



# HEC-RAS 2D Mesh Generation

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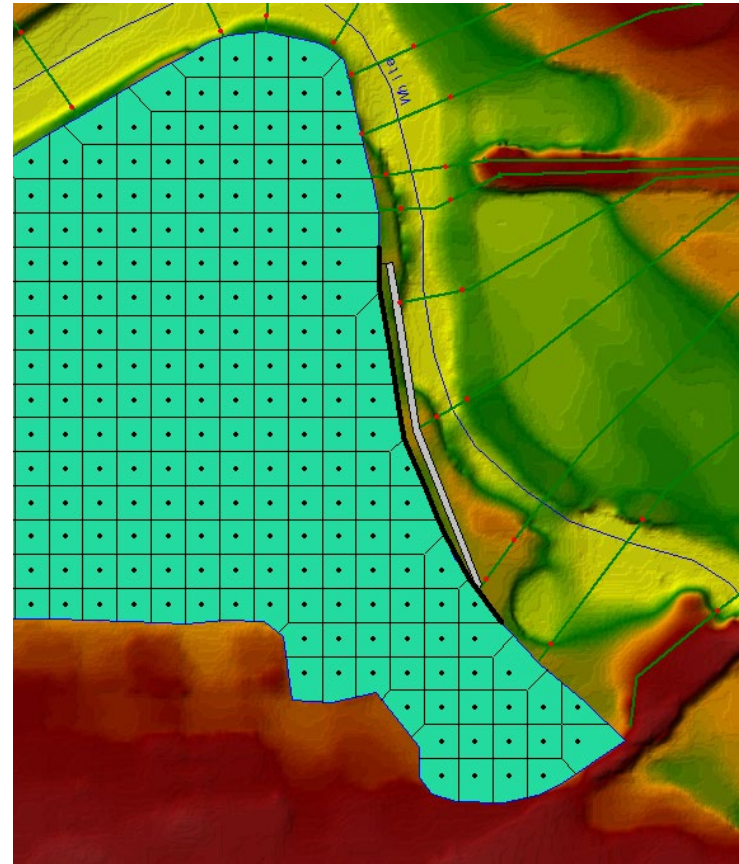
USACE, Institute for Water Resources, Hydrologic Engineering Center





# Overview

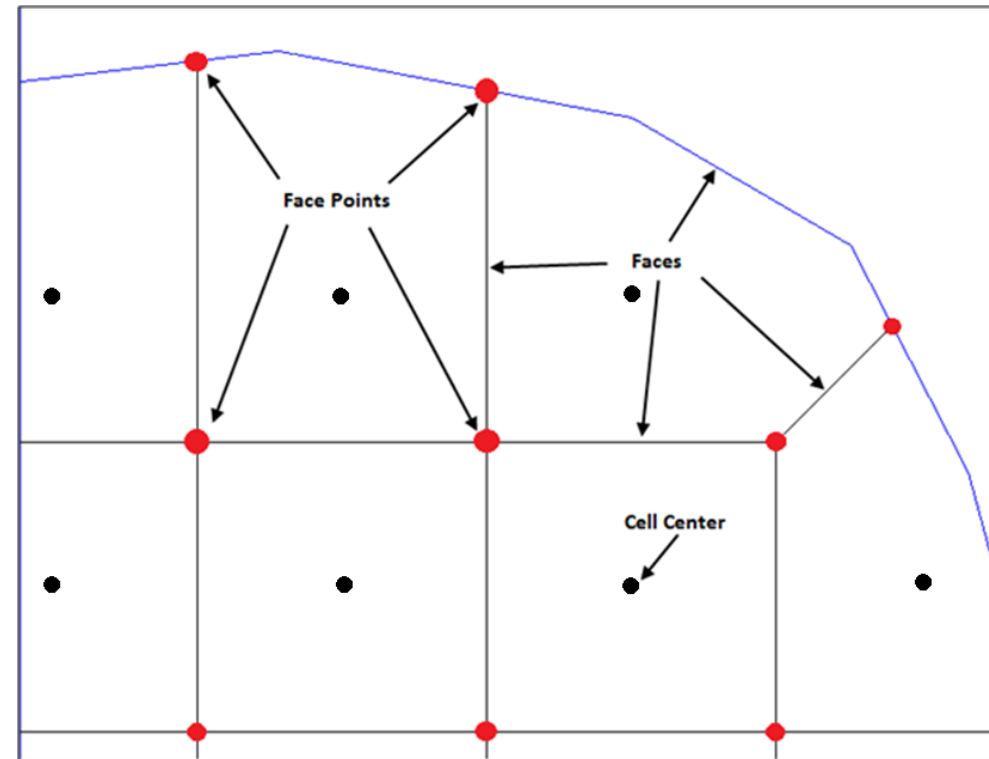
- Common Terms
- How to Create a Mesh
- Limitations
- Fixing Mesh Problems
- Hydraulic Property Tables





# Finite Volume Mesh

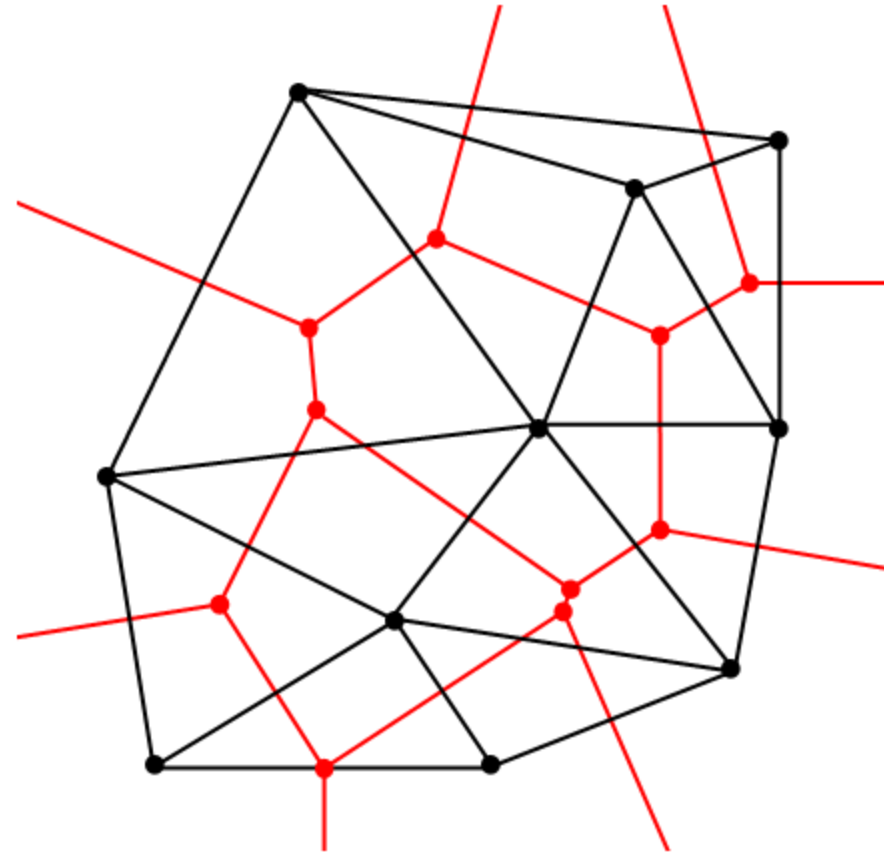
- Naming Convention
  - Face Points
  - Faces
  - Cells
  - Computation Points (center)





# Mesh Generation

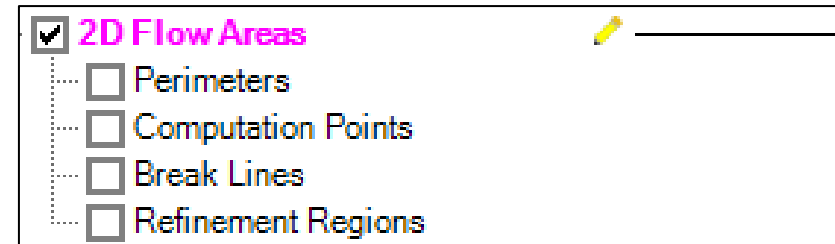
- Define mesh boundary and triangulation (black dots)
- Face Points (red dots) are triangle centroids
- Faces (red lines) connect face points
- Faces are also “Enforced” with internal boundaries





# Create 2D Flow Area Mesh in RAS Mapper

- Meshes are generated from a set of computation points with consideration to polygons and breaklines.
- Steps/Features used to create a mesh:
  - Perimeter Polygon
  - Computation Points
  - Breaklines (Optional)
  - Refinement Regions (Optional)

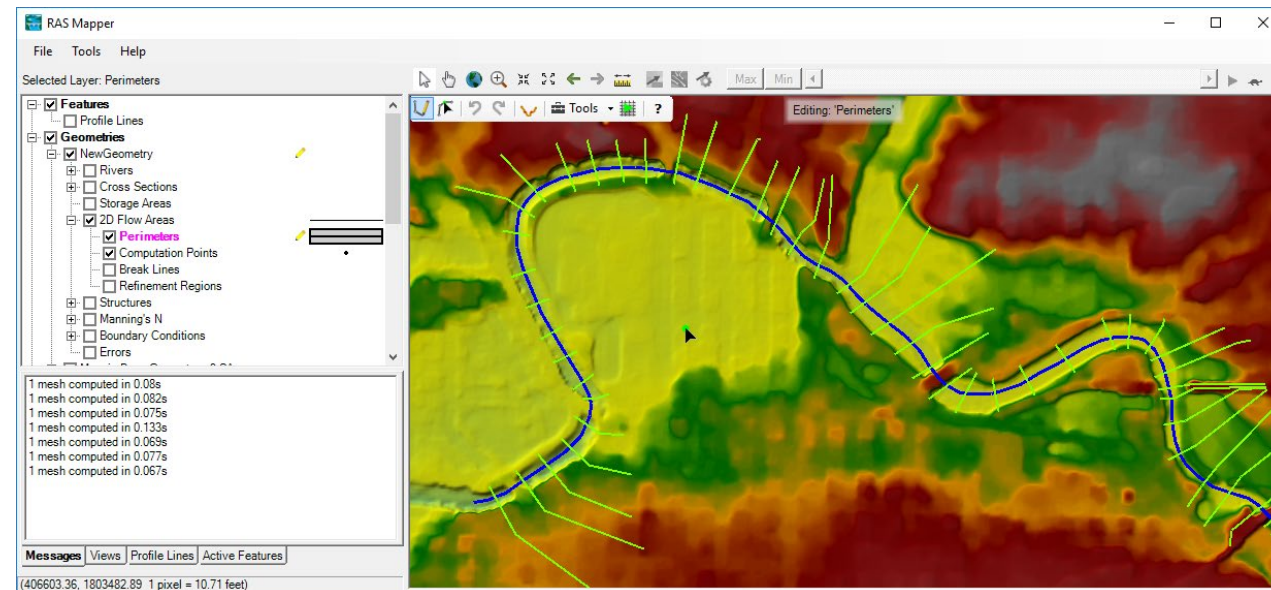
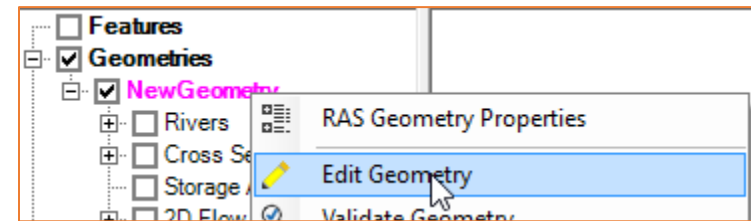
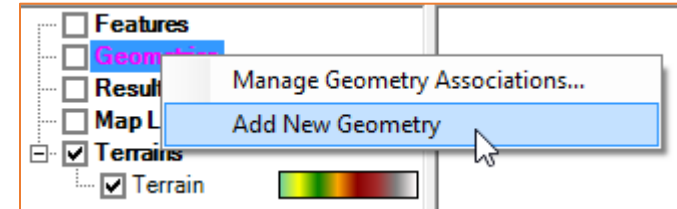


- Creating a good mesh is an iterative process!



# Editor Access

- Create a New Geometry
- Edit Geometry
- Edit Toolbar
- Select Layer





# Editing



- Add New Feature



- Select/Edit Feature



- Undo/Redo



- Plot Profile



- Tools



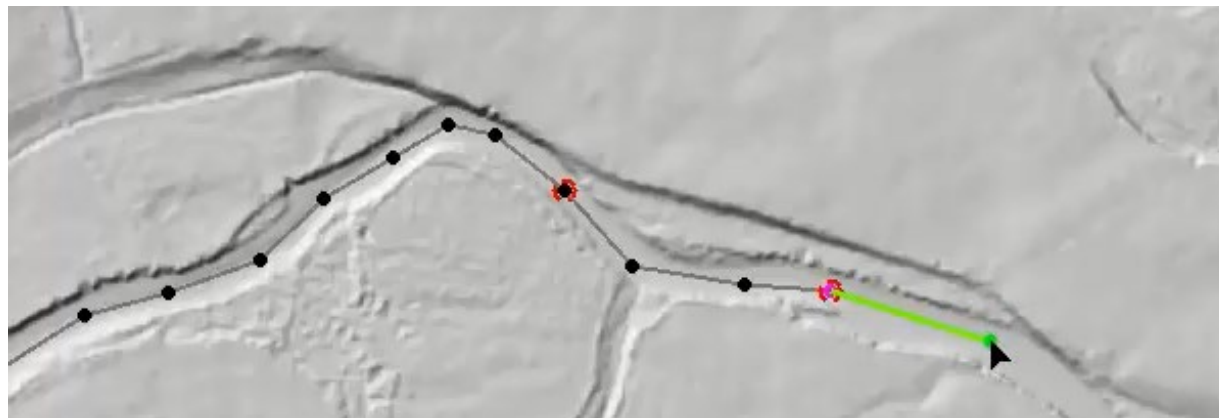
- Help





# Add New Feature

- Left-click to start adding a new point, line, or polygon
- Double-click to end a line or polygon
- Pan by switching to Pan tool, Shift key, Middle Mouse, or right-click to re-center.

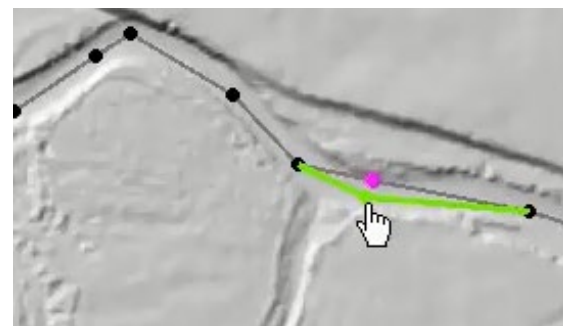
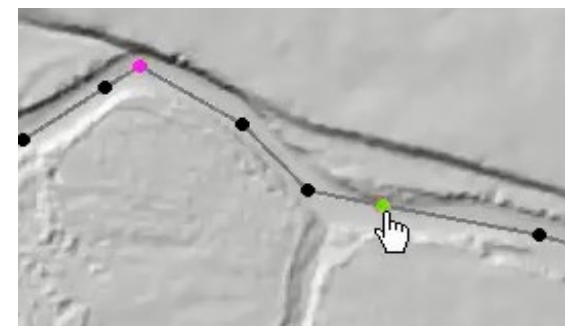
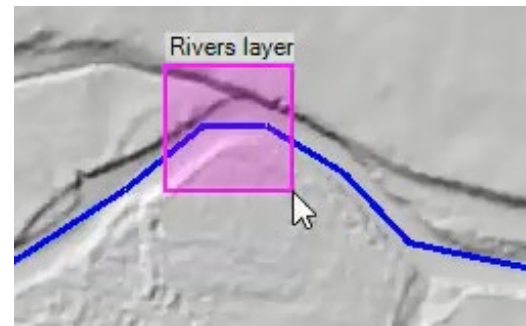






# Select / Edit

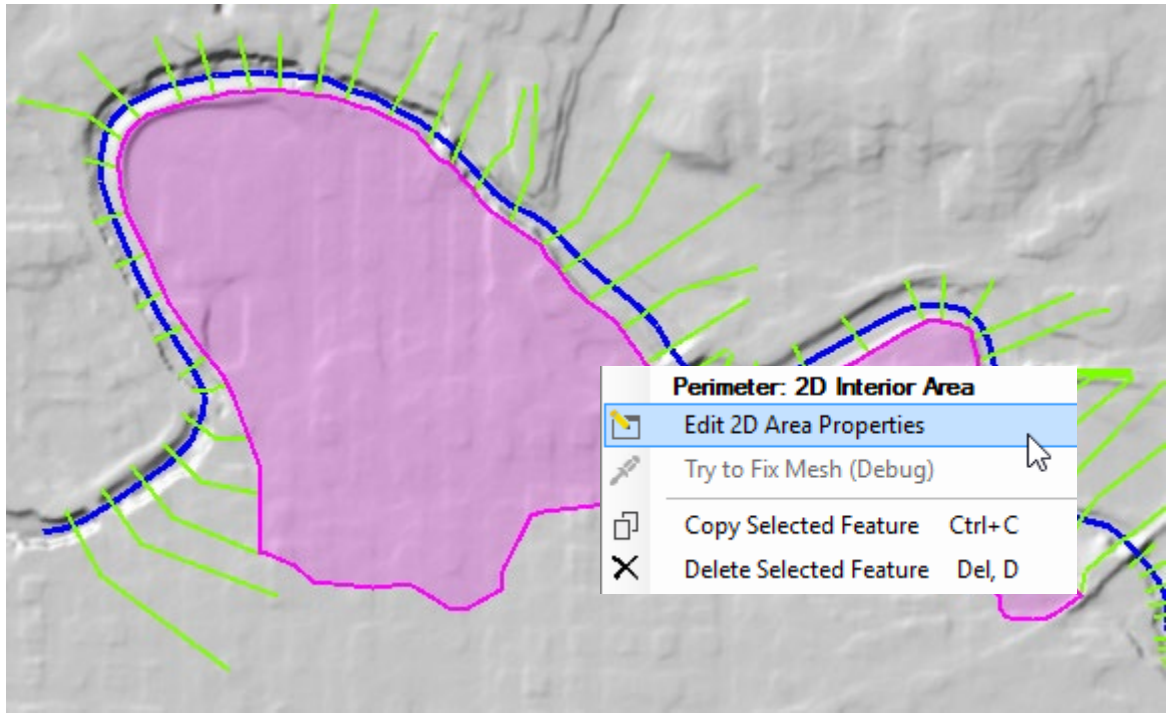
- Select / Edit tool is used to select feature(s) and then begin editing (move, add points, delete, etc).
  - Double-click to Start Editing (Open feature)
  - Double-click to End Editing (Close feature)
- Mouse hover indicates action
  - Green point indicates: Move, Insert, Delete point





# 2D Flow Area

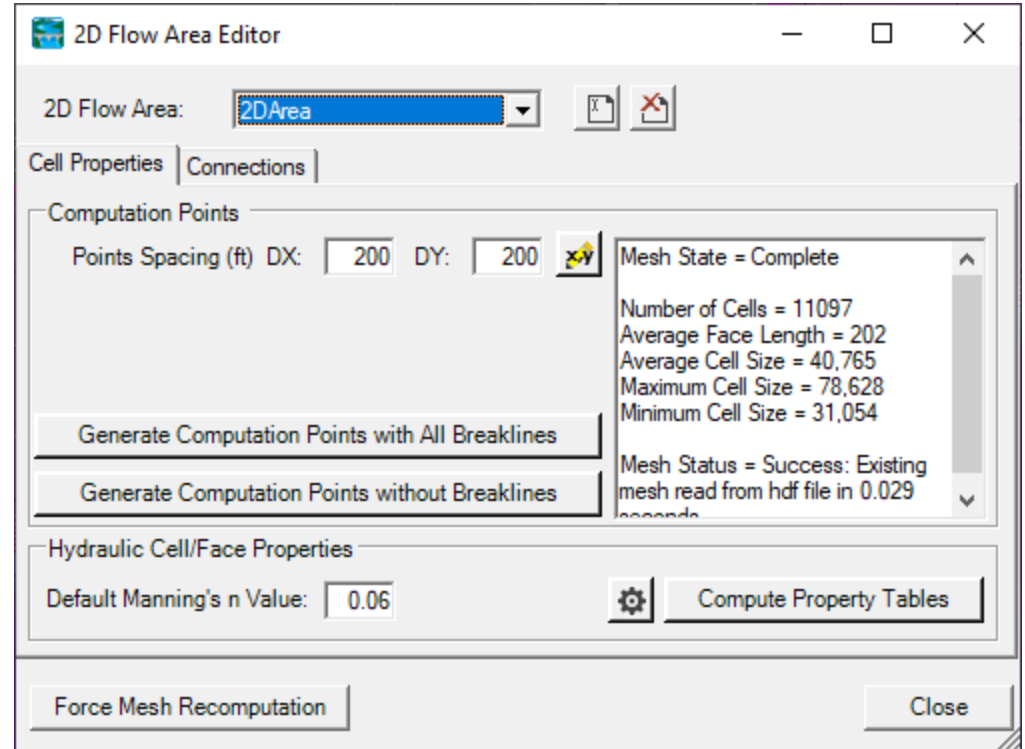
- Draw Perimeter



- 2D Flow Areas
  - Perimeters
  - Computation Points
  - Break Lines
  - Refinement Regions



- 2D Flow Area Editor





- 2D Flow Areas
- Perimeters
- Computation Points**
- Break Lines
- Refinement Regions



# Computation Points

- Generate Computation Points at an even interval
  - Breaklines and Refinement Regions area enforced
- Default n Value
- Hydraulic Table Property Tolerances

2D Flow Area Editor

2D Flow Area: 2DArea

Cell Properties | Connections

Computation Points

Points Spacing (ft) DX: 200 DY: 200

Mesh State = Complete

Number of Cells = 11097  
Average Face Length = 202  
Average Cell Size = 40,765  
Maximum Cell Size = 78,628  
Minimum Cell Size = 31,054

Mesh Status = Success: Existing mesh read from hdf file in 0.029 seconds

Generate Computation Points with All Breaklines

Generate Computation Points without Breaklines

Hydraulic Cell/Face Properties

Default Manning's n Value: 0.06

Compute Property Tables

Hydraulic Property Table Tolerances

2D\_Area

Set the 2D Flow Area's Cell and Face Filter Tolerances for the Hydraulic Table Computations.

Cell Elev-Vol Filter Tol (ft):	0.01
Cell Minimum Area Fraction:	0.01
Face Profile Filter Tol (ft):	0.01
Face Elev-Area Filter Tol (ft):	0.01
Face Conveyance Tol Ratio:	0.02
Face Laminar Depth (ft):	0.2

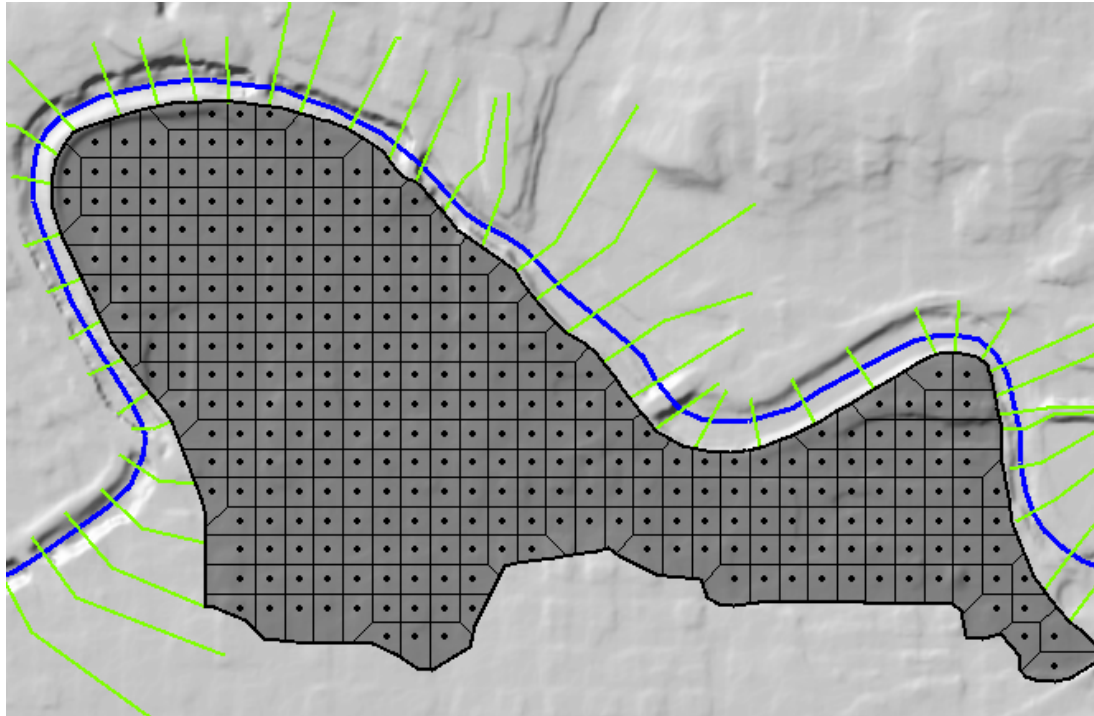
Defaults OK Cancel



- 2D Flow Areas
- Perimeters
- Computation Points**
- Break Lines
- Refinement Regions



# Computation Points



- Mesh is generated from resultant set of computation points.

Edit Points

Selected Area Edits

Table Tools

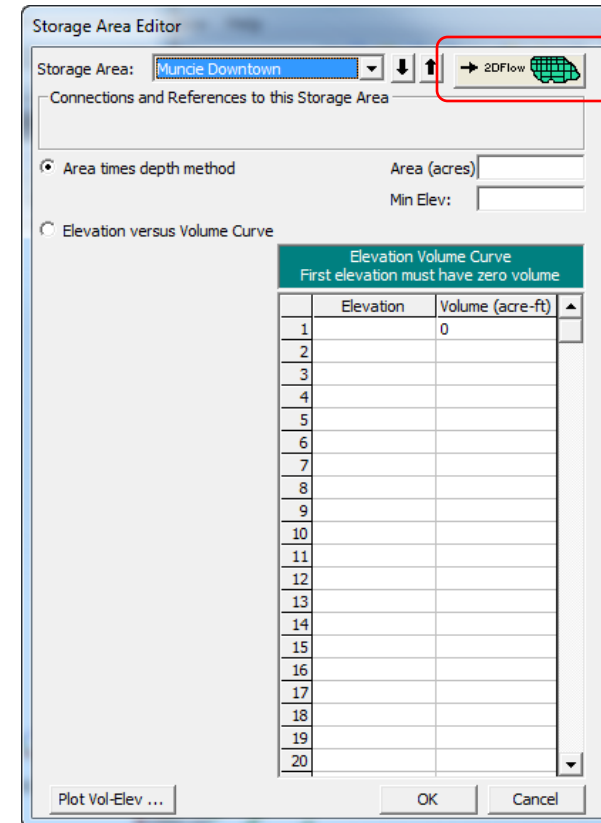
	X	Y
1	405880.1458	1804922.839
2	406080.1458	1804922.839
3	406280.1458	1804922.839
4	406480.1458	1804922.839
5	405280.1458	1804722.839
6	405480.1458	1804722.839
7	405680.1458	1804722.839
8	405880.1458	1804722.839
9	406080.1458	1804722.839
10	406280.1458	1804722.839
11	406480.1458	1804722.839
12	405080.1458	1804522.839
13	405280.1458	1804522.839
14	405480.1458	1804522.839
15	405680.1458	1804522.839
16	405880.1458	1804522.839
17	406080.1458	1804522.839
18	406280.1458	1804522.839

OK Cancel



# Create 2D Flow Area Mesh from an existing Storage Area

- Converting Existing Storage Area
  - Click convert button





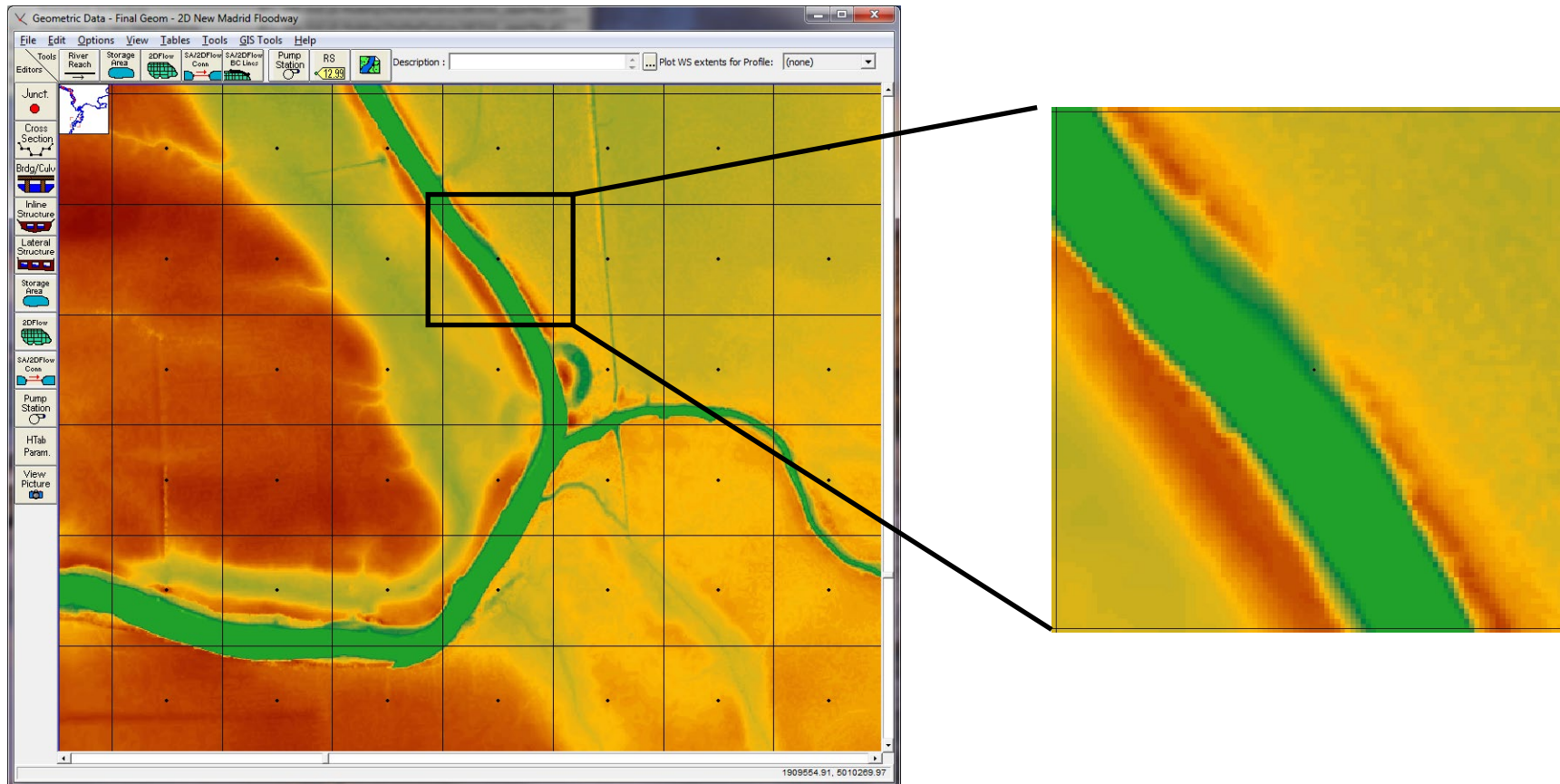
# Hydraulic Property Tables

- Computation engine uses hydraulic property tables to represent the geometry of the system
- Cells
  - Elevation/Volume
- Faces
  - Elevation/Area
  - Elevation/Wetter Perimeter
  - Elevation/Manning's  $n$
  - (all from station elevation profile)



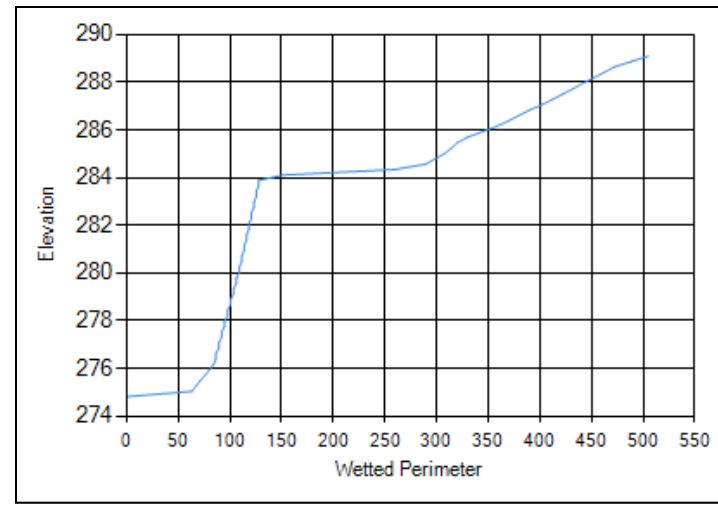
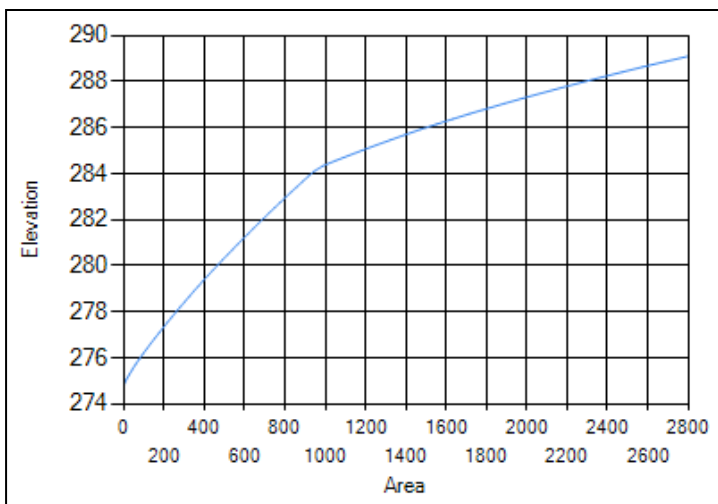
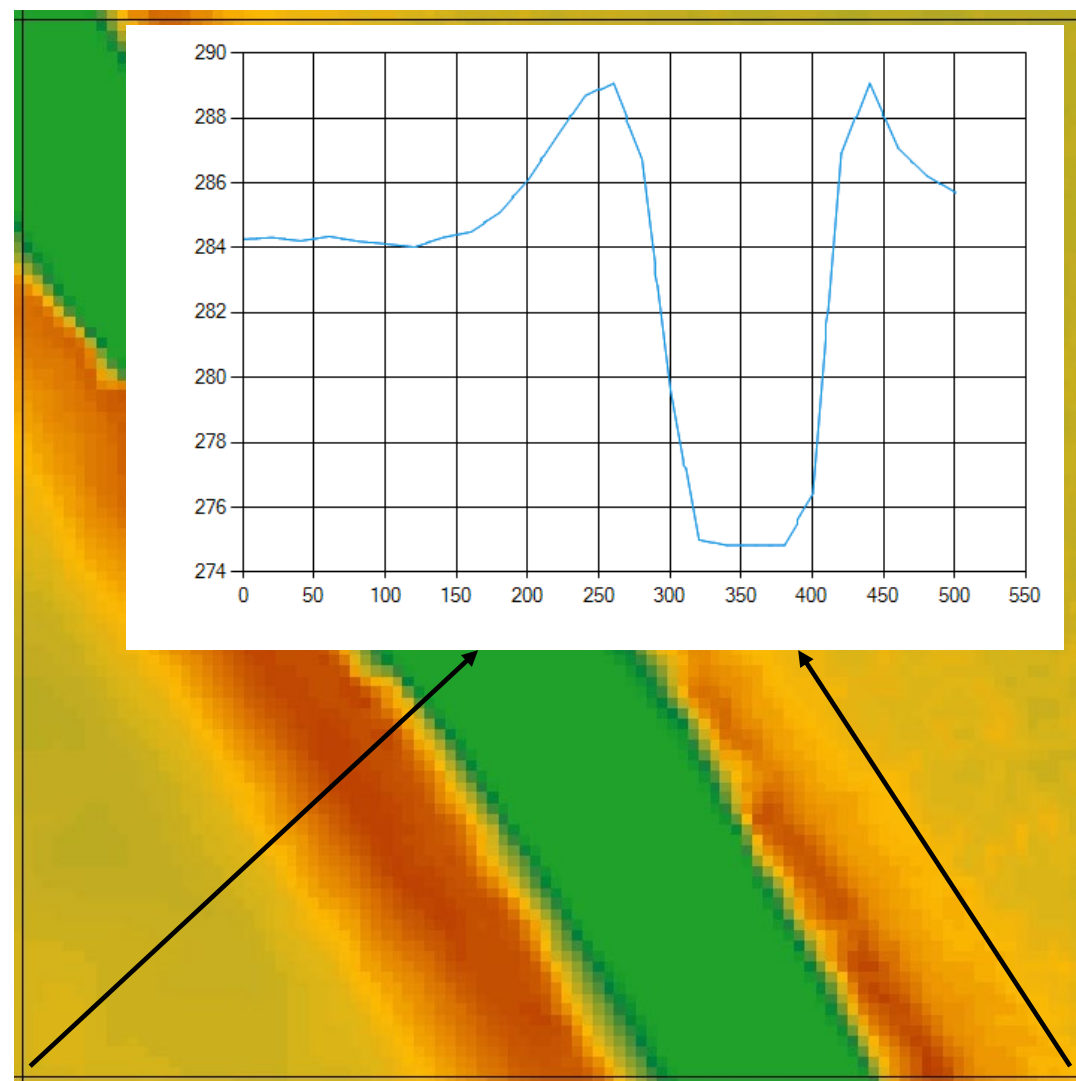
# Benefits of Hydraulic (Sub-grid) Tables

- Can model small channels in larger cells





# Benefits of Hydraulic (Sub-grid) Tables

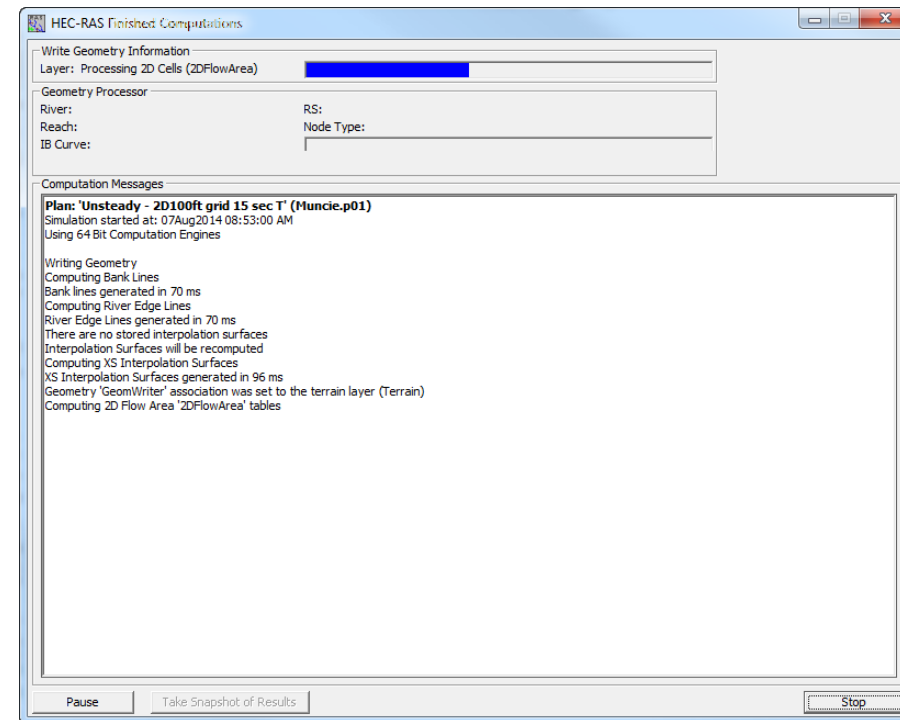
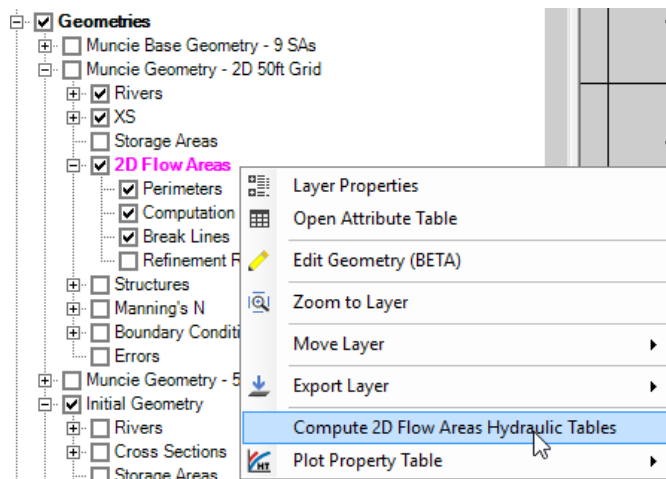






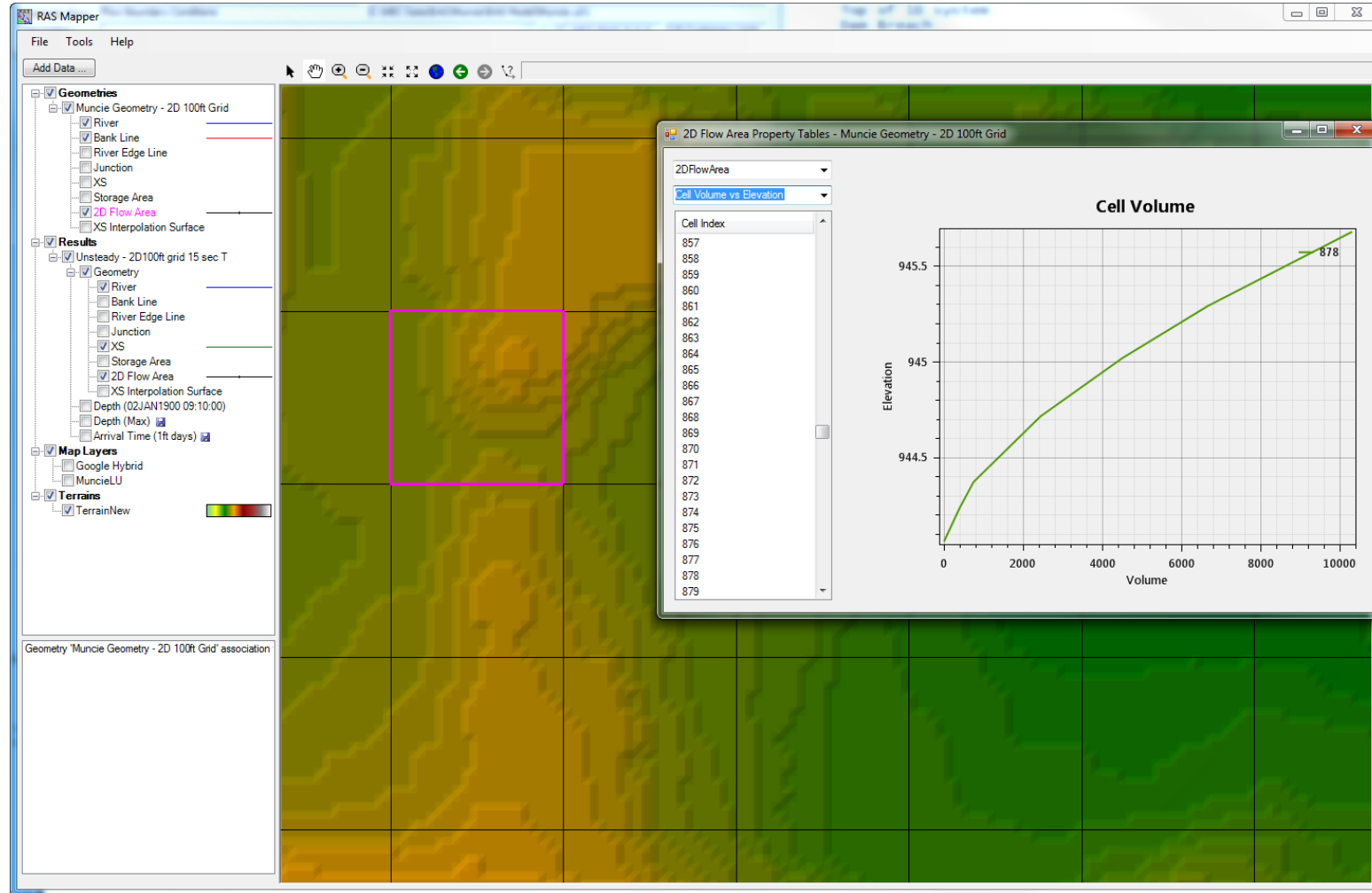
# Hydraulic Property Tables

- Computed (once and stored in geometry \*.hdf)
  - From RAS Mapper
  - Before unsteady-flow simulation





# Cells





# Faces

The screenshot displays the RAS Mapper interface. On the left, a tree view shows the project structure under 'Geometries' and 'Results'. The '2D Flow Area' is highlighted in pink. The main window shows a topographic map with a grid of red arrows representing flow direction. A dialog box titled '2D Flow Area - Layer Properties' is open, showing the 'Features' tab. The 'Additional Options' section has 'Mesh Face Numbers' checked. The 'Source File' path is 'C:\HEC Data\RAS\MuncielRAS Model\Muncie.g01.hdf'.

**Geometries**

- Muncie Geometry - 2D 100ft Grid
  - River
  - Bank Line
  - River Edge Line
  - Junction
  - XS
  - Storage Area
  - 2D Flow Area
  - XS Interpolation Surface

**Results**

- Unsteady - 2D100ft grid 15 sec T
  - Geometry
    - River
    - Bank Line
    - River Edge Line
    - Junction
    - XS
    - Storage Area
    - 2D Flow Area
    - XS Interpolation Surface
    - Depth (02JAN1900 09:10:00)
    - Depth (Max)
    - Arrival Time (1ft days)

**Map Layers**

- Google Hybrid
- MuncieLU

**Terrains**

- TerrainNew

**2D Flow Area - Layer Properties**

Visualization and Information | Features

Point Symbol: [Select...]  
Line Style: [Select...]  
Fill Style: [Select...]

Surface Color Style  
Color Ramp: [Edit]

Label Features  
 Label Features with Attribute Column(s) [Select...]

Messages

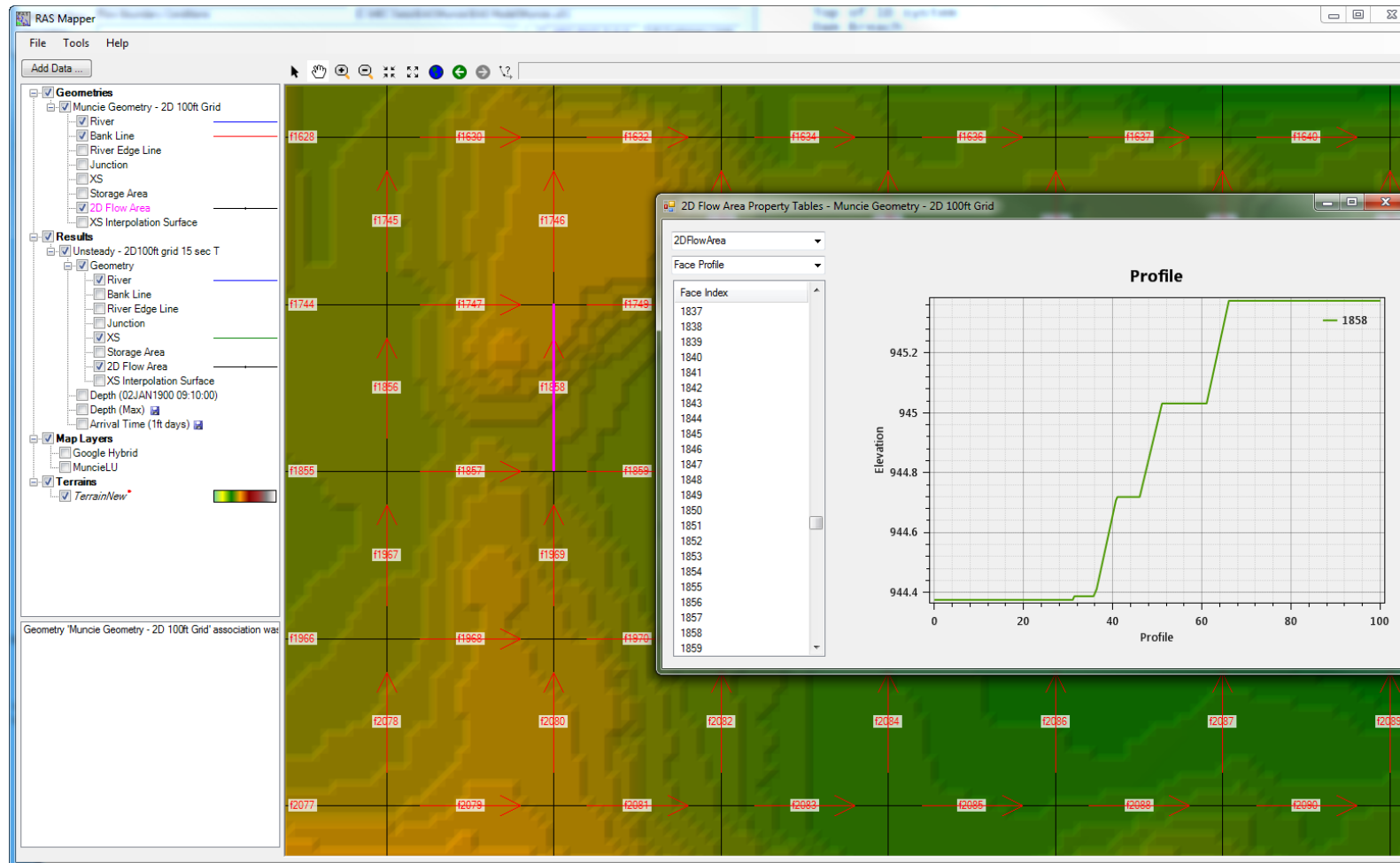
Additional Options

- Mesh Edges
- Mesh Cell Numbers
- Mesh Face Numbers
- Mesh Face Point Numbers
- Mesh Dual TIN

Source File  
C:\HEC Data\RAS\MuncielRAS Model\Muncie.g01.hdf

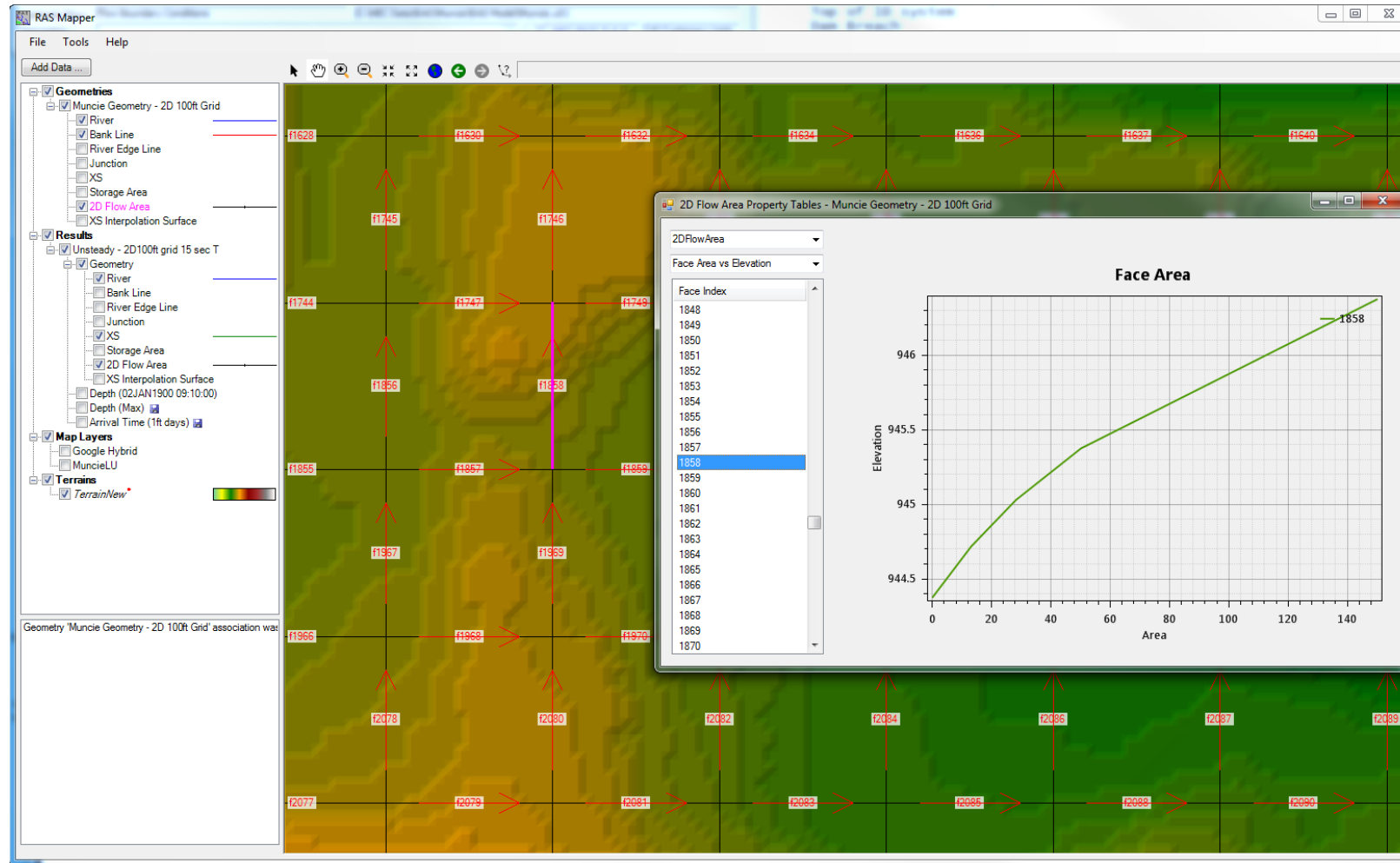


# Face Profile





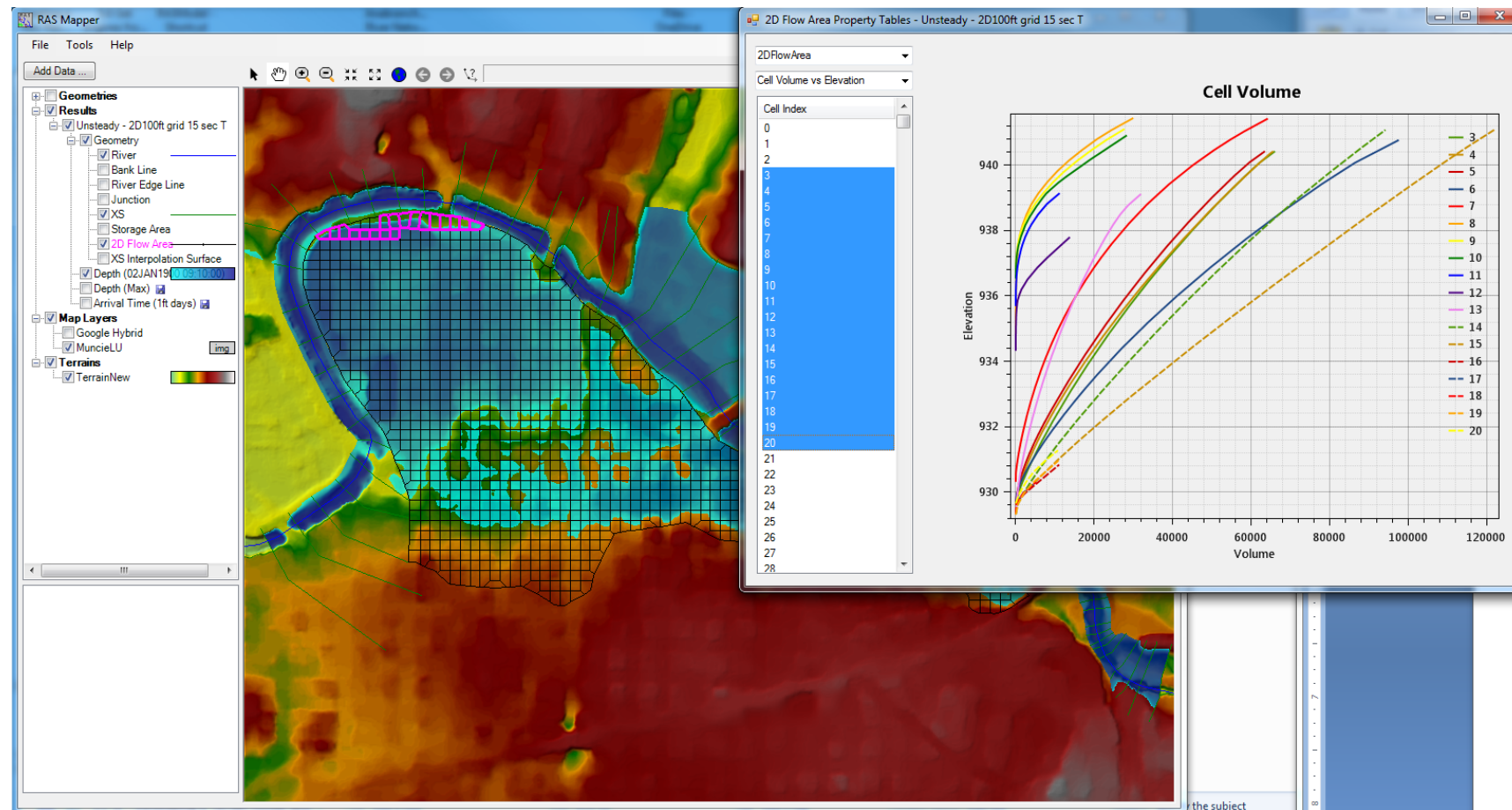
# Face Elevation vs Area





# Hydraulic Property Tables

- View from RAS Mapper - '2DFlow Area' in 'Geometry' or 'Results'





# Mesh Limitations

- One face between cells – even on perimeter
- Only one boundary condition per Face
- Except for Lateral structures
  - Lateral structures can stop and start on the same 2D external Face, when connecting 1D reach to a 2D area.

# Questions?