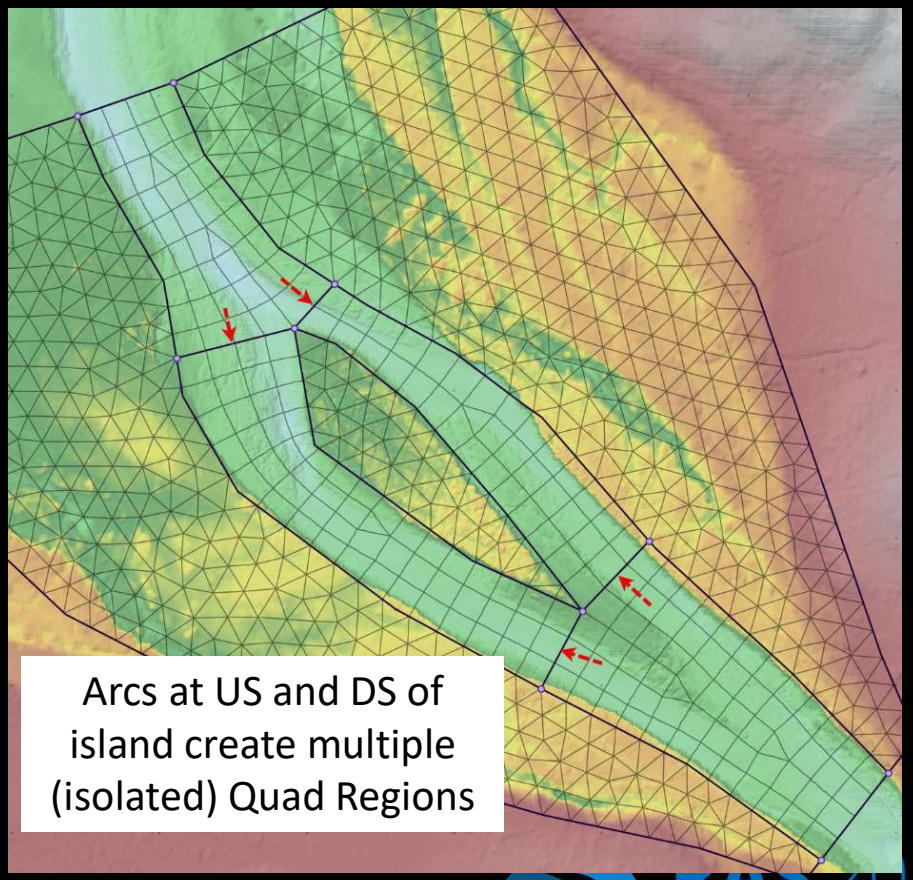


Modeling a Flow Split or Island

Less than desirable Quad Region



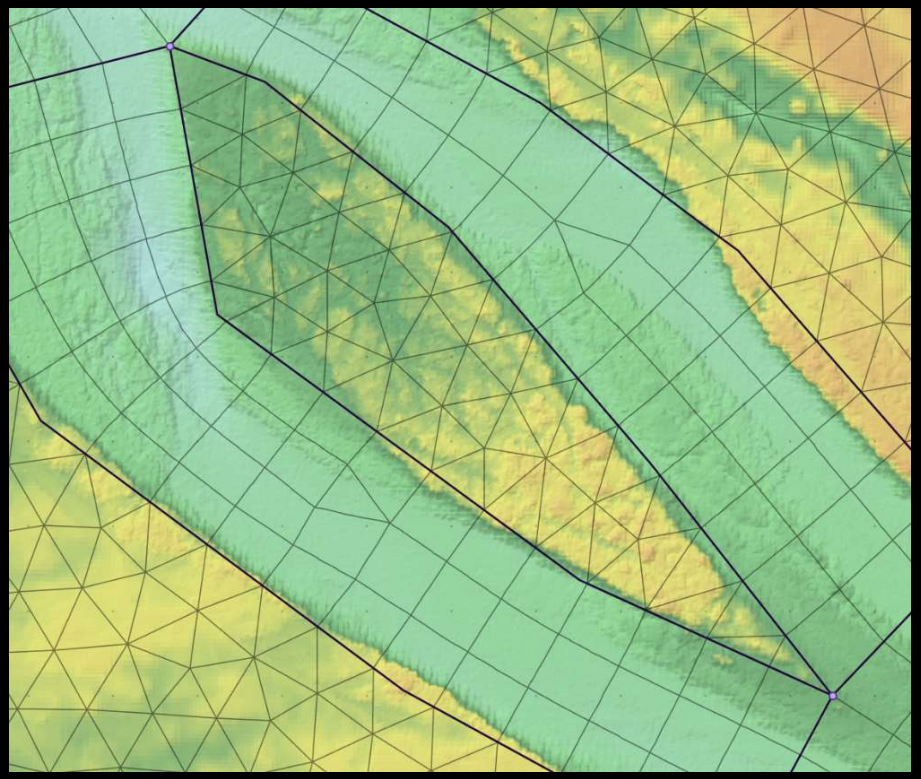
Much improved Quad Region



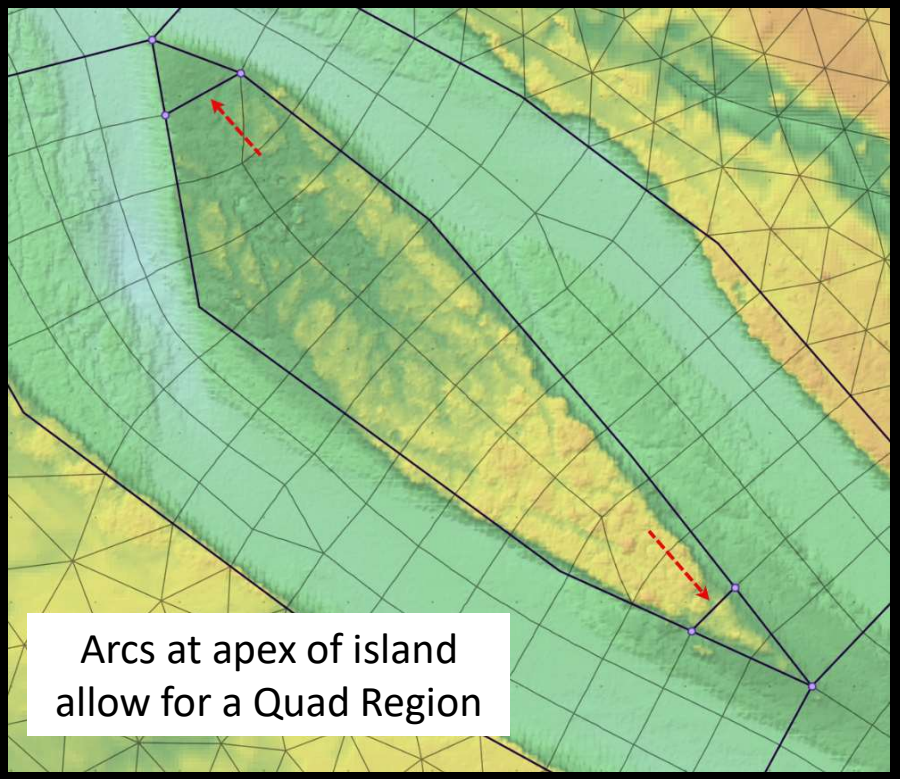
Arcs at US and DS of island create multiple (isolated) Quad Regions

Modeling a Flow Split or Island

Triangle Region for Island



Quad Region for Island



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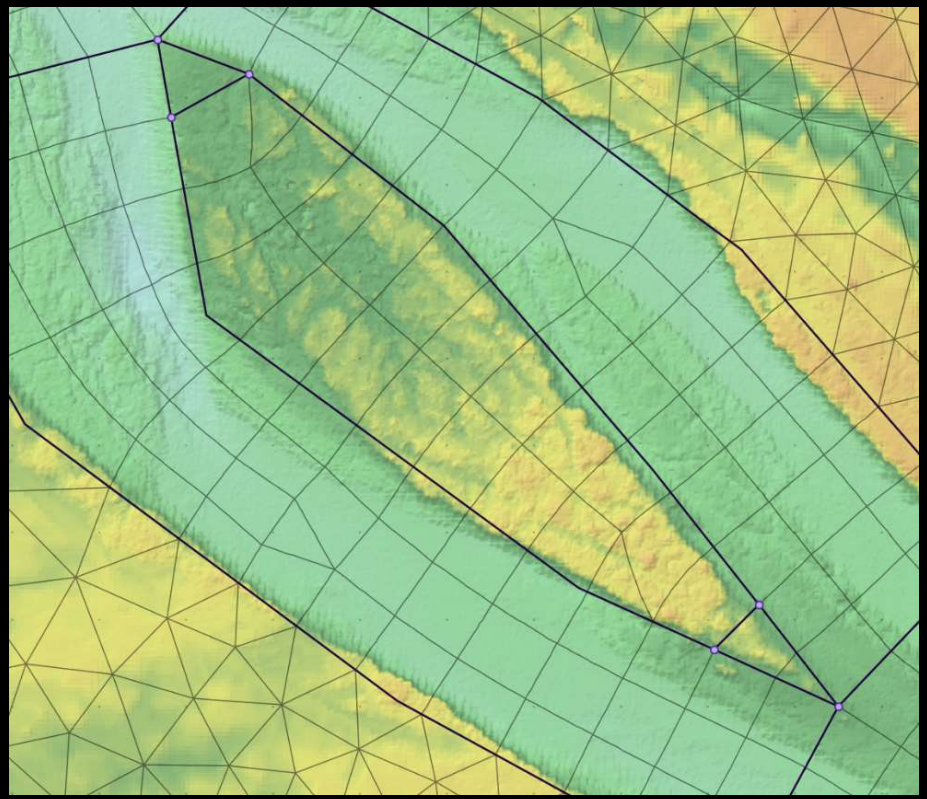

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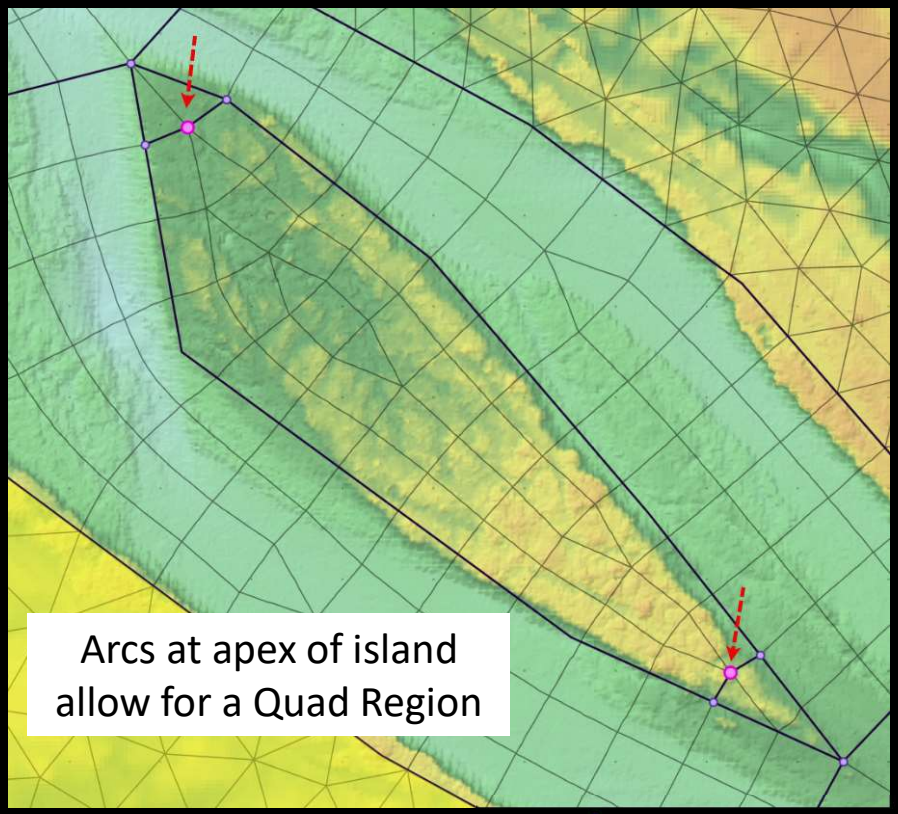

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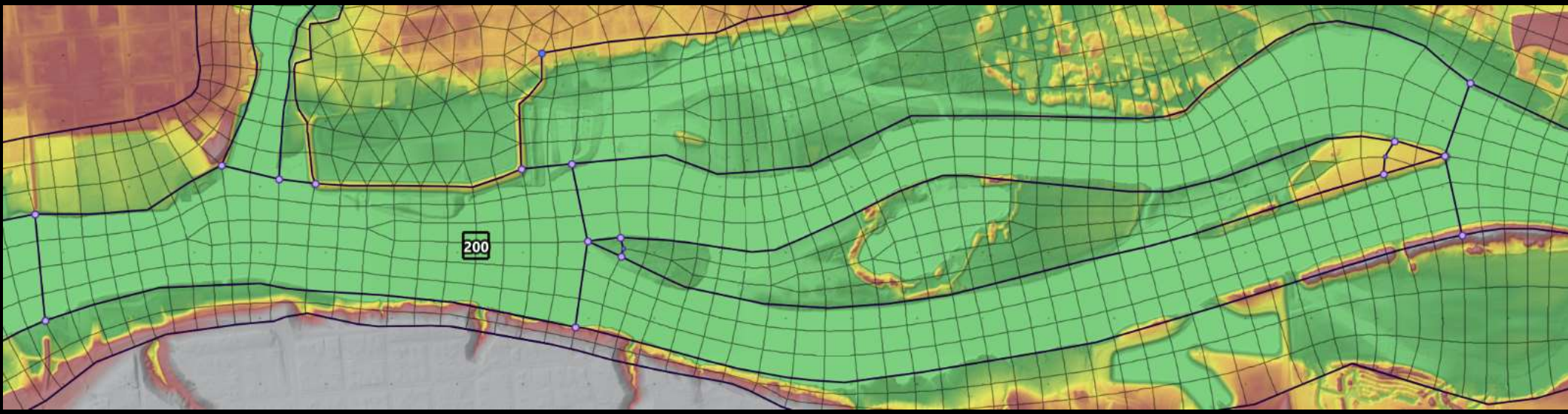
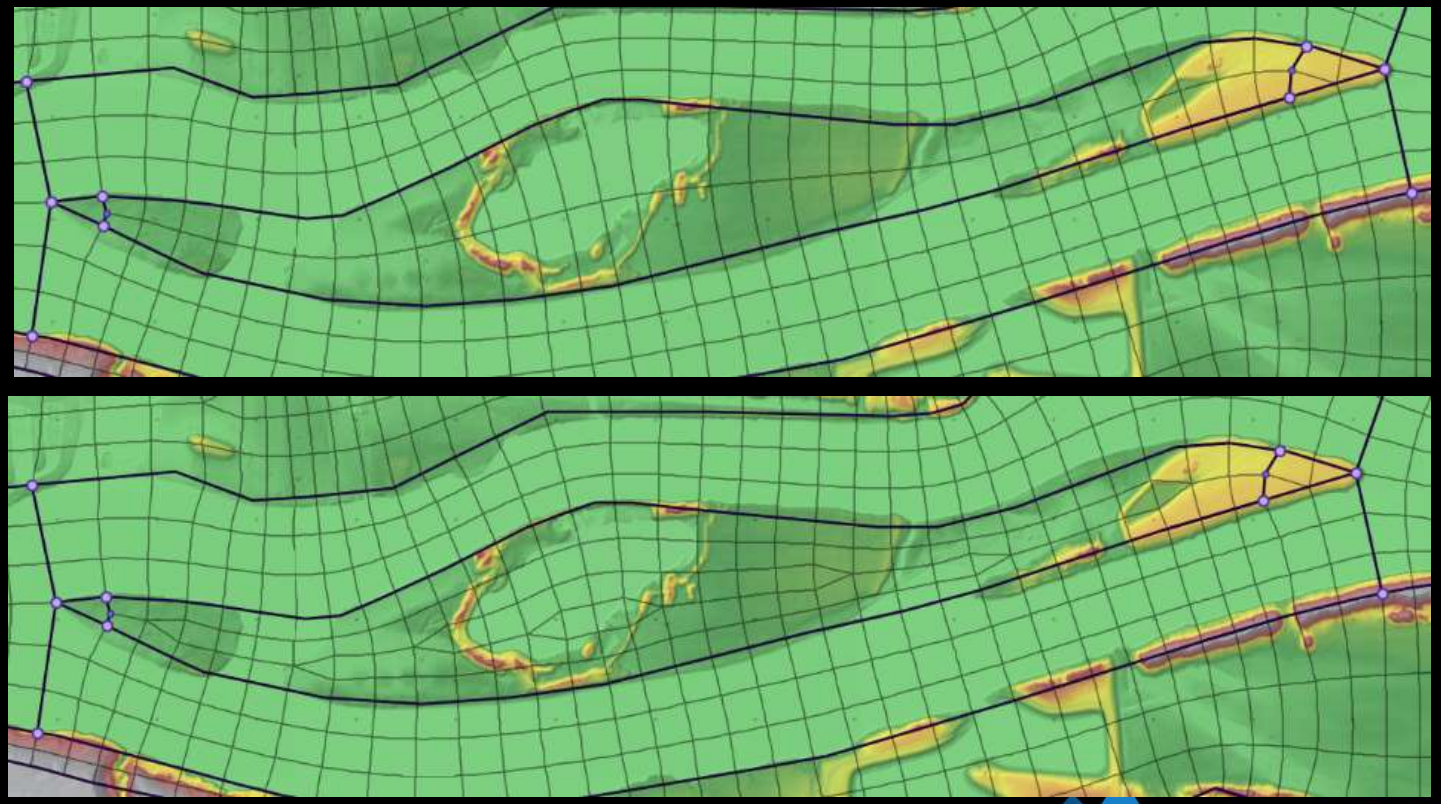
Modeling a Flow Split or Island

- Channel Quad is split into multiple Regions
- Cell Size – basic cell control
- Arc Count – forces “flow tubes”



Modeling a Flow Split or Island

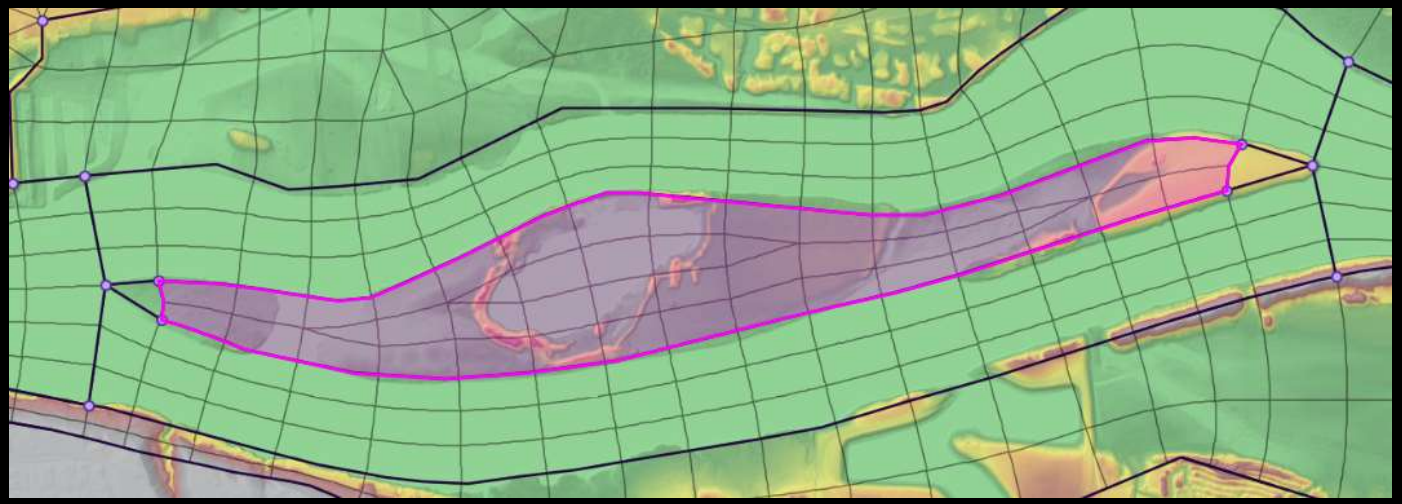
- Quad/Triangle Tolerance (1 = All Quads)
  - Tol = 1.0
  - Tol = 0.5

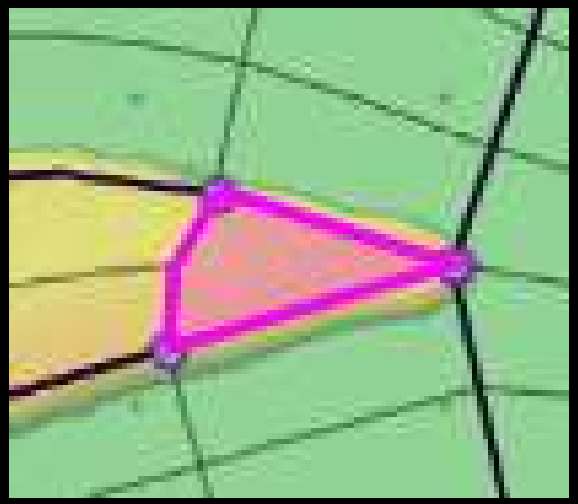


Modeling a Flow Split: Island Interior

- Separation Area – Small Region - Cartesian Mesh Type
  - Cell should be Convex, with large cell size to get 1 cell
  - RemoveFaces(Threshold=1.0) Post-processor option - no triangles
- Interior Area - Quad Mesh Type
  - End Arcs – Count = 2
  - Transition – Quad/Triangle Tolerance <1.0

Quad/Triangle Tolerance	0.7
Post Processor Opt	RemoveFaces(threshold=1)





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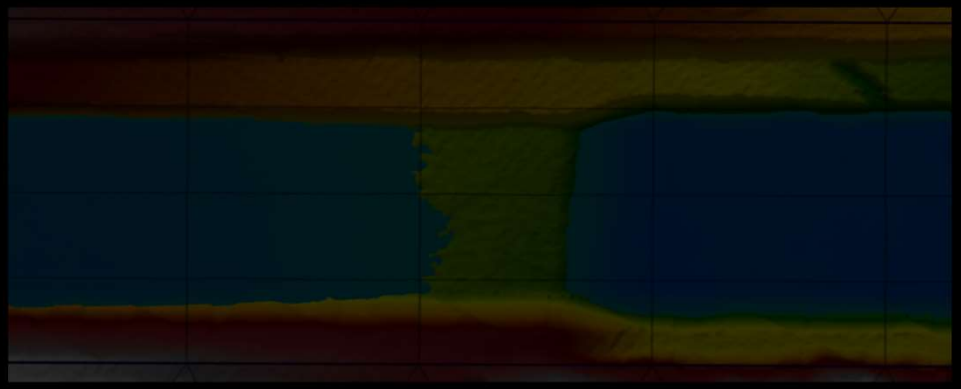

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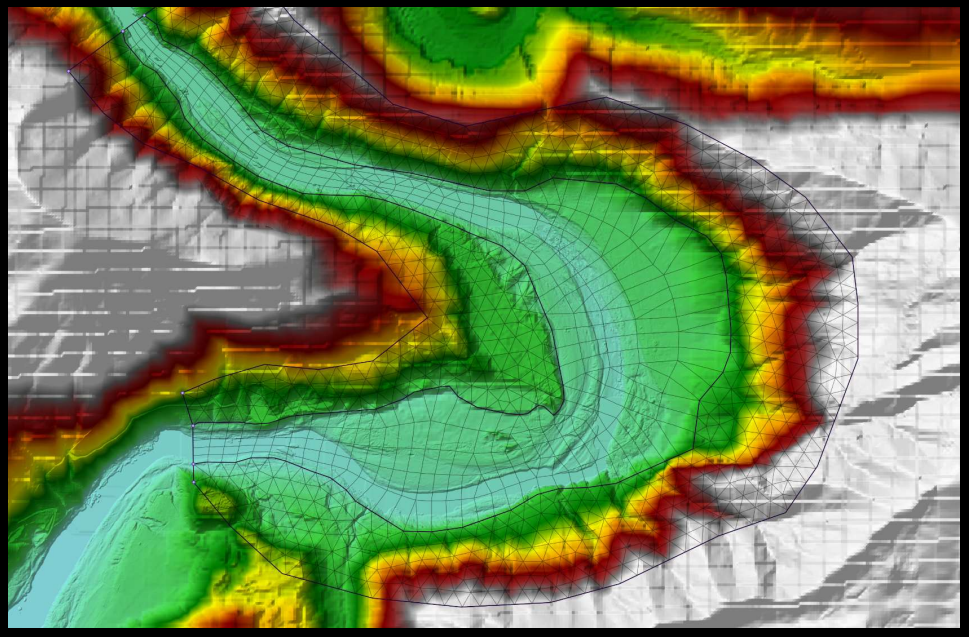

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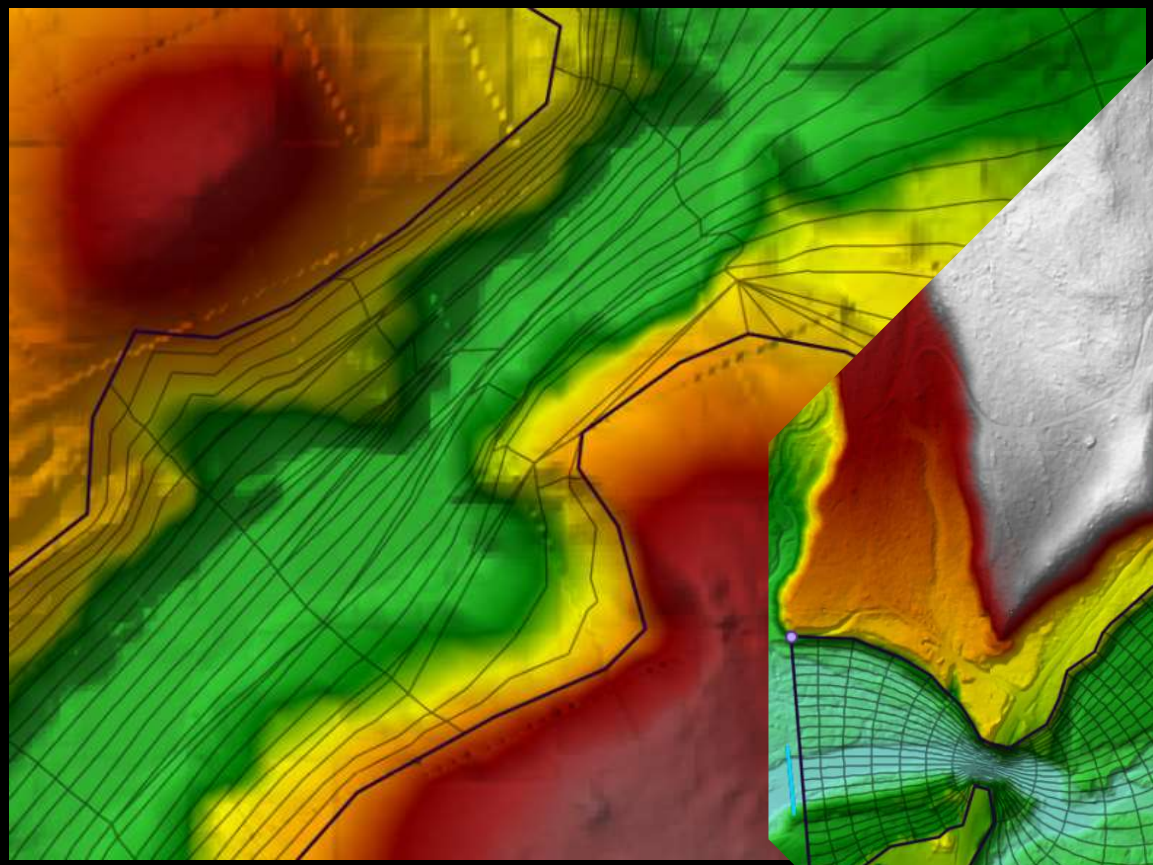
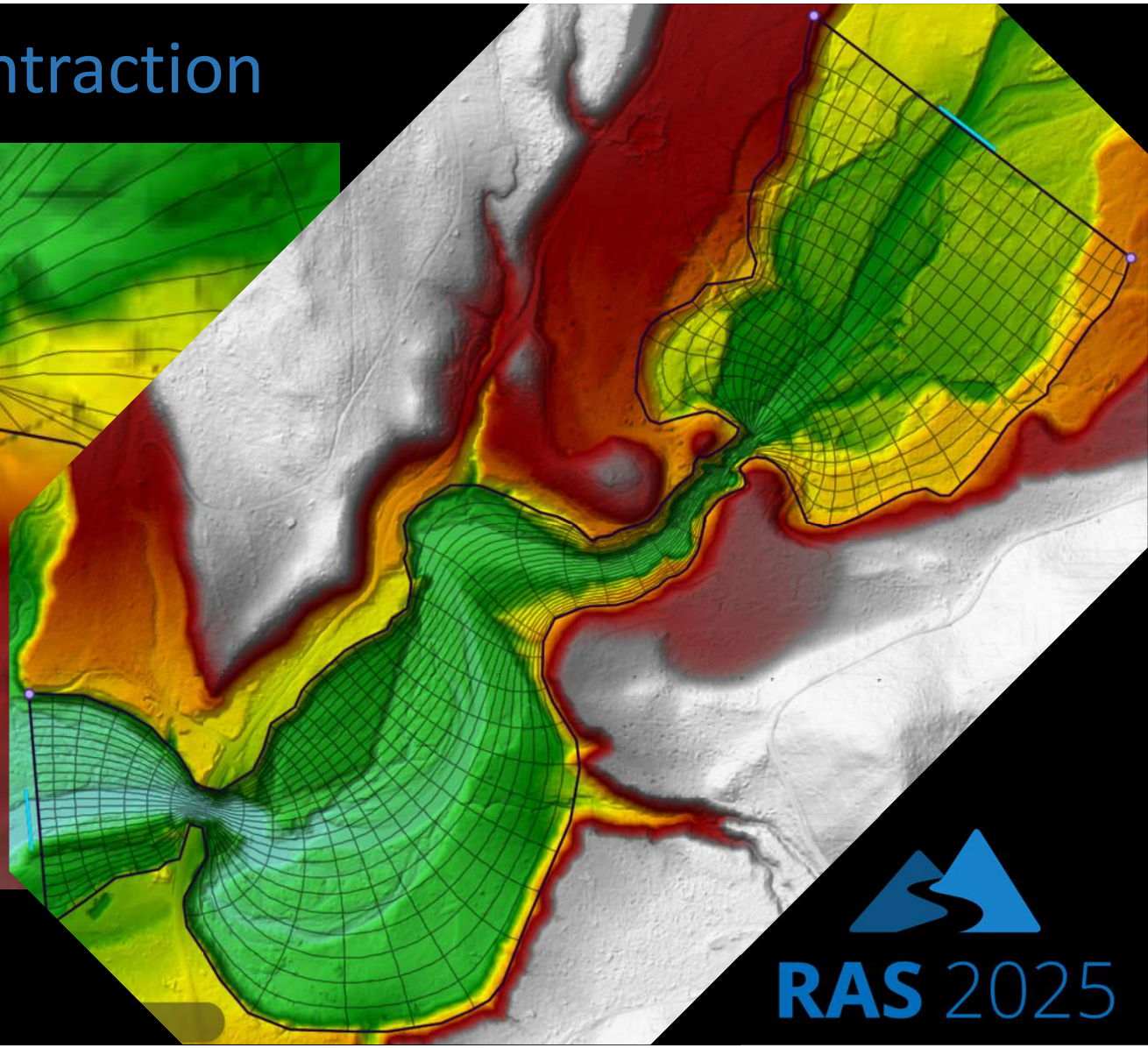
Expansion/Contraction





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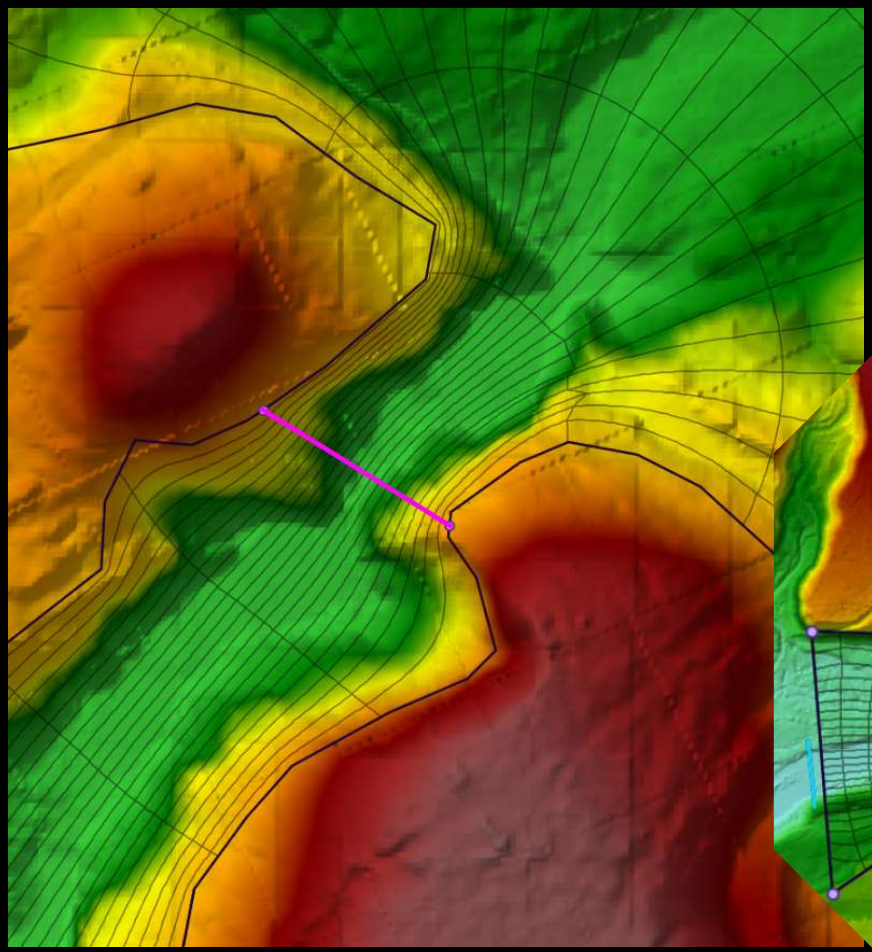
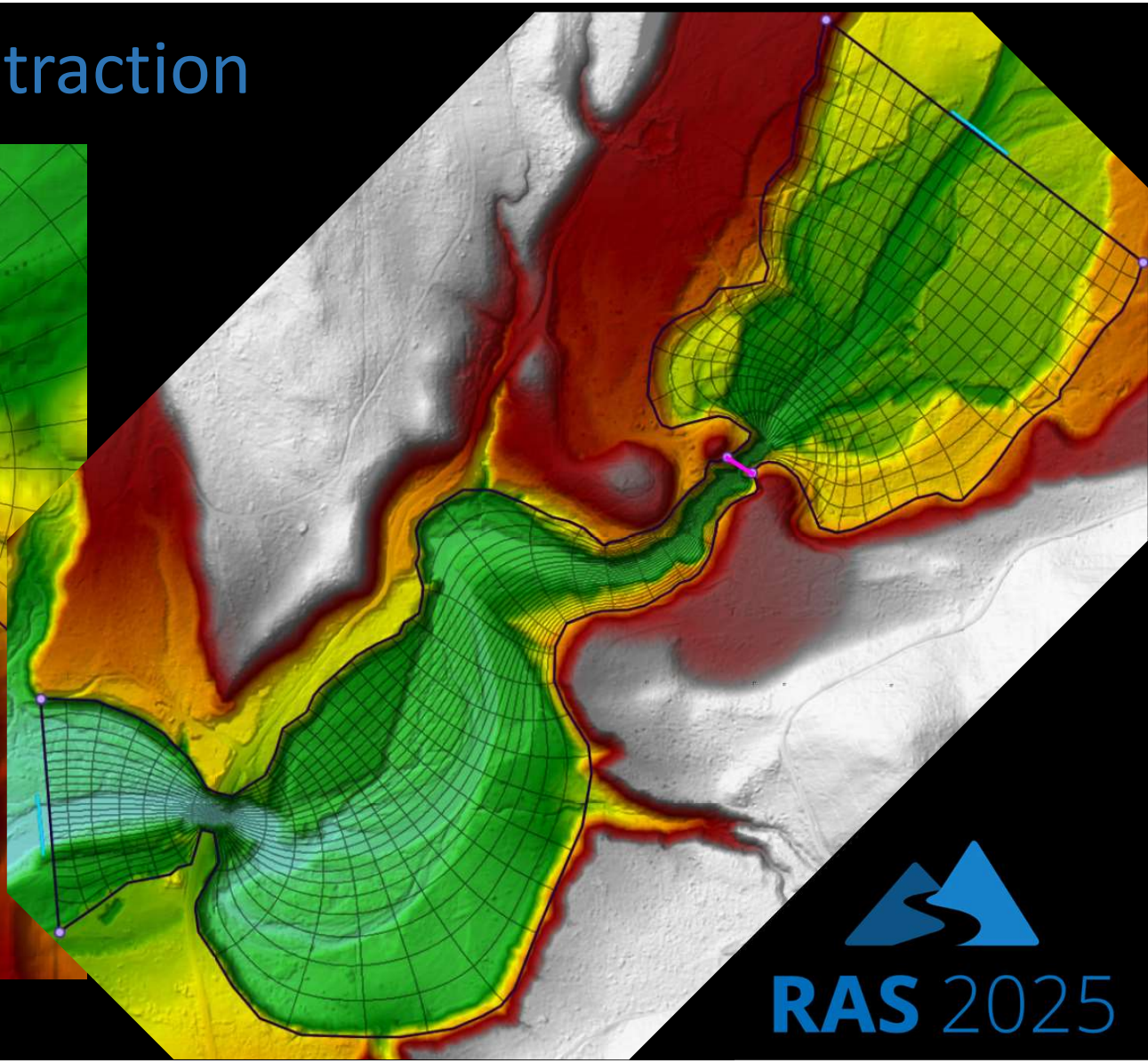
Expansion/Contraction





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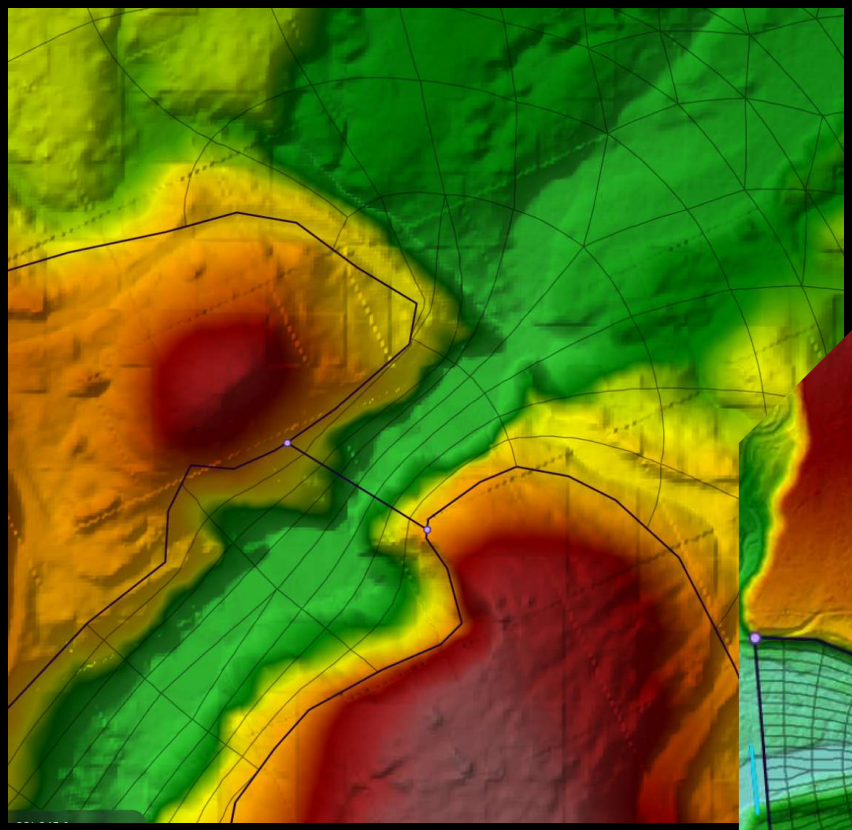

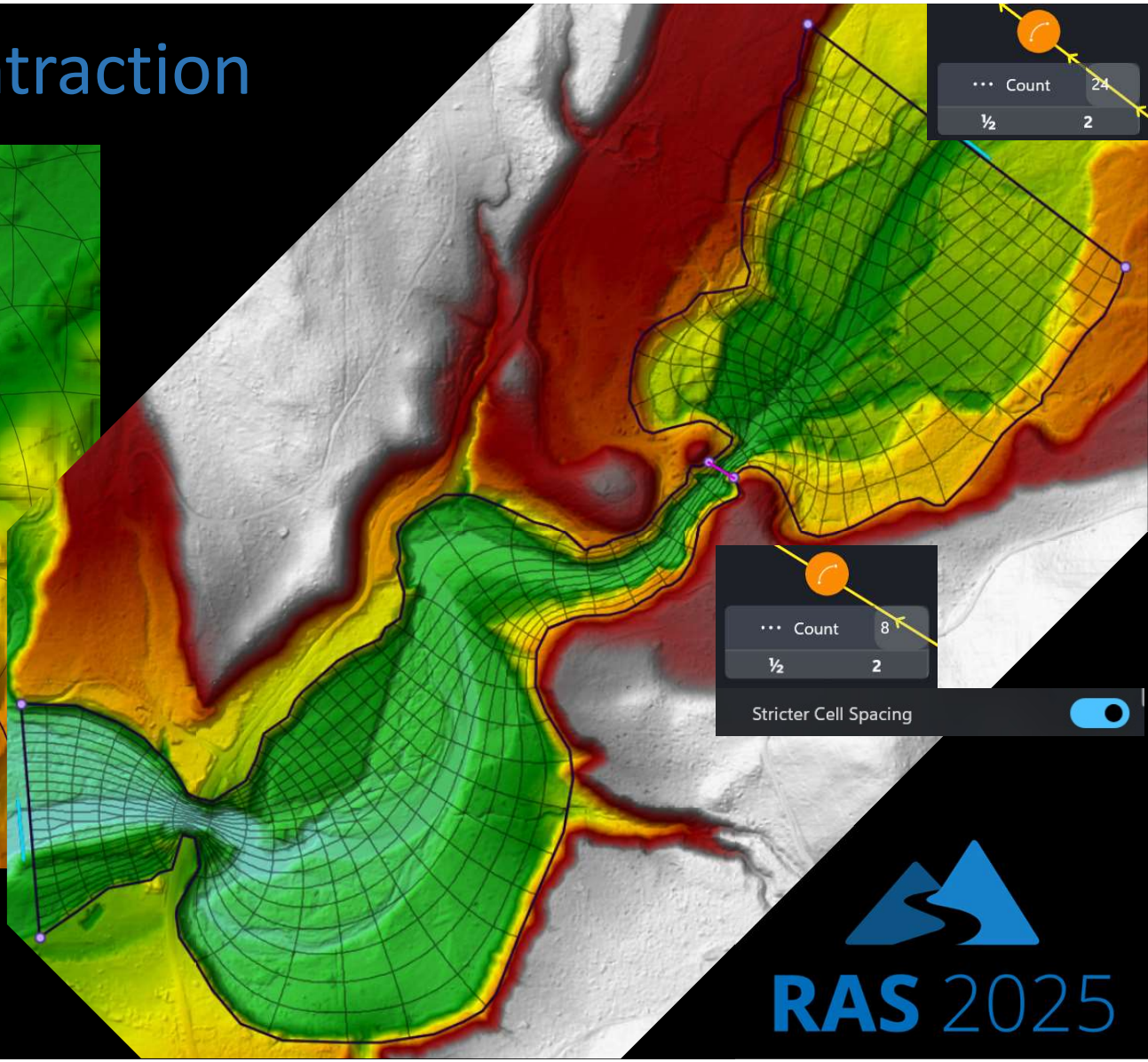

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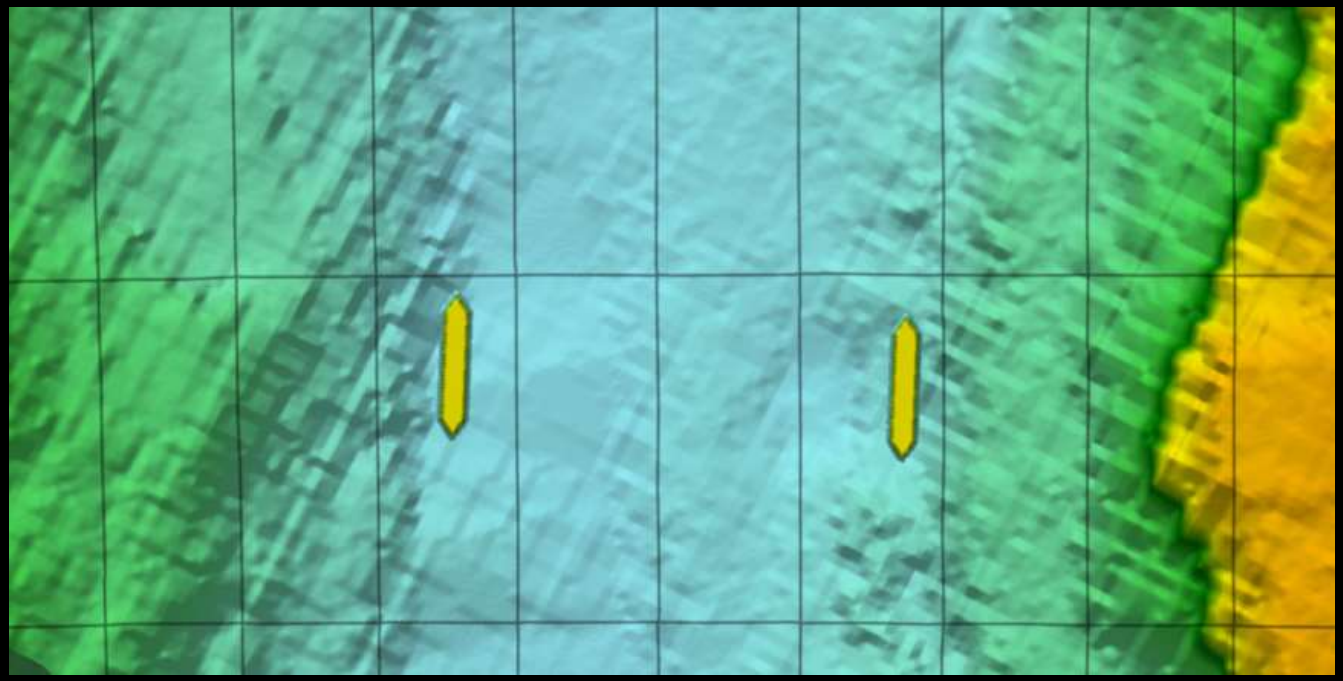
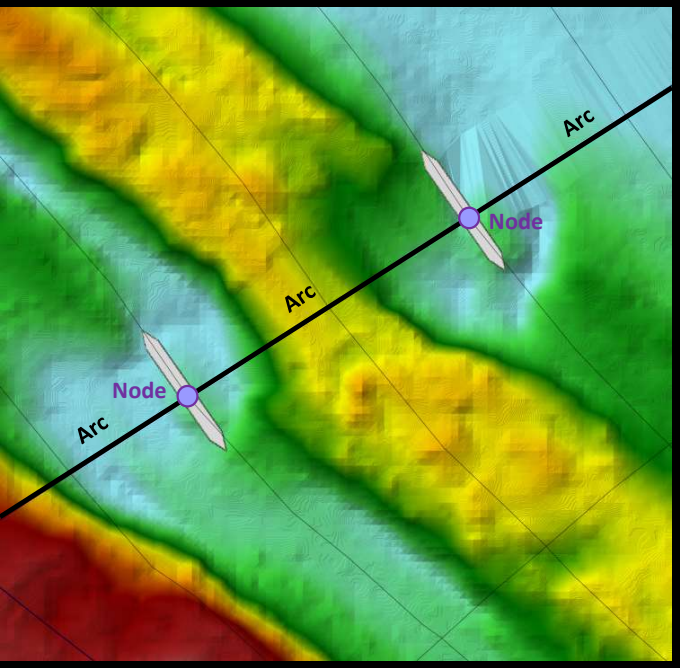
Quad Limitations and Special Cases: Piers

What's wrong with this mesh?



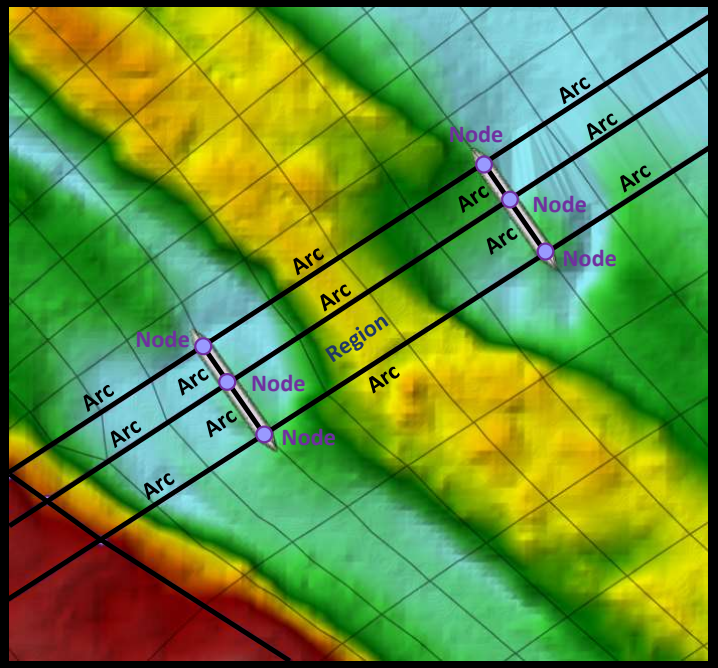
Three Pier Meshing Approaches

Cells >> Piers



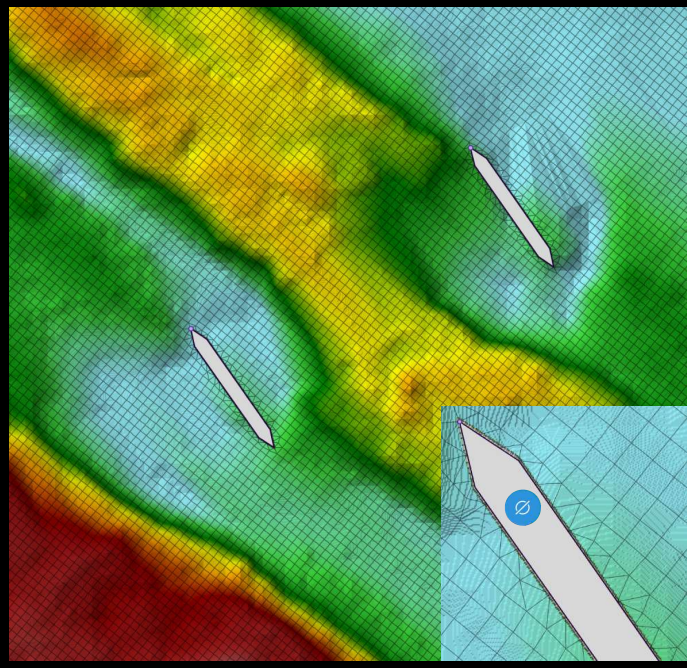
When you need pier losses in a regional-scale model but don't want tiny bridge cells to control the time step, represent the bridge with a single centerline Arc and one Node at the pier center.

Cells ~ Piers

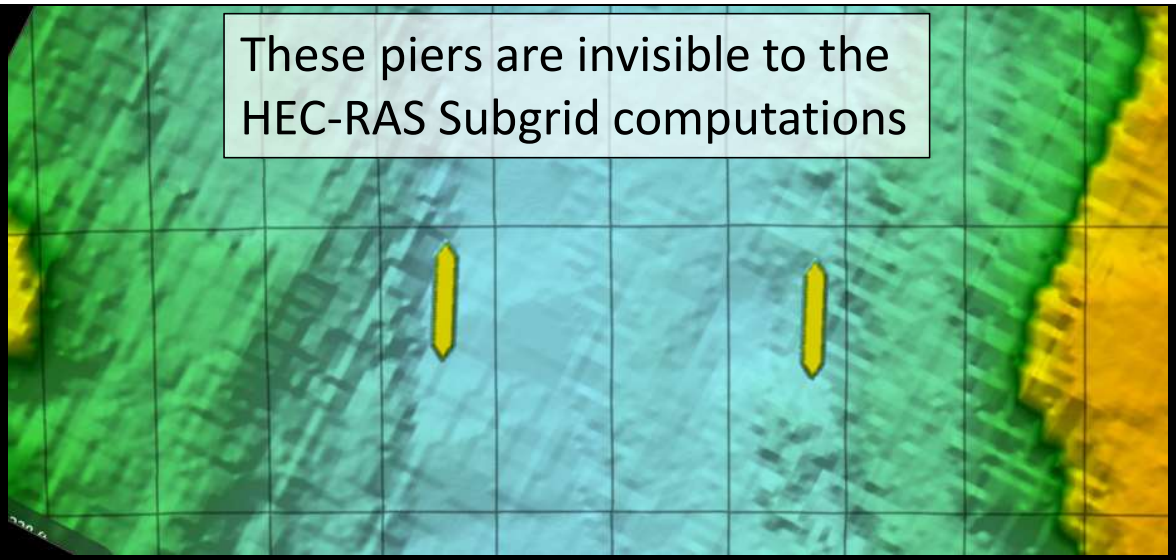


When cell size through the bridge is similar to pier size, you can project the pier width and length by connecting the nodes at the center and ends of the piers with Arcs to form internal bridge Regions.

Cells << Piers



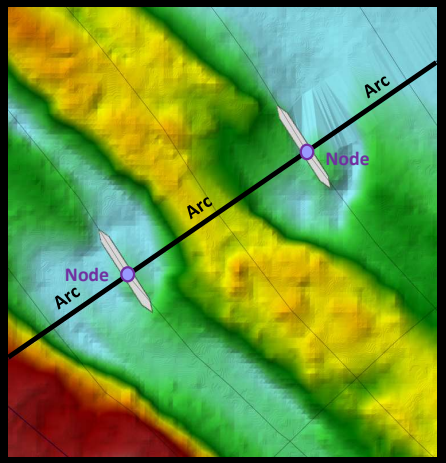
When detailed velocities through the bridge are important, define the piers with a blank Region. The mesh will use small triangles that conform to the pier shape to transition to the flow-field mesh.

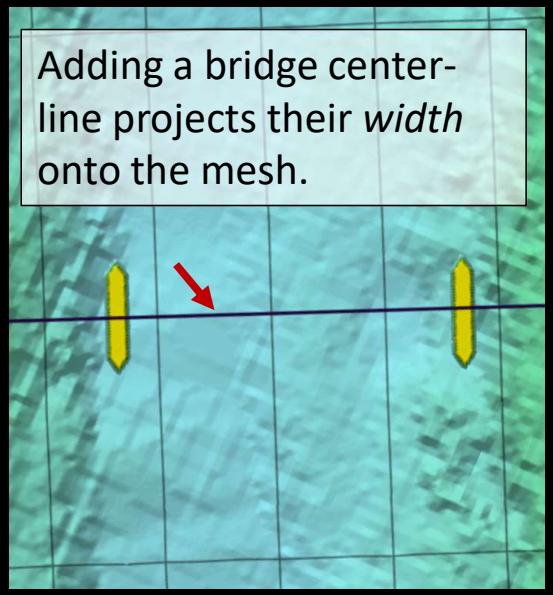


A simple method to include piers in a RAS2025 mesh

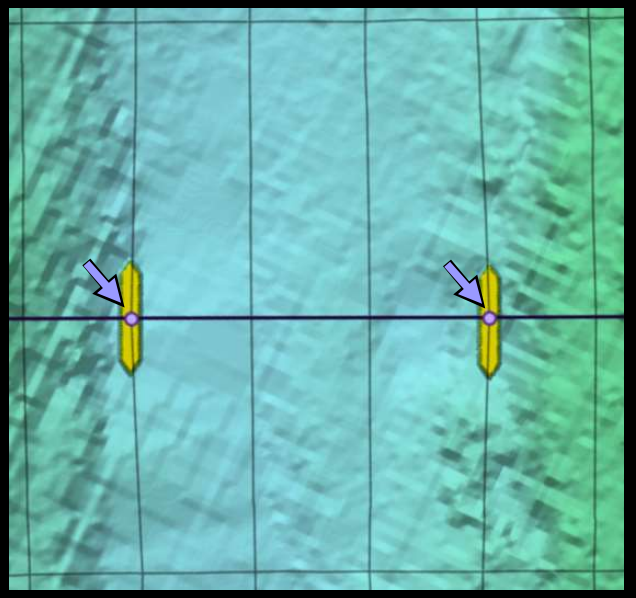
(if cell size > pier size)

Cells >> Piers



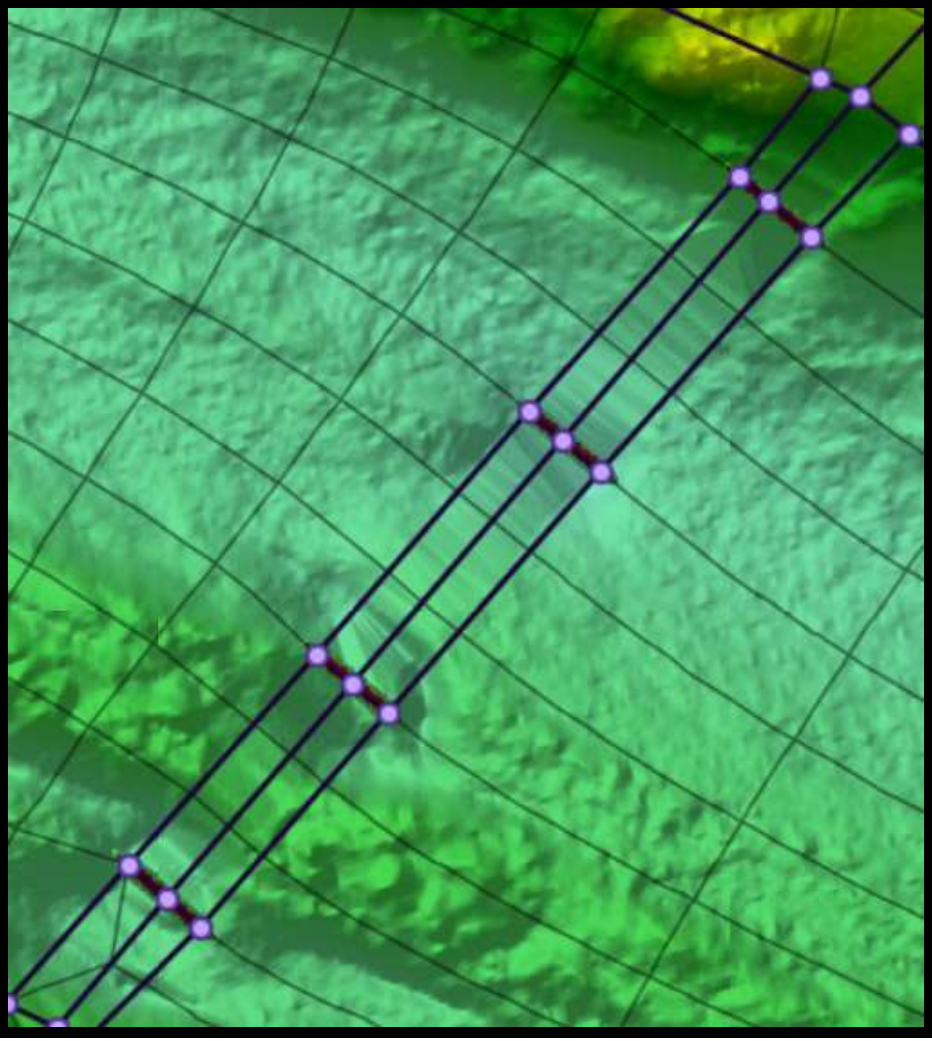


But dropping nodes at the center of the piers will force the mesh to pass through them…



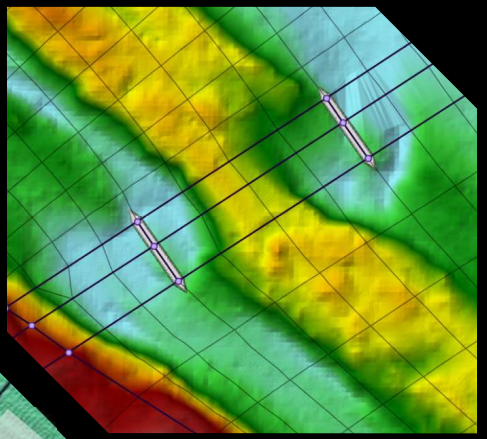
…often aligning cell faces along their *length*, projecting the pier obstruction onto those faces.

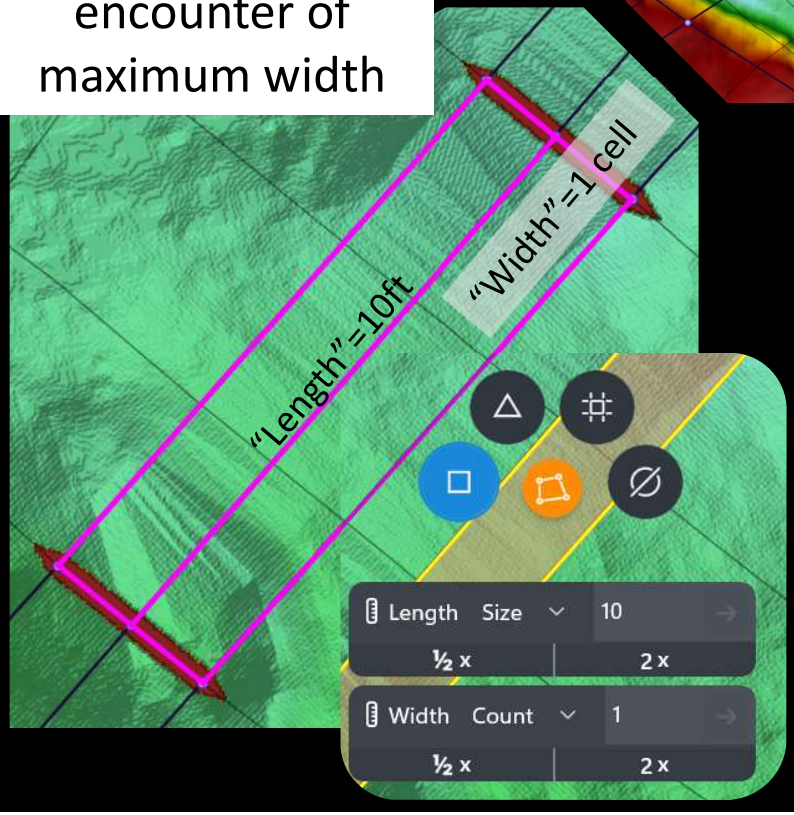
Three Pier Meshing Approaches



Intersects at first encounter of maximum width

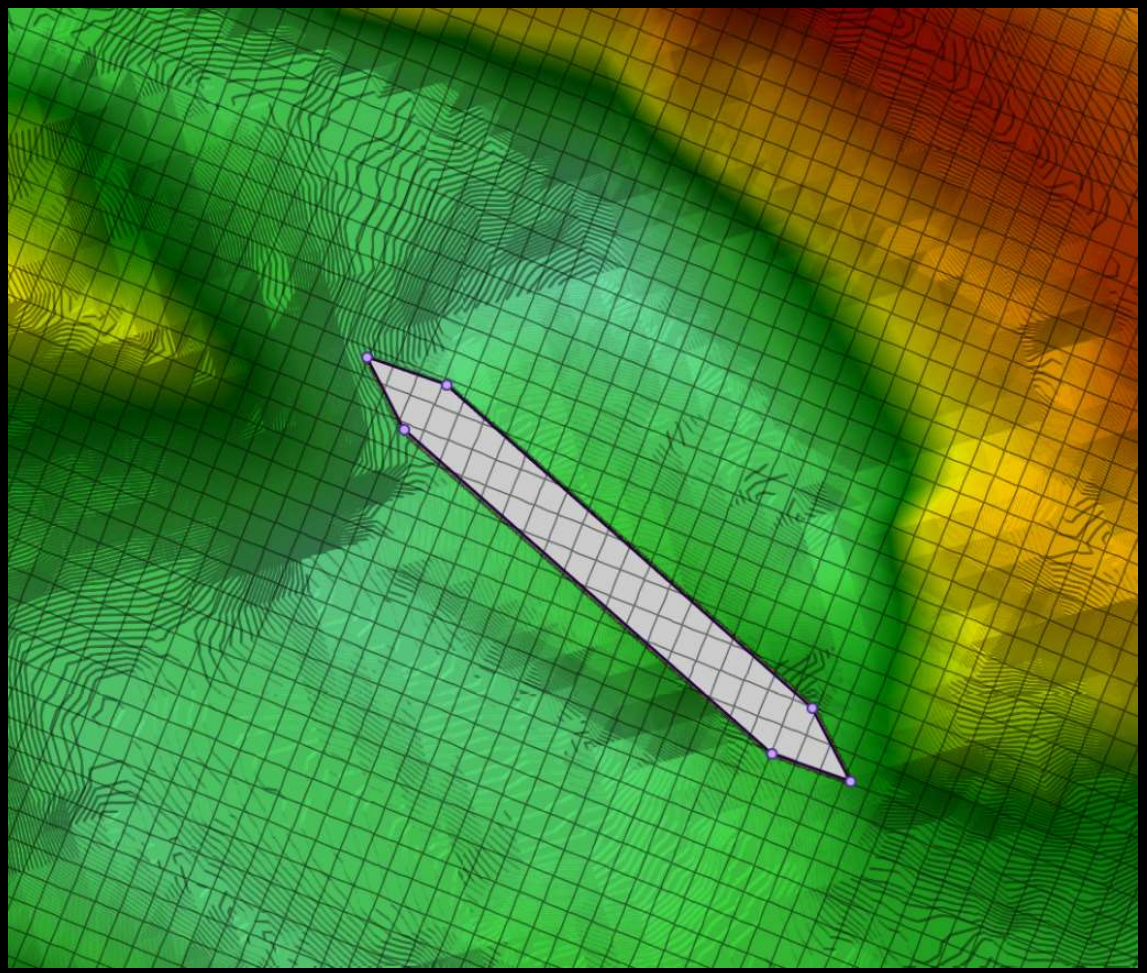
Cell Size Scales to Piers

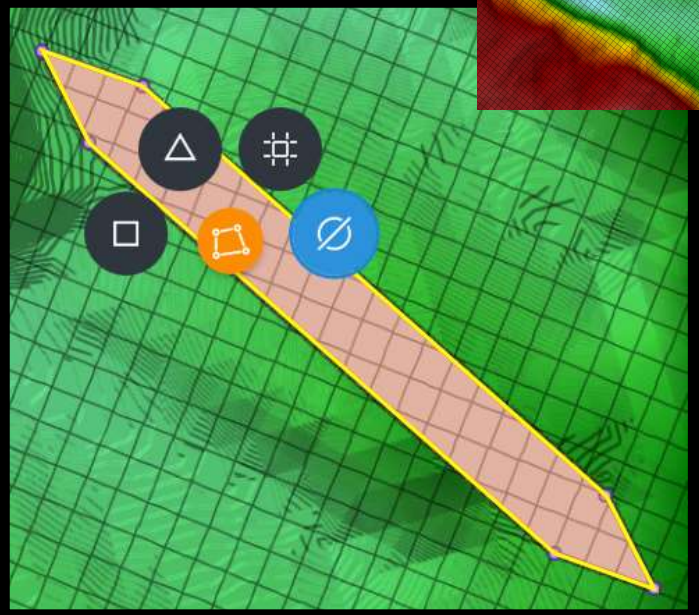


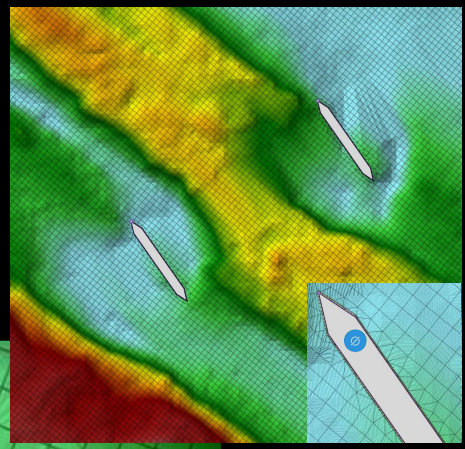


Three Pier Meshing Approaches

Cells << Piers







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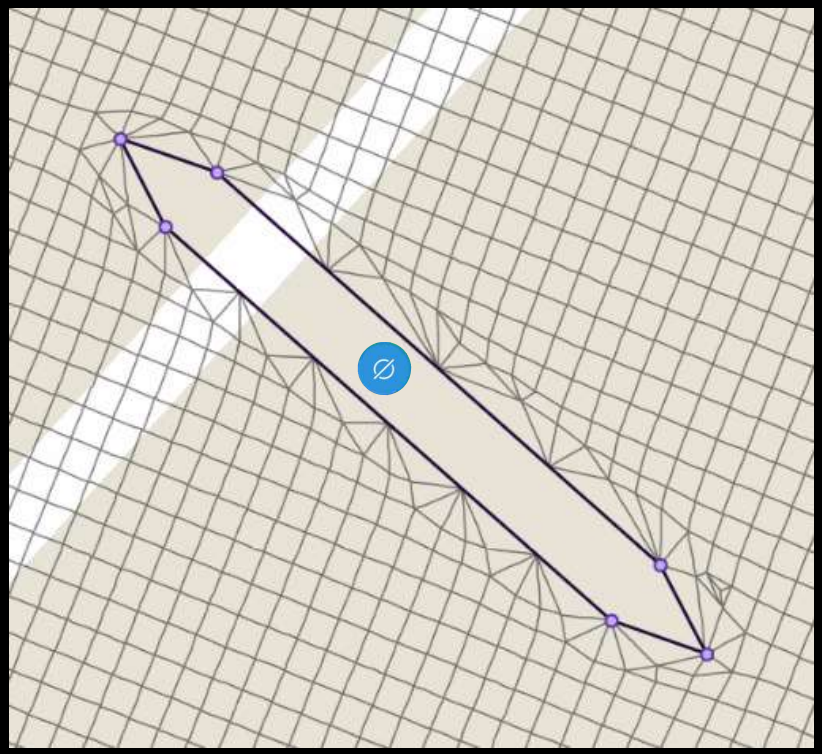
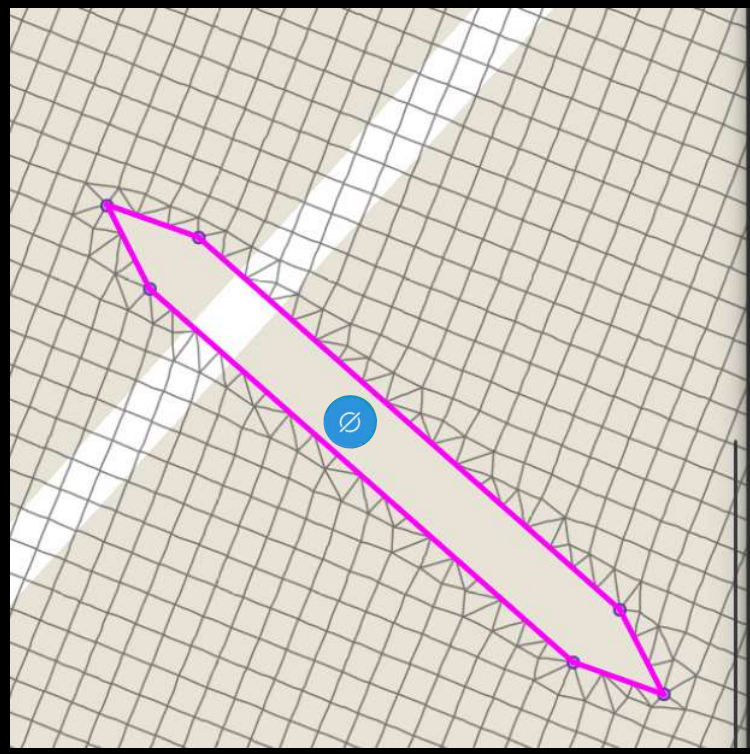
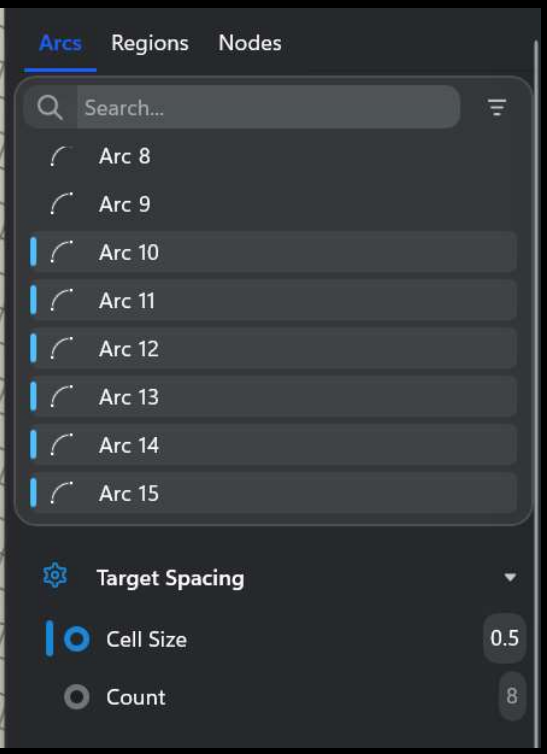
Pier Meshing Approaches

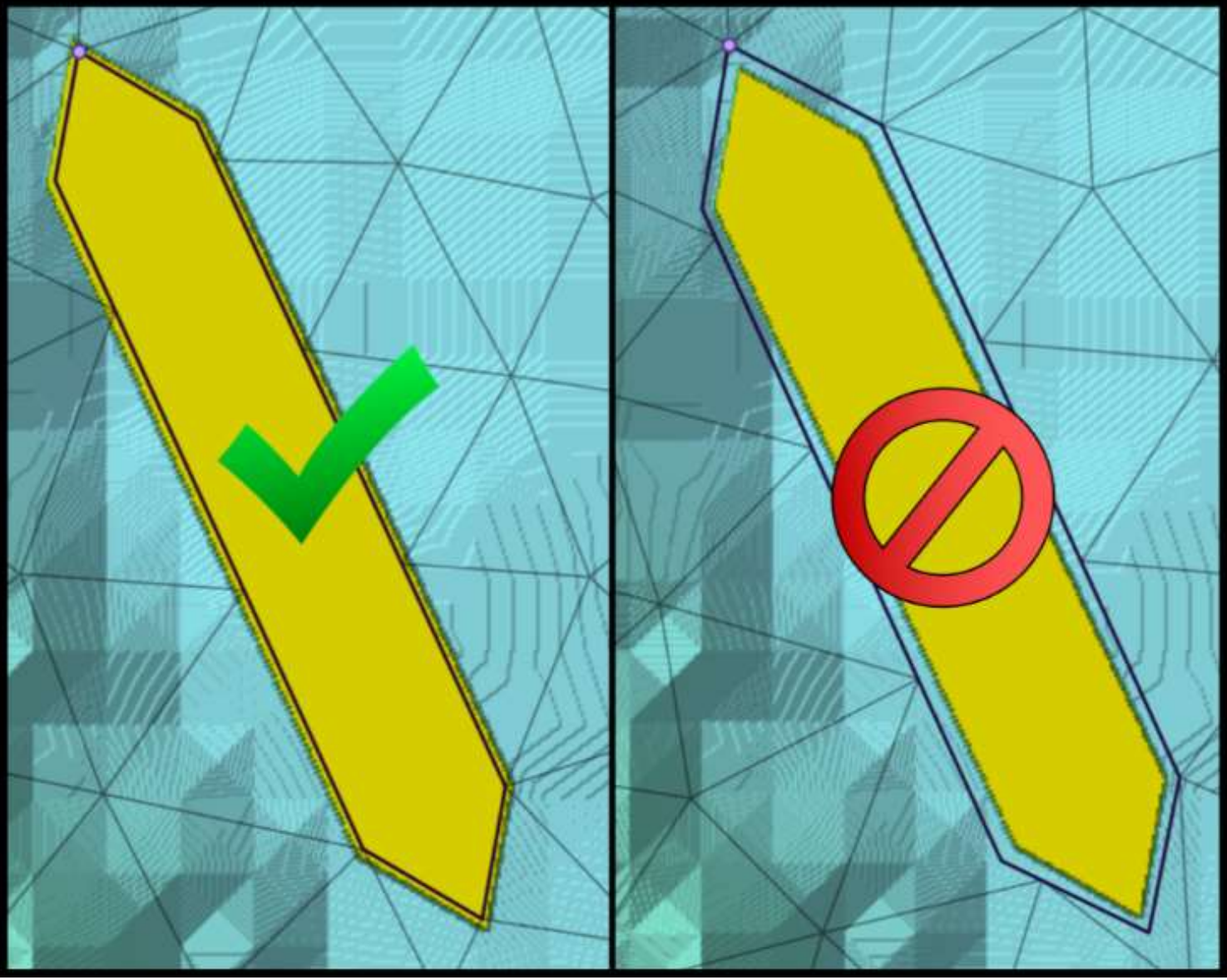






Blank region perimeter arcs have a cell size that you have to adjust to align with the surrounding detailed mesh

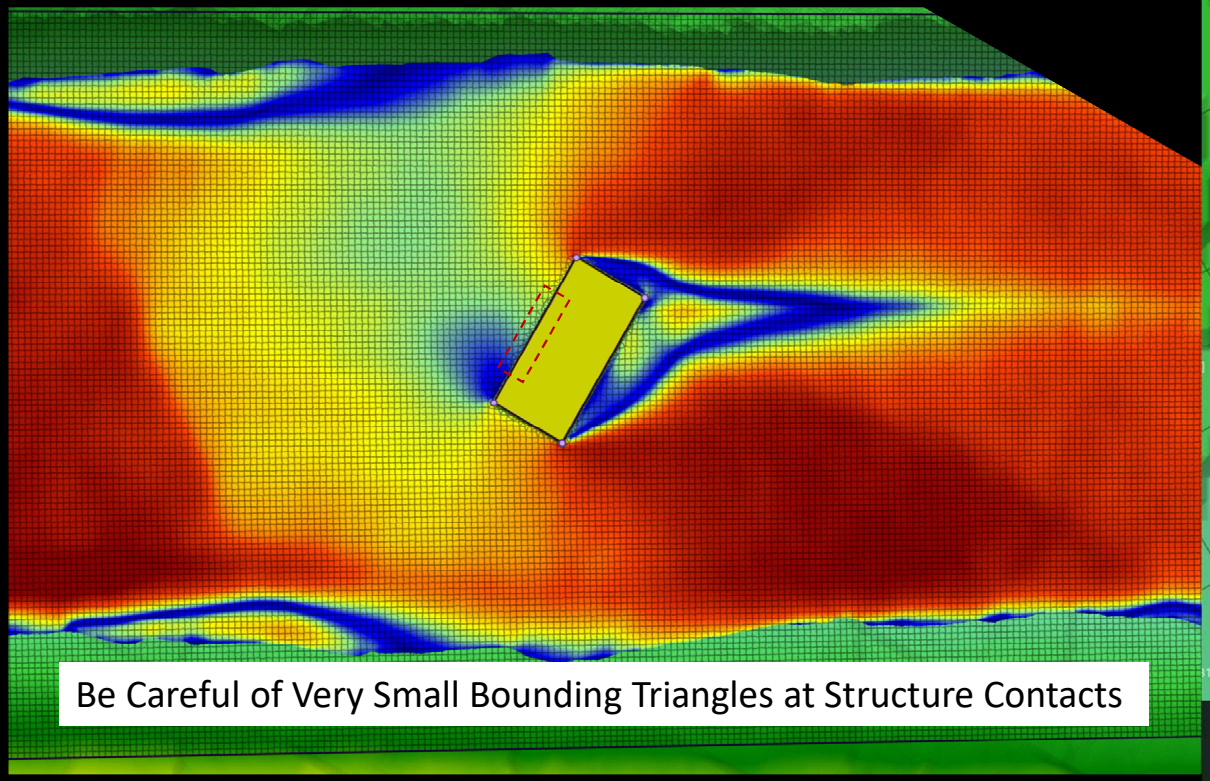
RAS 2025



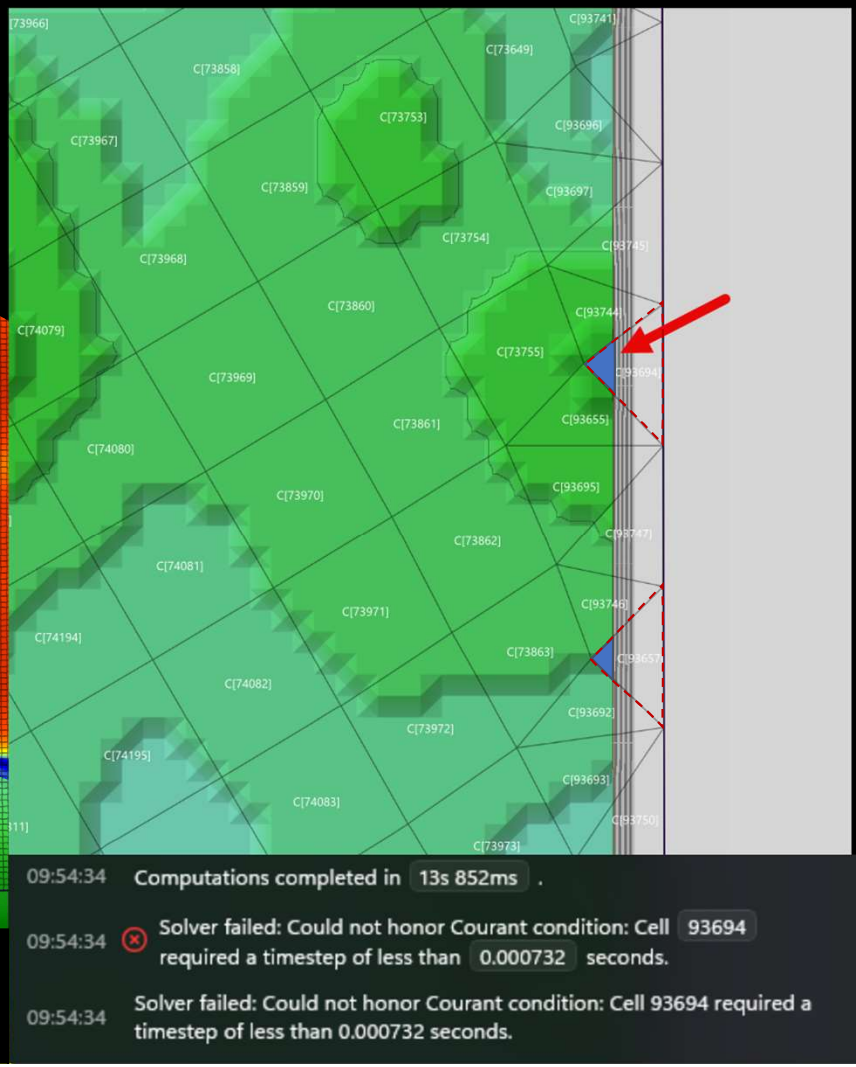
The “Blank” cell type does not introduce any boundary friction.

When you use it to digitize structures place the Arc just inside the footprint of the structure in the Terrain.

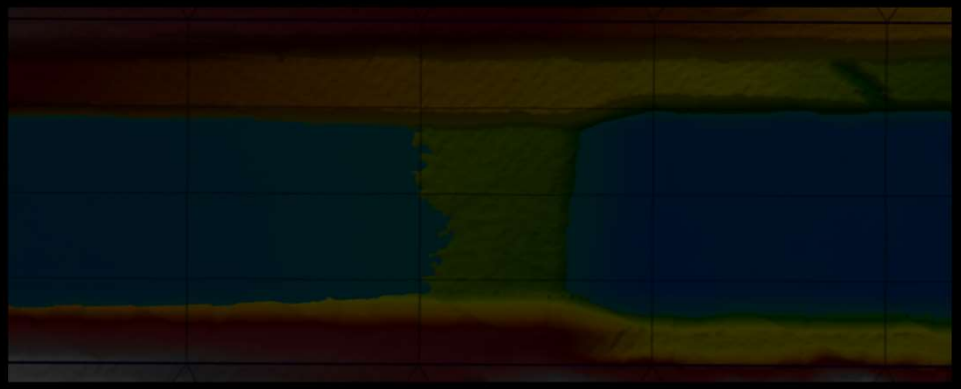
Blank Region Instabilities



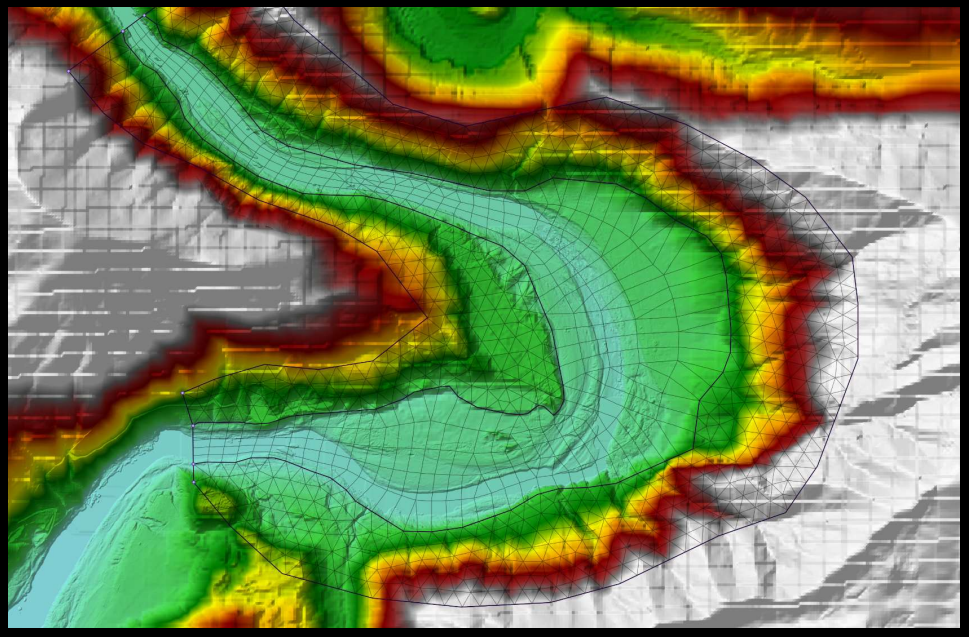
Be Careful of Very Small Bounding Triangles at Structure Contacts



Common Meshing Applications

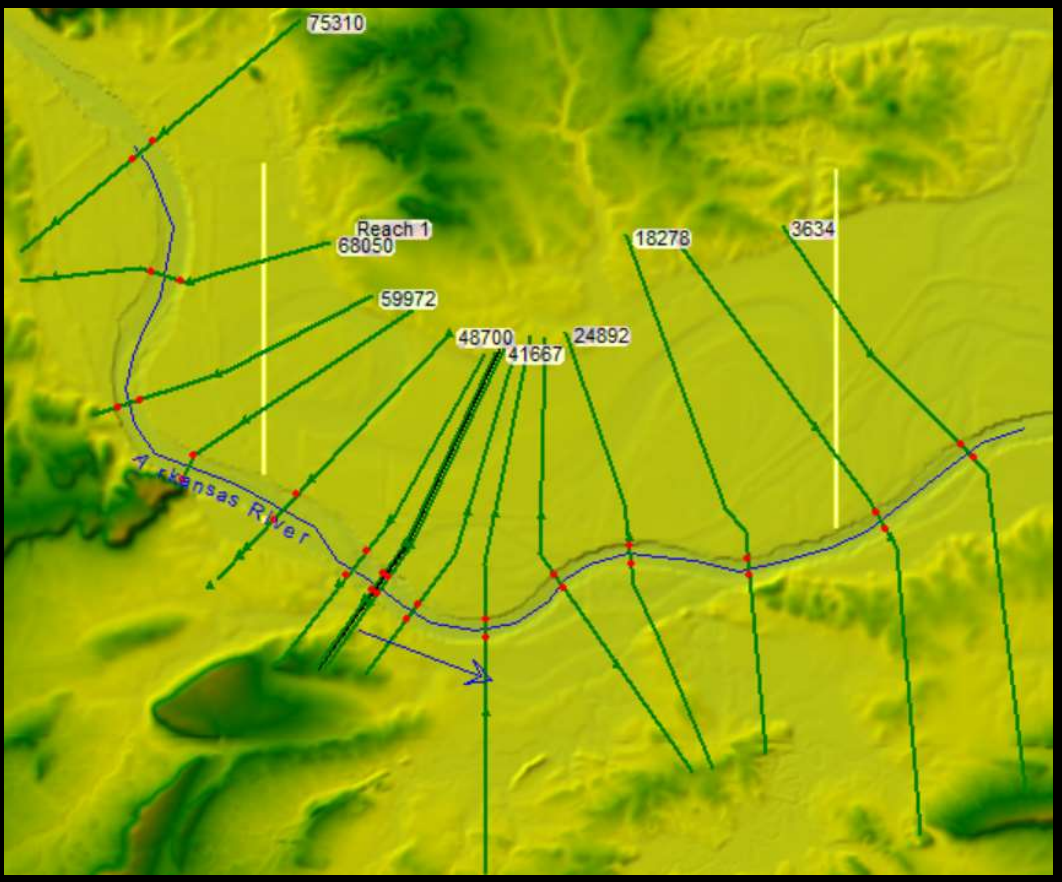


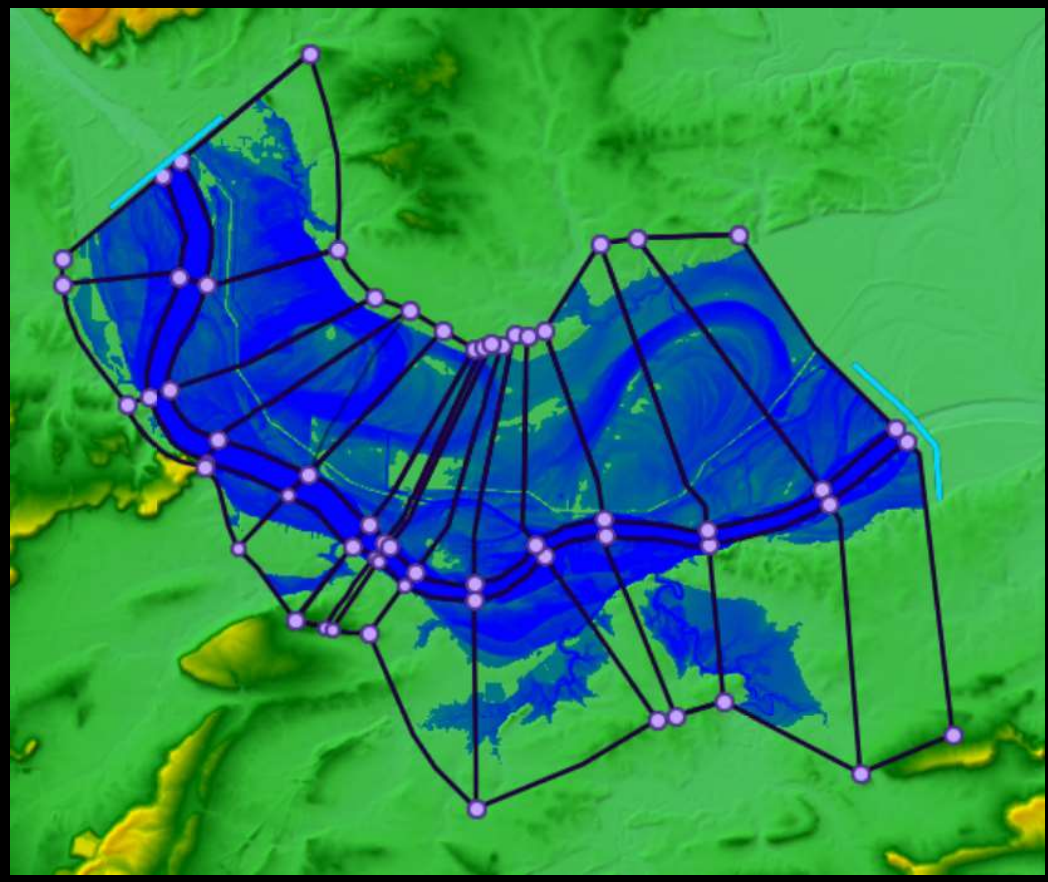
- Subgrid Mesh Principles



- Common Application
  - Meander
  - Tributary Confluence
  - Flow Split/Island
  - Expansion-Contraction
  - Bridge Pier
  - Three-Cell Simplification

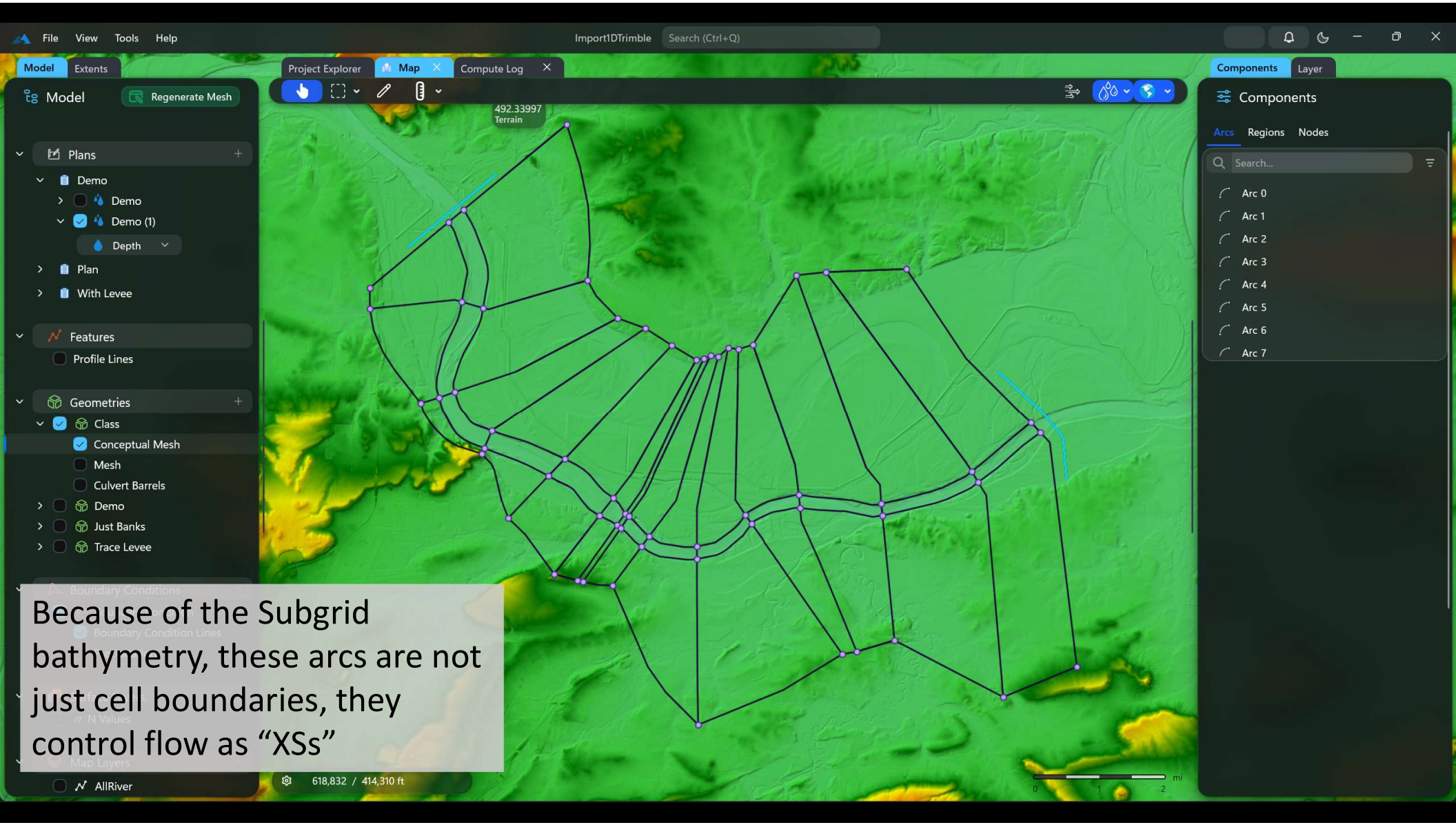
Importing “1D” and 3-Cell Models from Mapper





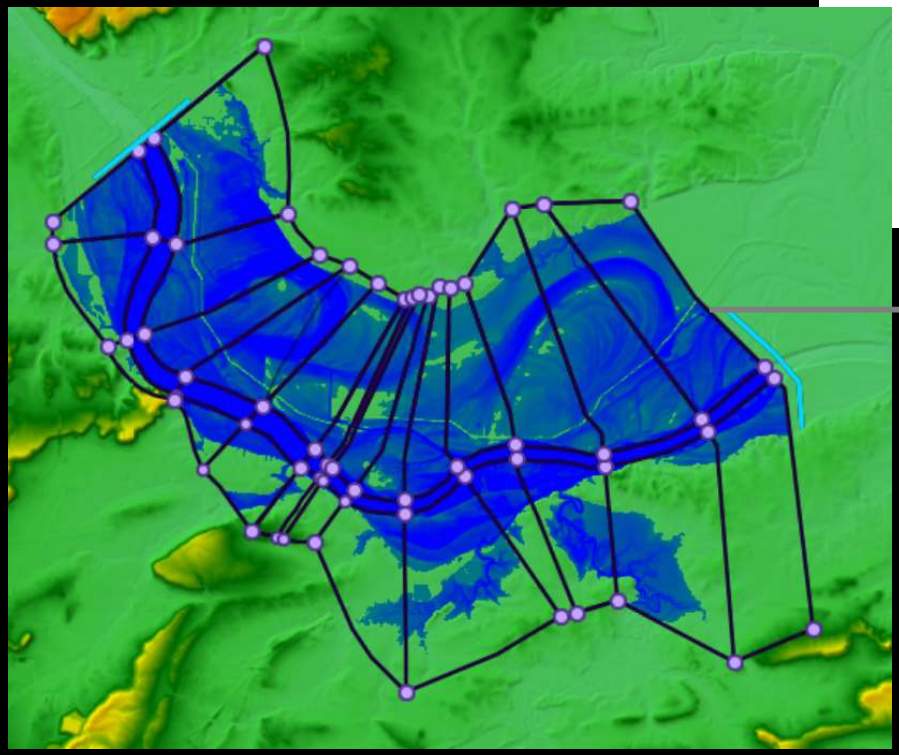
Video Demo: https://youtu.be/6ids7jc8dNg

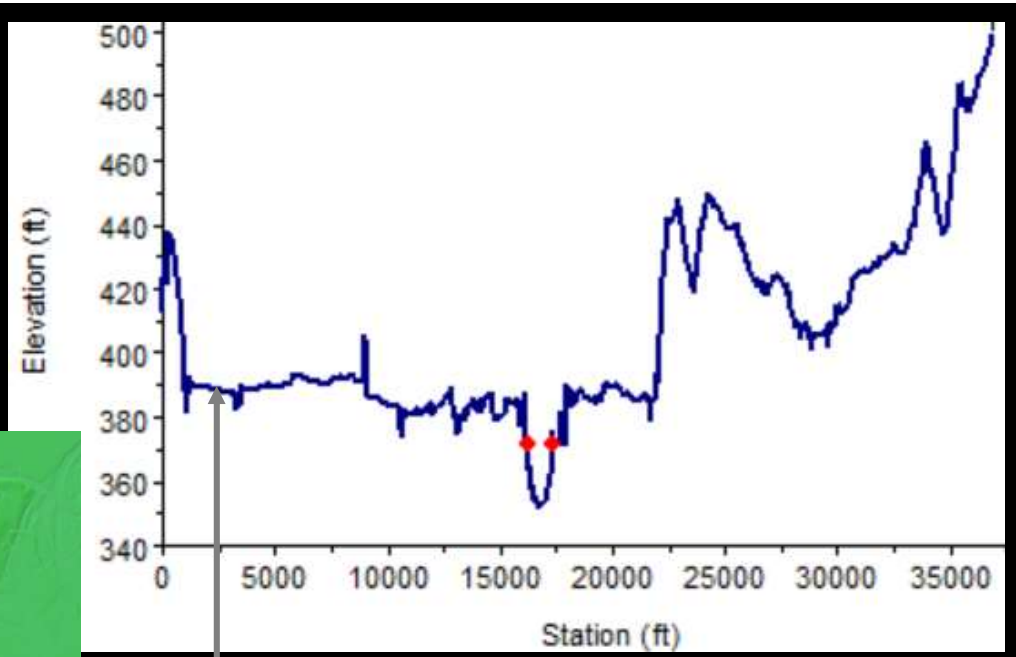
RAS 2025



Because of the Subgrid bathymetry, these arcs are not just cell boundaries, they control flow as “XSs”

Subgrid XSs




Elevation (ft)
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480
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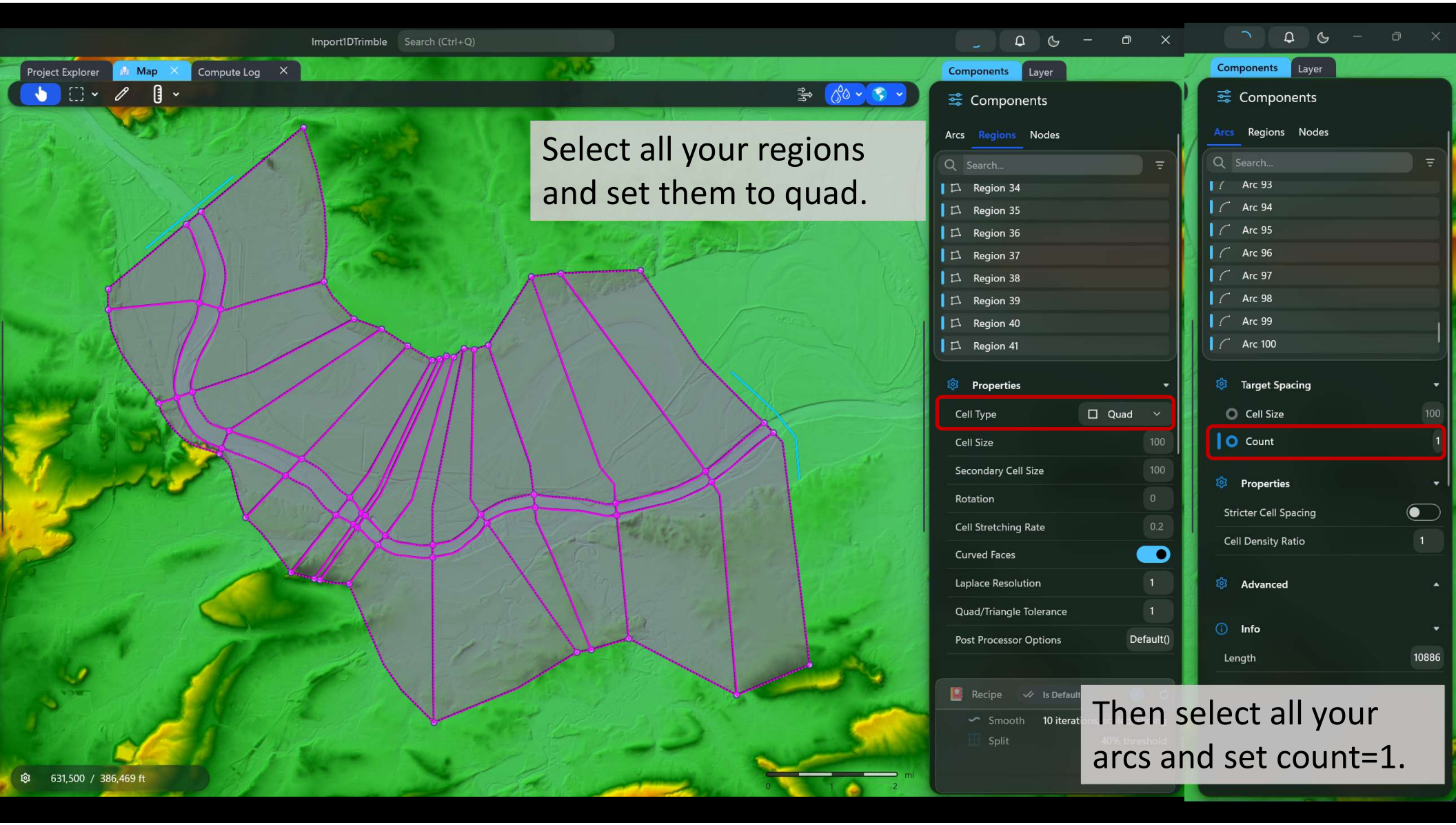
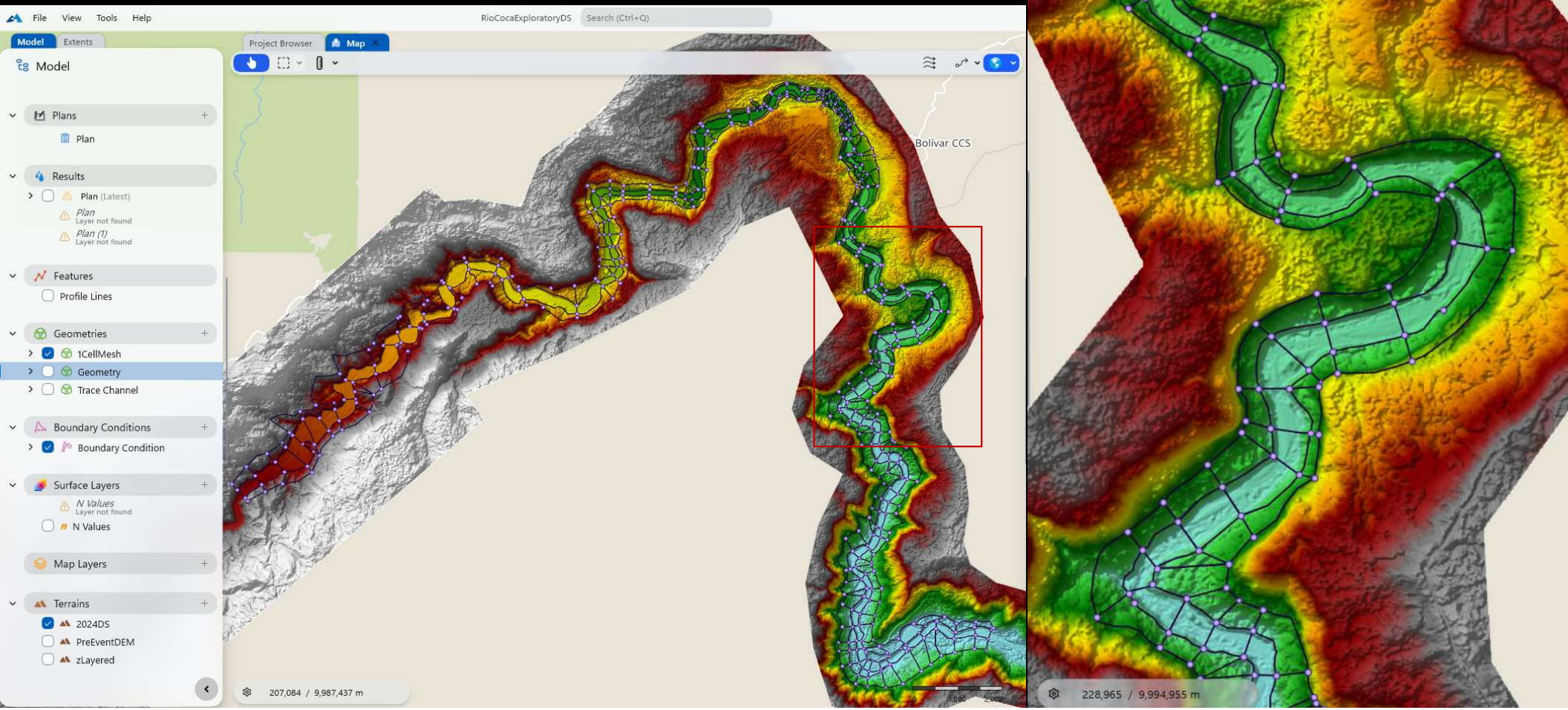
440
420
400
380
360
340
0
5000
10000
15000
20000
25000
30000
35000
Station (ft)


Import1DTrimble
Search (Ctrl+Q)
Project Explorer
Map
Compute Log
Components
Layer
Components
Arcs
Regions
Nodes
Search...
Region 34
Region 35
Region 36
Region 37
Region 38
Region 39
Region 40
Region 41
Properties
Cell Type
Quad
Cell Size
100
Secondary Cell Size
100
Rotation
0
Cell Stretching Rate
0.2
Curved Faces
Laplace Resolution
1
Quad/Triangle Tolerance
1
Post Processor Options
Default()
Recipe
Smooth
Split
Select all your regions and set them to quad.
631,500 / 386,469 ft
Components
Layer
Components
Arcs
Regions
Nodes
Search...
Arc 93
Arc 94
Arc 95
Arc 96
Arc 97
Arc 98
Arc 99
Arc 100
Target Spacing
Cell Size
100
Count
1
Properties
Stricter Cell Spacing
Cell Density Ratio
1
Advanced
Info
Length
10886
Then select all your arcs and set count=1.

Region=Cell Simplified Mesh (1X1 Quads)



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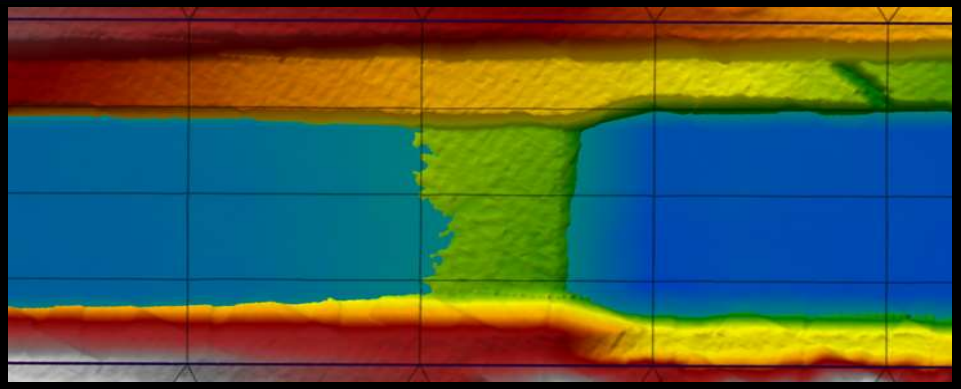

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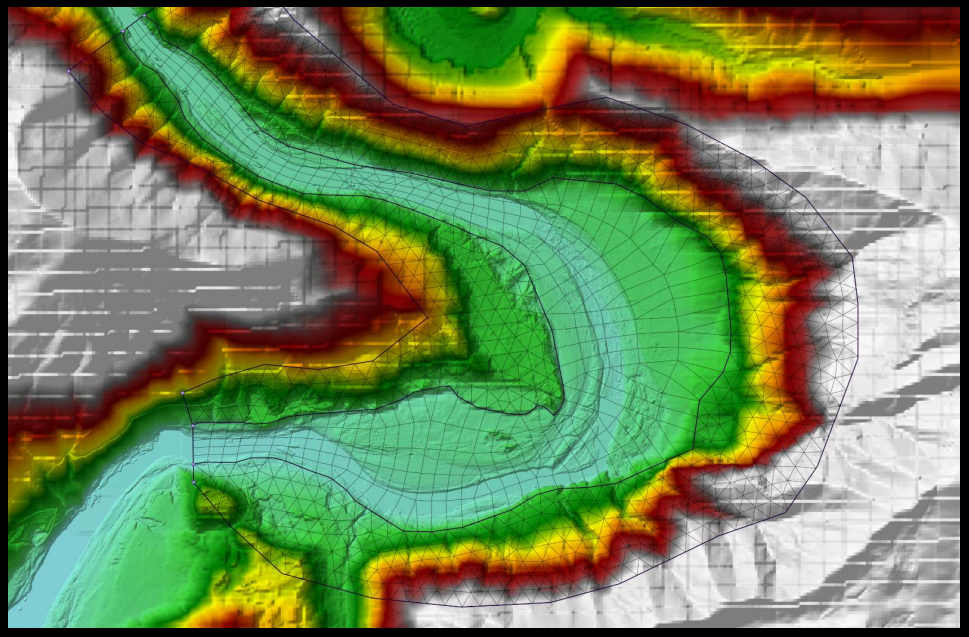

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Navigation Structures