

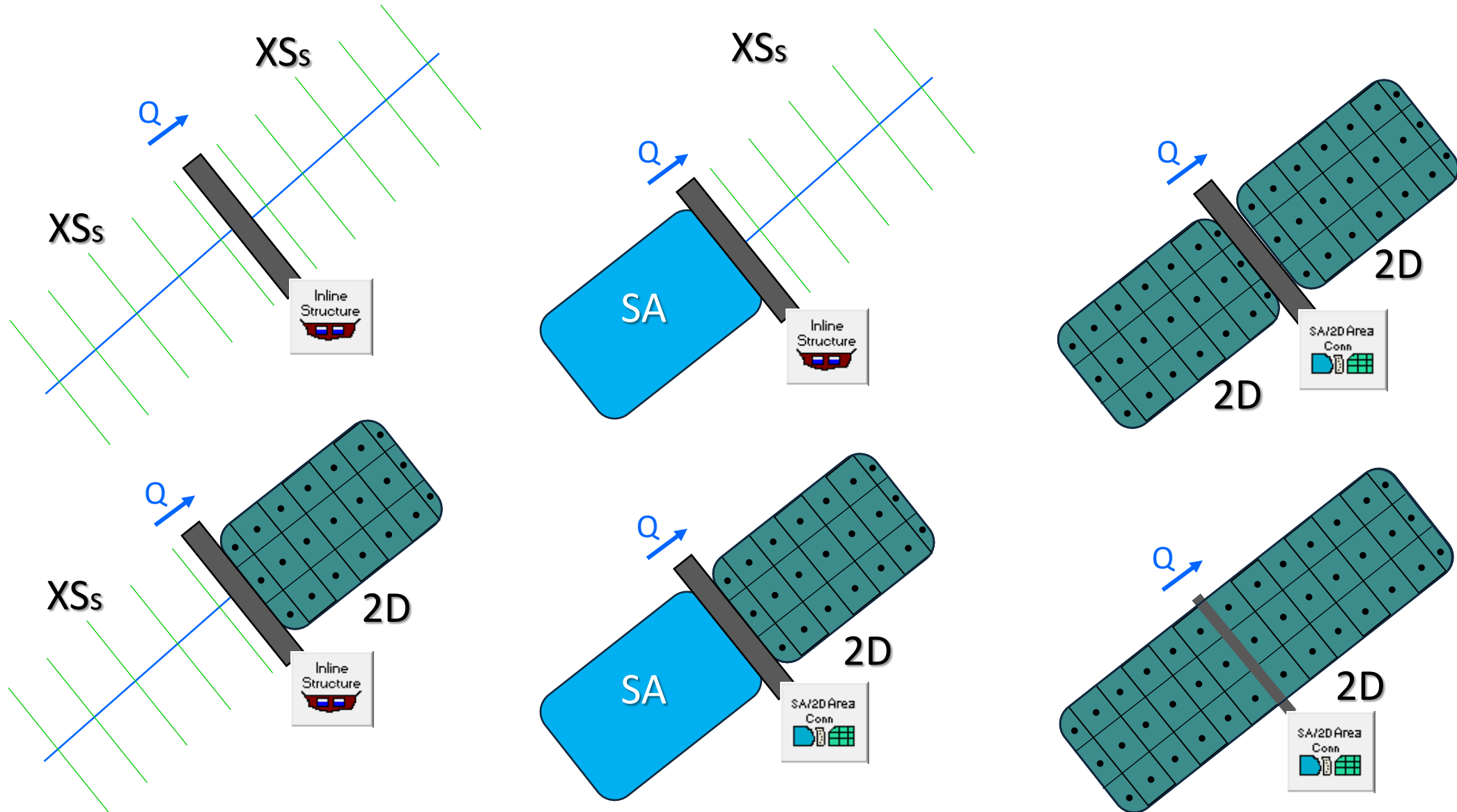
HEC-RAS Geometry for Dam Breach Analysis

Cameron Ackerman, P.E., D.WRE

USACE, Institute for Water Resources, Hydrologic Engineering Center

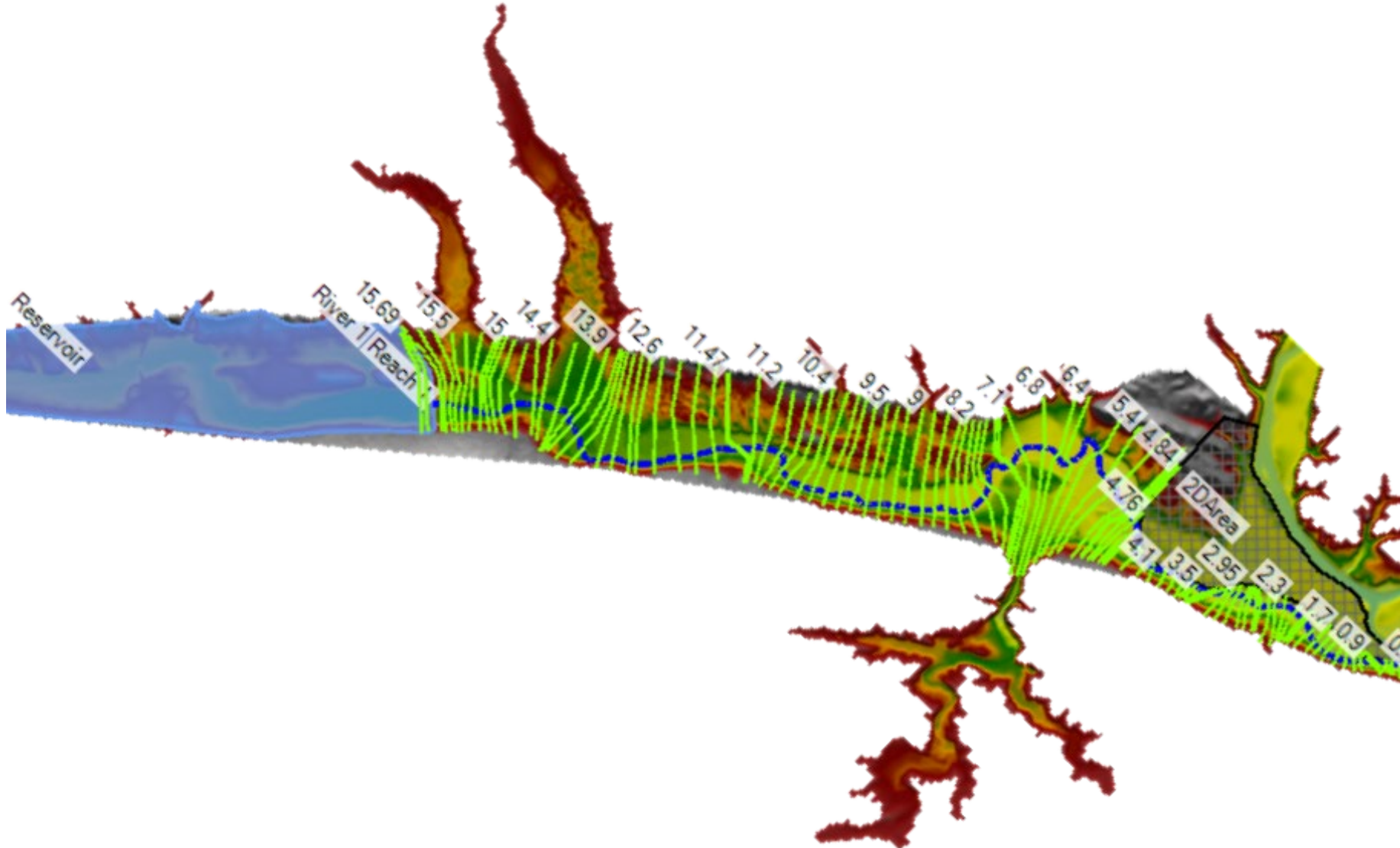


Breach Model Configurations





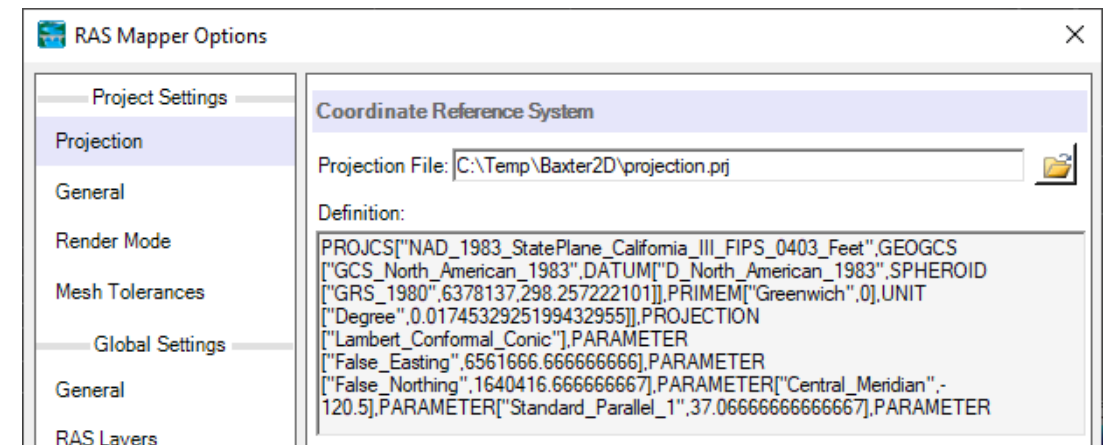
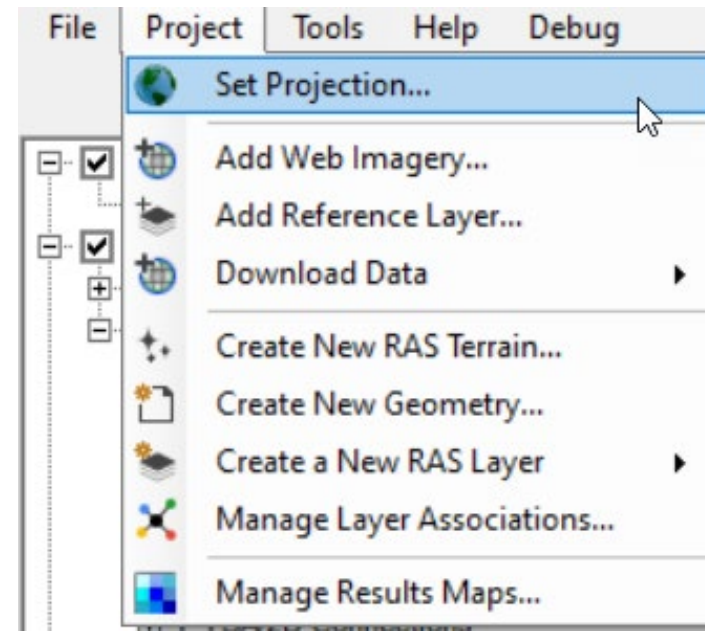
RAS Model Creation – RAS Mapper





Projection

- Data used in RAS Mapper must be a common coordinate system.
- Projection will be used to re-project Terrain data that is imported into RAS Mapper.
 - Defined using esri PRJ file.
- Web Imagery will be projected on-the-fly to RAS Mapper coordinate system.

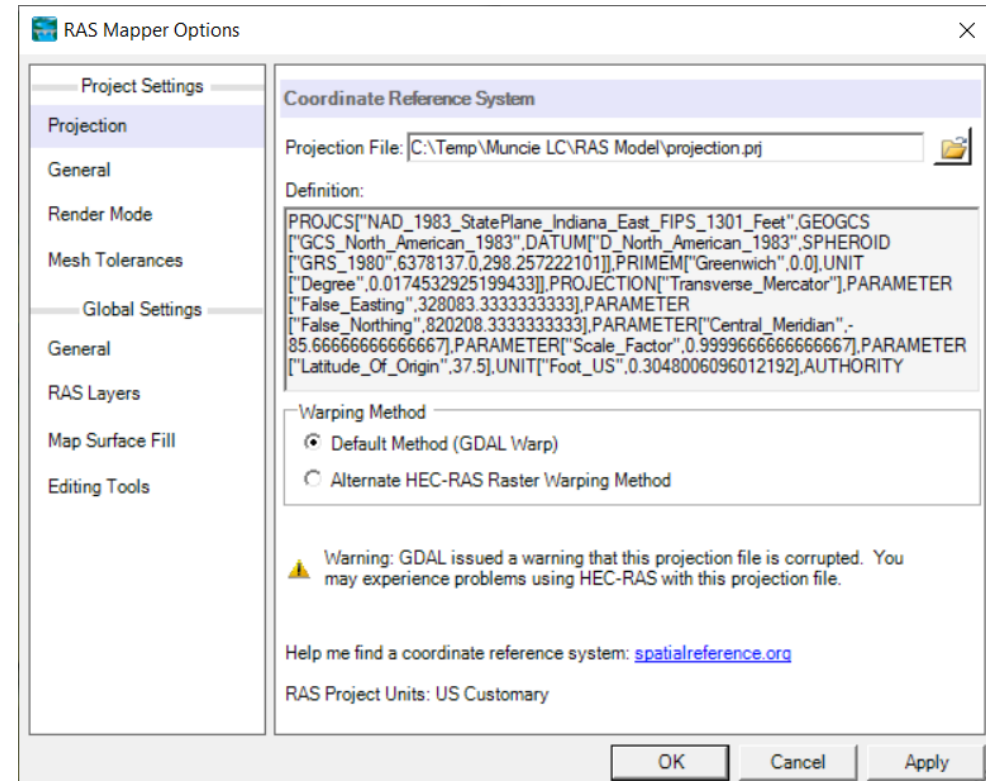
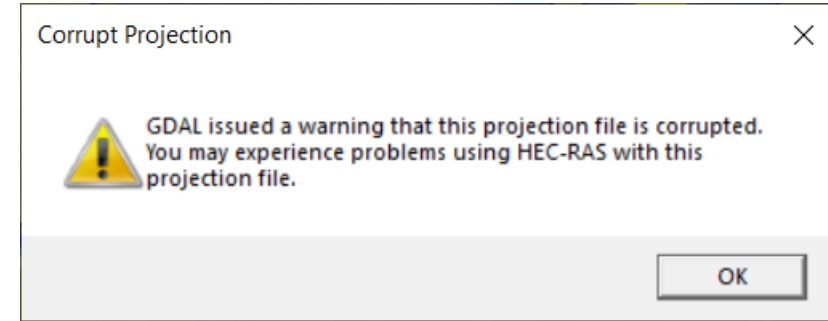




Projection Files

- Not all PRJ files are the same

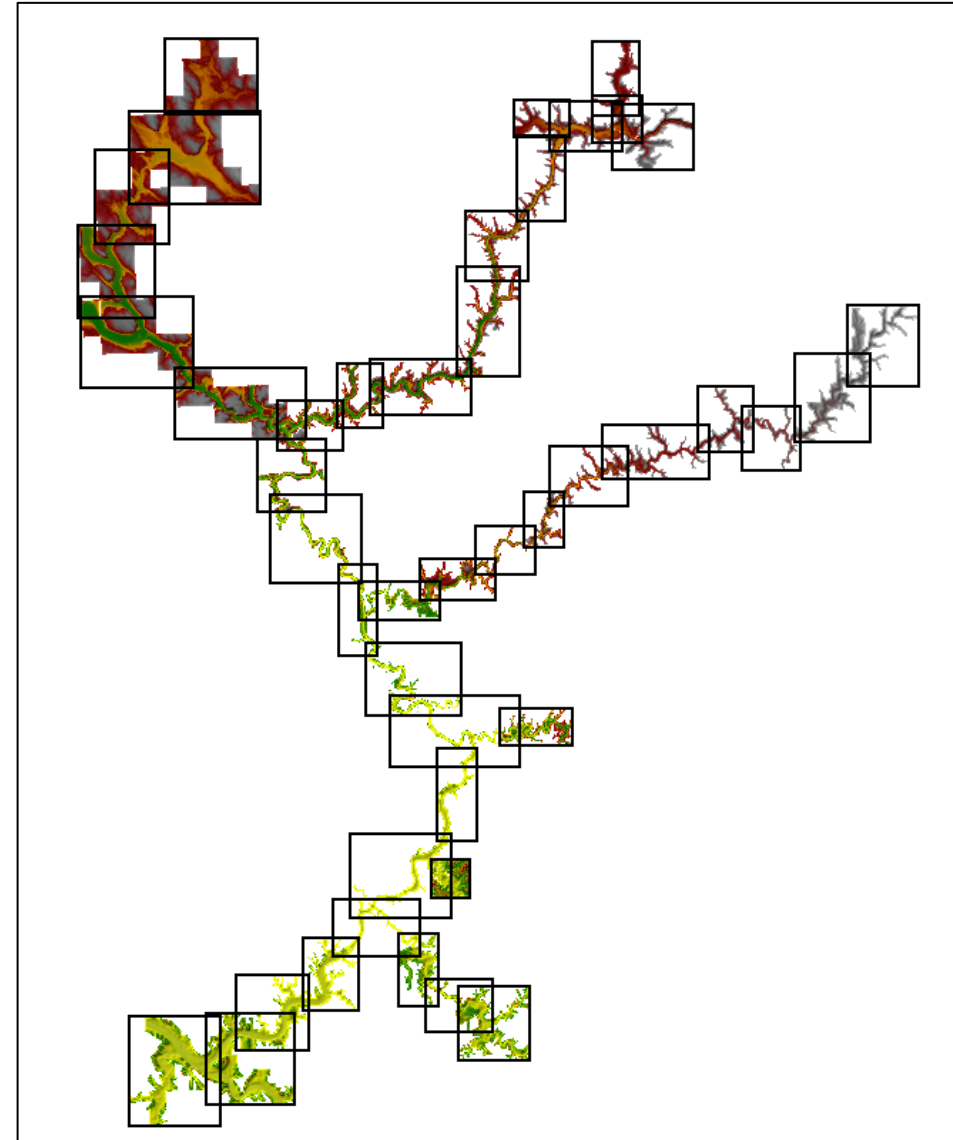
```
PROJCS["NAD_1983_StatePlane_Pennsylvania_South_FIPS_3702_Feet",
GEOGCS["GCS_North_American_1983",
DATUM["D_North_American_1983",
SPHEROID["GRS_1980",6378137.0,298.257222101]],
PRIMEM["Greenwich",0.0],
UNIT["Degree",0.0174532925199433]],
PROJECTION["Lambert_Conformal_Conic"],
PARAMETER["False_Easting",1968500.0],
PARAMETER["False_Northing",0.0],
PARAMETER["Central_Meridian",-77.75],
PARAMETER["Standard_Parallel_1",39.93333333333333],
PARAMETER["Standard_Parallel_2",40.96666666666667],
PARAMETER["Latitude_Of_Origin",39.33333333333334],
UNIT["Foot_US",0.3048006096012192]]
```





Terrain in RAS Mapper

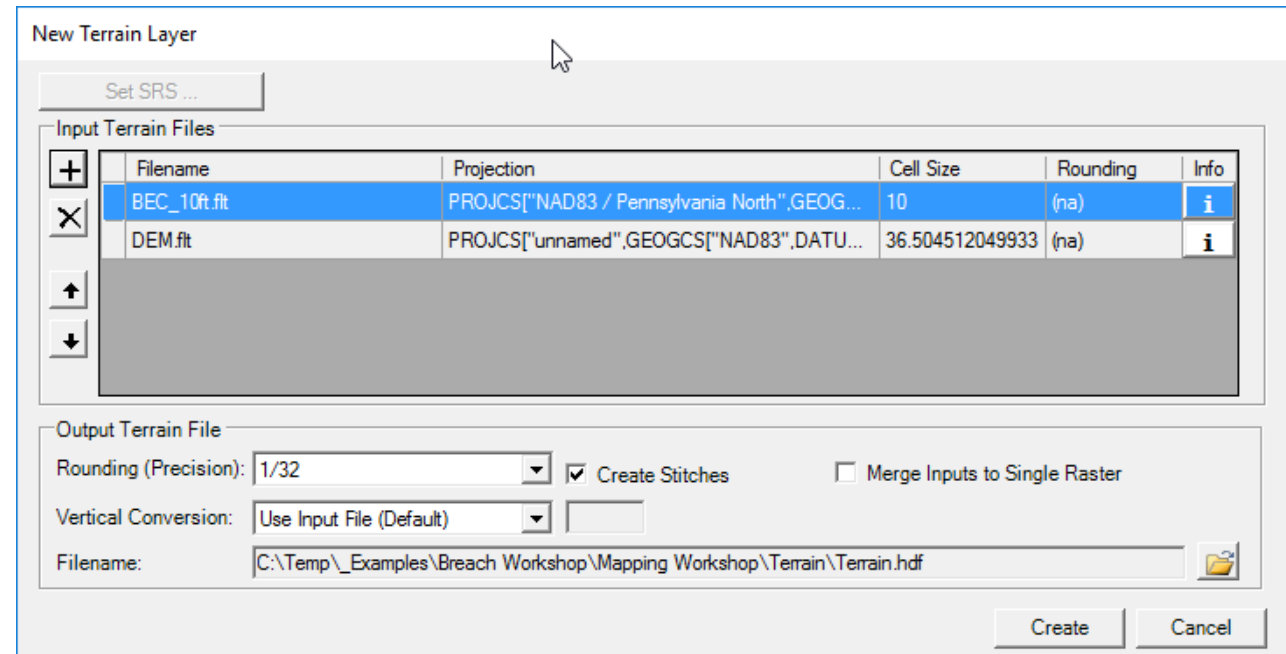
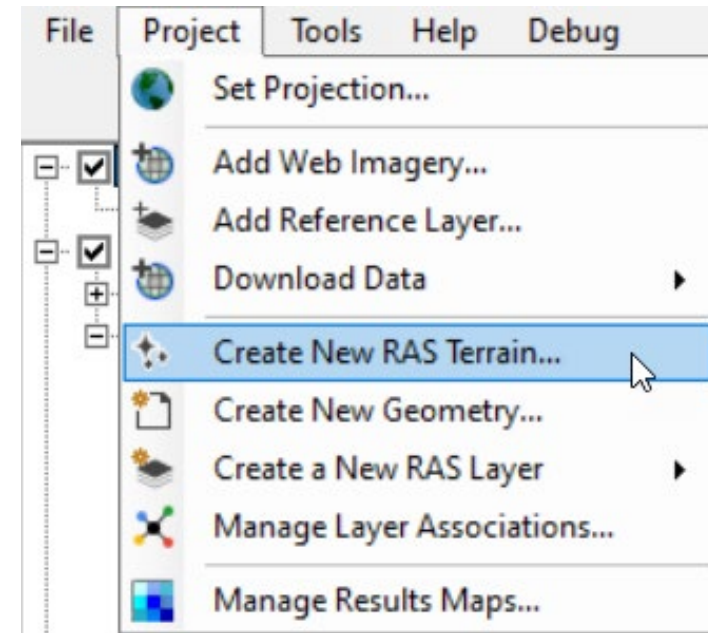
- Uses GeoTIFF format
 - Tiled data for more efficient storage
 - Compressed data for efficient storage
 - Pyramided data for fast visualization
 - Allows for on-the-fly inundation mapping
- One Layer for Multiple Terrain Models
- No file size limitations – BigTIFF supported





Terrain Importer

- Click **Project | Create New RAS Terrain**
- **Add** raster files for import

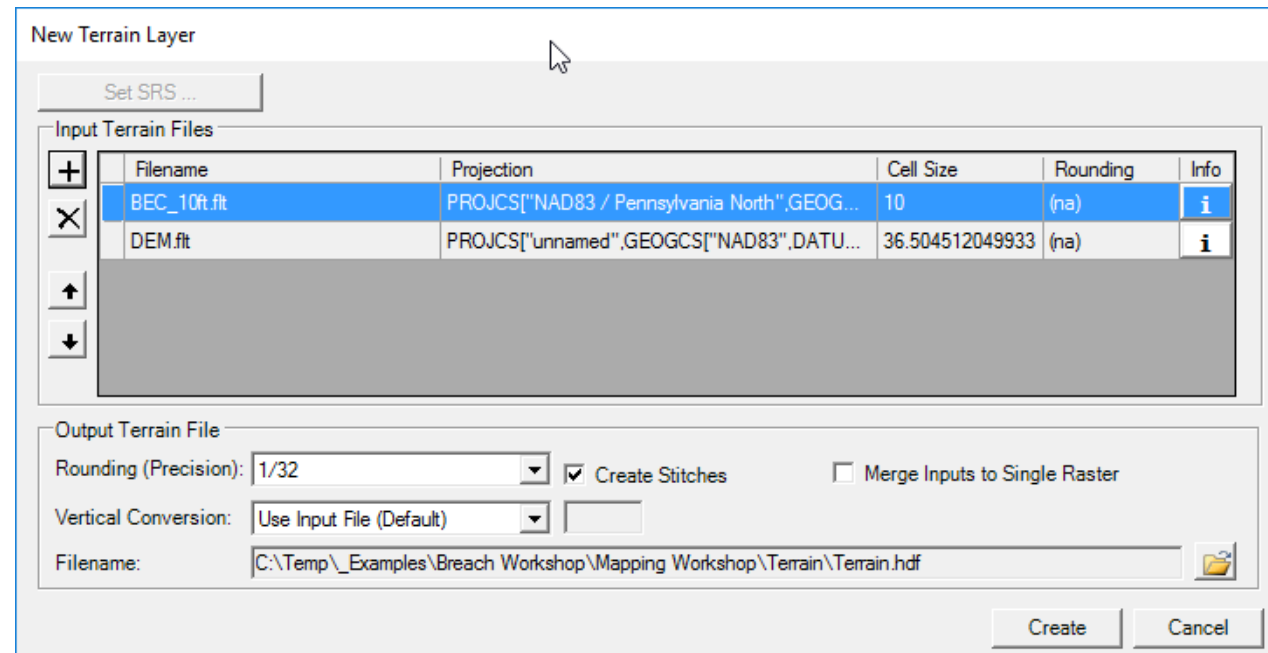


- Click **Create**



Terrain Importer

- Add files – allows user to select rasters for import
- Order raster files based on **Priority** on what cell value should be used if there is overlap by the terrain models.
 - Highest Priority to the top





Terrain Importer

- Data is translated (to .tif), projected, and rounded for all data
- Data is pyramided (overlays created) and compressed
- TIN stitches are created for overlapping regions
- **Terrain.hdf** is the single layer loaded to RAS Mapper

Compute Window - Creating Terrain 'Terrain'

```

Importing 1 of 2: BEC_20ft.flt
Step 1 of 4: Translating to GeoTiff with SRS...           |           1
Step 2 of 4: Rounding and/or Generating Statistics...   |           7
Step 3 of 4: Generating Histogram...                   |           2
Step 4 of 4: Adding Overlays...                         |           2
BEC_20ft.flt Import Complete.                           |          14
-----
Importing 2 of 2: BEC_DEM.flt
Step 1 of 4: Translating to GeoTiff and reprojecting... |          26
Step 2 of 4: Rounding and/or Generating Statistics...   |         1:05
Step 3 of 4: Generating Histogram...                   |          11
Step 4 of 4: Adding Overlays...                         |          13
BEC_DEM.flt Import Complete.                           |         1:56
-----
Final Processing: Terrain.hdf
Step 1 of 3: Creating Terrain.vrt...                     |           0
Step 2 of 3: Creating Terrain.hdf...                    |         1:17
Step 3 of 3: Creating Stitch-TIN for merging rasters... |           6
Terrain Complete                                       |         3:34
  
```

Close



Terrain in RAS Mapper



RAS Mapper

File Project Tools Help

Max Min

Terrains

- Features
- Geometries
- Event Conditions
- Results
- Map Layers
- Terrains
 - Terrain

Messages Views Profile Lines Active Features Layer Values

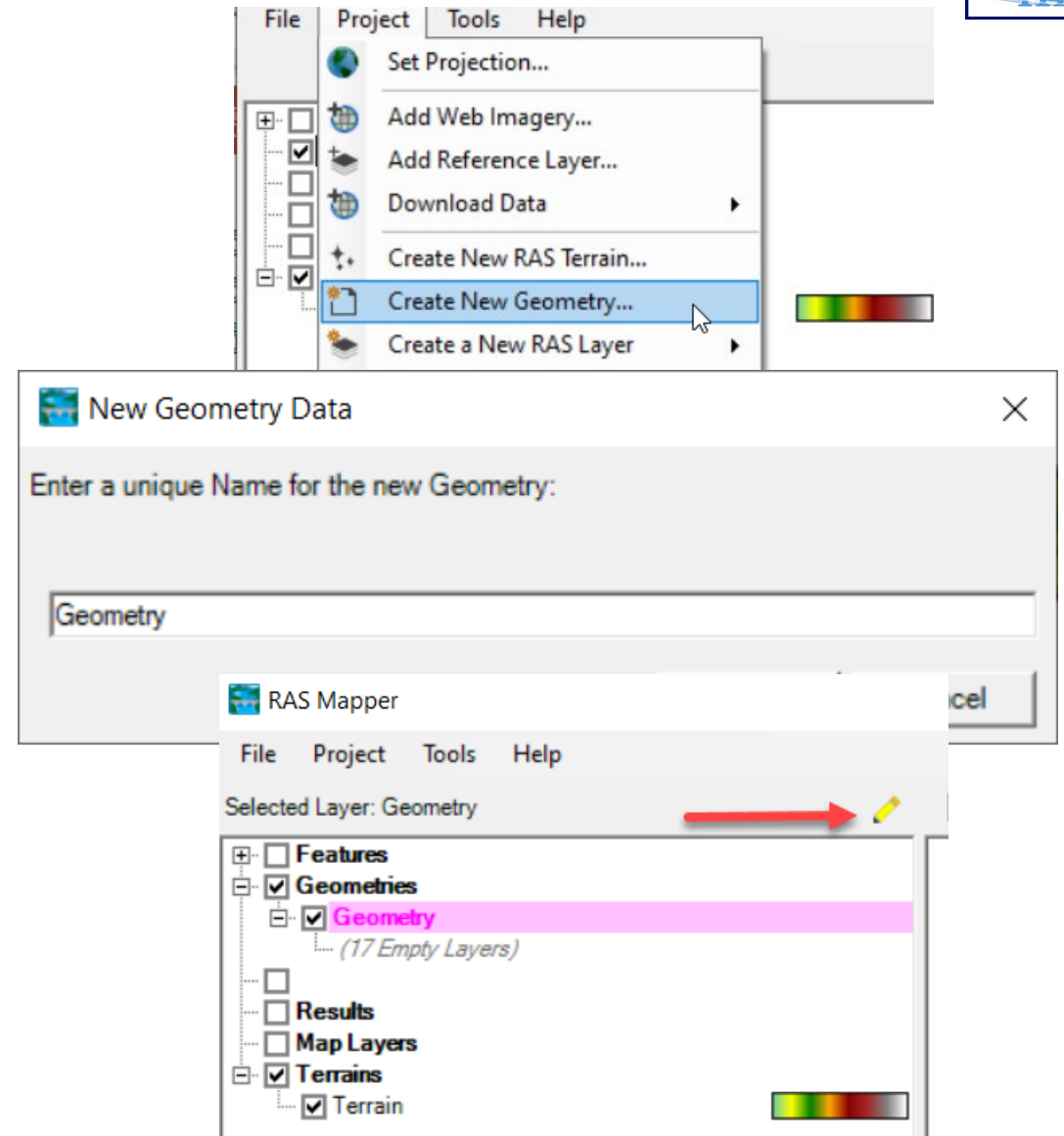
(2058227.99, 311155.13 1 pixel = 182.86 ft)

5 mi 10



Create a New Geometry

- Create a New Geometry
- Provide a Name
- Select the Geometry
- Edit the New Geometry









The image shows two screenshots from the RAS Mapper software interface. The top screenshot displays the 'Tools' menu with 'Create New Geometry...' selected. The bottom screenshot shows the 'New Geometry Data' dialog box with the text 'Enter a unique Name for the new Geometry:' and a text input field containing 'Geometry'. Below the dialog box, the 'RAS Mapper' main window is visible, showing the 'Selected Layer: Geometry' and a tree view where 'Geometry' is highlighted in pink. A red arrow points to a yellow pencil icon in the top right corner of the tree view, indicating the edit function.



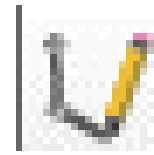
Editing Tools



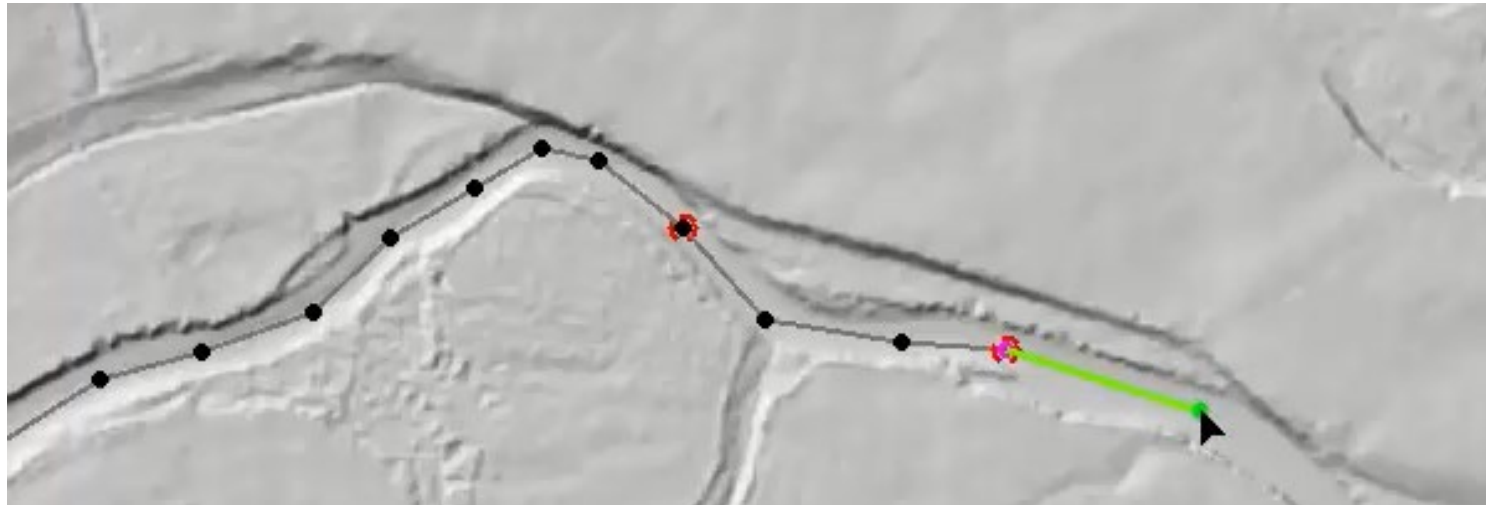
- Add New Feature 
- Select/Edit Feature 
- Undo/Redo 
- Plot Profile 
- Tools 
- Help 



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.

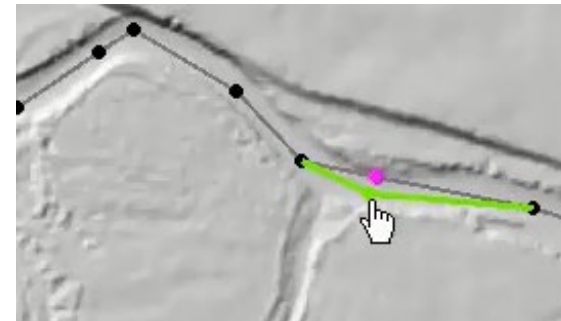
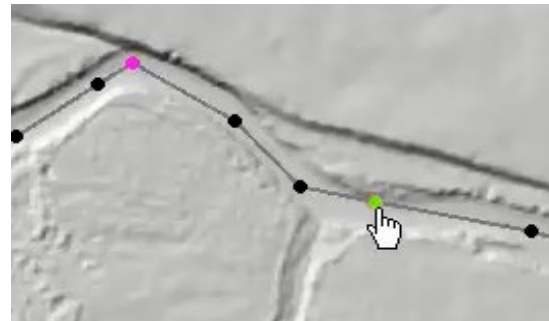
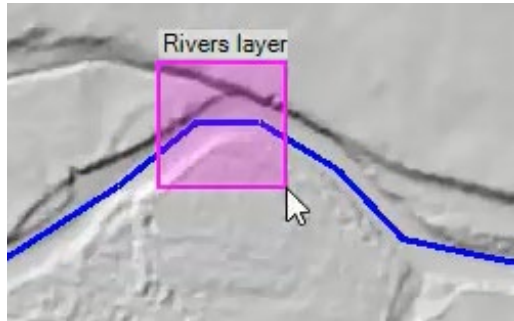




Select / Edit



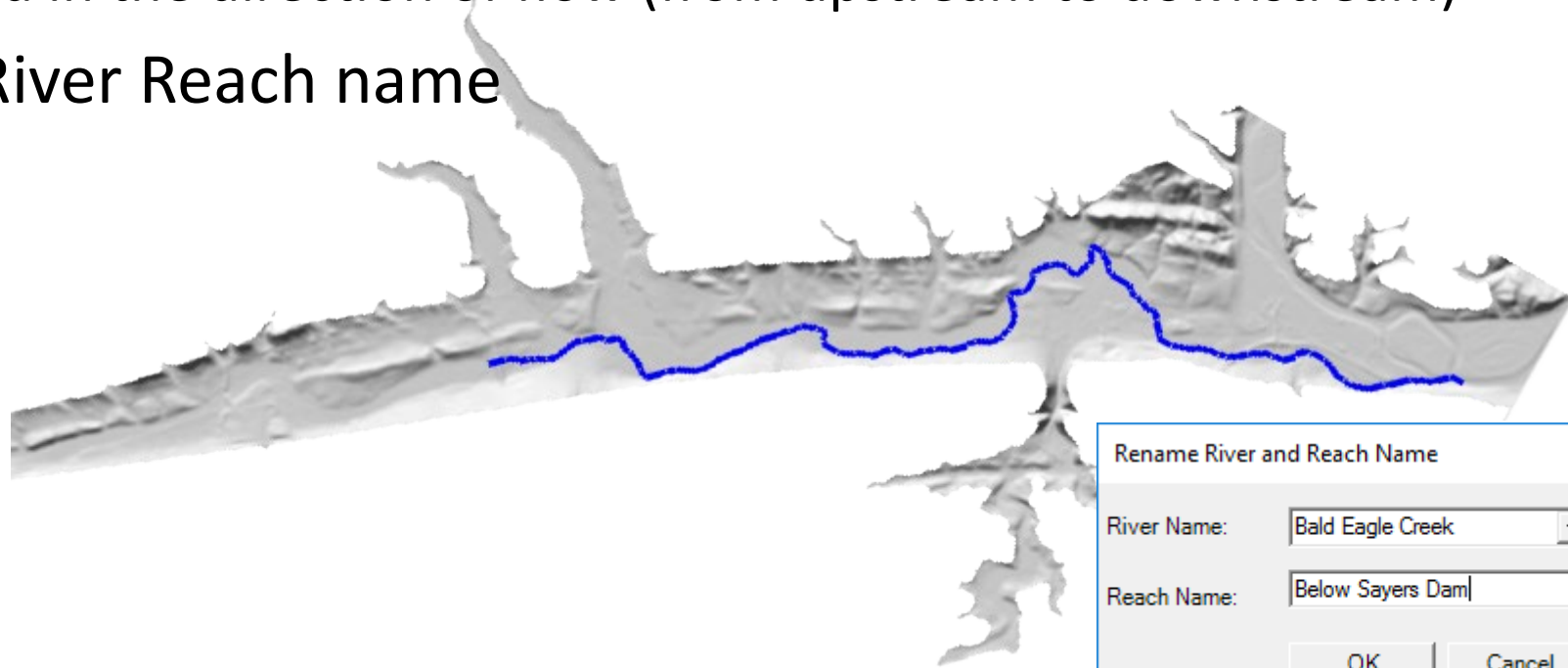
- Select / Edit tool is used to select feature(s) and then begin editing (move, add points, delete, etc).
 - Double-click to Start Editing (Open feature)
 - Double-click to End Editing (Close feature)
- Mouse hover indicates action
 - **Green** point indicates: Move, Insert, Delete point





River

- Establishes the stream network and connectivity
 - Created in the direction of flow (from upstream to downstream)
- Unique River Reach name



- Establish River Stations for Cross Sections



Junctions

- Junctions are formed at the confluence of rivers
- Automatically created in RAS Mapper at endpoints of river reaches

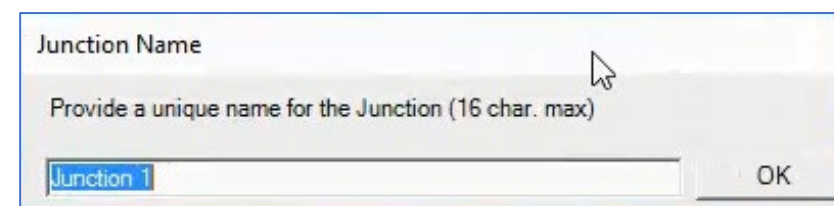
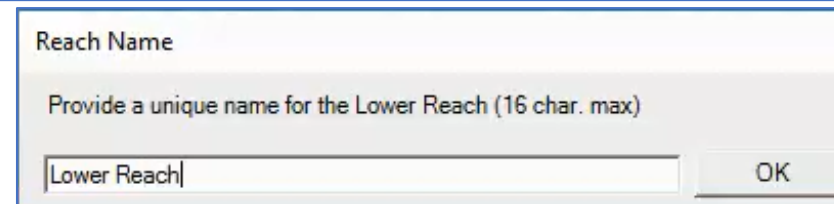
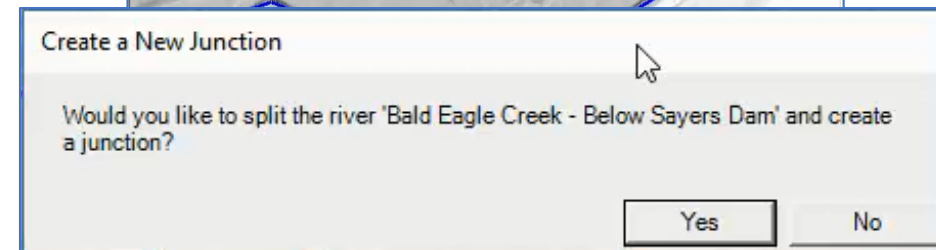
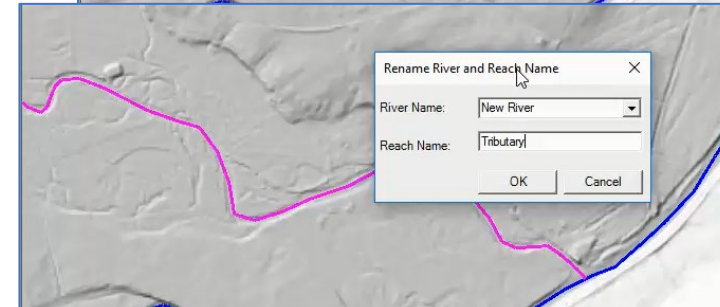


River	Reach	US Type	US Name	DS Type	DS Name	US XS Distance	DS XS Distance
Bald Eagle Creek	Below Sayers Dam	External		Junction	Junction 1		874.5
New River	Tributary	External		Junction	Junction 1		437.3
Bald Eagle Creek	Lower Reach	Junction	Junction 1	External		205.8	



Junction Creation

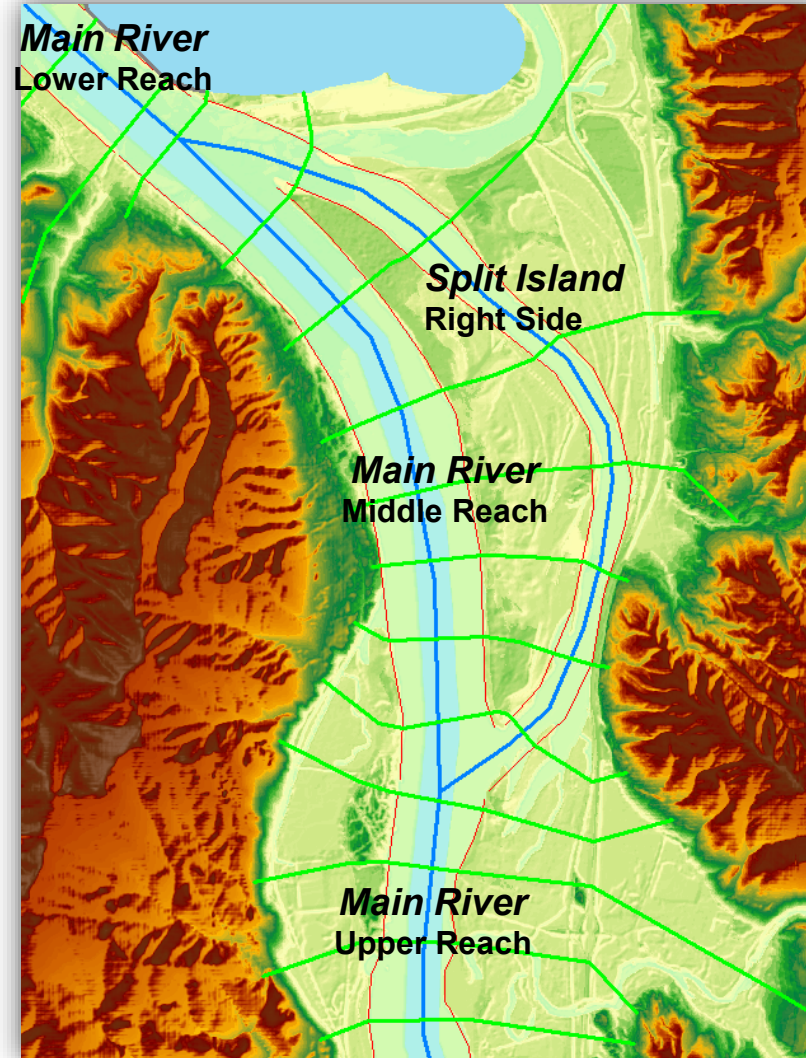
- Create a new river with endpoint of new river on an existing river
- Name new river
- Ask to split existing river
- Enter new Reach Name for reach below split
- Enter Junction Name





Unique Situations

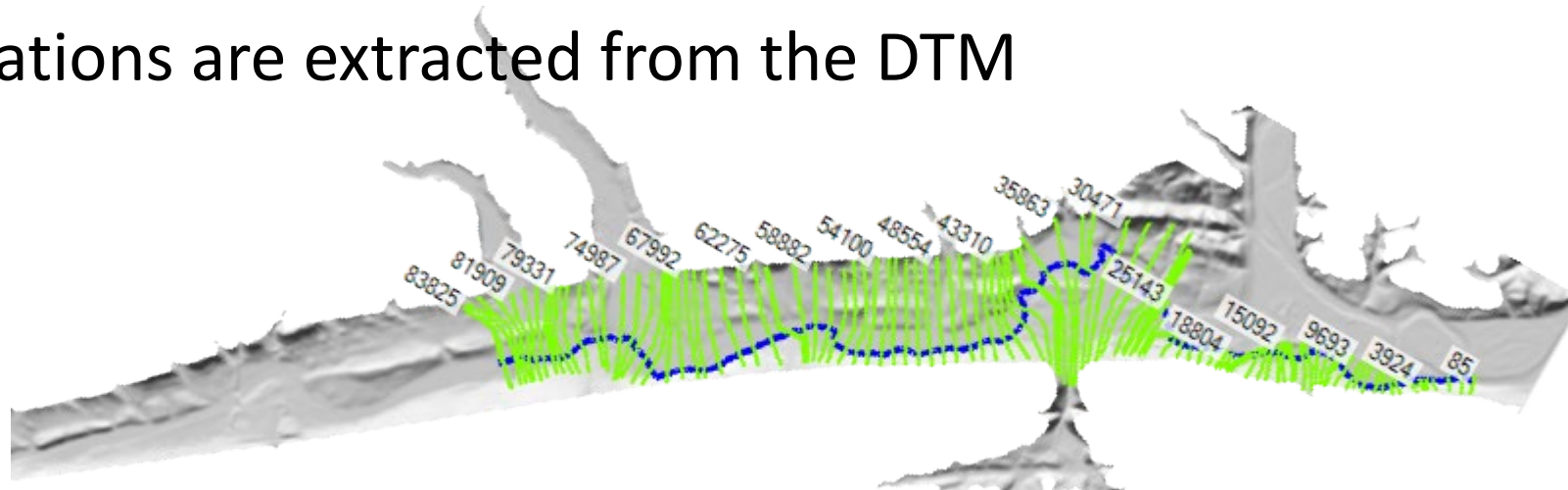
- Unique naming at split flow locations such as islands
- Pick main river name
- Requires new River name for split





Cross Sections

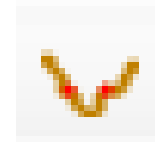
- XS location are oriented from the left to right bank (looking d/s)
- Perpendicular to flow for correct XS area
- River Names, Reach Names, and River Stations are assigned to XS based on stationing along the stream centerline
- Elevations are extracted from the DTM



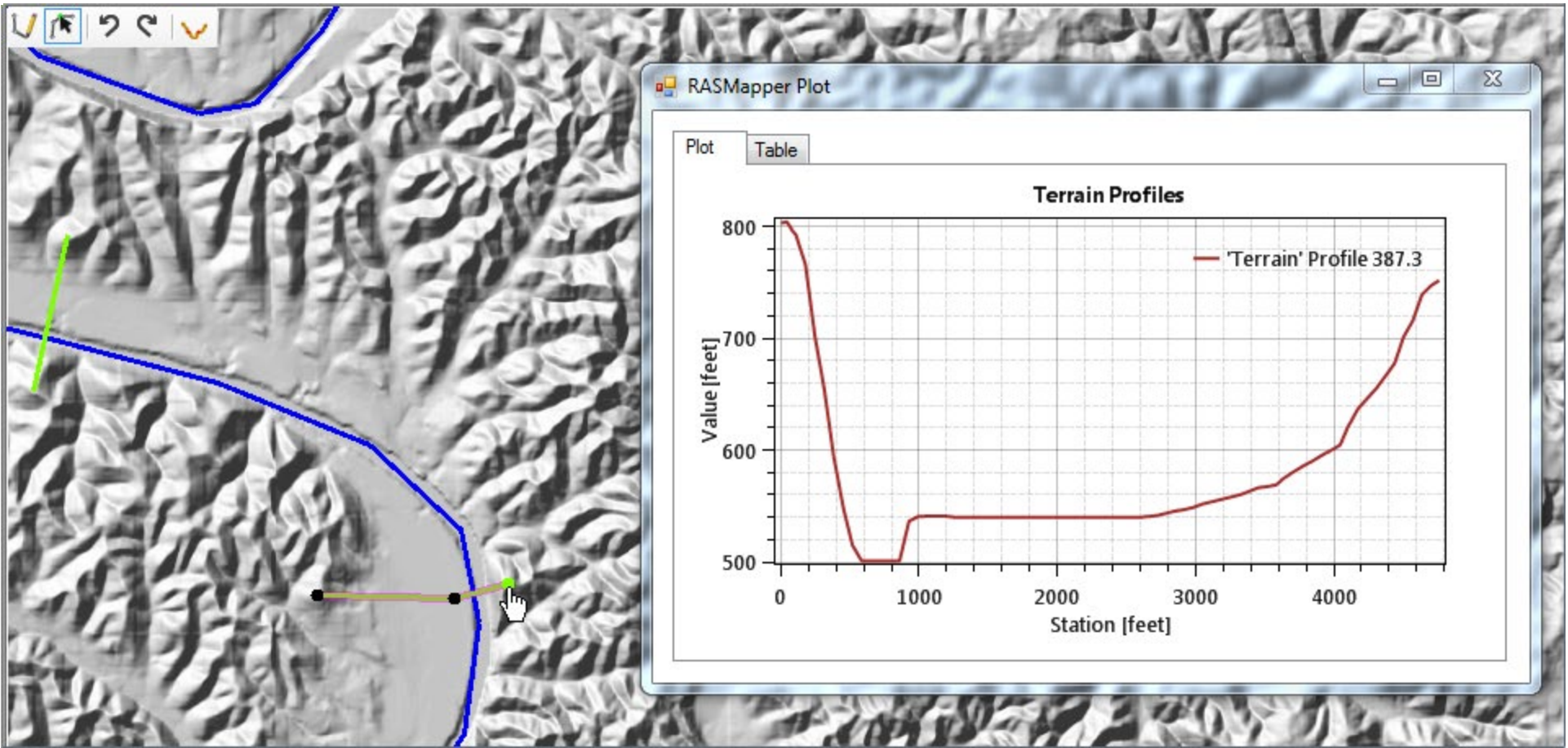
River	Reach	River Station	Length LOB	Length Channel	Length ROB	Left Bank	Right Bank
Bald Eagle Creek	Below Sayers Dam	82671	332.924347	332.924347	332.924347	5393.39844	5593.358
Bald Eagle Creek	Below Sayers Dam	82338	429.508026	429.508026	429.508026	5113.08154	5319.7915
Bald Eagle Creek	Below Sayers Dam	81909	494.6595	494.6595	494.6595	4921.44873	5068.88867
Bald Eagle Creek	Below Sayers Dam	81414	527.047241	527.047241	527.047241	5033.24268	5154.98242
Bald Eagle Creek	Below Sayers Dam	80887	688.114441	688.114441	688.114441	5083.96826	5224.024



Profile Plot



- Plot updates interactively





Cross Section Details

- Capture a smooth transition in floodplain geometry.
- Appropriate spacing to satisfy the Courant condition:

$$C = V \frac{\Delta t}{\Delta x} \leq 1.0 \qquad \Delta t \leq \frac{\Delta x}{V}$$

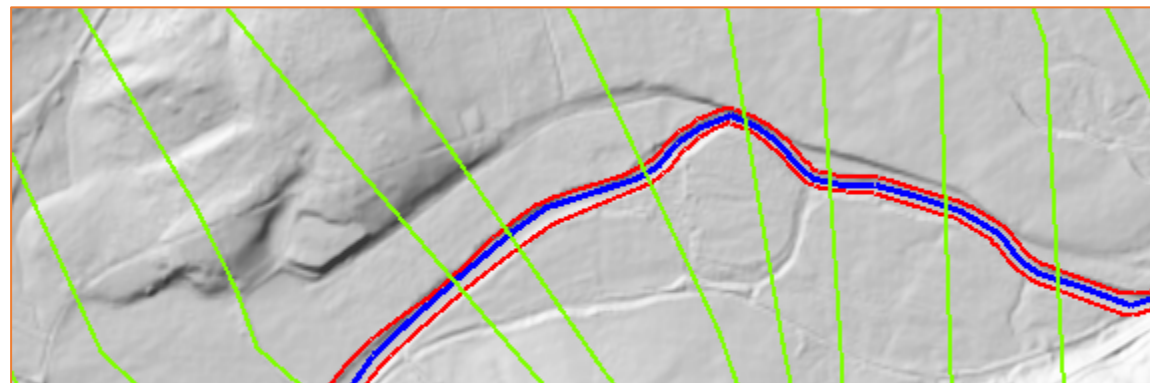
- Include a low-flow channel to model a range of flow events. Channel assists in modeling hydrographs that change rapidly.



Bank Lines



- Stream bank lines are located at the river banks to delineate the main river channel from the overbanks areas



River	Reach	River Station	Length LOB	Length Channel	Length ROB	Left Bank	Right Bank
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Bald Eagle Creek	Below Sayers Dam	80887	688.114441	688.114441	688.114441	5083.96826	5224.024

- Defining banks are important to identify where the main channel is!



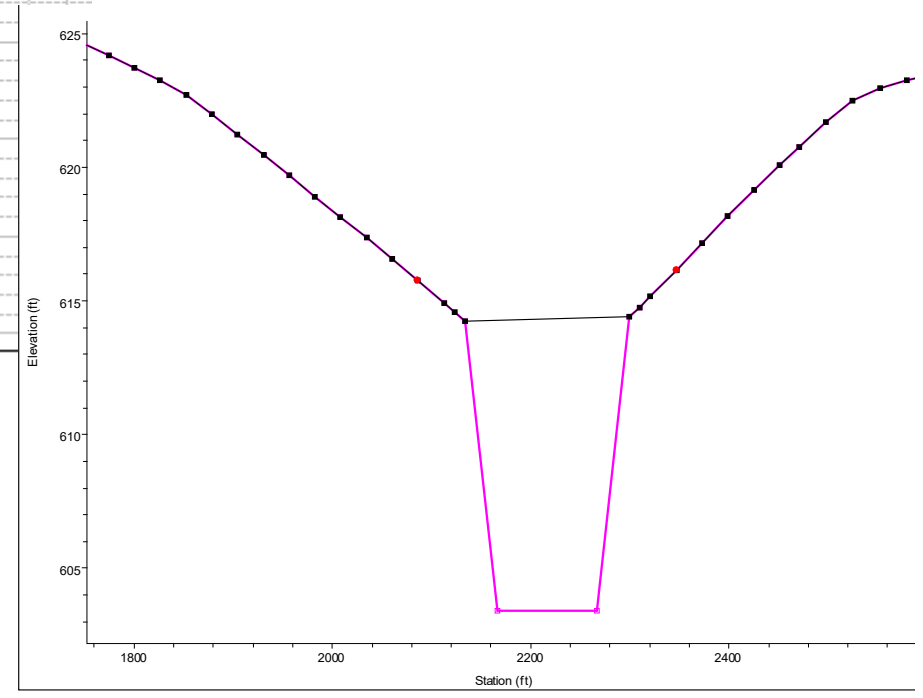
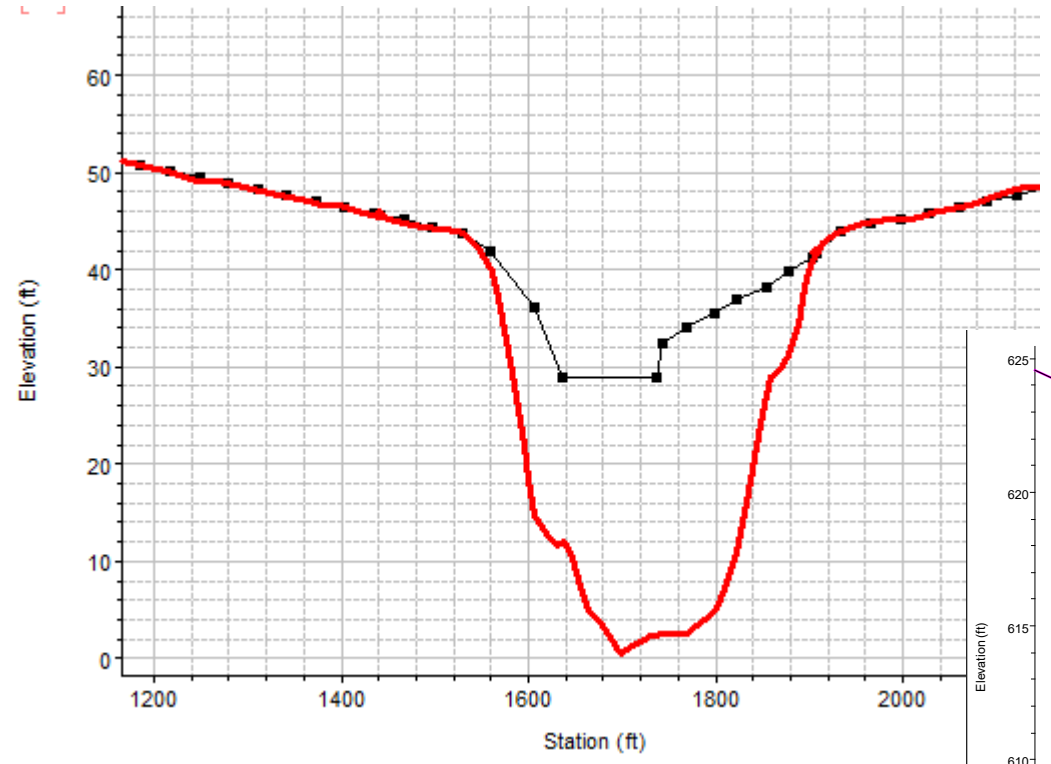
Bank Locations

- Terrain often doesn't clearly indicate location of main channel.
- Use imagery to establish banks.



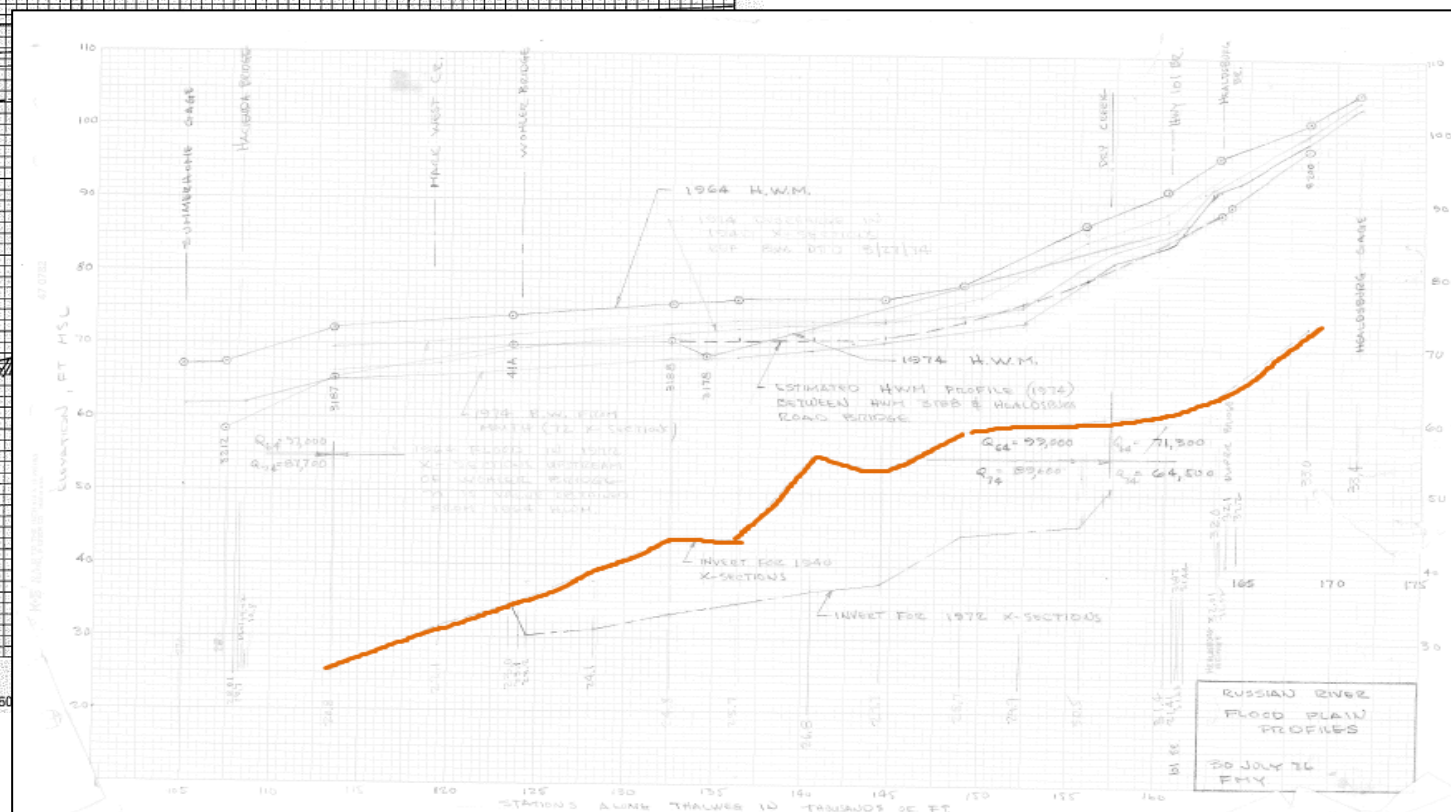
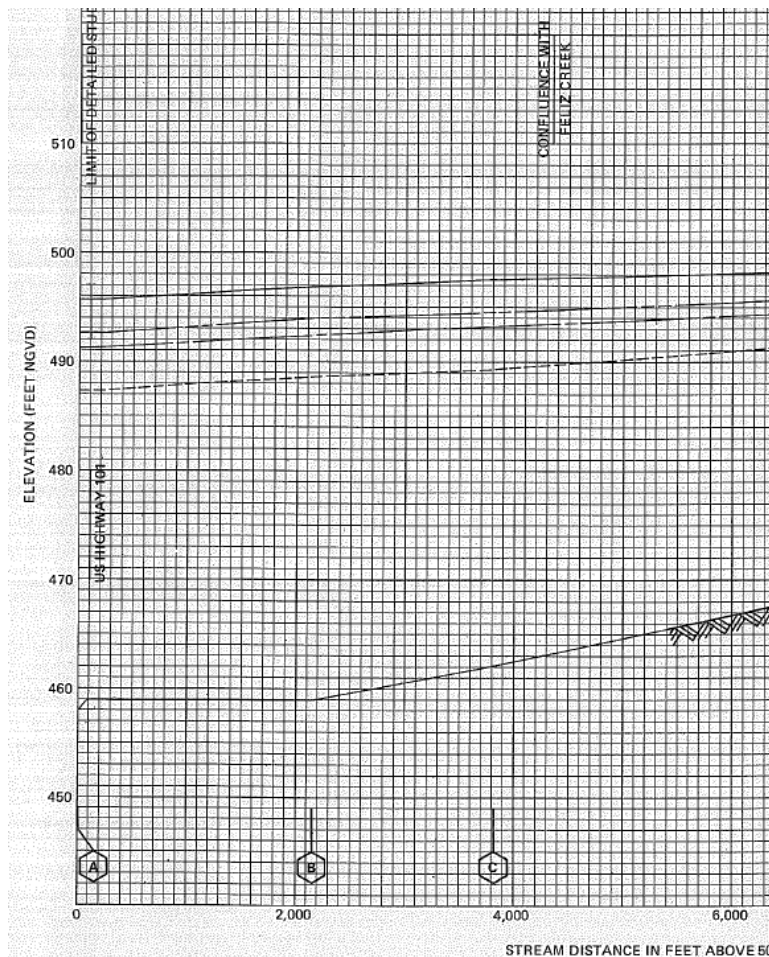


Bank Locations





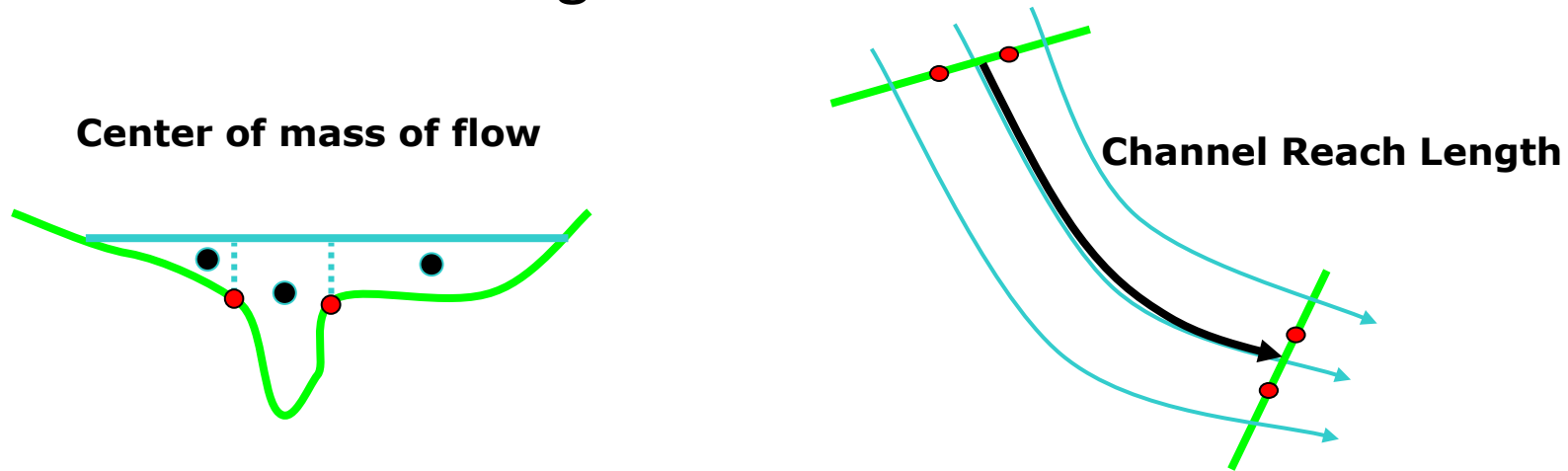
Published Elevation Data





Flow Path Lines

- Used to compute Reach Lengths
- Drawn at the center-of-mass of flow in the left overbank and right overbank in the direction of flow
- River is used for channel length

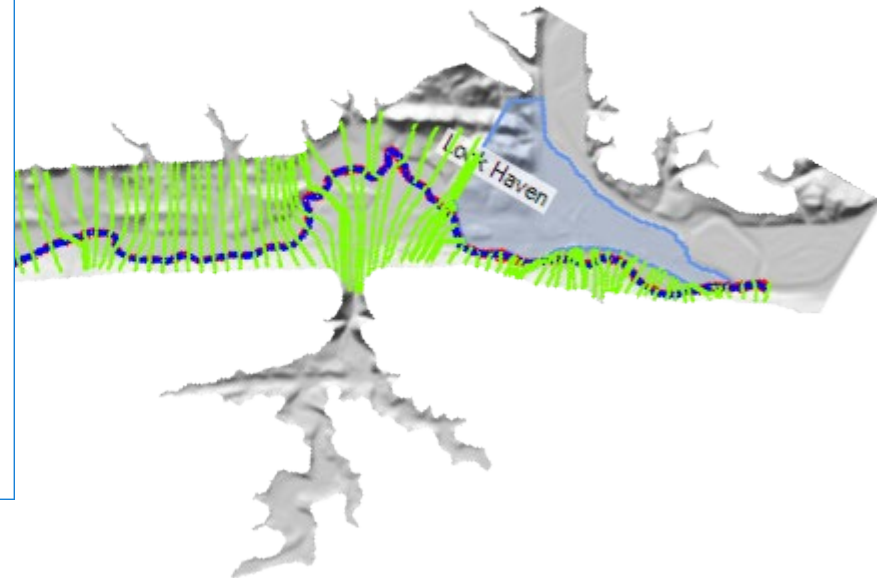
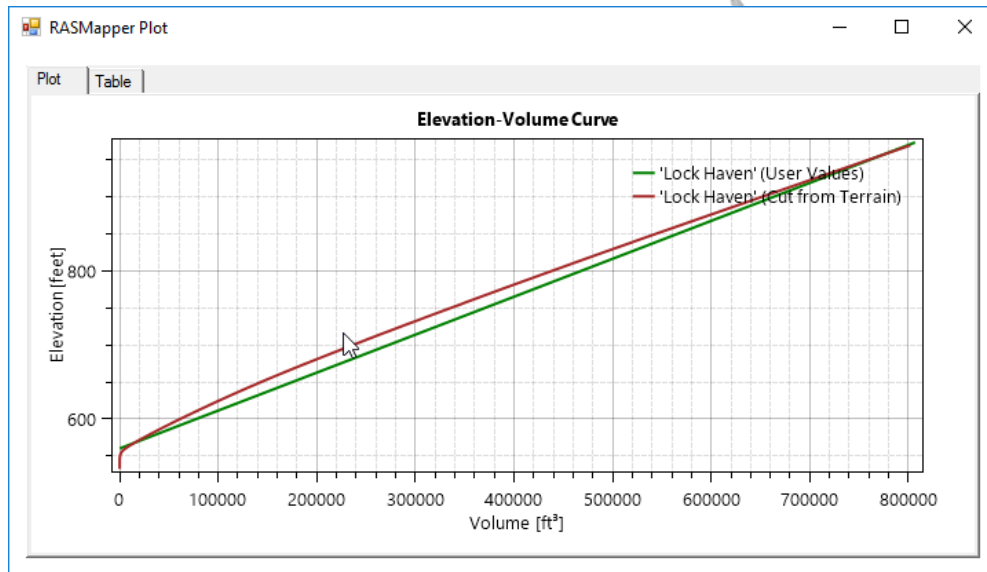


River	Reach	River Station	Length LOB	Length Channel	Length ROB	Left Bank	Right Bank
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Bald Eagle Creek	Below Sayers Dam	80887	688.114441	688.114441	688.114441	5083.96826	5224.024



Storage Areas

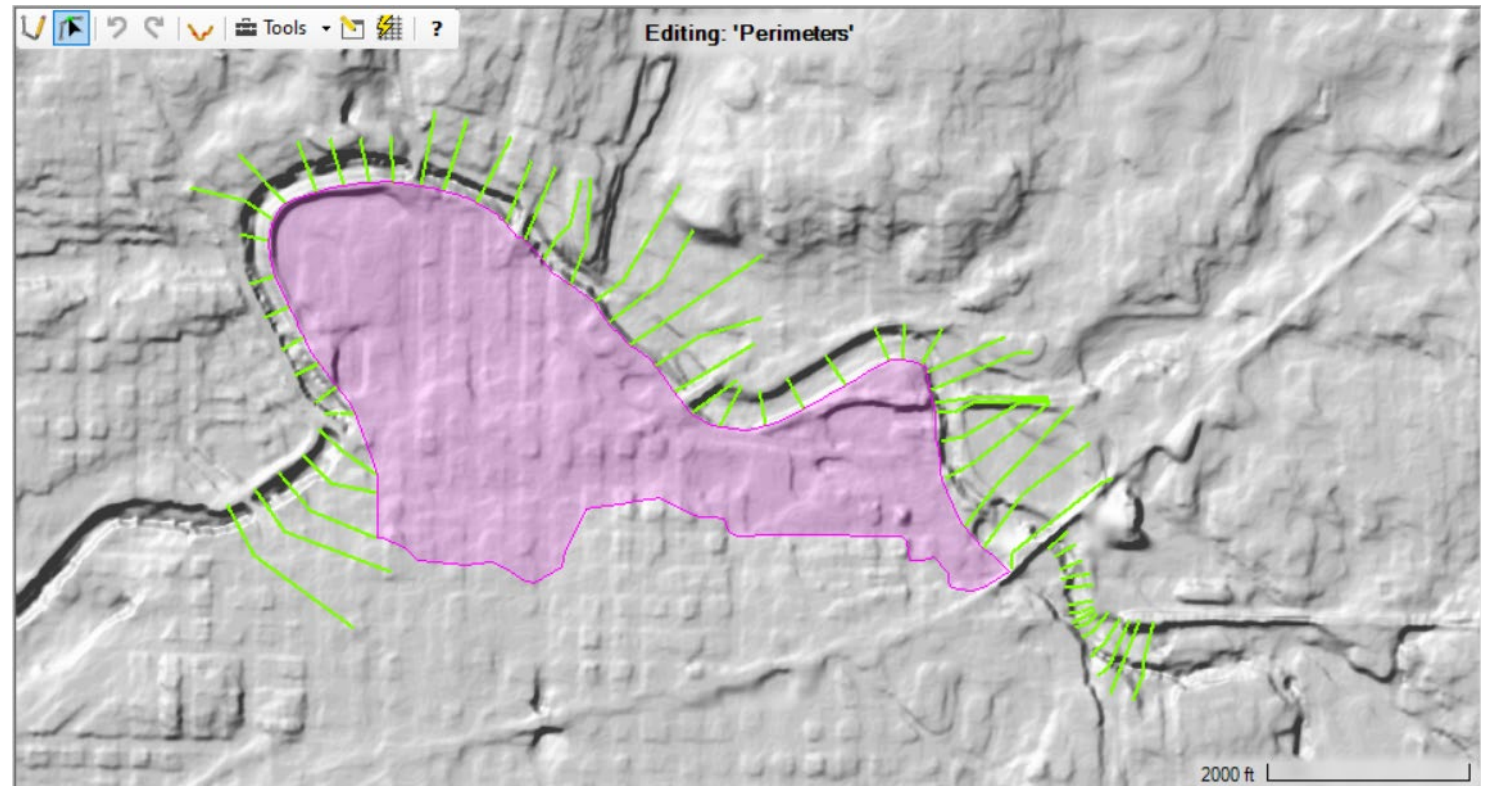
- Used to represent areas that will store water.
- Elevation-Volume curve is developed from Terrain.
- Horizontal water surface is used.
- Water fills lowest portion of SA first.





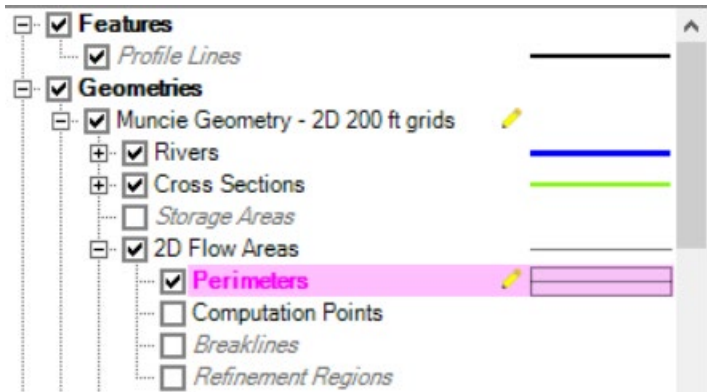
2D Flow Areas

- 2D Flow Areas are used where flow direction is highly variable/unknown.
- Can use for the entire study area or for specific areas.
 - Reservoir
 - River Floodplain
 - Protected Area
 - Tributaries

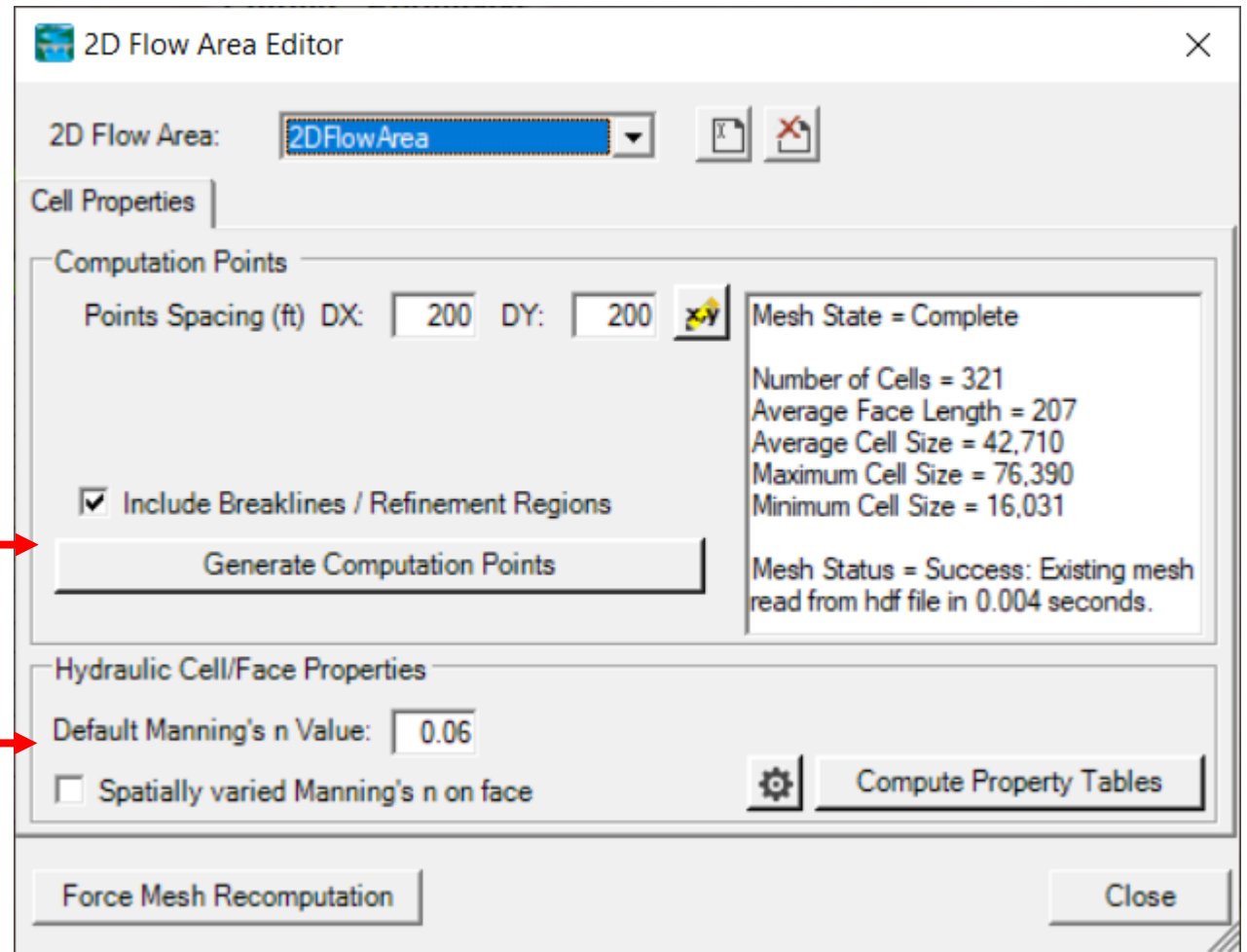




2D Flow Areas



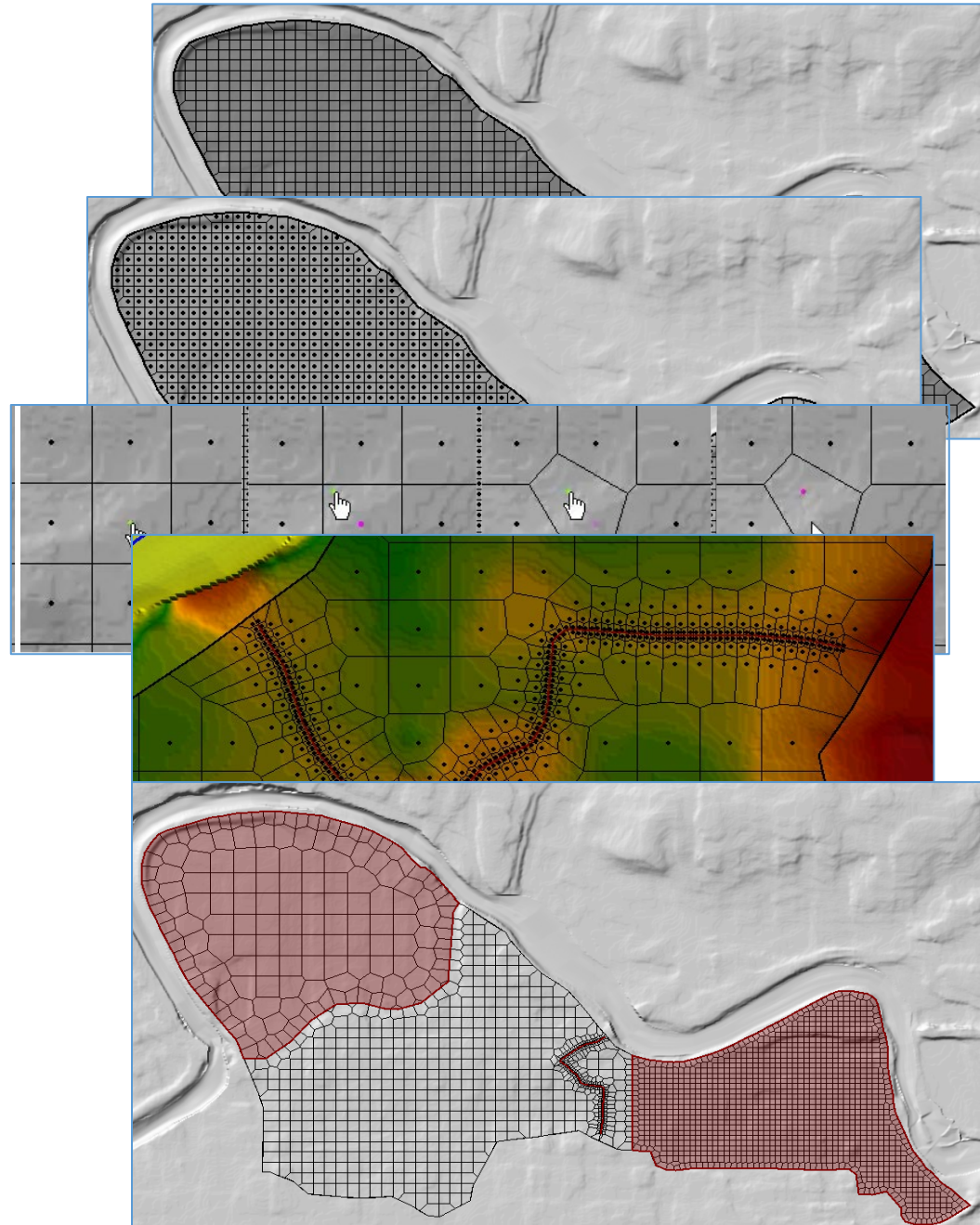
- Tools to autogenerate computation points
- Manning's n values
 - Single - or -
 - Spatially Varied





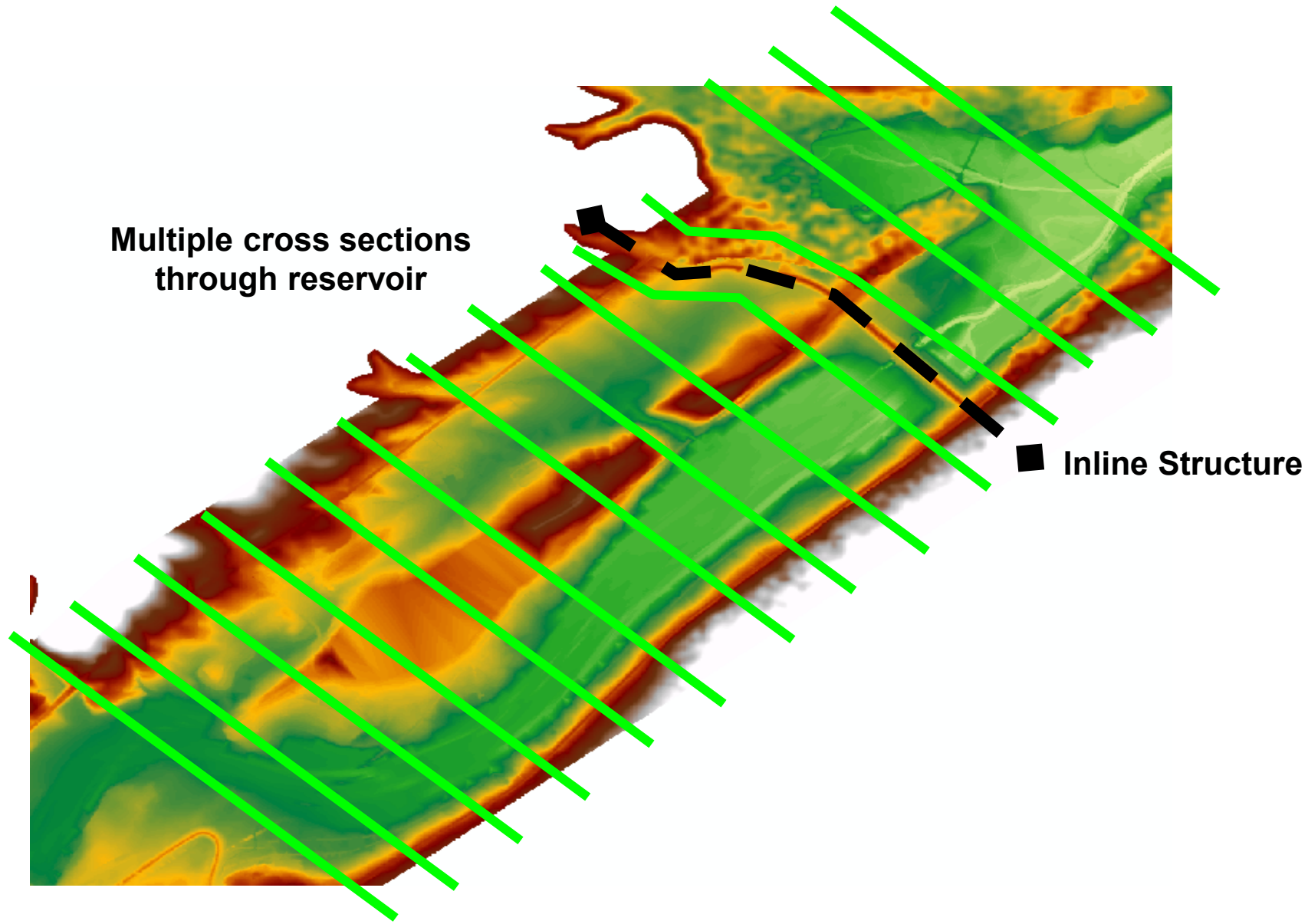
2D Flow Areas

- Perimeter
- Computation Points
- Breaklines
- Refinement Regions



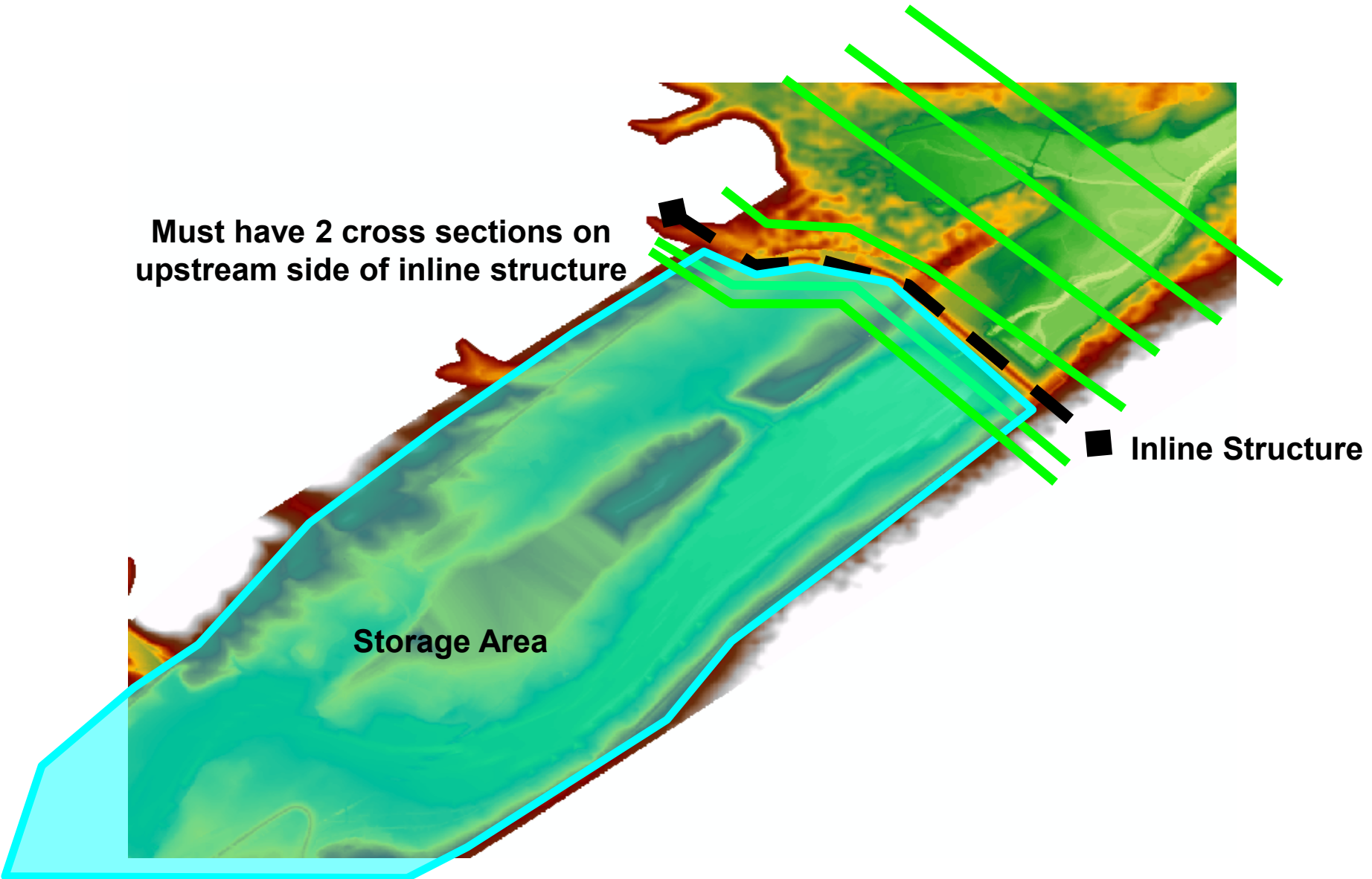


Modeling Reservoirs





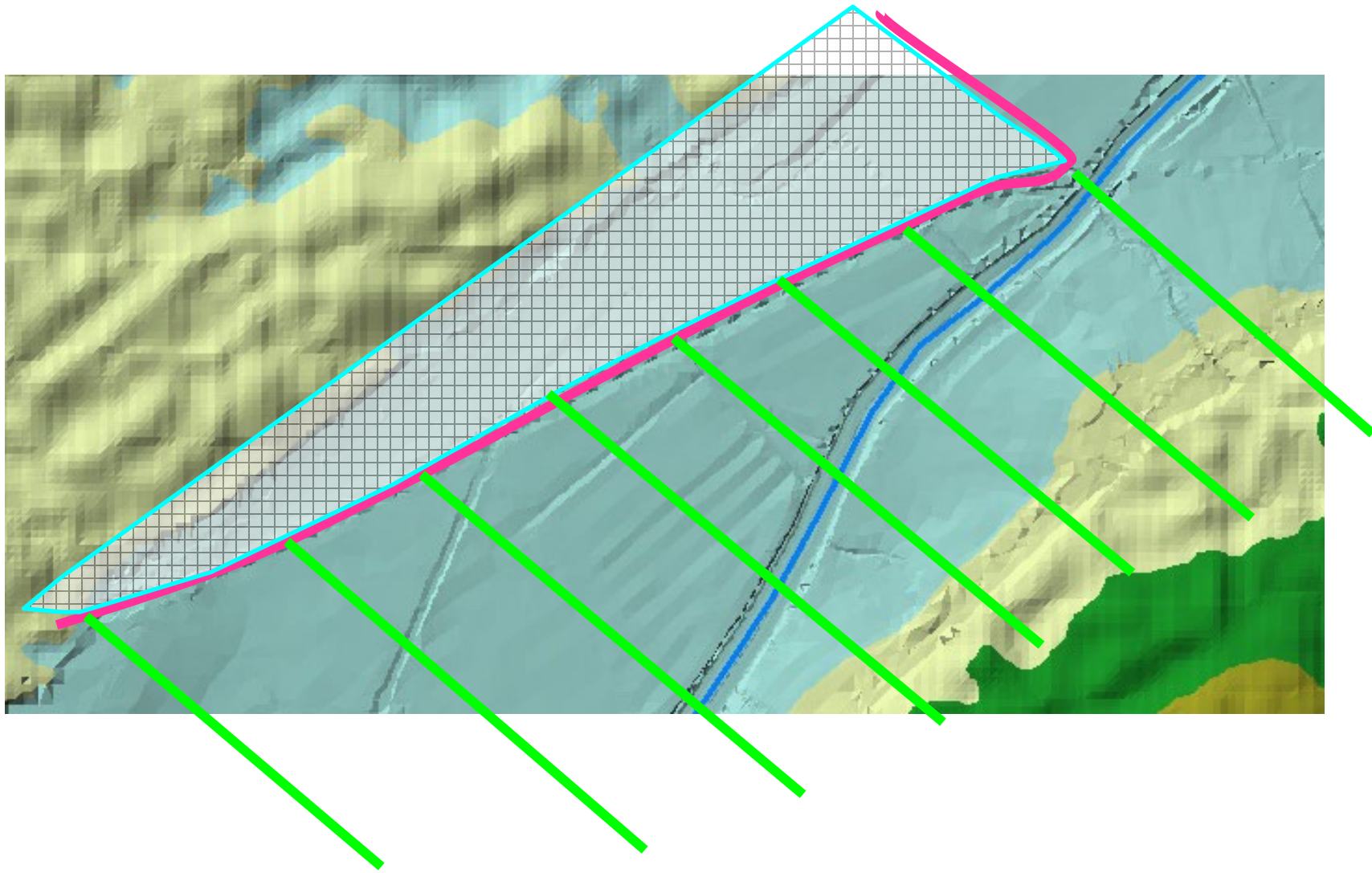
Modeling Reservoirs





Modeling Protected Areas

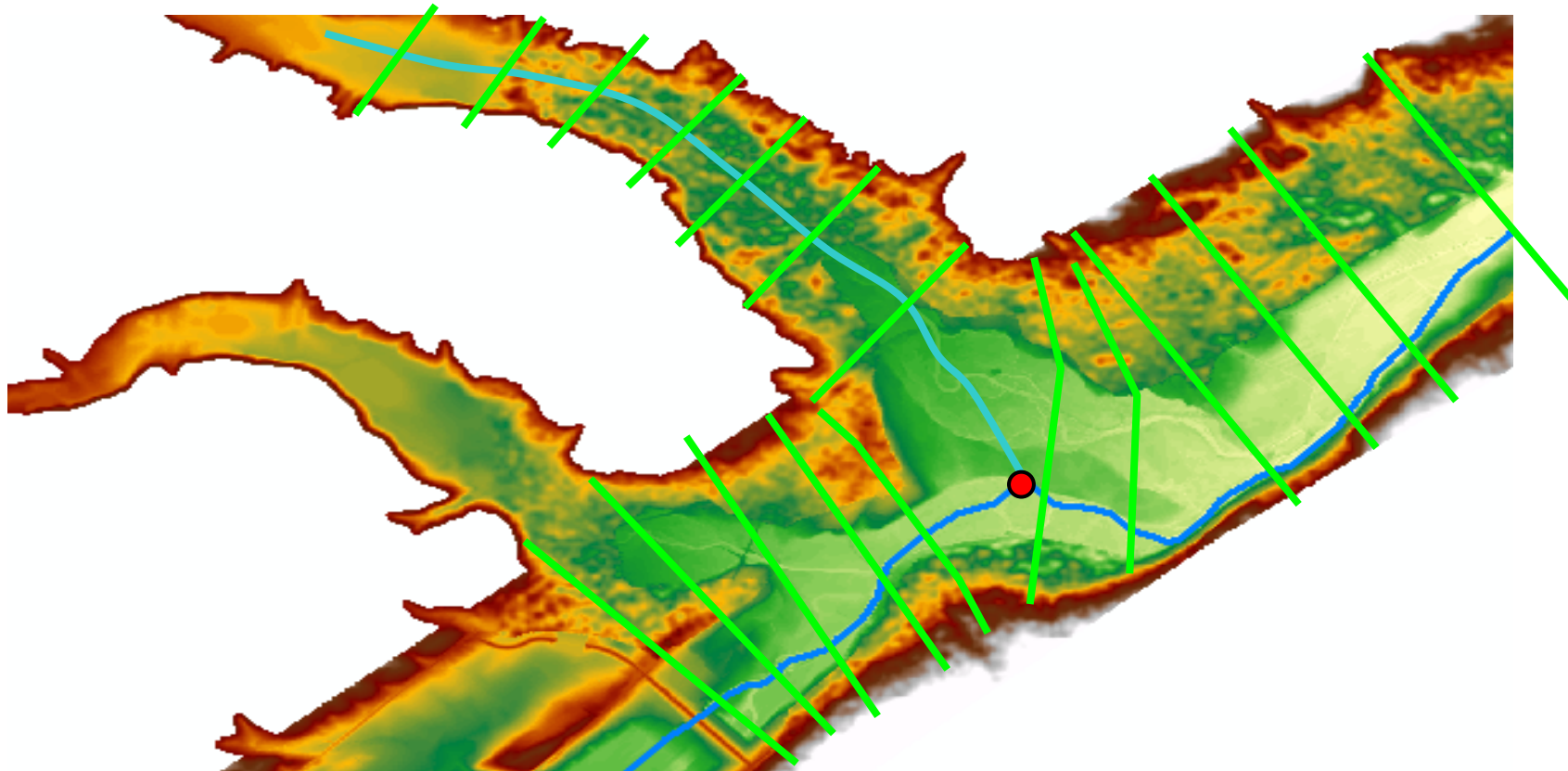
- Lateral Structure + 2D Flow Area





Modeling Tributaries

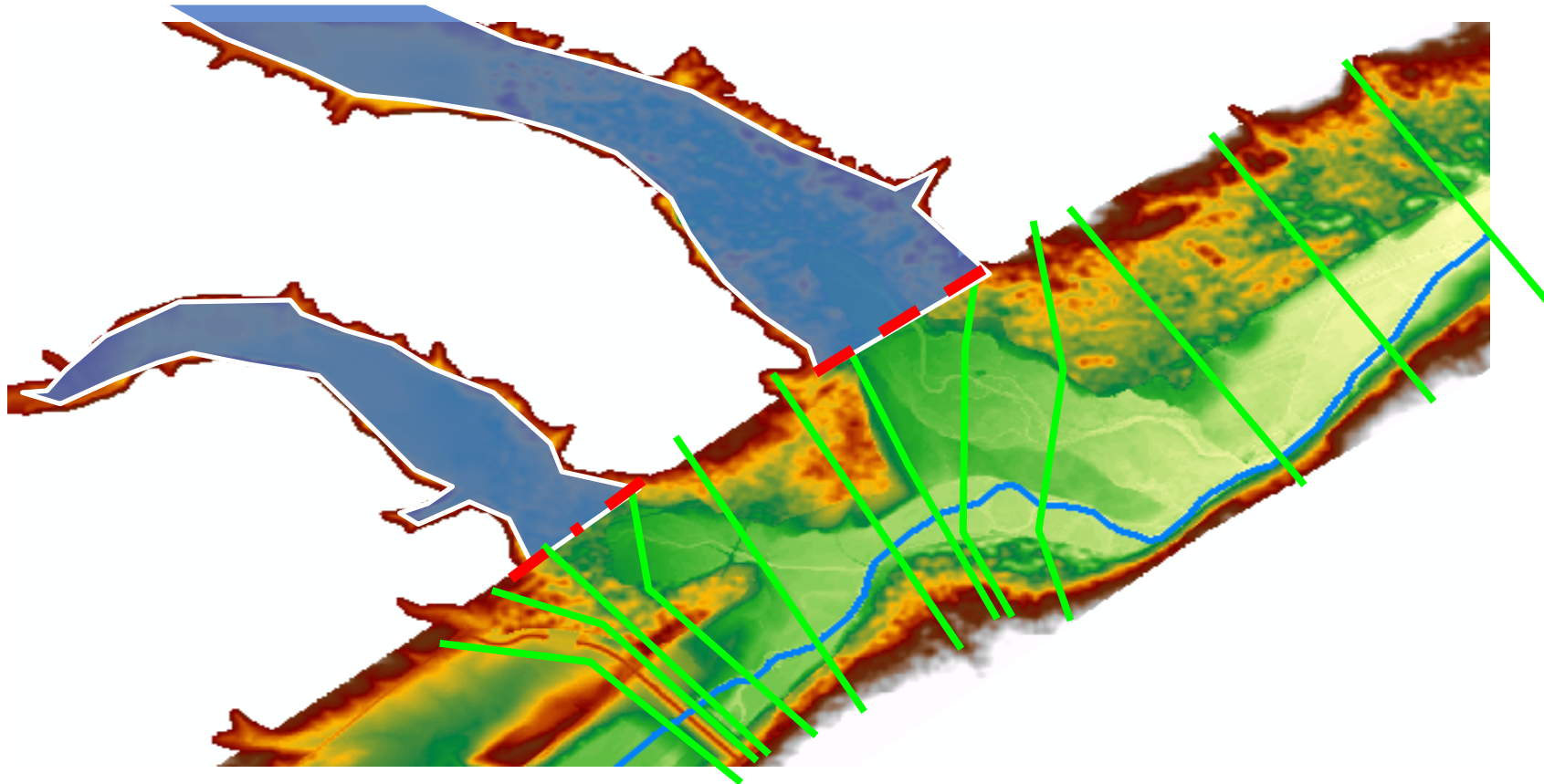
- Separate River Reach with Junction





Modeling Tributaries

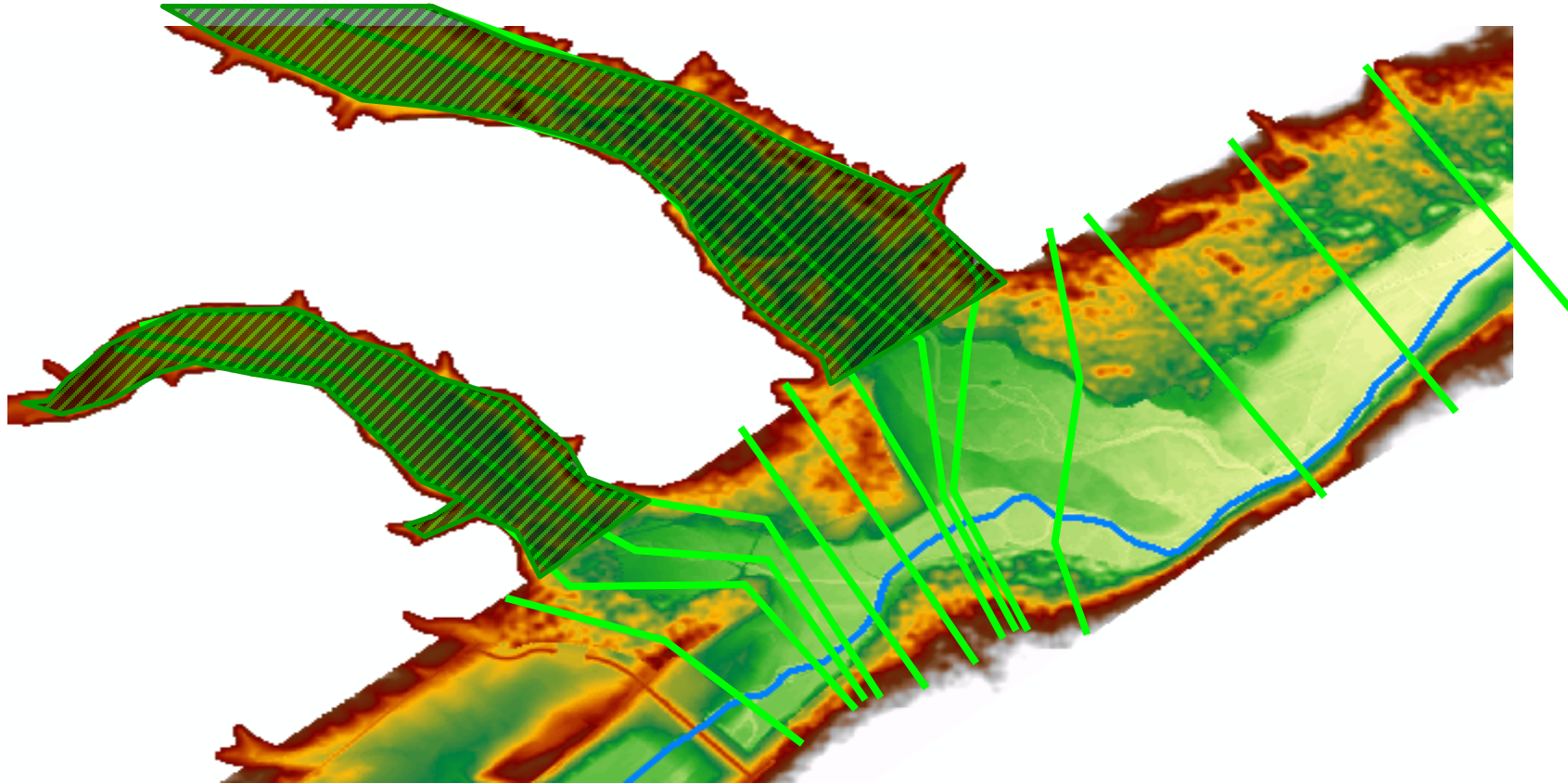
- Storage Areas + Lateral Structures





Modeling Tributaries

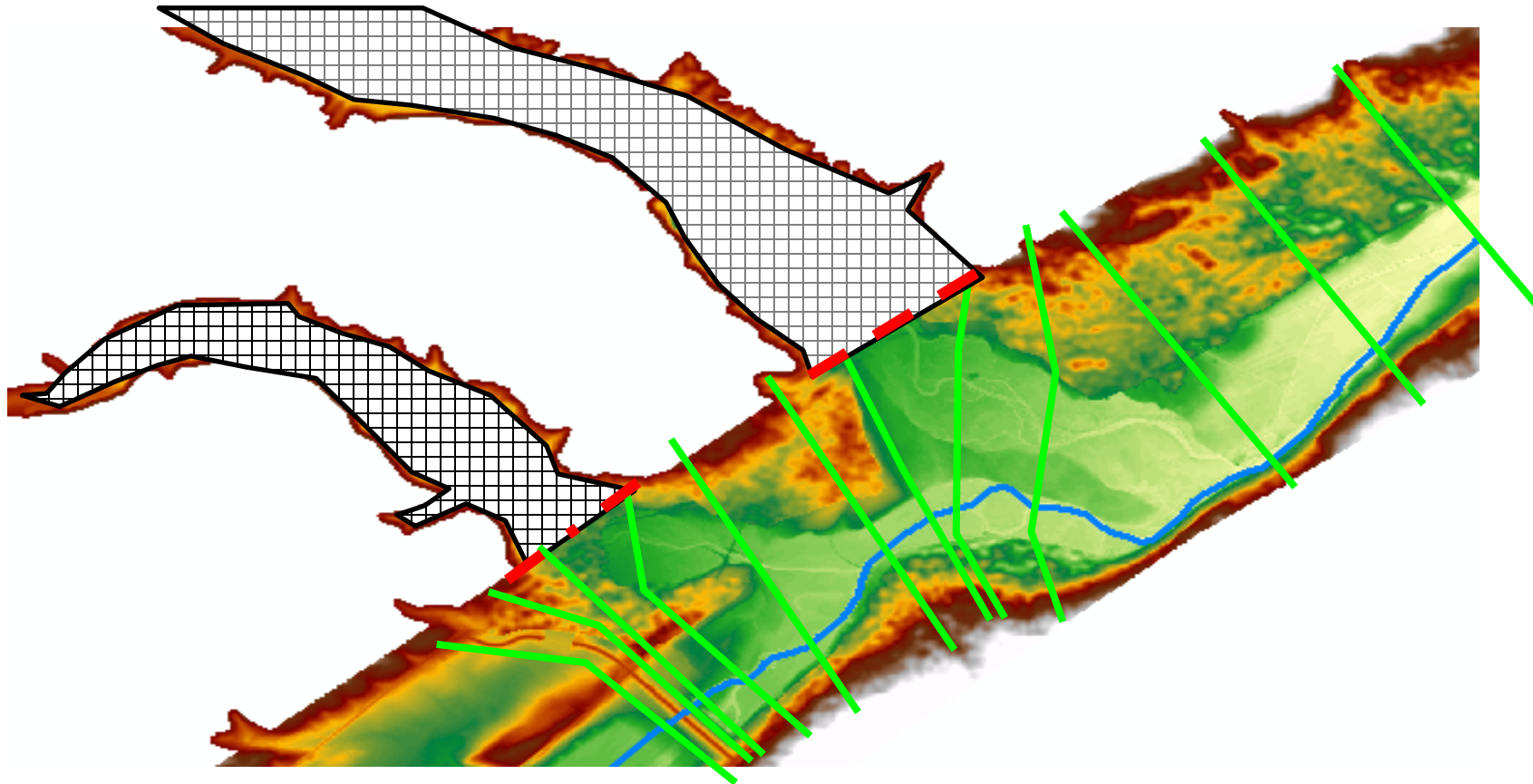
- Extended cross sections





Modeling Tributaries

- 2D Flow Areas+ Lateral Structures



Questions?