

# HEC-RAS Mapper Results Visualization

Eric Tichansky P.E., CFM  
Cameron Ackerman, P.E., D.WRE

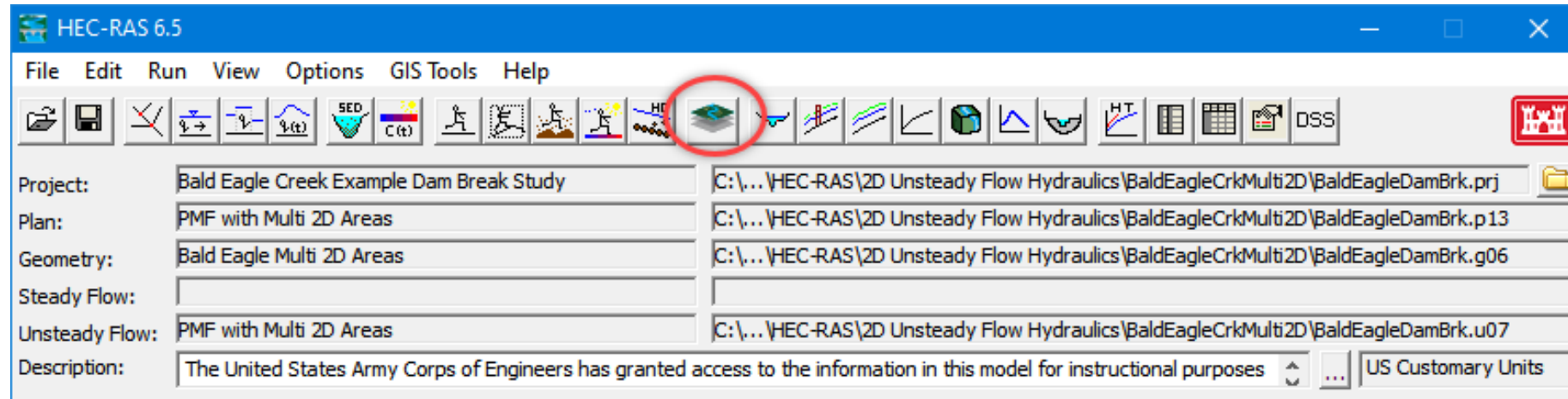
USACE, Institute for Water Resources, Hydrologic Engineering Center





# Overview

- How do we visualize RAS results?
- How do we debug our model?
- How do we compare different plans?





# HEC-RAS Mapper



The screenshot displays the HEC-RAS Mapper software interface. The main window shows a satellite map of a river system with a flood simulation overlay. The simulation results are color-coded, with darker blue representing higher water depths. A red box highlights the top toolbar, which includes navigation tools (pan, zoom, pan up/down, pan left/right, pan zoom) and animation controls (play, stop, reset). The left sidebar contains a 'Layers List' with a tree view of simulation layers, including 'Features', 'Geometries', 'Event Conditions', 'Results', 'Map Layers', and 'Terrains'. The 'Depth (Max)' layer is selected and highlighted in pink. Below the layers list is a 'Status Area' with a list of tools: 'US End of Levee', 'Left Split', 'Right Split', and 'Cross Section'. The bottom status bar shows the current coordinates (2036985.82, 346945.58) and a scale of 1 pixel = 19.94 ft. A scale bar in the bottom right corner indicates 2000 ft.

**View Tools**

**Animation Controls**

**Layers List**

**View Area**

**Status Area**



# Layers List

- Profile Lines
- Geometries
- Results
- Map Layers
- Terrains

Selected Layer: Depth

- Features**
  - Profile Lines
- Geometries**
  - Grid 50ft
  - grid200ft
  - Grid400ft
    - Rivers
    - Cross Sections
    - Storage Areas
    - 2D Flow Areas
    - Bridges/Culverts
    - Inline Structures
    - Lateral Structures
    - SA/2D Connections
    - Pump Stations
    - BC Lines
    - Manning's n
    - Infiltration
    - Percent Impervious
    - Reference Points
    - Errors

- Event Conditions**
- Results**
- Grid 50ft
  - Event Conditions
  - Geometry
  - Depth (02JAN1900 02:45:00)**
  - Velocity (02JAN1900 05:00:00)
  - WSE (02JAN1900 00:00:00)
  - Inundation Boundary (Max Value\_0)
  - Depth (Max)
- Grid 200ft
- Grid 400ft
- Map Layers**
- LandCover
  - Classification Polygons
- VOD\_LC
- Google Satellite
- Terrains**
- Terrain
- TerrainWithChannel


Symbology is shown to the right of any checked layers.

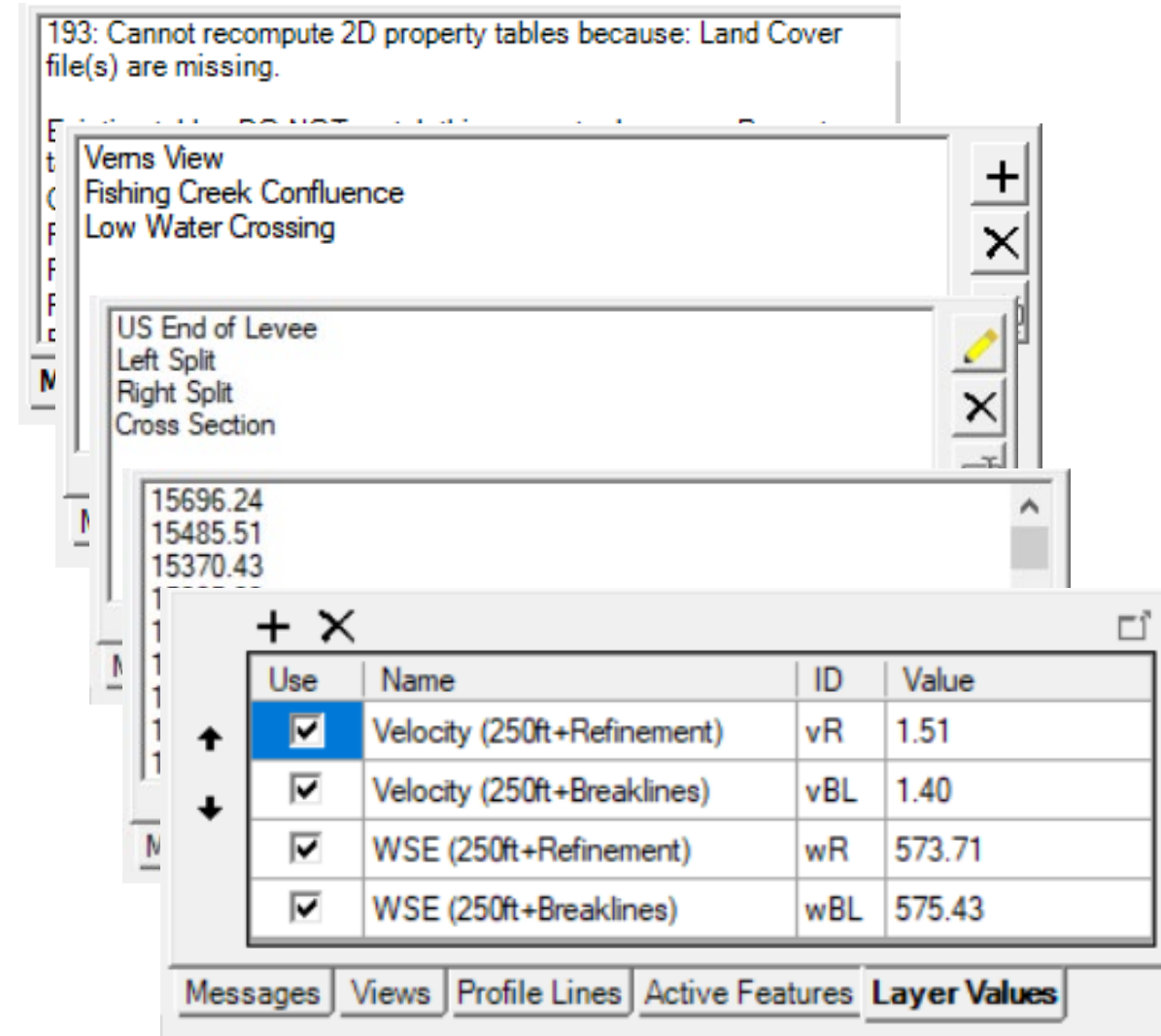


The selected layer is highlighted in magenta.



# Status Area

- Messages – What just happened
- View – Quickly zoom to predefined areas
- Profile Lines – Access results at specific locations
- Active Features – Quick access to features in layer
- Layer Values – Watch values for multiple results



193: Cannot recompute 2D property tables because: Land Cover file(s) are missing.

Vems View  
Fishing Creek Confluence  
Low Water Crossing

US End of Levee  
Left Split  
Right Split  
Cross Section

15696.24  
15485.51  
15370.43

Use	Name	ID	Value
<input checked="" type="checkbox"/>	Velocity (250ft+Refinement)	vR	1.51
<input checked="" type="checkbox"/>	Velocity (250ft+Breaklines)	vBL	1.40
<input checked="" type="checkbox"/>	WSE (250ft+Refinement)	wR	573.71
<input checked="" type="checkbox"/>	WSE (250ft+Breaklines)	wBL	575.43

Messages Views Profile Lines Active Features **Layer Values**



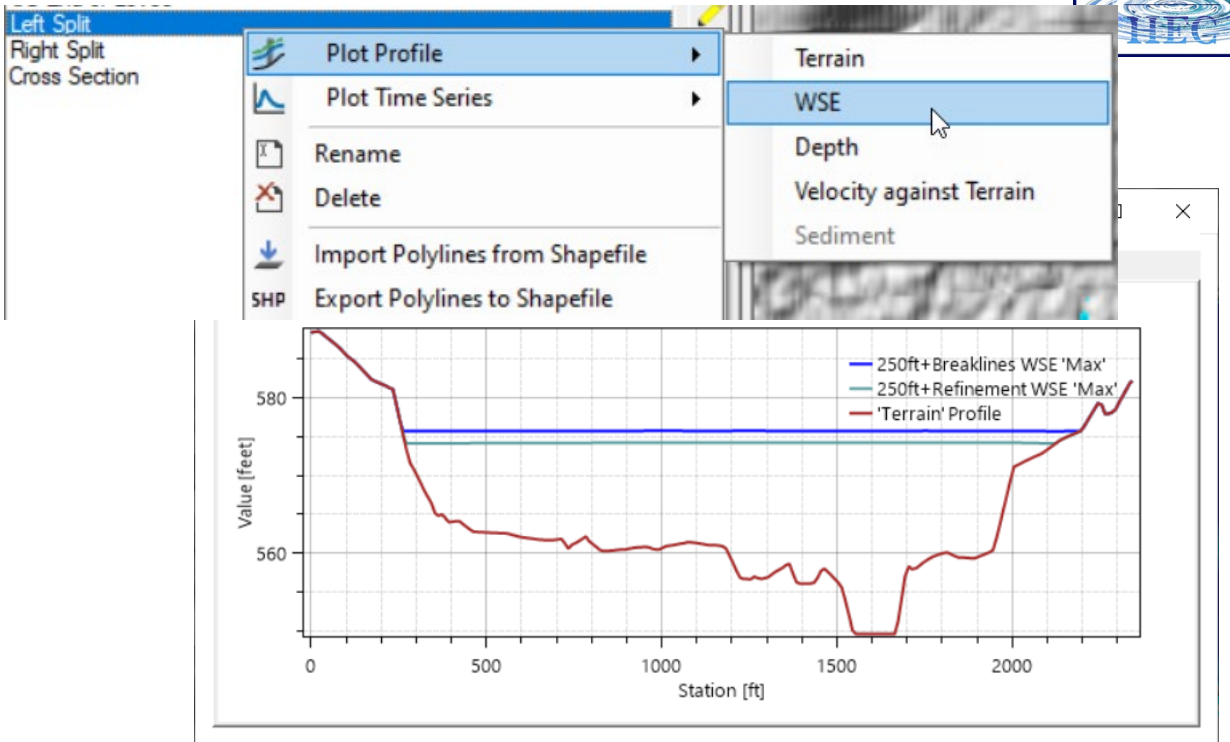
# Profile Lines

- User-defined/editable features

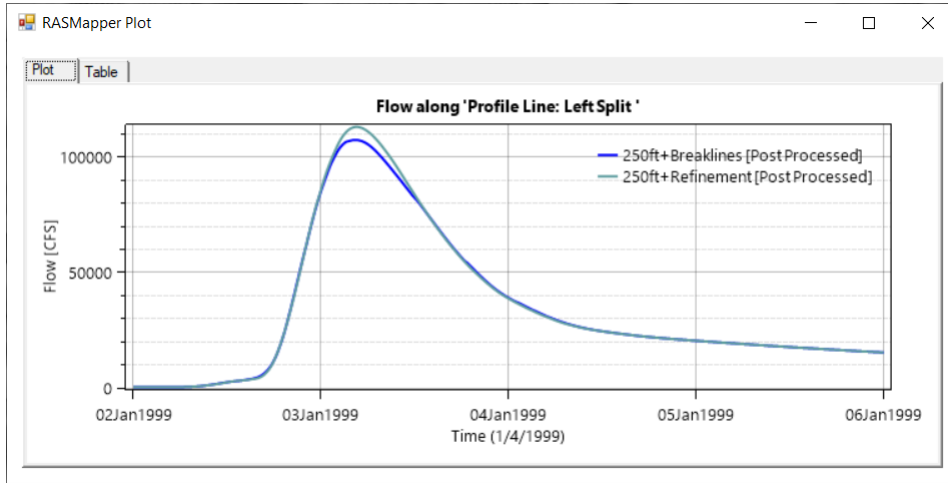
The interface shows a tree view of features with the following settings:

- Features** (checked)
- Profile Lines** (checked)
- Geometries** (checked)
  - Simple Geometry (unchecked)
  - 250ft (unchecked)
  - 250ft+Breaklines (unchecked)
  - 250ft+Refinement (unchecked)
- Event Conditions** (unchecked)
- Results** (checked)
- Map Layers** (checked)
  - CompareCellSize (unchecked)
  - Google Satellite (unchecked)
- Terrains** (checked)
  - Terrain (checked)

Below the tree view, a list of profile lines is shown: US End of Levee, Left Split, Right Split, and Cross Section. The 'Profile Lines' tab is selected in the bottom navigation bar.



The 'Plot Time Series' menu is open, showing options: Flow, Volume Accumulation, Rating Curve (Beta, 2D only), and SHP Import Polyline from Shapefile. The 'Flow' option is selected.





# Active Features



RAS Mapper

File Project Tools Help

Selected Layer: Cross Sections

- SA2D Connections
- Pump Stations
- BC Lines
- Manning's n
- Infiltration
- Percent Impervious
- Reference Points
- Errors
- Depth (02JAN1900 02:45:00)
- Velocity (02JAN1900 05:00:00)
- WSE (02JAN1900 00:00:00)
- Inundation Boundary (Max Value\_0)
- Depth (Max)
- Grid 200ft
- Grid 400ft
- Event Conditions
- Geometry
- Depth (02JAN1900 05:40:00)

9081.195  
8757.405  
8434.332  
8110.505  
7864.487  
7490.833  
7158.903  
6868.344  
6626.553  
6295.048  
5925.654  
5688.906

Messages Views Profile Lines **Active Features** Layer

(408602.96, 1803059.32 1 pixel = 8.14 ft)

Selected: 'Cross Sections'

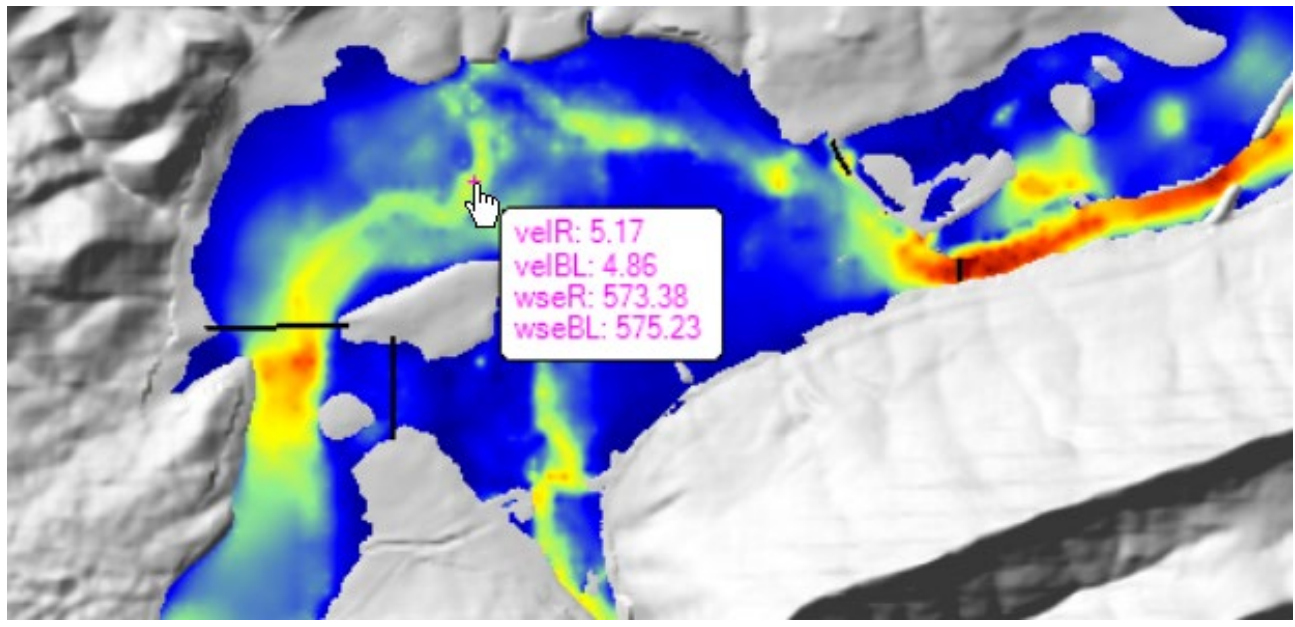
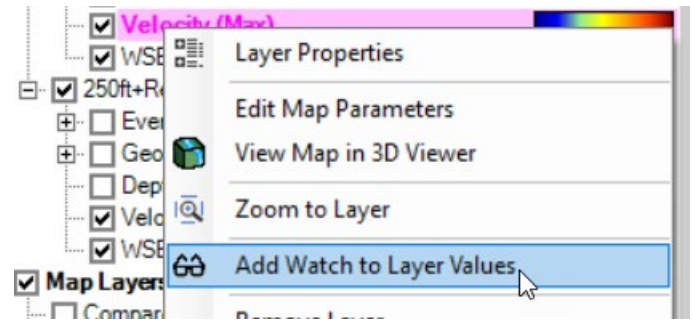
Cross Sections: 8434.332 (Grid 50ft) (Results)

- Copy Selected Feature Ctrl+C
- Plot Terrain Profile
- Save as Profile Line
- View Points
- Results Profile Plot
  - WSE
  - Velocity
  - Depth
- Results Time Series

1000 ft



# Watch Layer Values



Use	Name	ID	Value
<input checked="" type="checkbox"/>	Velocity (250ft+Refinement)	velR	5.14
<input checked="" type="checkbox"/>	Velocity (250ft+Breaklines)	velBL	5.00
<input checked="" type="checkbox"/>	WSE (250ft+Refinement)	wseR	573.78
<input checked="" type="checkbox"/>	WSE (250ft+Breaklines)	wseBL	575.47

Messages Views Profile Lines Active Features **Layer Values**

(2037649.22, 346306.26 1 pixel = 42.29 ft)





# Web Imagery



GDALWMS

Select WMS image server

- ArcGIS NatGeo World Map
- ArcGIS Ocean Basemap
- ArcGIS USA Topo Maps
- ArcGIS World Imagery
- ArcGIS World Physical Map
- ArcGIS World Shaded Relief
- ArcGIS World Street Map
- ArcGIS World Terrain Base
- ArcGIS World Topo Map
- Bing Satellite
- Google Hybrid
- Google Map
- Google Satellite
- Google Terrain Streets Water
- Google Terrain
- NSI\_Test
- OpenStreetMaps
- USGS Imagery
- USGS Topo

Reprojection Resample Method: near

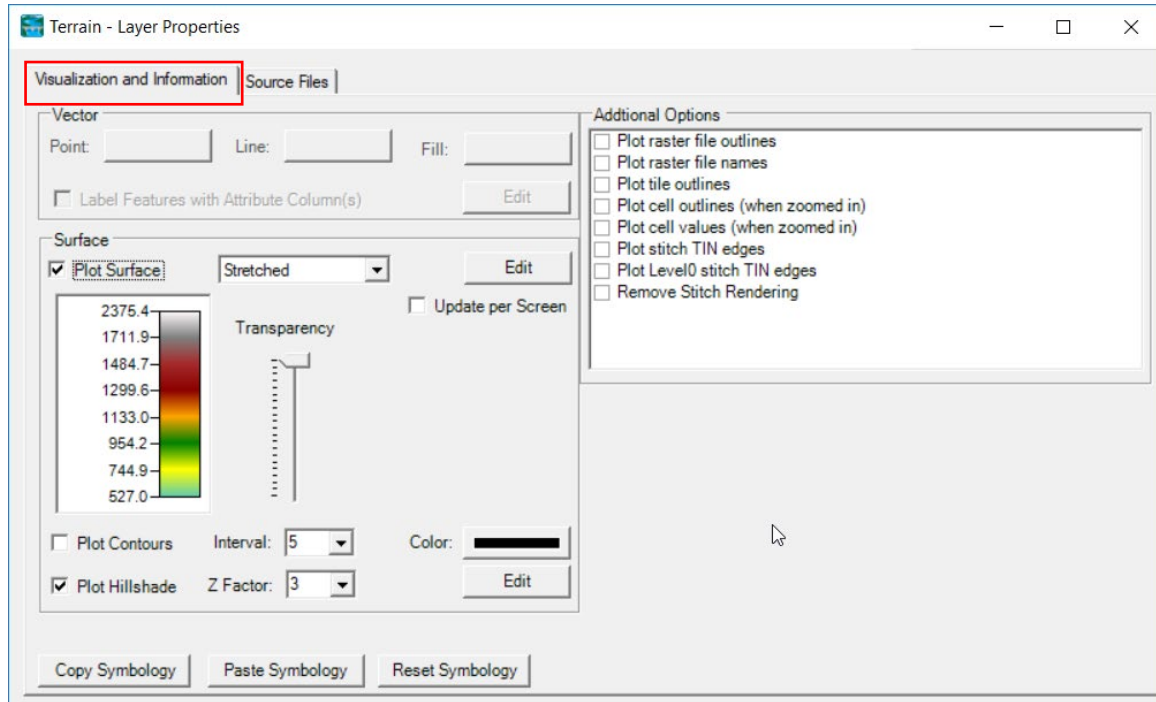
OK Close

Messages Views Profile Lines

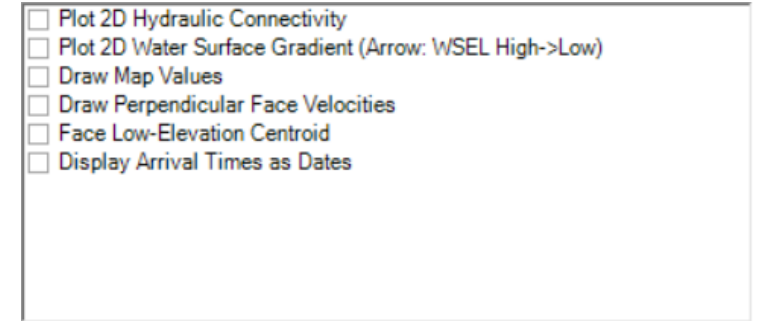


# Plot Options

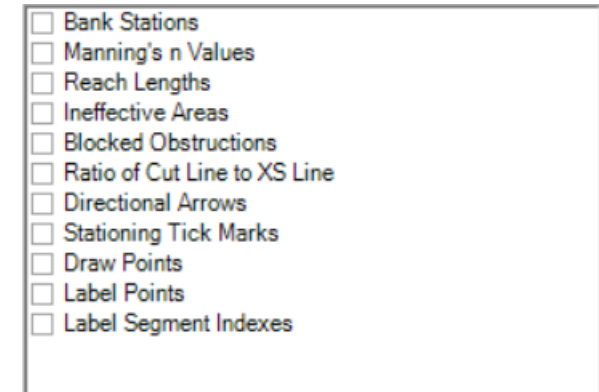
- Terrain



- Depth, WSE



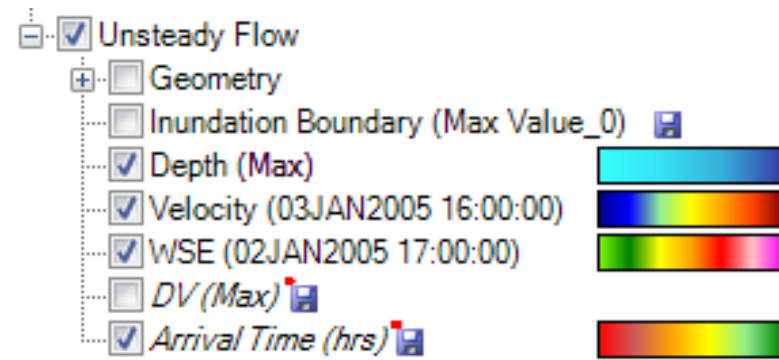
- River, Cross Sections





# Results Mapping

- Dynamic Mapping – on-the-fly mapping
  - Animation of results without waiting



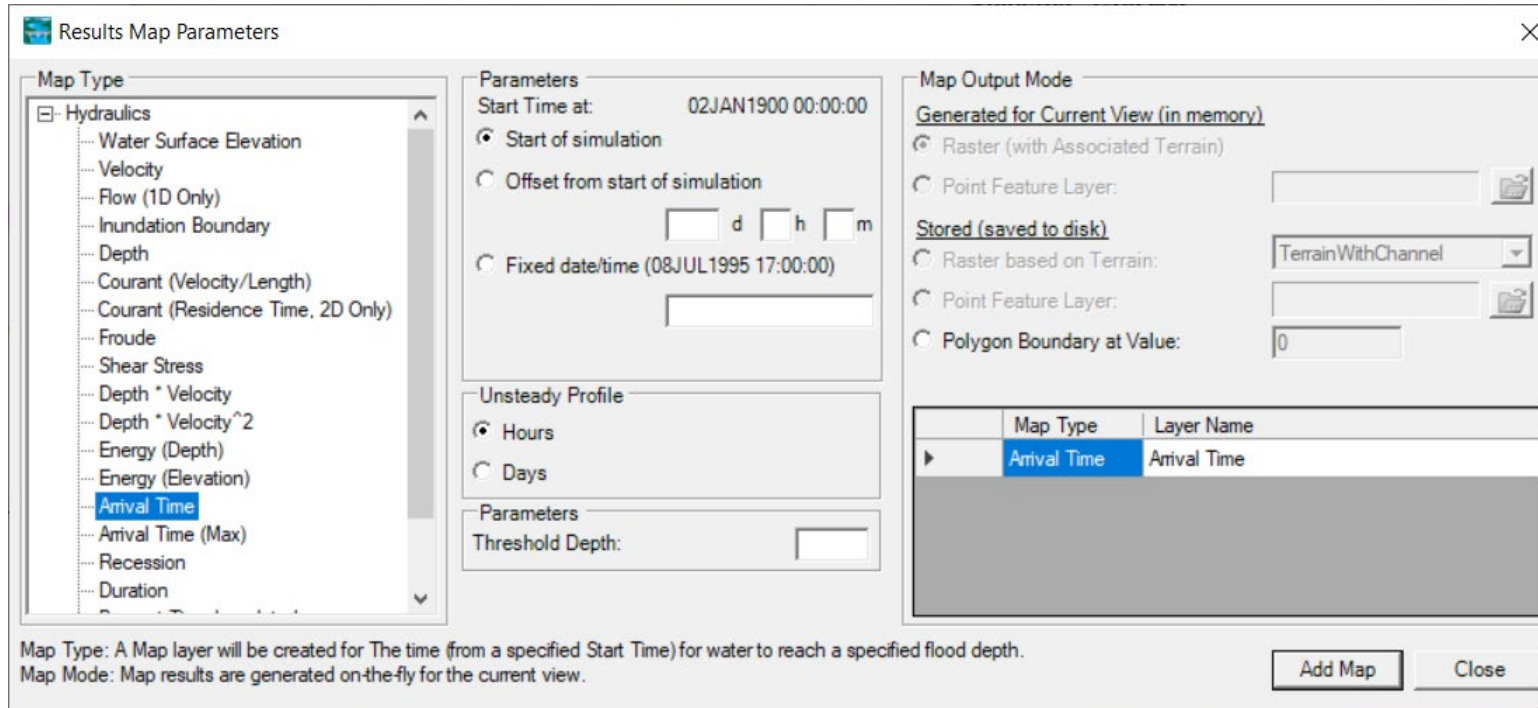
- Stored Maps – results written to file

\* = *There was a problem reading data*



# Results Mapping

Map Type | Profile/Parameter | Mode



**Map Type**

- Hydraulics
  - Water Surface Elevation
  - Velocity
  - Flow (1D Only)
  - Inundation Boundary
  - Depth
  - Courant (Velocity/Length)
  - Courant (Residence Time, 2D Only)
  - Froude
  - Shear Stress
  - Depth \* Velocity
  - Depth \* Velocity<sup>2</sup>
  - Energy (Depth)
  - Energy (Elevation)
  - Arrival Time**
  - Arrival Time (Max)
  - Recession
  - Duration

**Parameters**

Start Time at: 02JAN1900 00:00:00

Start of simulation

Offset from start of simulation

d  h  m

Fixed date/time (08JUL1995 17:00:00)

**Unsteady Profile**

Hours

Days

**Parameters**

Threshold Depth:

**Map Output Mode**

Generated for Current View (in memory)

Raster (with Associated Terrain)

Point Feature Layer:

Stored (saved to disk)

Raster based on Terrain:

Point Feature Layer:

Polygon Boundary at Value:

Map Type	Layer Name
Arrival Time	Arrival Time

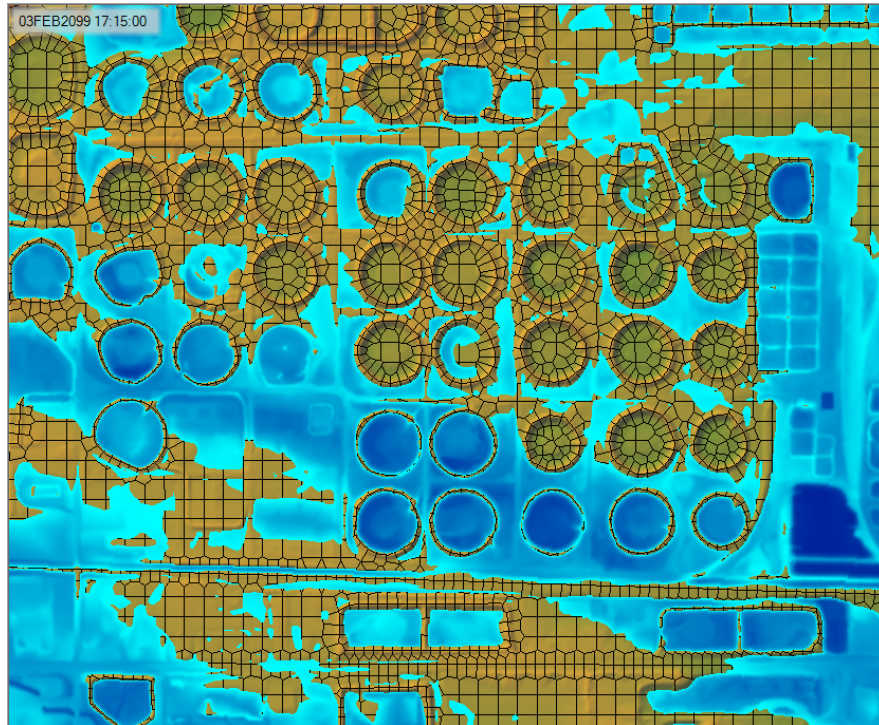
Map Type: A Map layer will be created for The time (from a specified Start Time) for water to reach a specified flood depth.  
 Map Mode: Map results are generated on-the-fly for the current view.

Default maps: Depth, Water Surface Elevation, Velocity

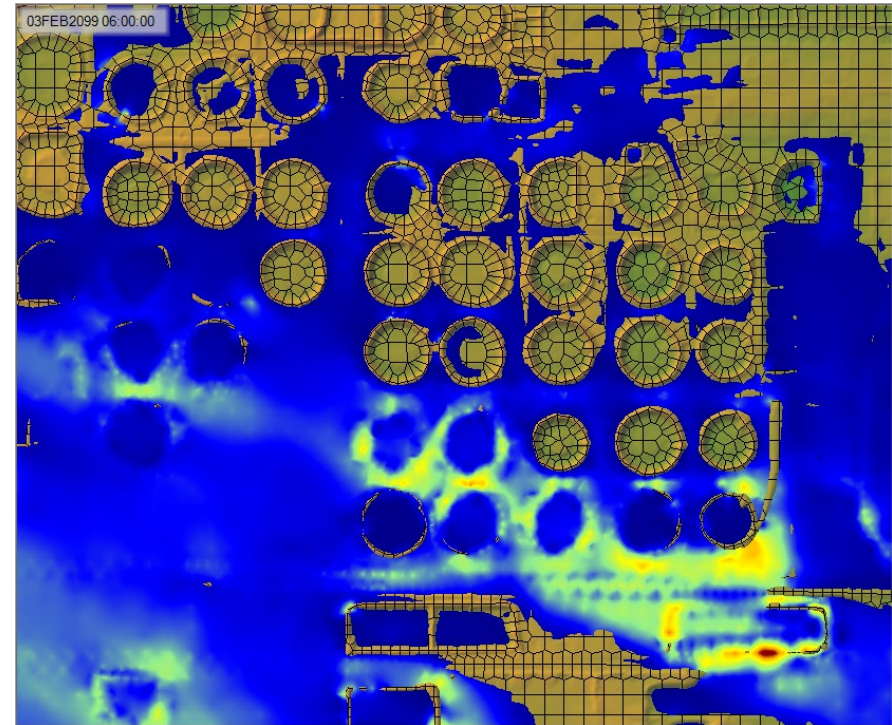


# Example Maps

- Depth

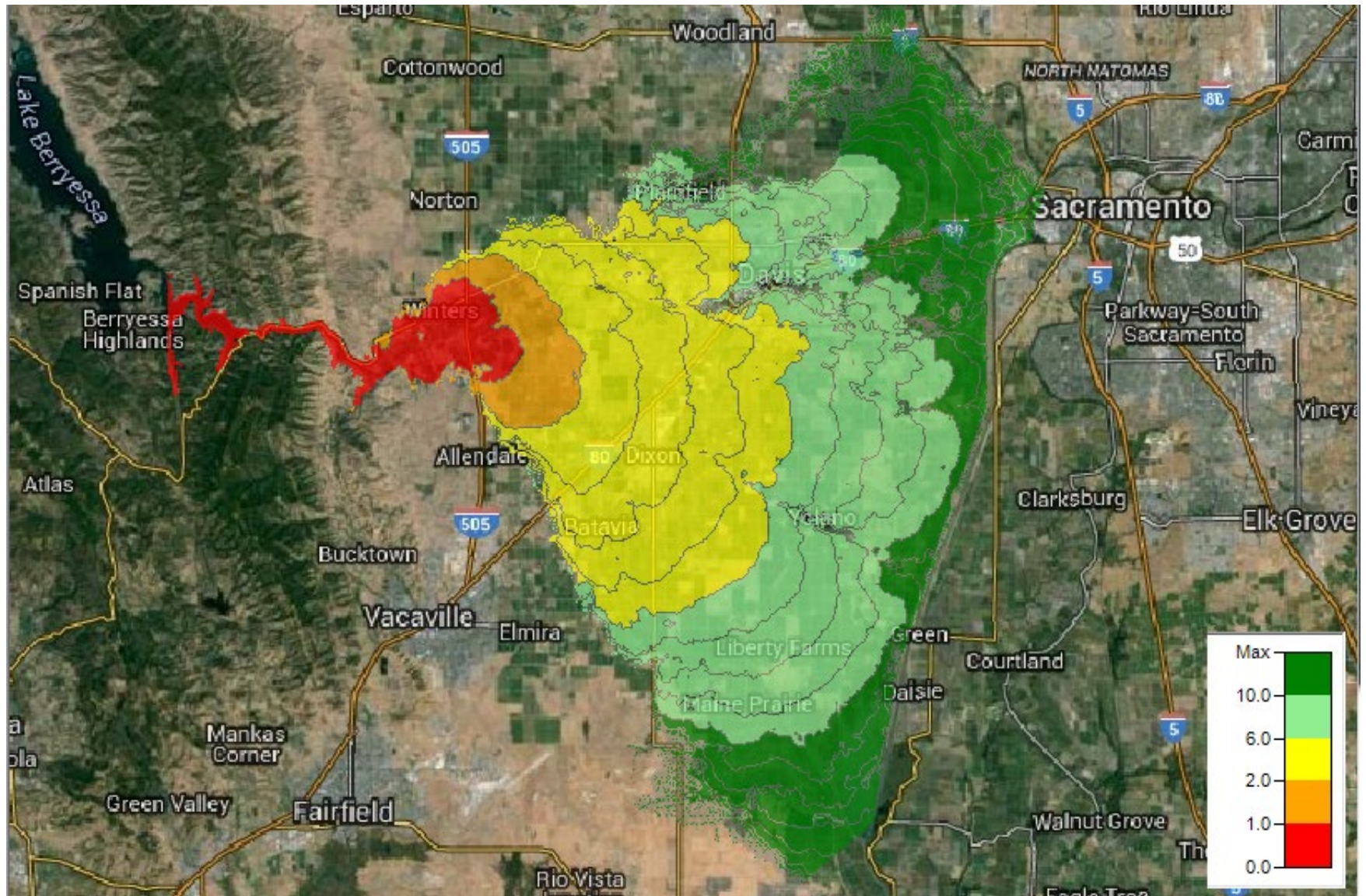


- Velocity



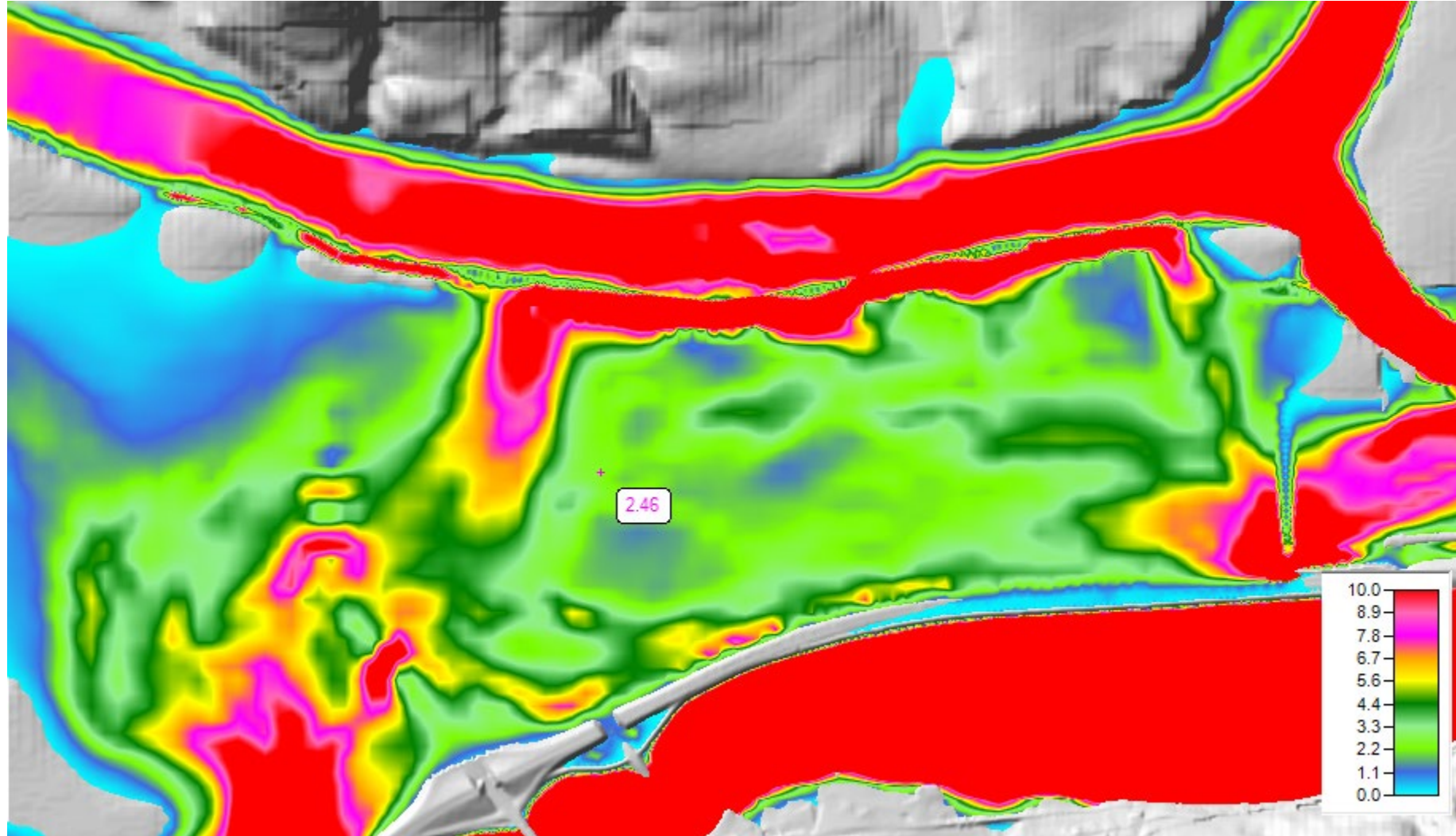


# Arrival Time



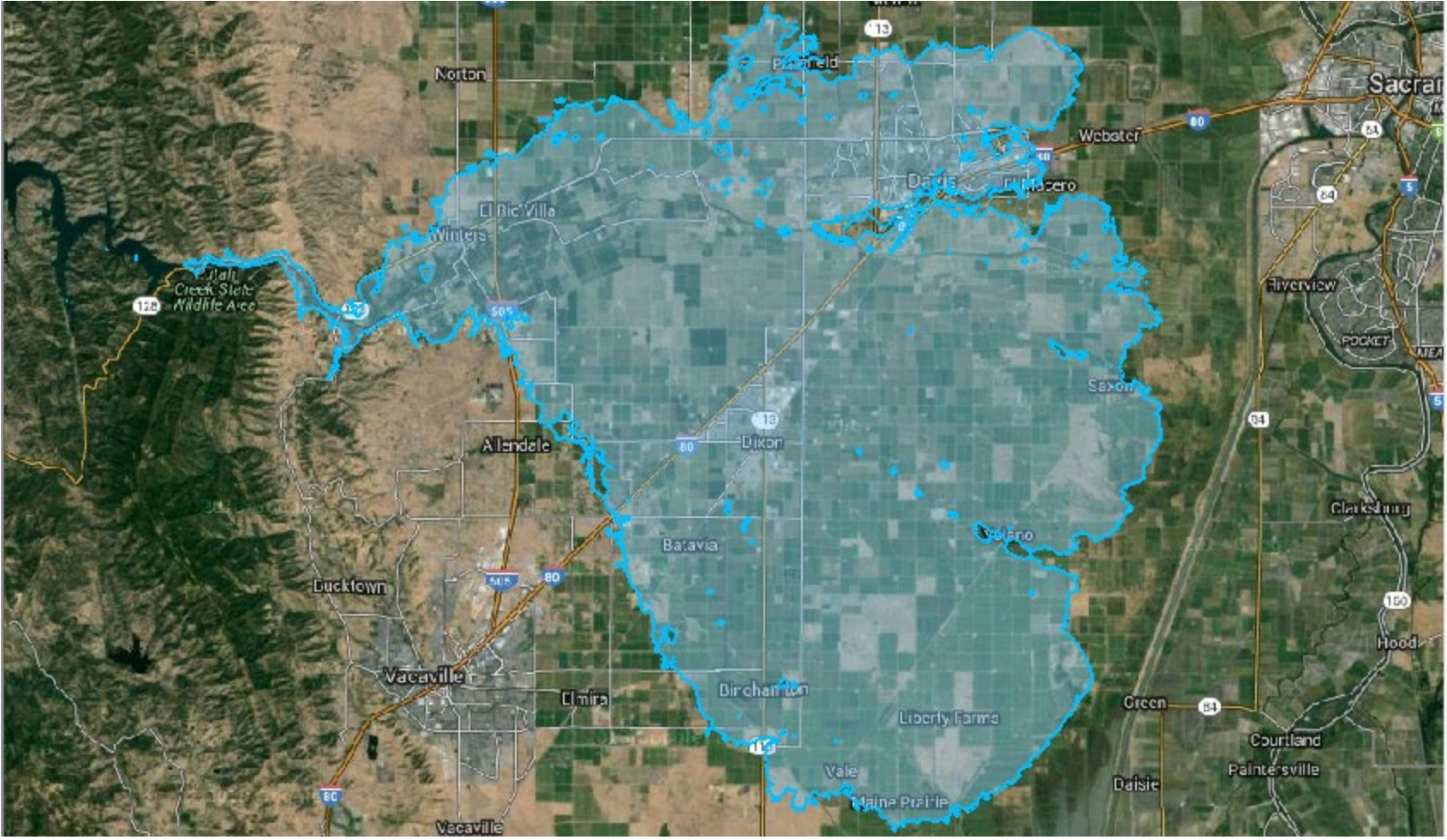


# Hazard Mapping





# Inundation Boundary







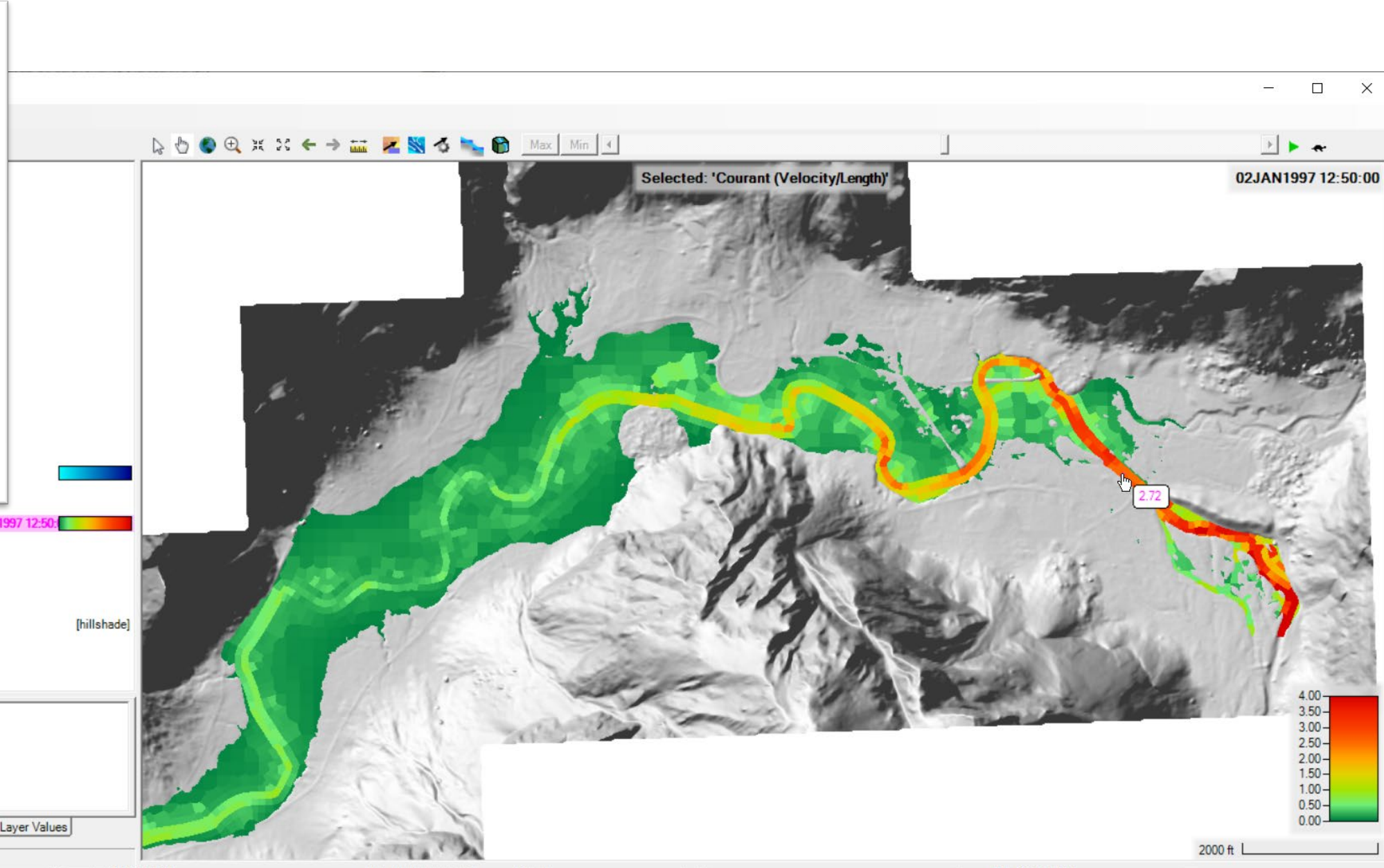
# RAS Mapper Courant Number Map



Results Map Parameters

Map Type

- Hydraulics
  - Water Surface Elevation
  - Velocity
  - Flow (1D Only)
  - Inundation Boundary
  - Depth
  - Courant (Velocity/Length)**
  - Courant (Residence Time, 2D Only)
  - Froude
  - Shear Stress
  - Depth \* Velocity
  - Depth \* Velocity<sup>2</sup>
  - Energy (Depth)
  - Energy (Elevation)
  - Arrival Time
  - Arrival Time (Max)
  - Recession
  - Duration



- WSE (Max)
- Courant (Velocity/Length) (02JAN1997 12:50:00)

Map Layers

- LandCover
- Google Hybrid
- Floodplain HWM

Terrains

- Terrain [hillshade]

Messages | Views | Profile Lines | Active Features | Layer Values

(6831747.77, 2093356.97 1 pixel = 15.33 ft)



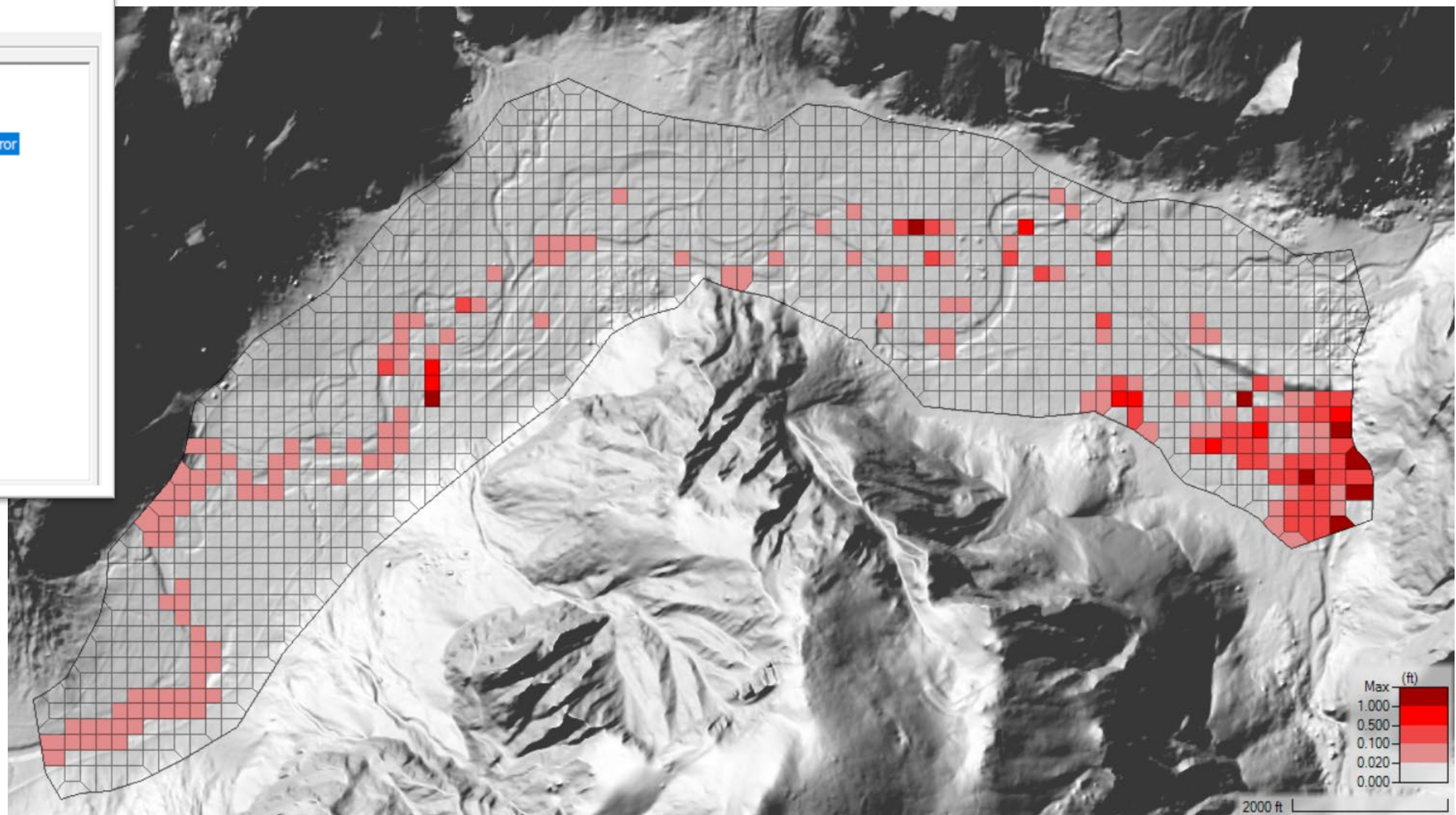
# Maximum Water Surface Error



Results Map Parameters

Map Type

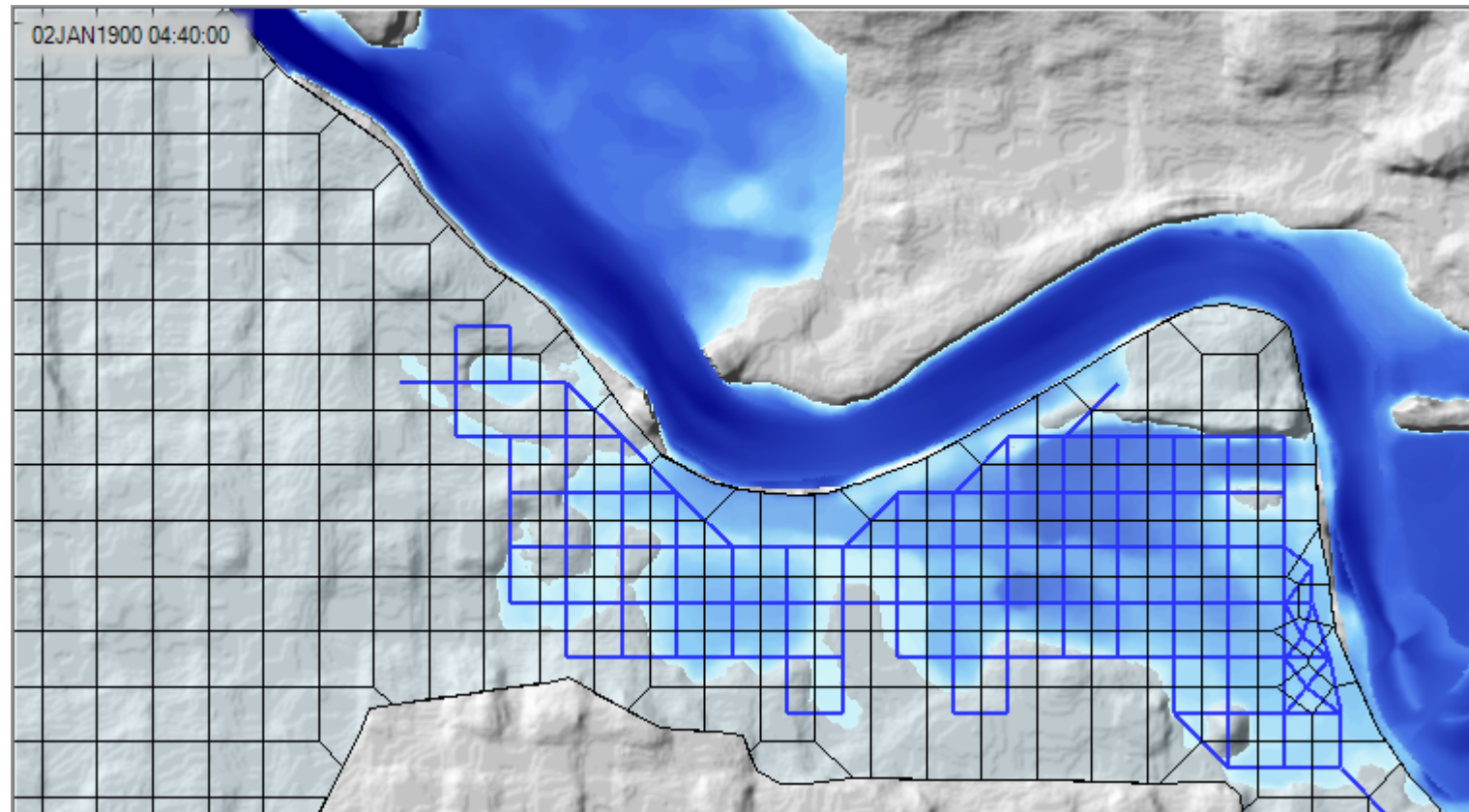
- Hydraulics
- Additional 2D Variables
  - Cumulative Iteration
  - Maximum Water Surface Error**
  - Face Velocity Maximum
  - Face Velocity Minimum






# Hydraulic Connectivity (2D)

- Hydraulic connectivity from mesh



A small red icon of a castle with three towers and a central archway is positioned to the left of the main title.

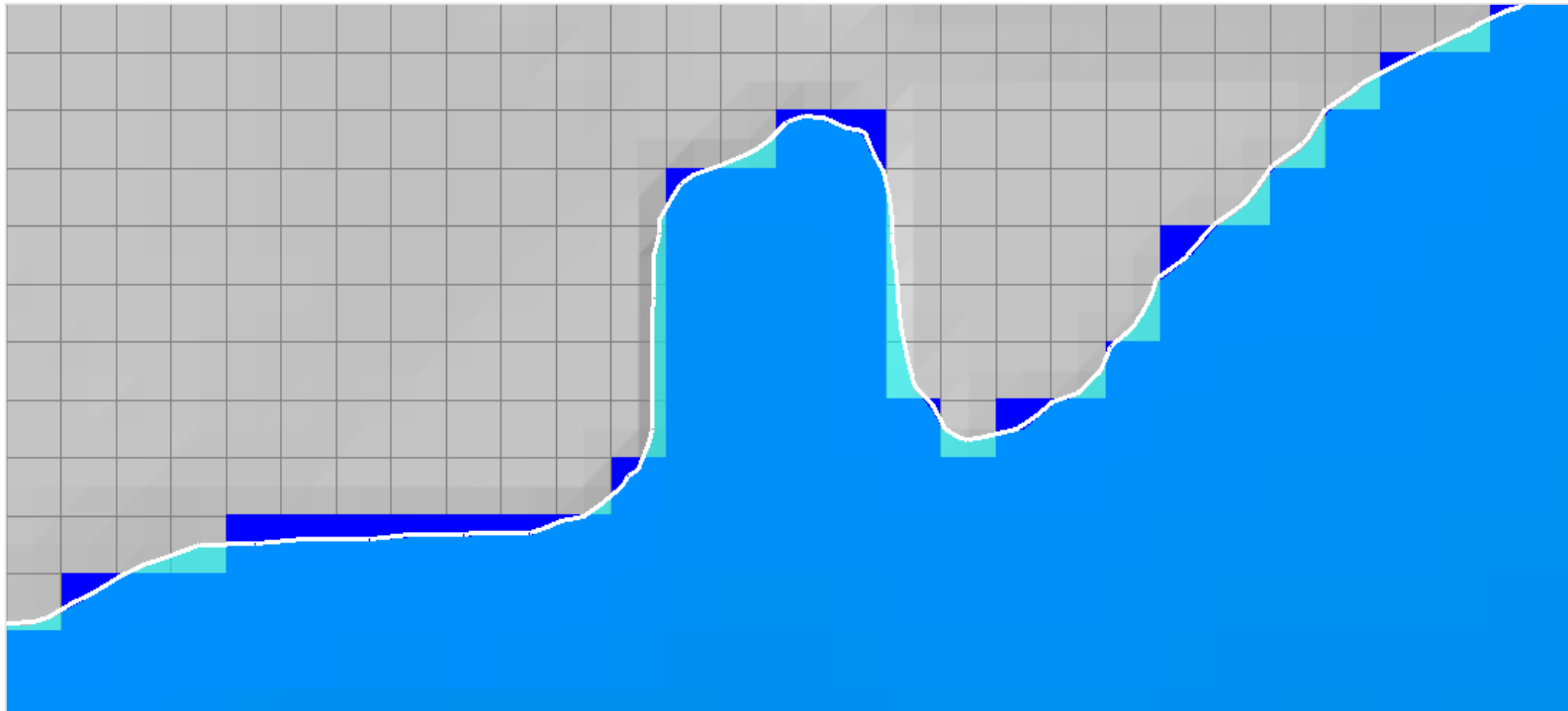
# Map Types – Dynamic vs Stored

- Dynamic: Computed on-the-fly
  - Smooth: Computes to screen-resolution
  - Doesn't use disk space
- Stored: Computed to terrain resolution
  - Stored to disk
  - Faster rendering for slow map types



# Dynamic vs Stored Results

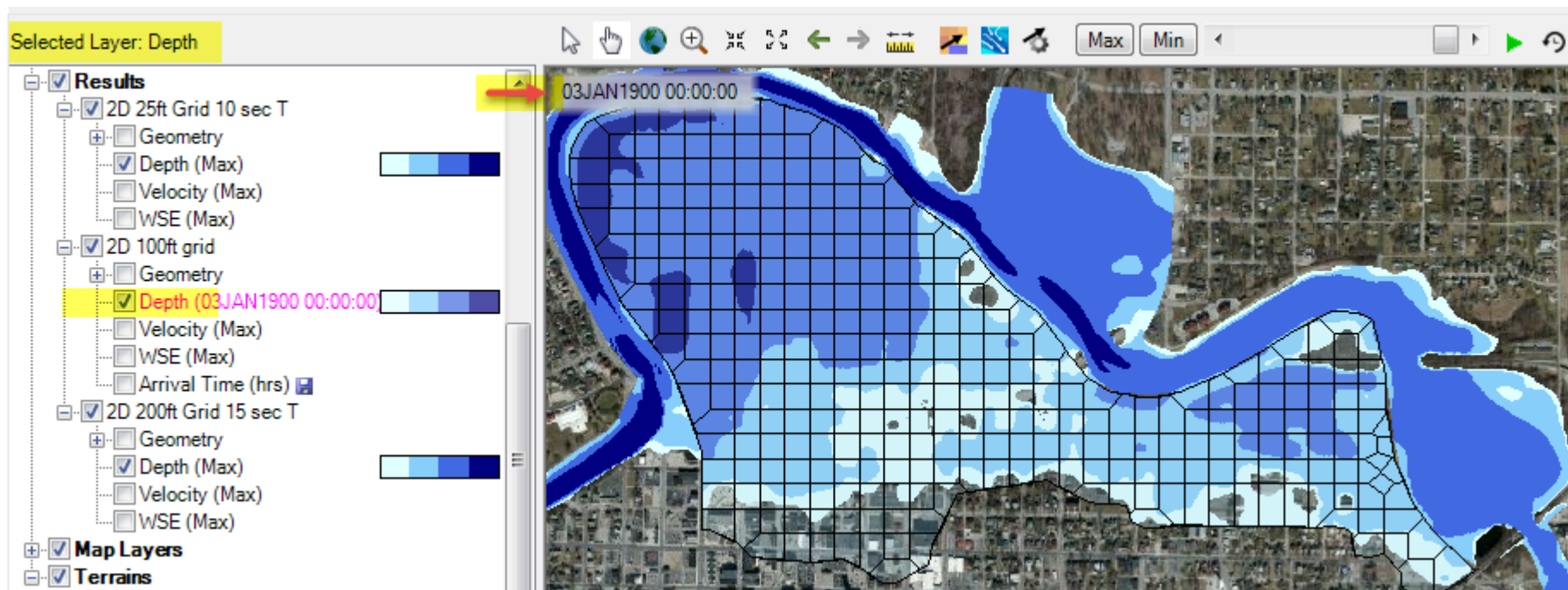
- Dynamic results plot values for the current pyramid level. Boundaries are defined based on interpolation.
- Stored results have a single value per cell.





# Dynamic Mapping

- Animation Toolbar – works on selected layer or group and syncs the timestep



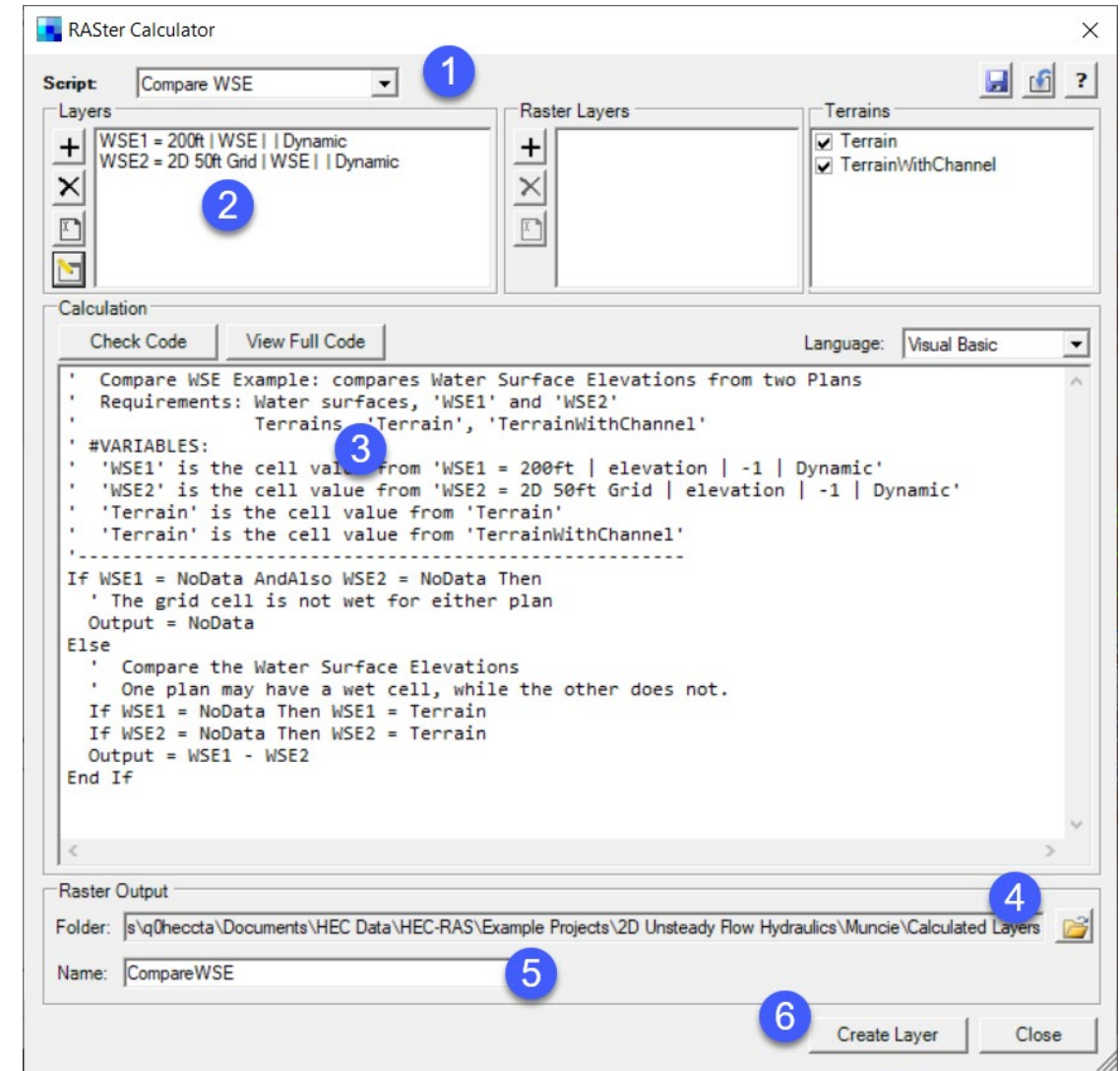
# Dynamic Mapping - Animation





# Calculated Layer

- RASter Calculator
- Custom scripting code to use multiple results
- Works with RAS Results and Terrains
- Works with Rasters on disk



The screenshot shows the RASter Calculator dialog box with the following components and callouts:

- 1**: Script dropdown menu set to "Compare WSE".
- 2**: Layers list containing "WSE1 = 200ft | WSE | | Dynamic" and "WSE2 = 2D 50ft Grid | WSE | | Dynamic".
- 3**: Calculation code editor showing the script for comparing water surface elevations from two plans, including variable definitions and conditional logic.
- 4**: Raster Output folder path: "s:\q\heccta\Documents\HEC Data\HEC-RAS\Example Projects\2D Unsteady Flow Hydraulics\Muncie\Calculated Layers".
- 5**: Raster Output name: "CompareWSE".
- 6**: "Create Layer" button.

**Calculation Code:**

```

' Compare WSE Example: compares Water Surface Elevations from two Plans
' Requirements: Water surfaces, 'WSE1' and 'WSE2'
' Terrains: 'Terrain', 'TerrainWithChannel'

#VARIABLES:
' 'WSE1' is the cell value from 'WSE1 = 200ft | elevation | -1 | Dynamic'
' 'WSE2' is the cell value from 'WSE2 = 2D 50ft Grid | elevation | -1 | Dynamic'
' 'Terrain' is the cell value from 'Terrain'
' 'Terrain' is the cell value from 'TerrainWithChannel'
-----
If WSE1 = NoData AndAlso WSE2 = NoData Then
' The grid cell is not wet for either plan
Output = NoData
Else
' Compare the Water Surface Elevations
' One plan may have a wet cell, while the other does not.
If WSE1 = NoData Then WSE1 = Terrain
If WSE2 = NoData Then WSE2 = Terrain
Output = WSE1 - WSE2
End If
  
```



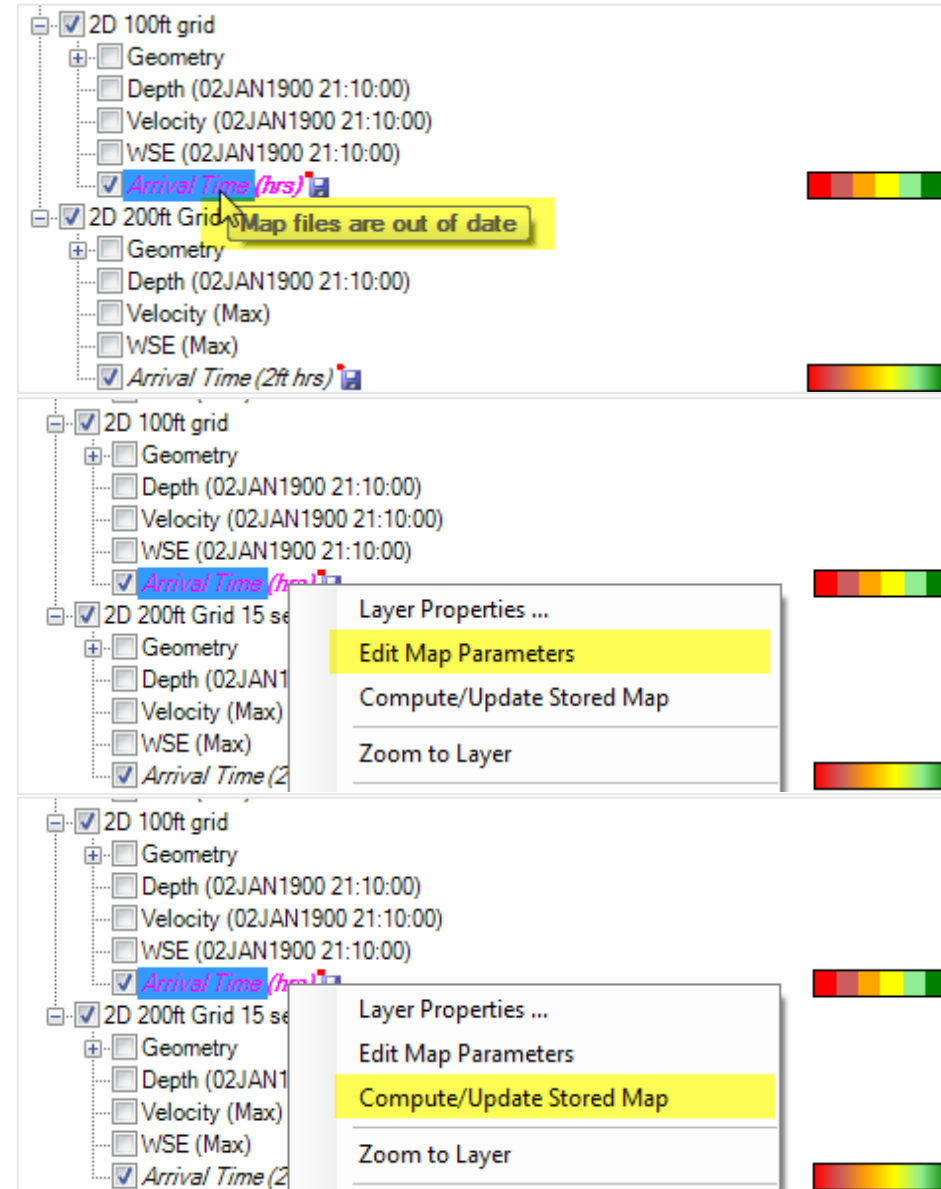


# Stored Maps

- Map status message on cursor tool tip

Right-click options:

- Edit Map Parameters
- Compute Map





# Results Layer Properties

The screenshot displays the HEC-RAS software interface. On the left is the Project Explorer tree, showing a hierarchy of results layers. The 'Results' folder is expanded, showing various layers including 'Arrival Time (hrs)'. The main map area shows a topographic map with a color-coded overlay representing arrival time, ranging from red (low) to green (high). Two dialog boxes are open over the map:

- arrival time - Layer Properties:** This dialog has two tabs: 'Visualization and Information' and 'Additional Options'. Under 'Visualization and Information', the 'Surface' section is active, showing 'Plot Surface' checked and 'Discrete' selected. A color ramp legend is visible, with values from 0.0 to 16.0. The 'Interval' is set to 5. Under 'Additional Options', 'Plot Contours' and 'Plot Hillshade' are unchecked.
- Select Surface Fill:** This dialog shows 'Surface Symbol Settings' with 'Color Ramp' set to 'Arrival Time'. 'Keep user values with color ramp change' is checked. 'Surface Symbol' settings include 'Max: 16.00', 'Interval Type: Linear', 'Min: 0.00', and 'No. Values: 6'. A table below shows the color mapping for each value.

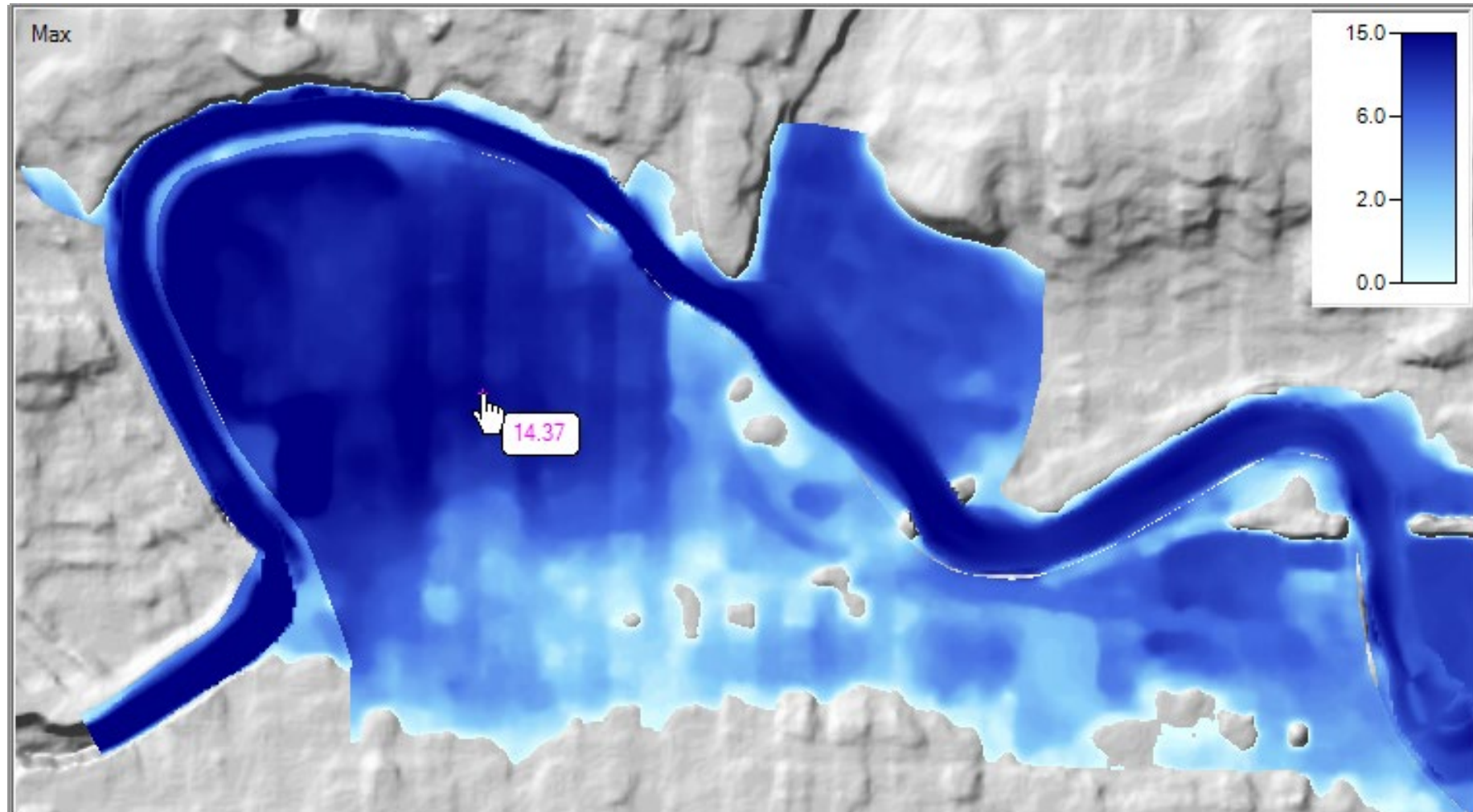
At the bottom left, a 'Messages' window shows the following text:

```

Creating Post Process completed [65 ms]
Stored map 'Arrival Time (hrs)' created.
Stored map 'Arrival Time (2ft hrs)' created.
  
```



# Results Visualization





# 2D Render Mode Options

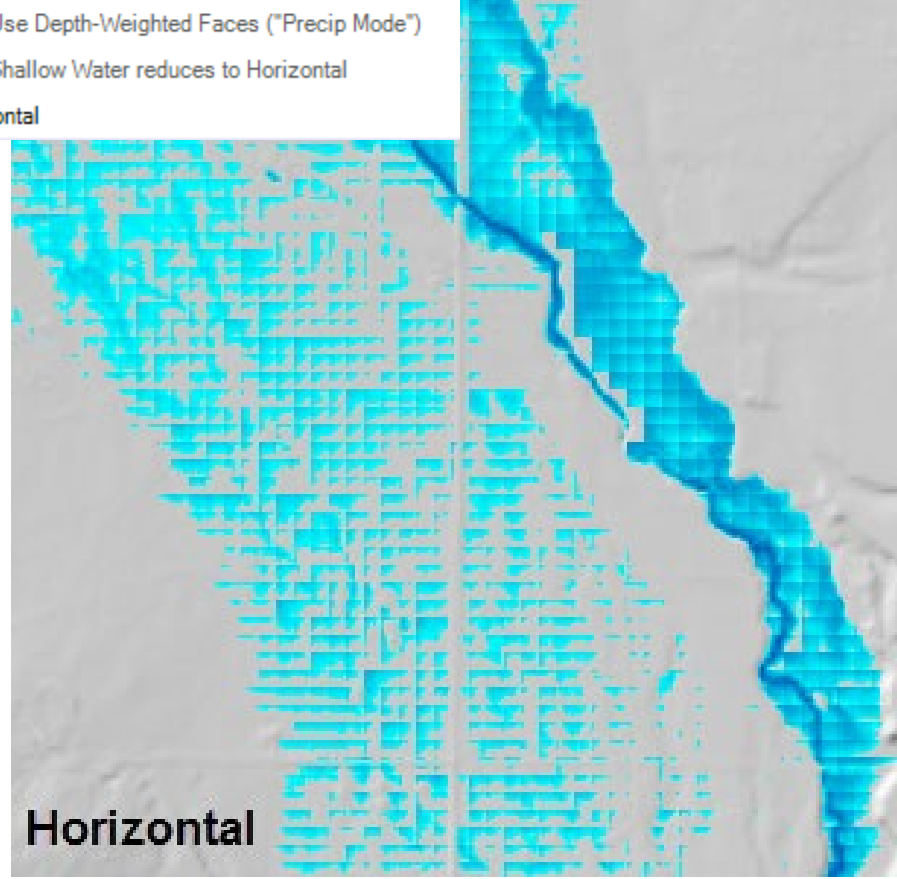
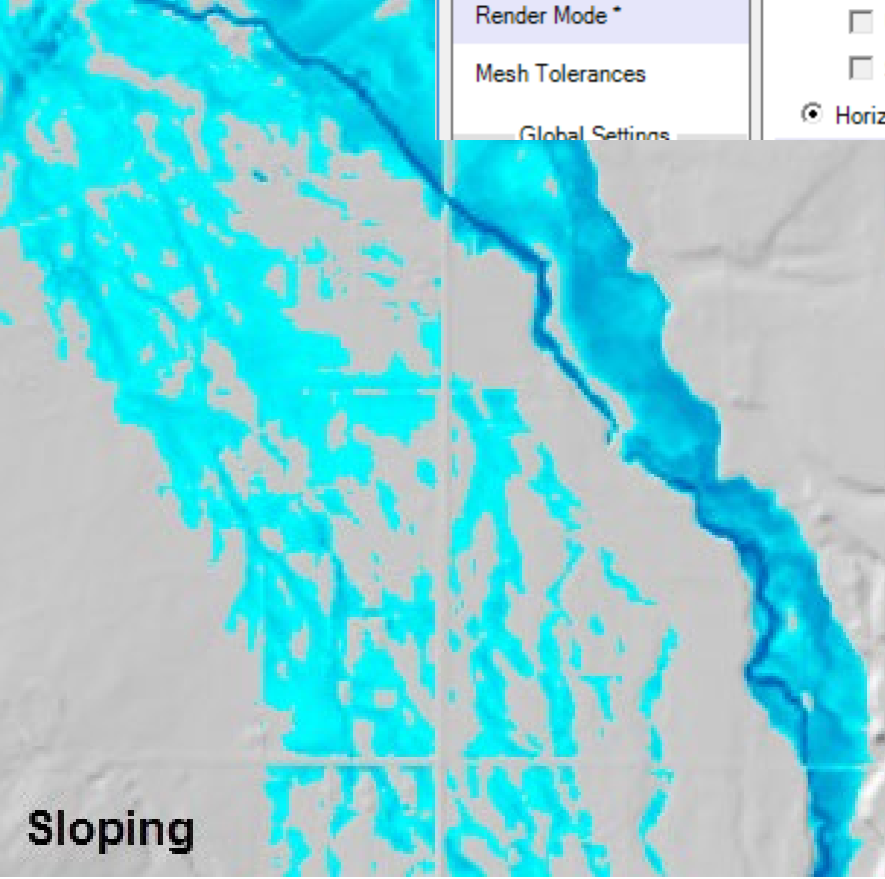


RAS Mapper Options

- Project Settings
- Projection
- General
- Render Mode \***
- Mesh Tolerances
- Global Settings

**Water Surface Rendering Mode**

- Sloping (Cell Corners)
- Sloping (Cell Corners + Face Centers)
  - Use Depth-Weighted Faces ("Precip Mode")
  - Shallow Water reduces to Horizontal
- Horizontal





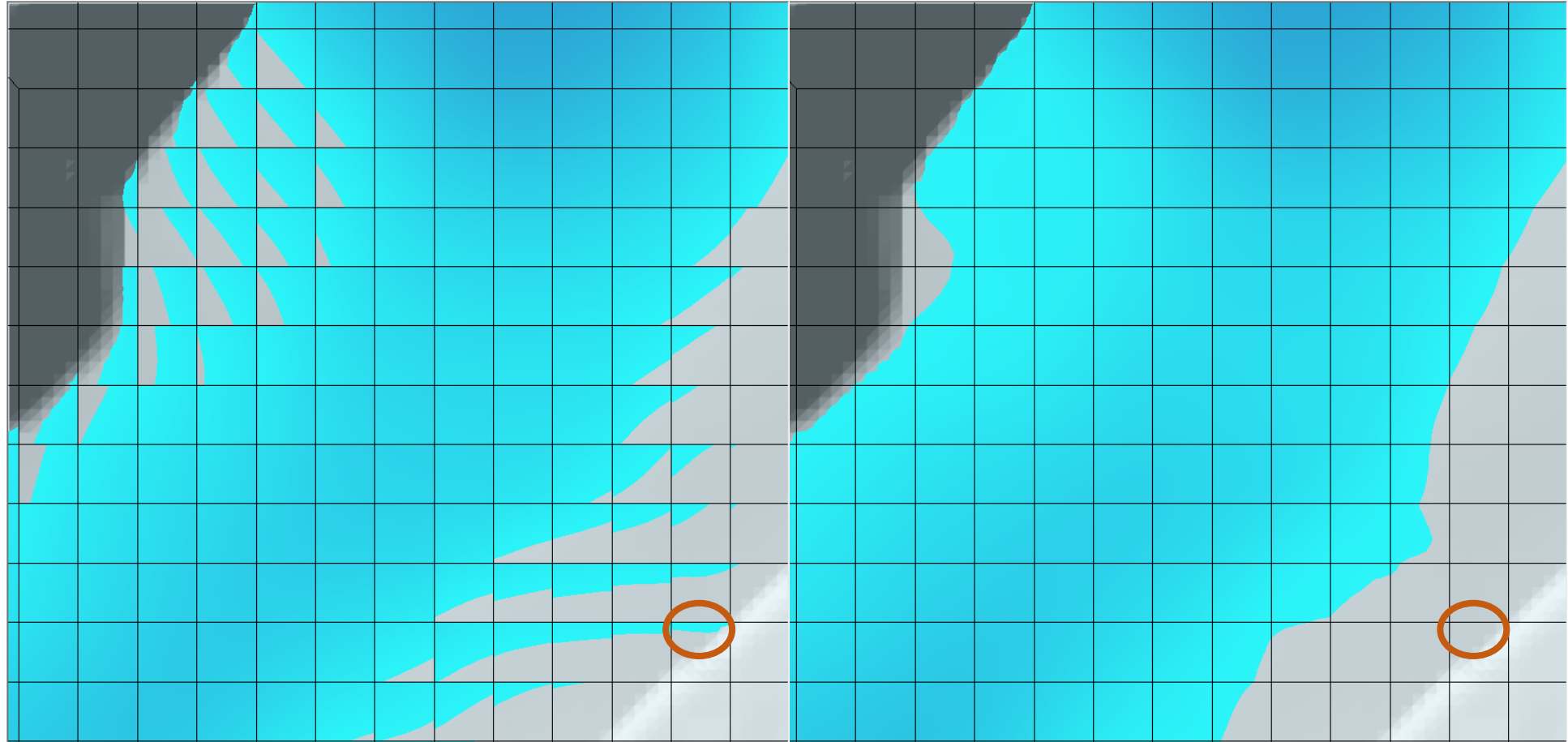
# Results Interpolation

- Render mode options allow for interpolation of water surface elevation values or plotting values at the cell centers.



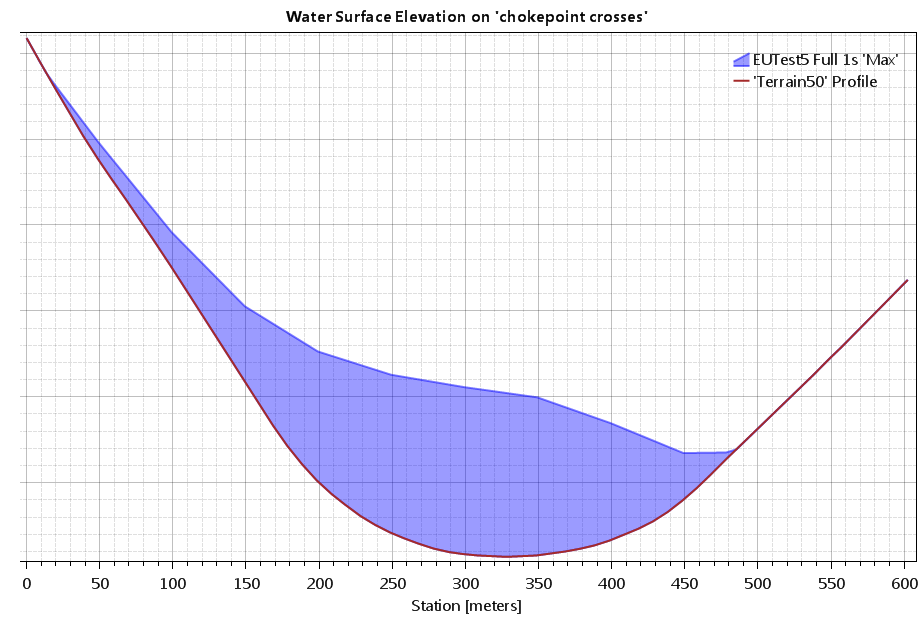
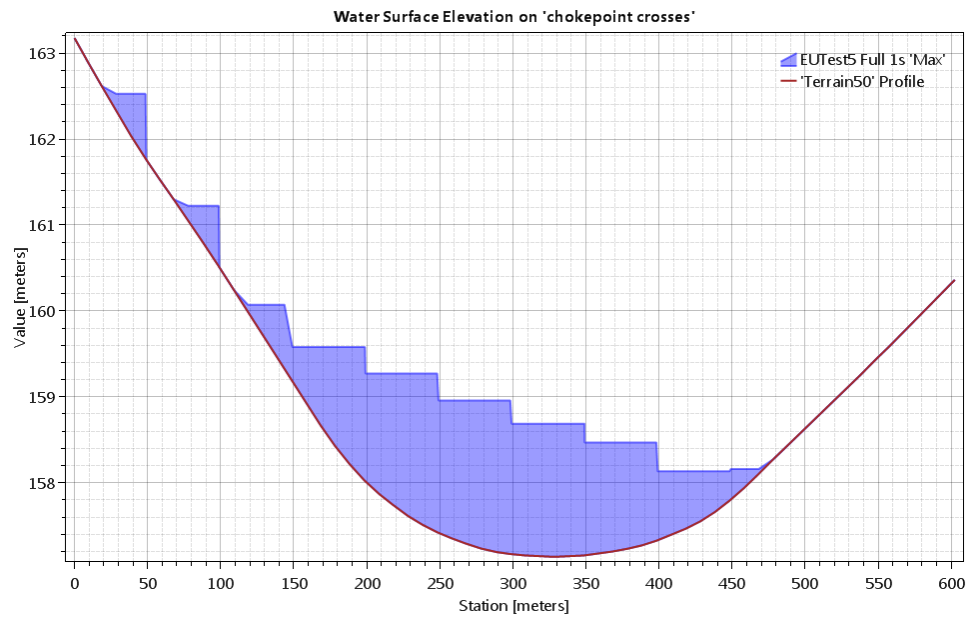


# Horizontal vs Sloping Surface



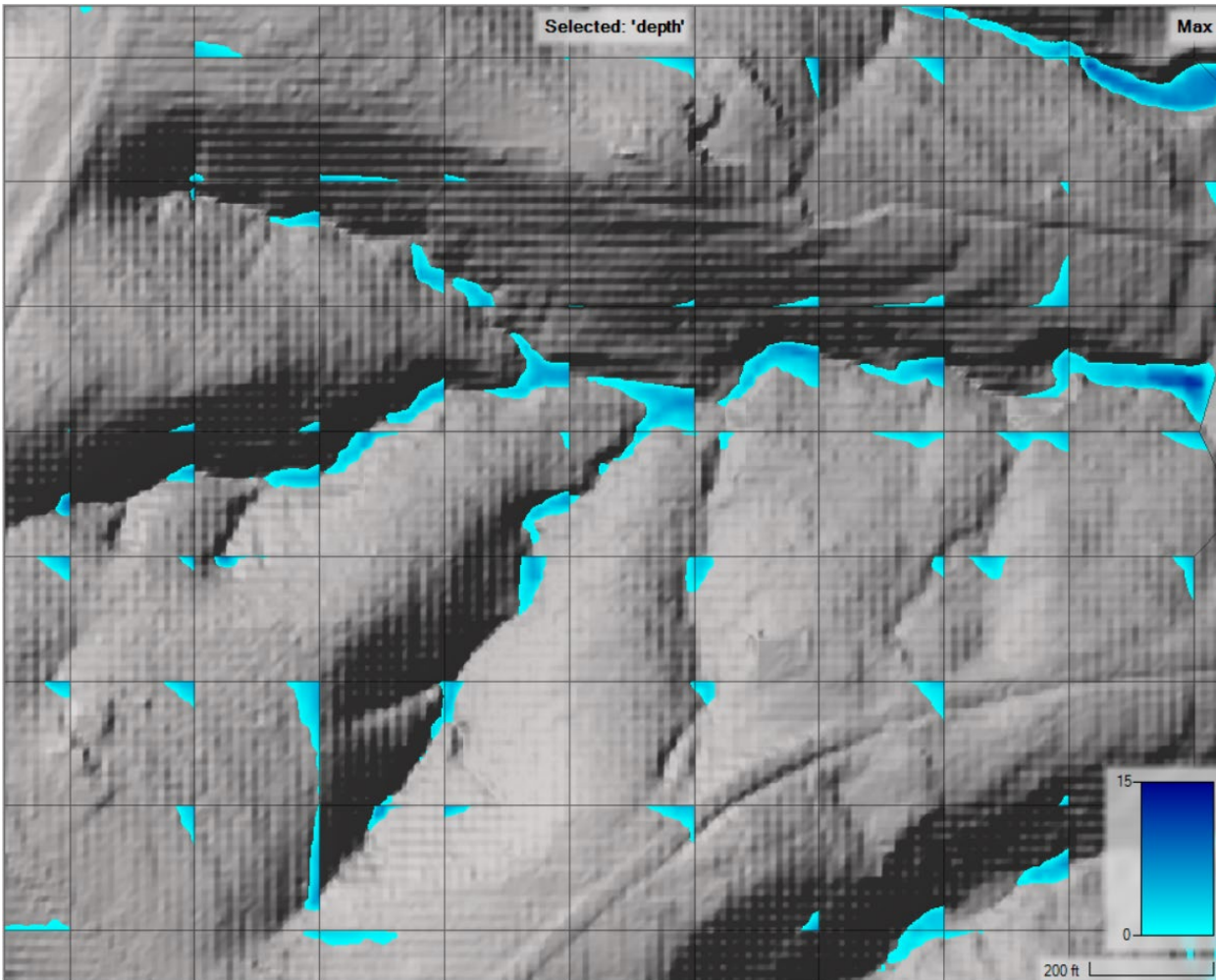


# Horizontal vs Sloping Surface

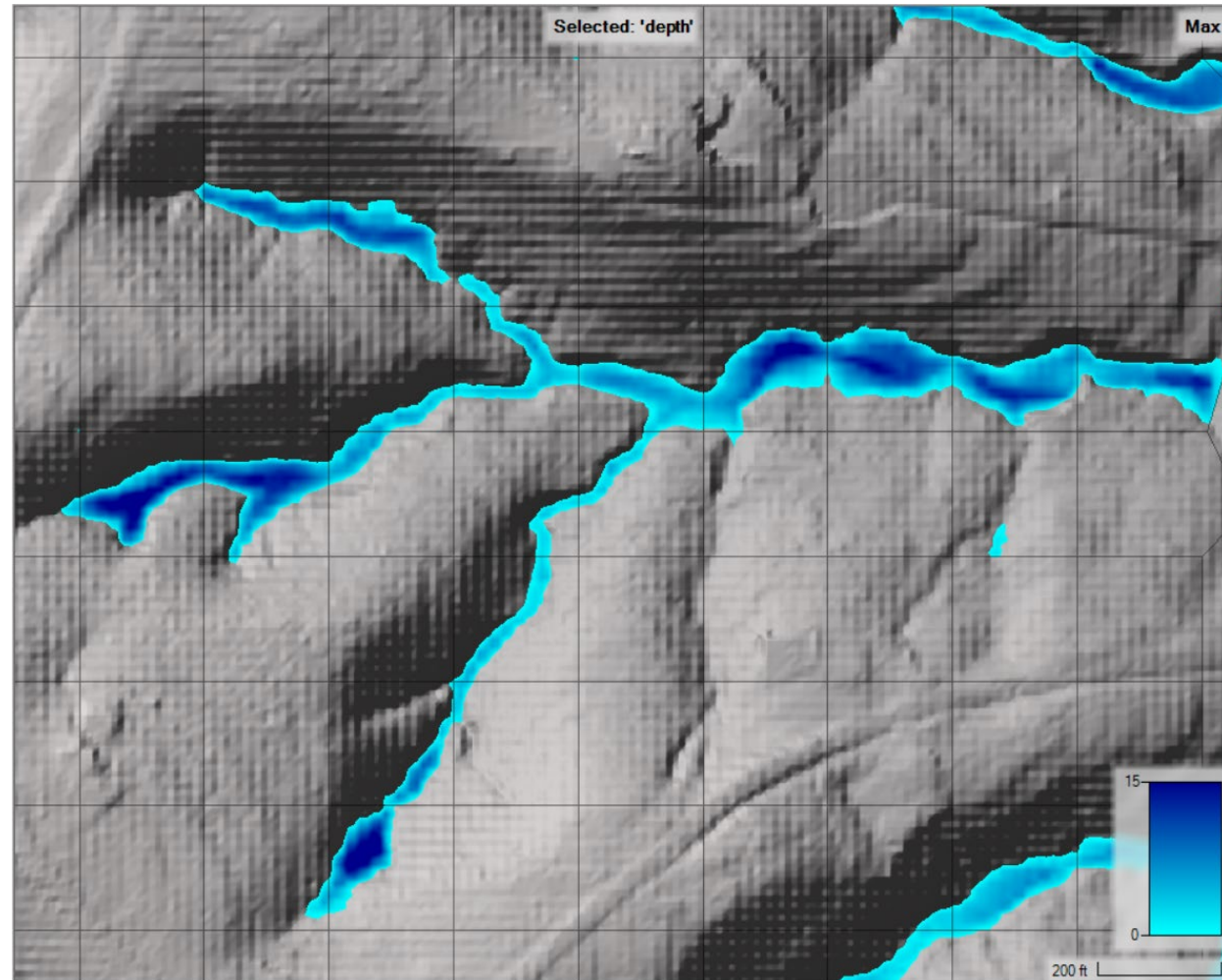




# Sloping Surface Errors



Horizontal

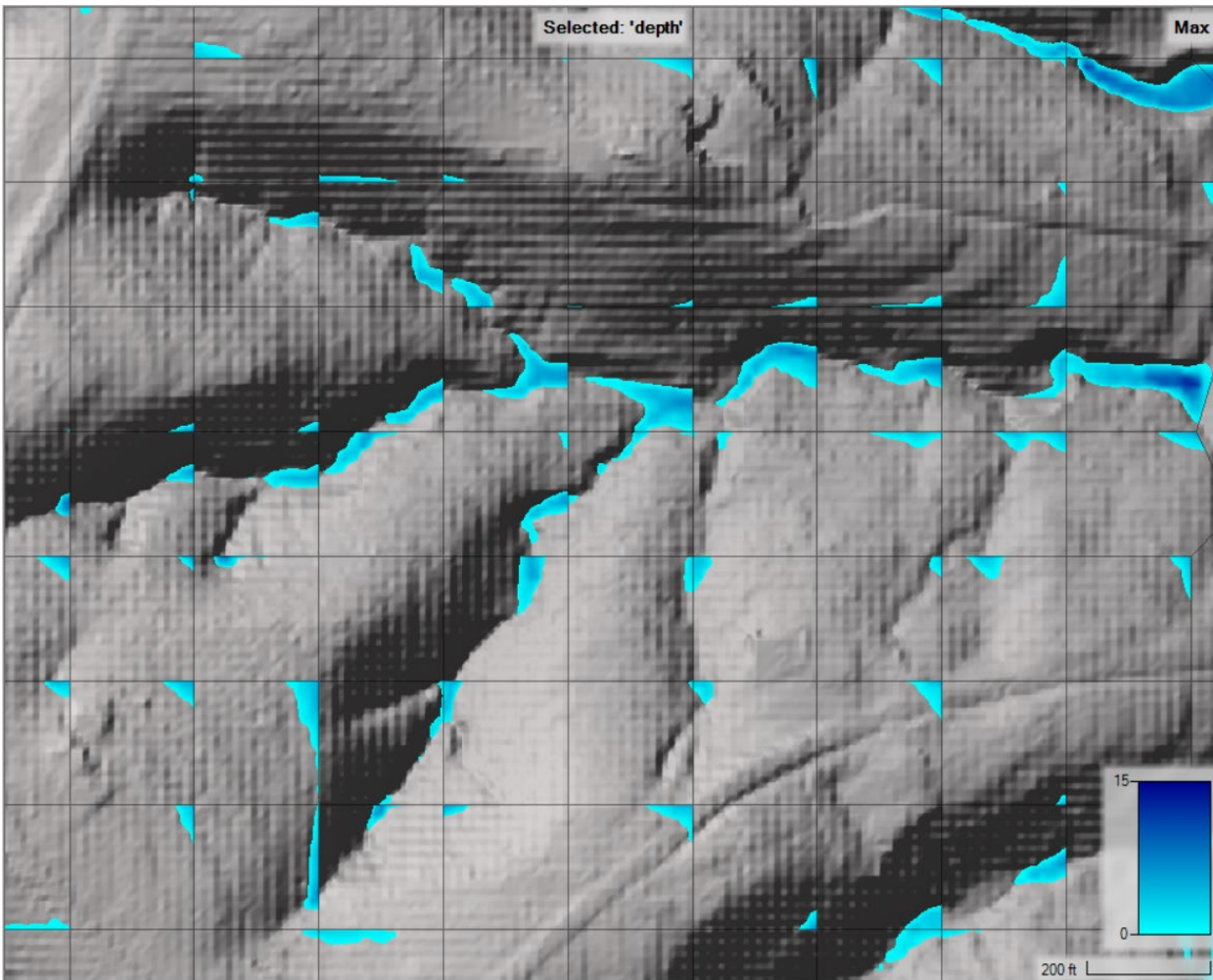


Sloping

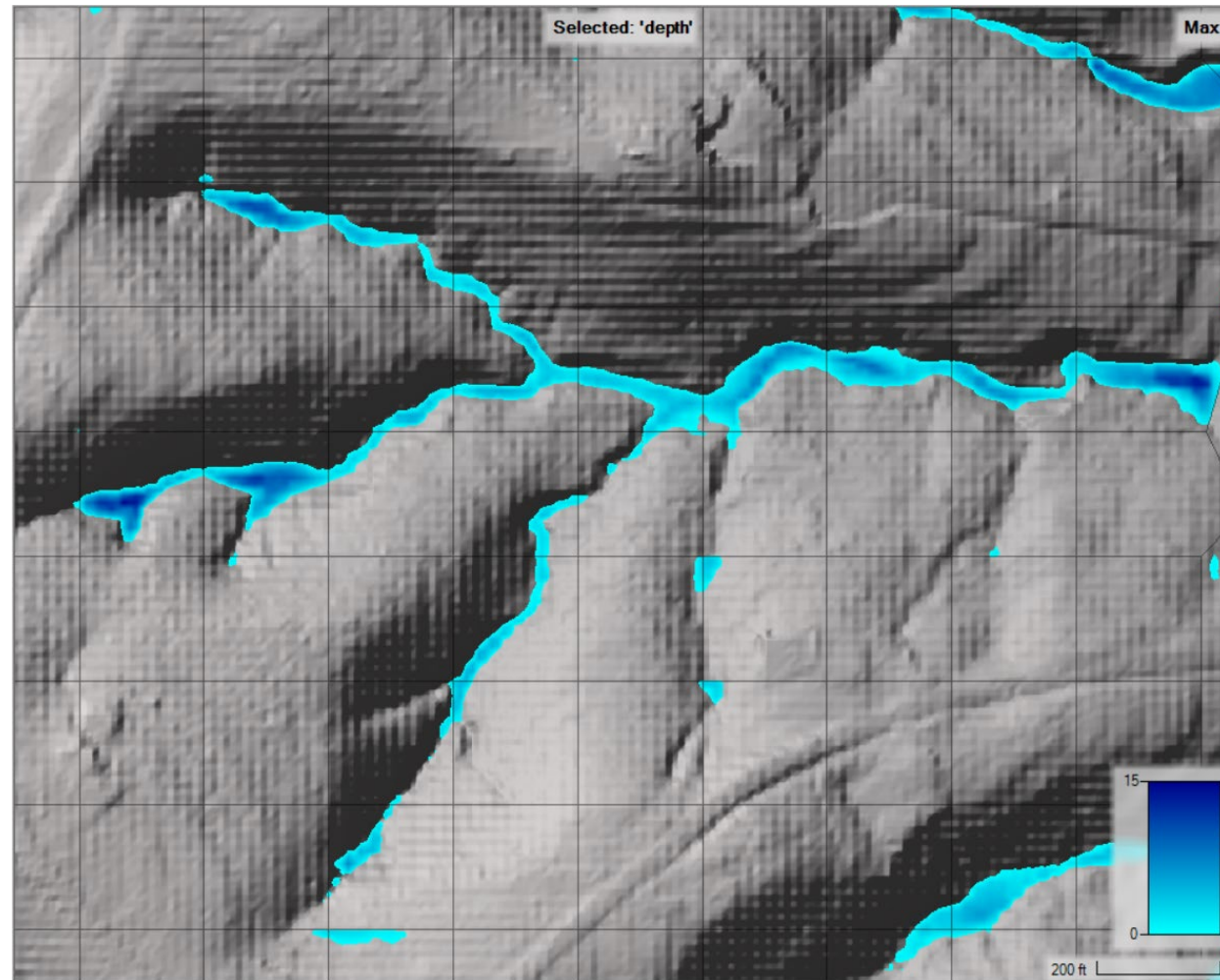




# Sloping Surface Errors



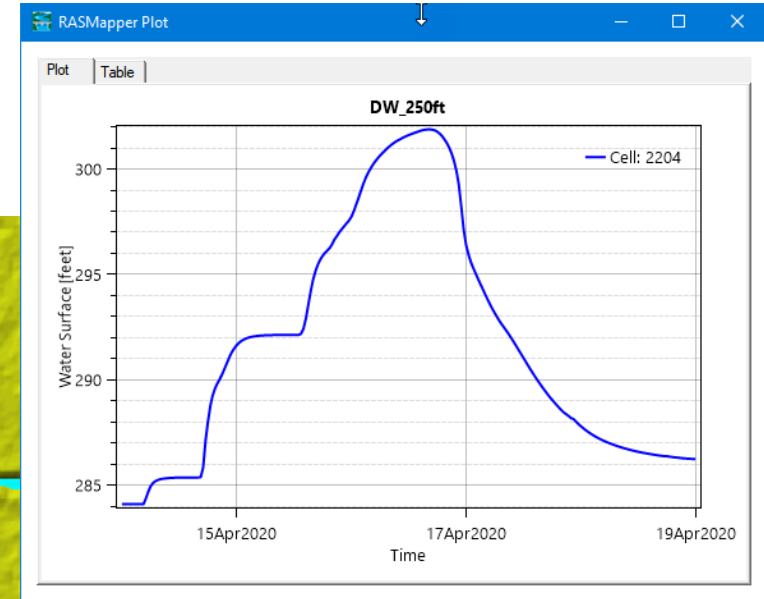
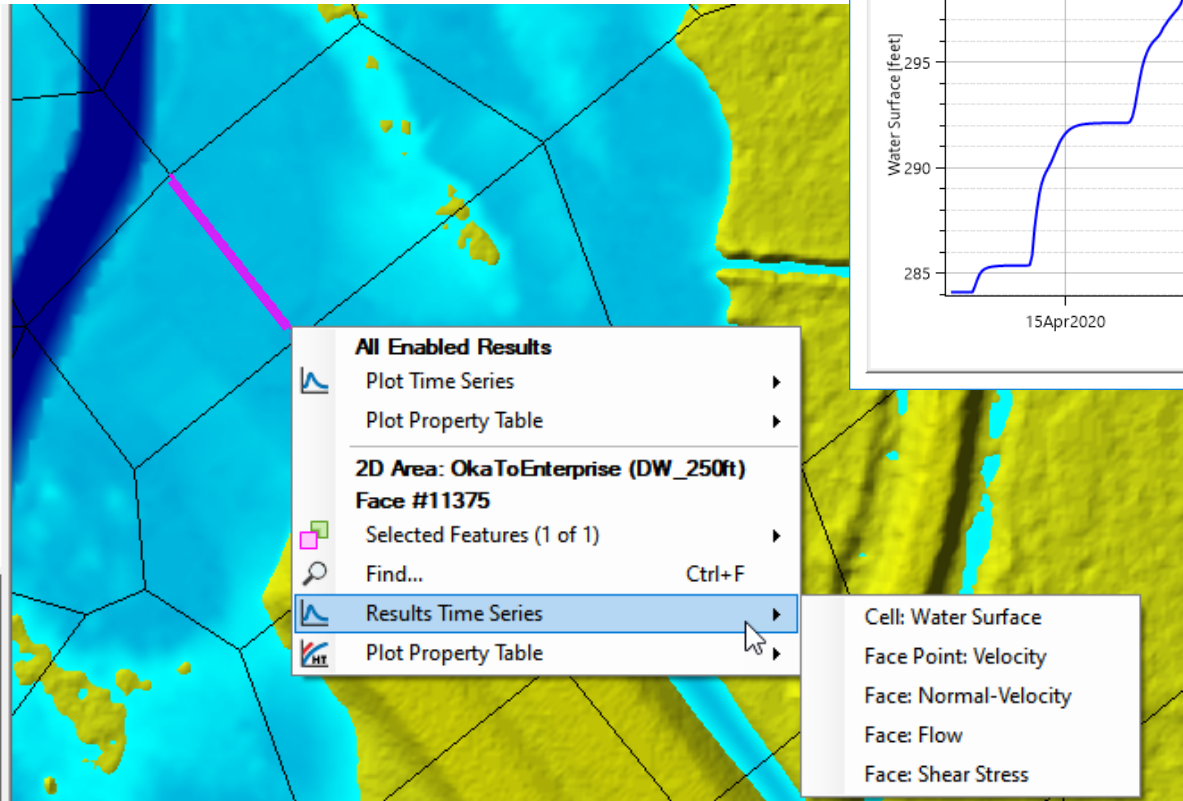
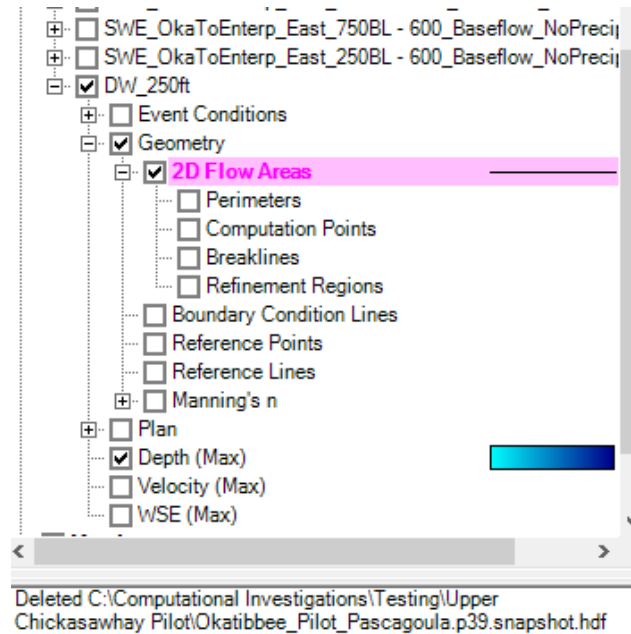
Horizontal



Precip Mode

# Results Time Series - Computed

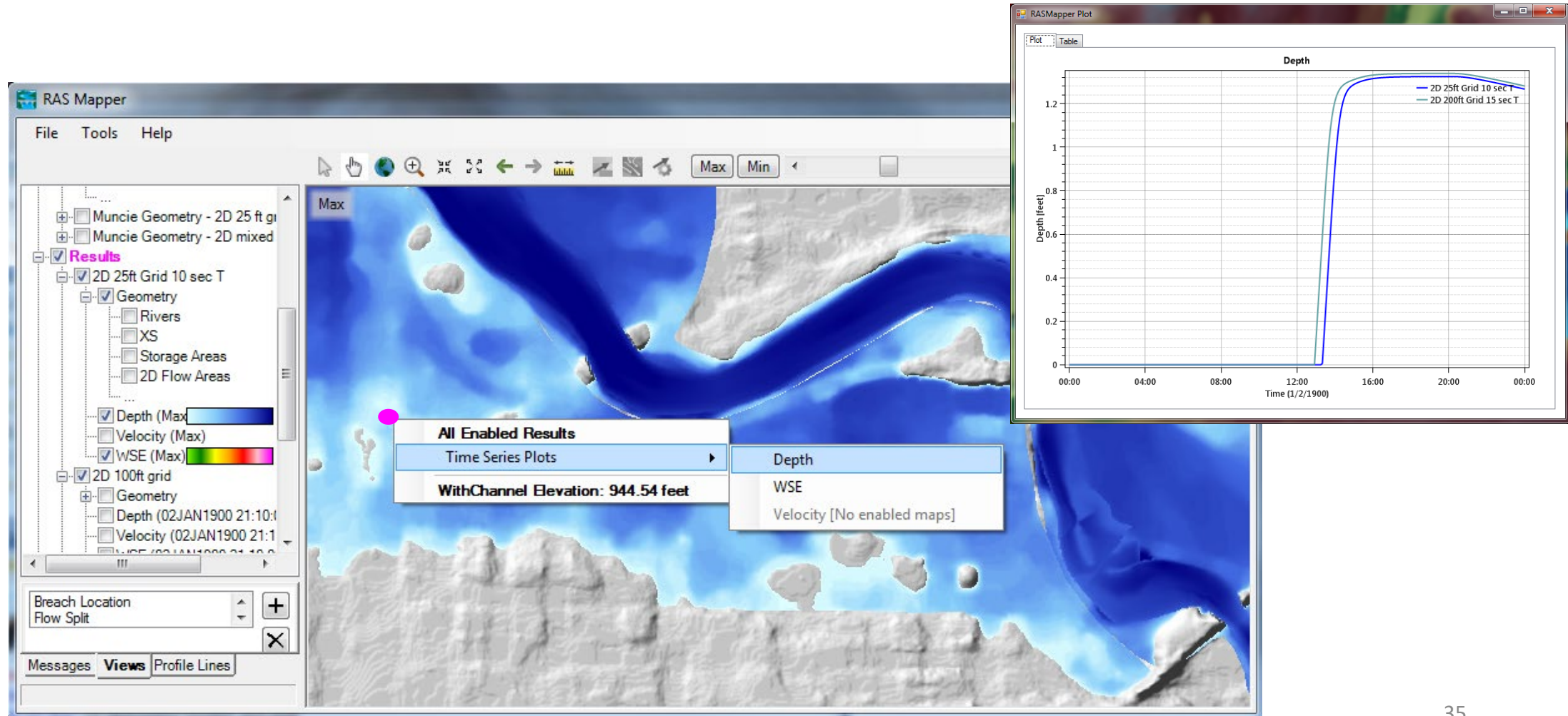
- Queries compute engine results for geometry element
  - 2D Cells
  - 2D Faces
  - 1D Elements





# Results Time Series - Interpolated

- Queries interpolated results any at any point in domain

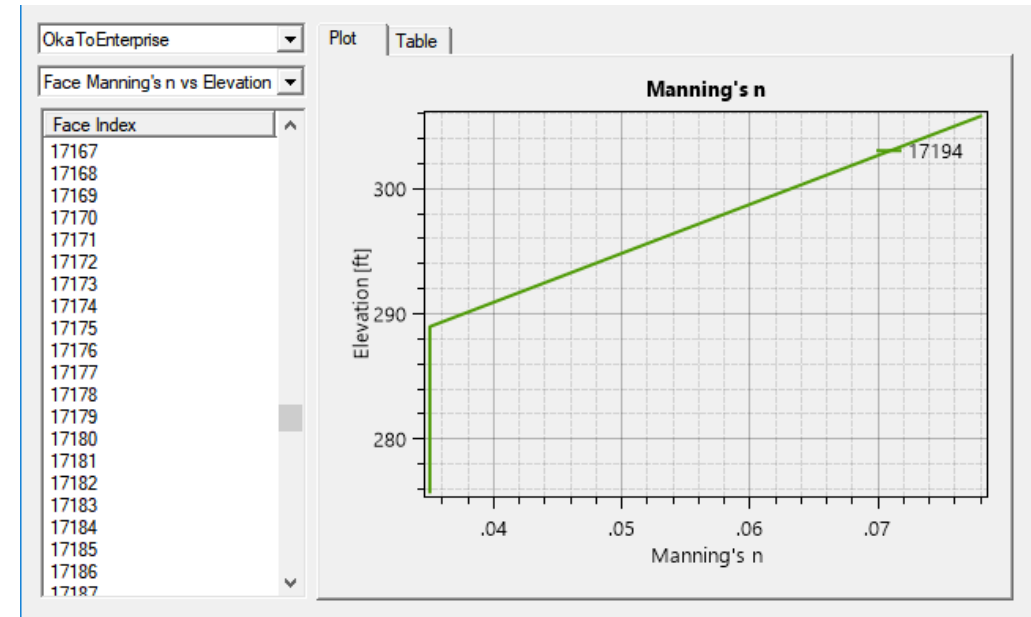
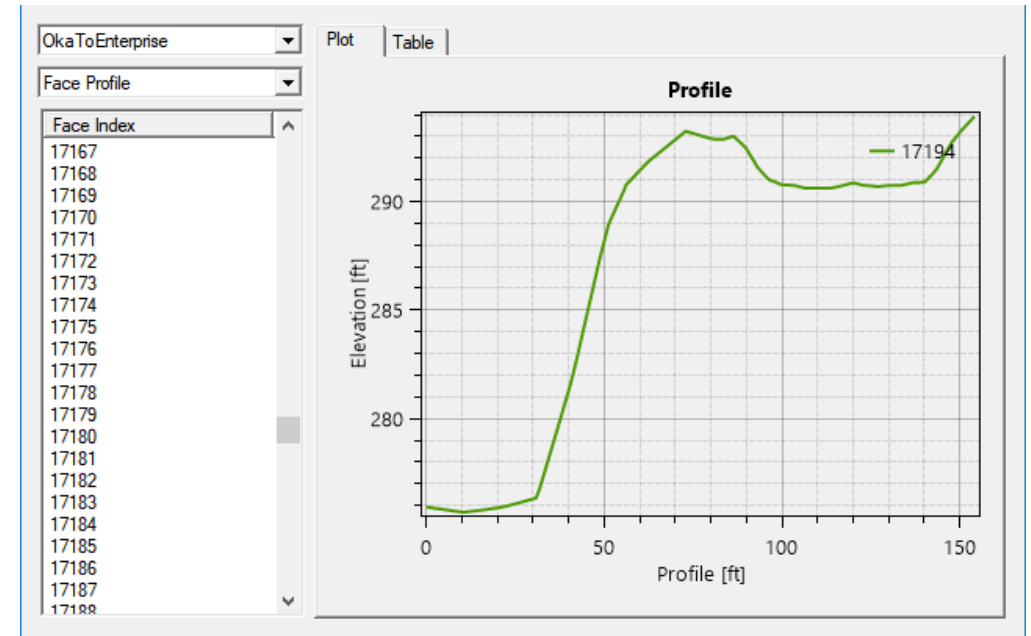
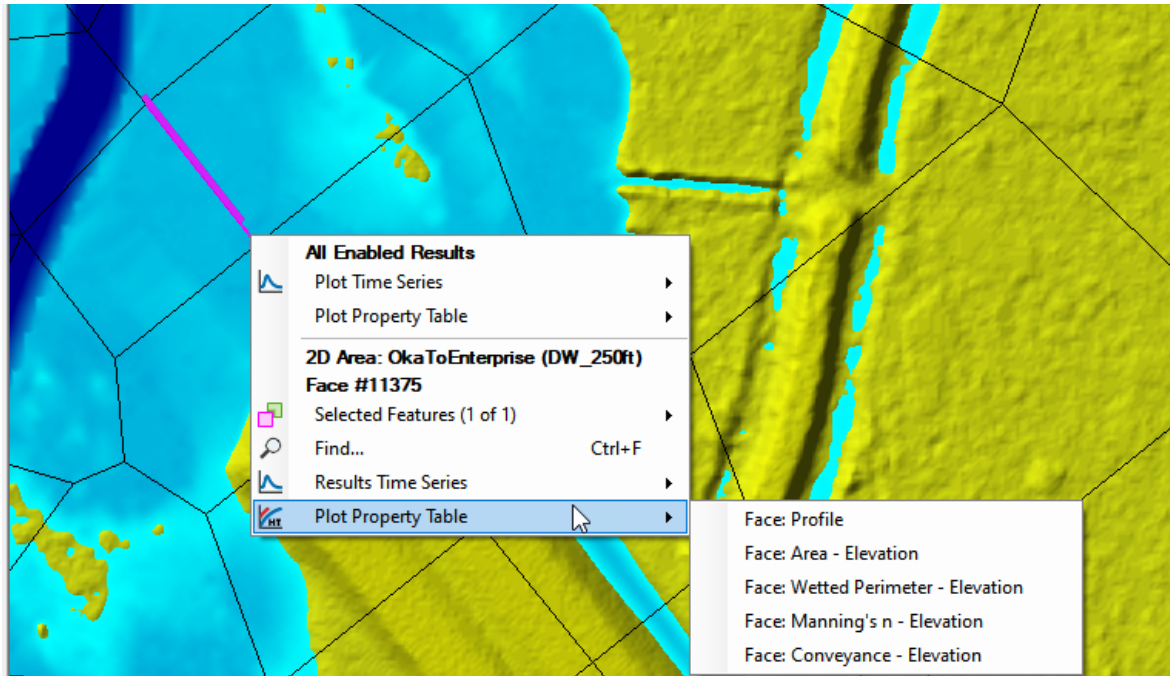




# 2D Flow Area Properties

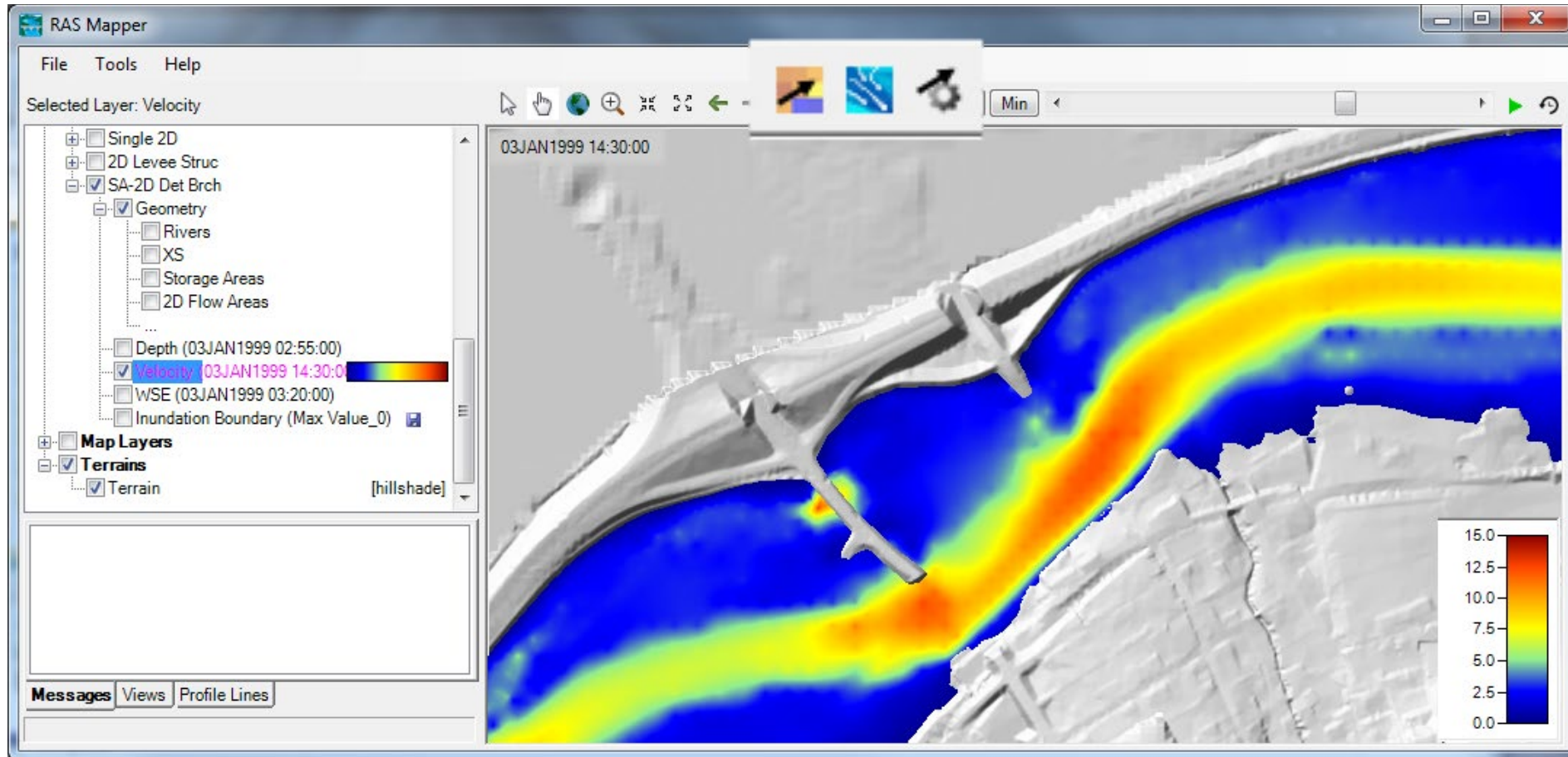
- Hydraulic Properties

- |                                    |
|------------------------------------|
| Cell: Volume - Elevation           |
| Face: Profile                      |
| Face: Area - Elevation             |
| Face: Wetted Perimeter - Elevation |
| Face: Manning's n - Elevation      |
| Face: Conveyance - Elevation       |





# Velocity Results





# Velocity Arrows



Velocity Map Parameters

**Static Arrows**

Regular Interval  
Spacing: 28

Computation Points [Disabled]

Color: White

**Particle Tracing**

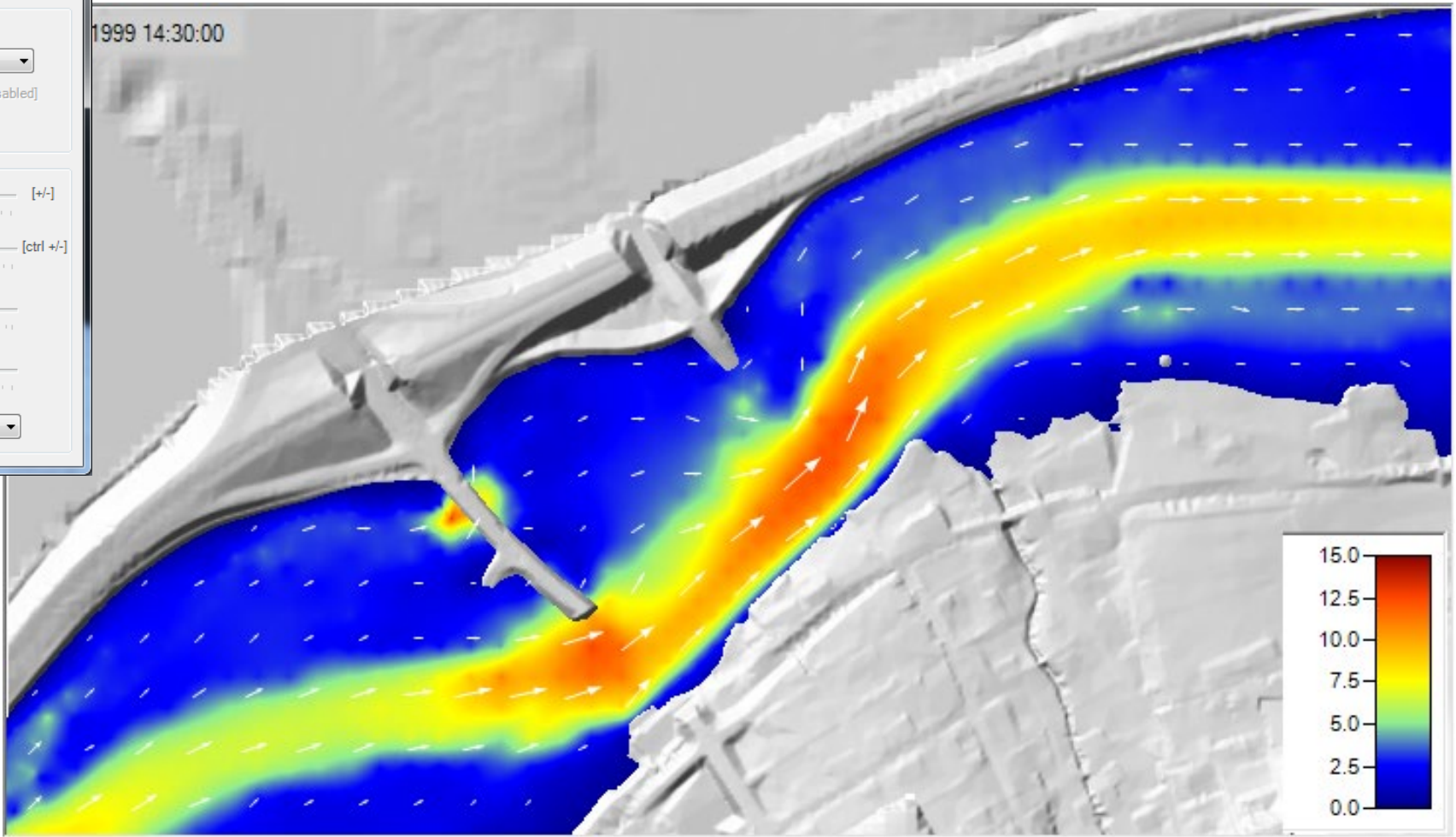
Speed: [Slider] [+/-]

Density: [Slider] [ctrl +/-]

Width: [Slider]

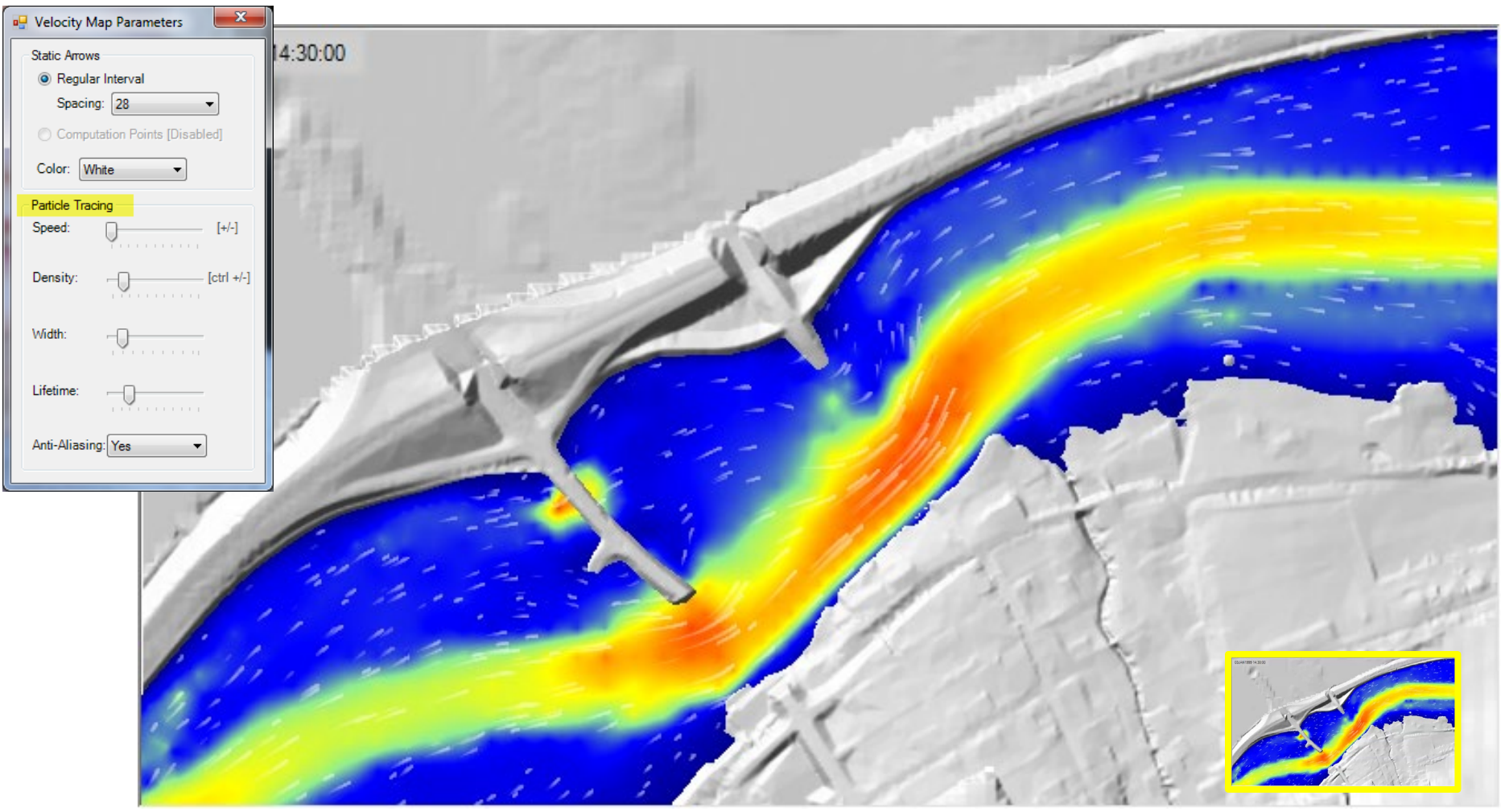
Lifetime: [Slider]

Anti-Aliasing: Yes



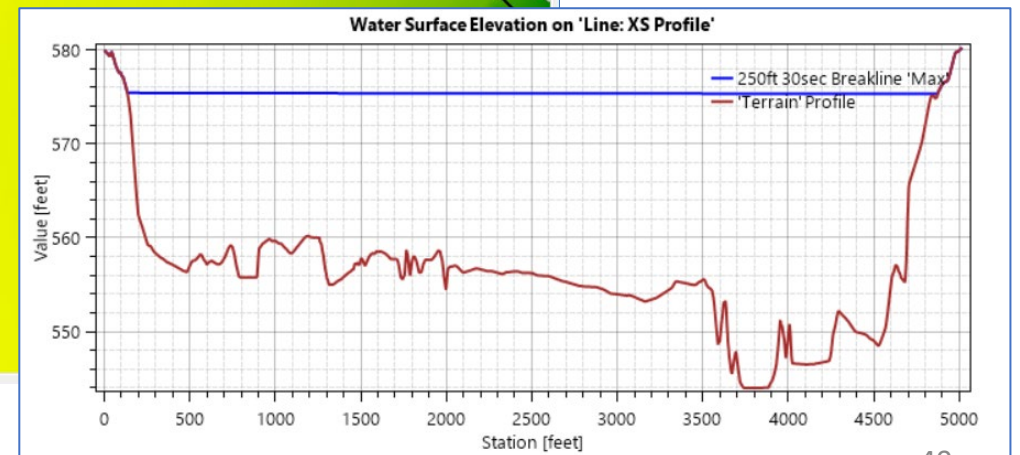
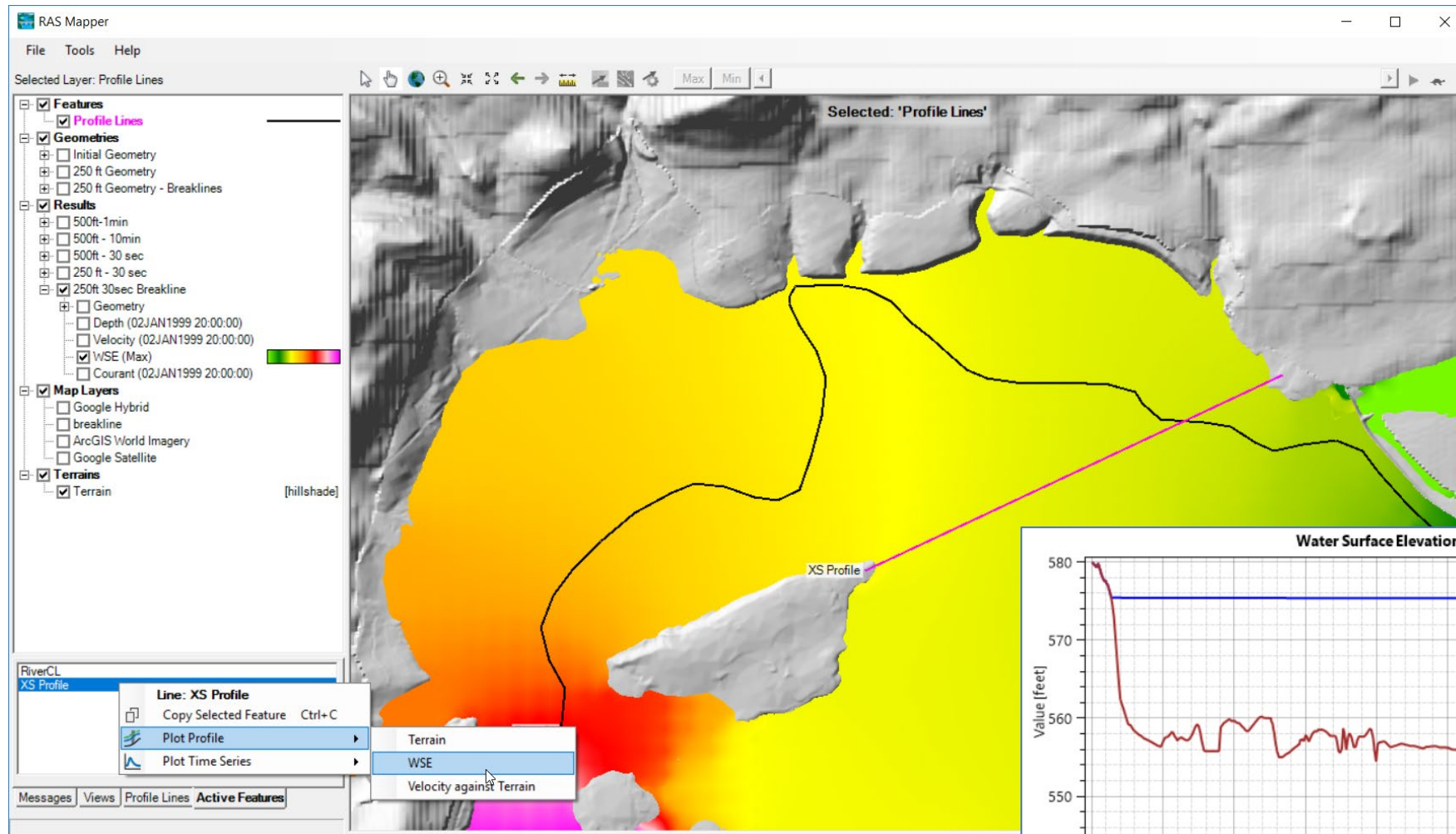


# Velocity Tracing





# Profile Lines

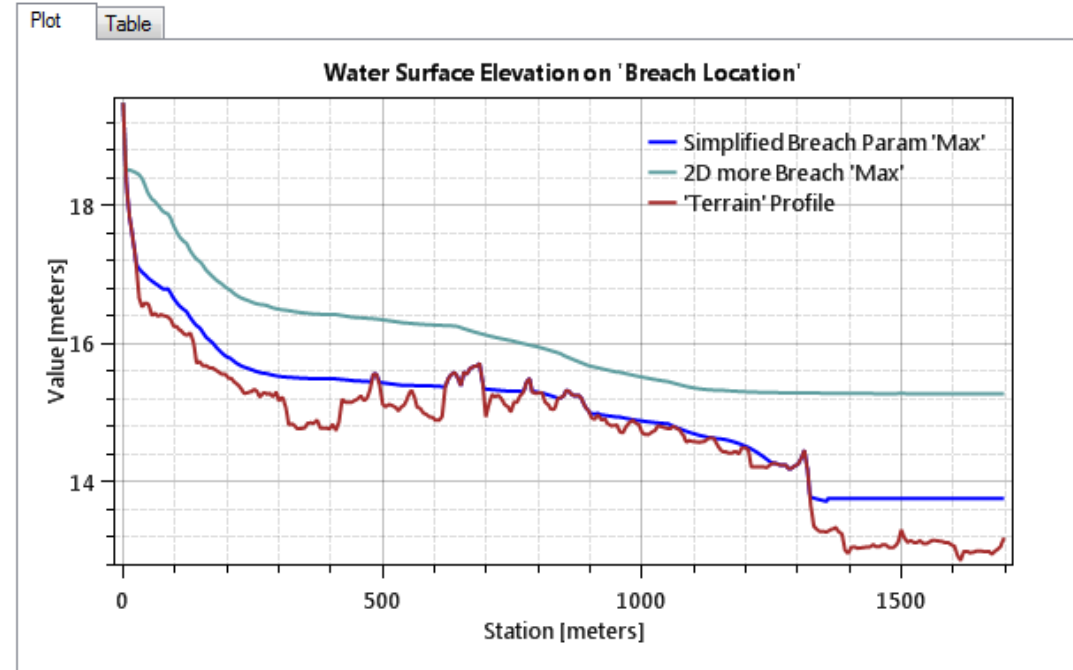
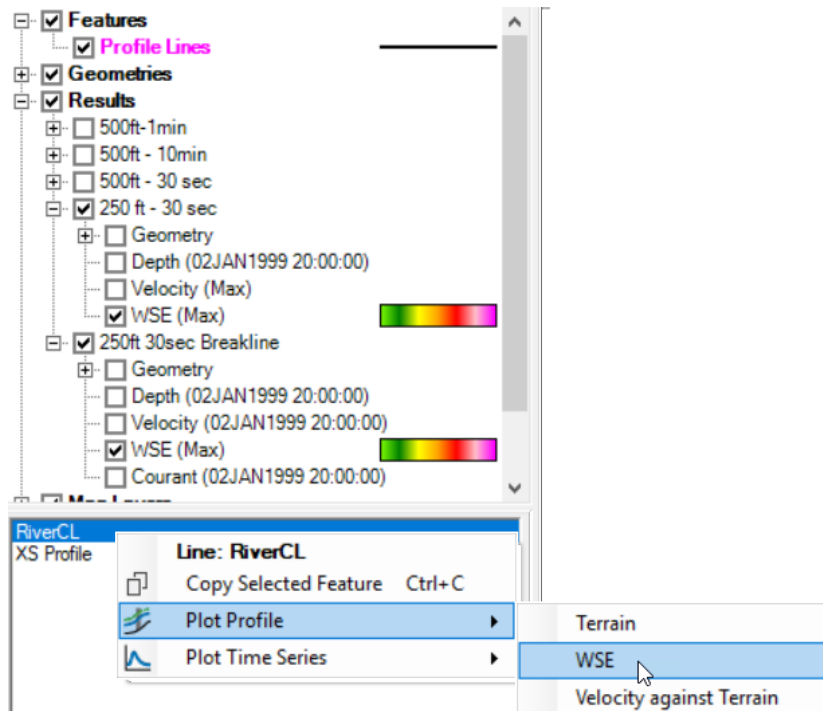






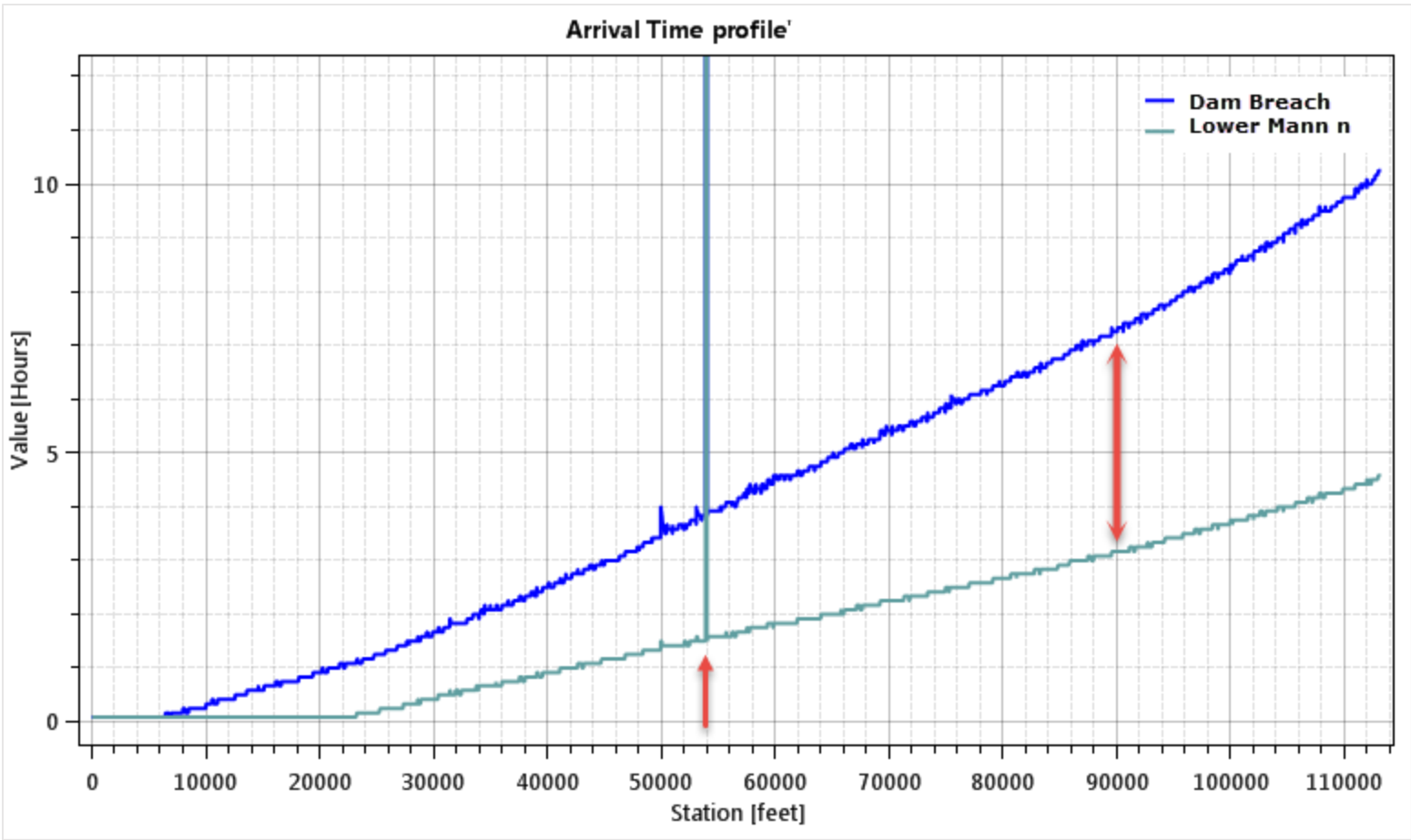
# Profile Line - Comparison

- Turn on multiple result maps
- Choose a Profile (i.e. 'Max')
- Choose **Plot Time Series** or **Plot Profile**



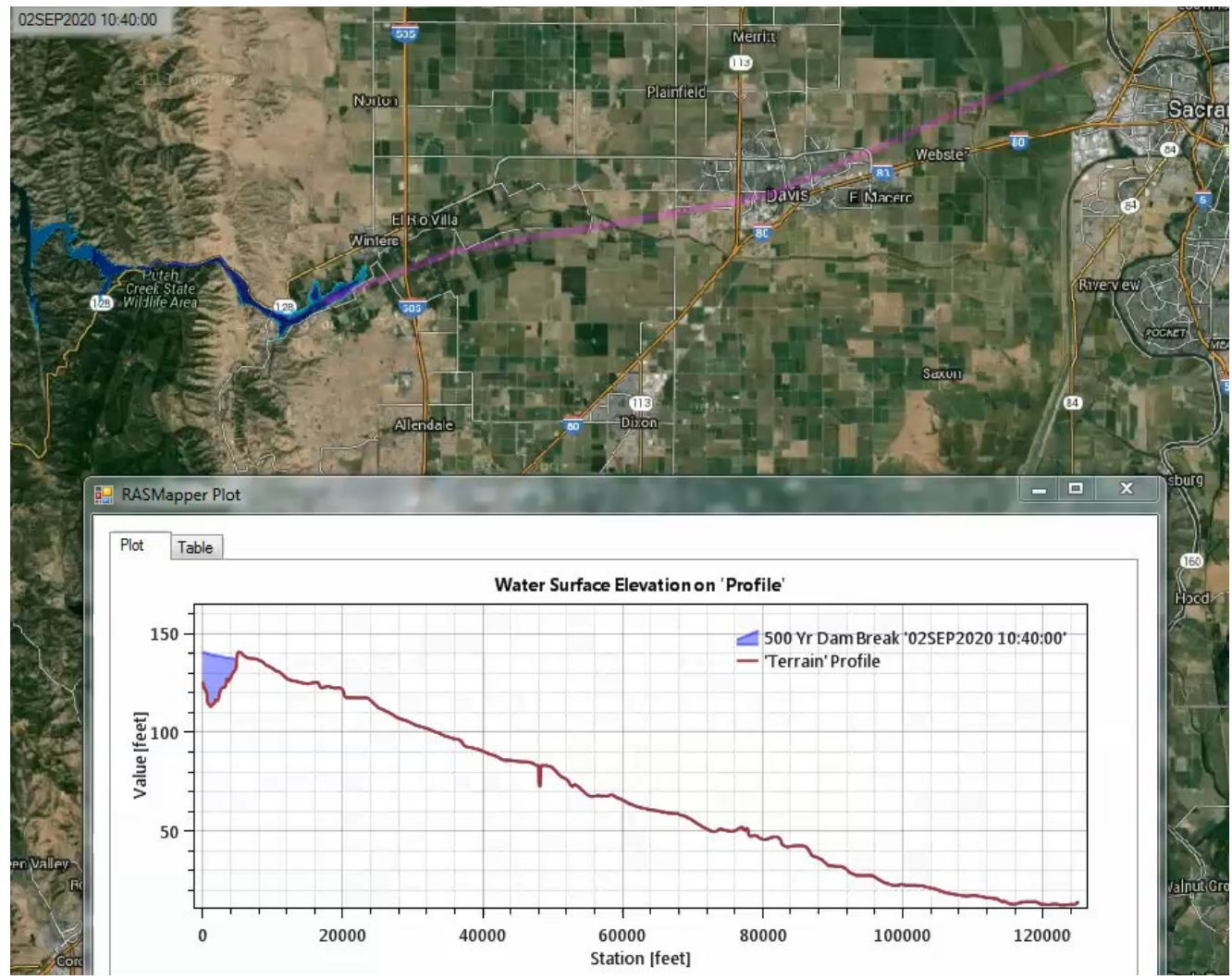


# Profile Lines - Comparison



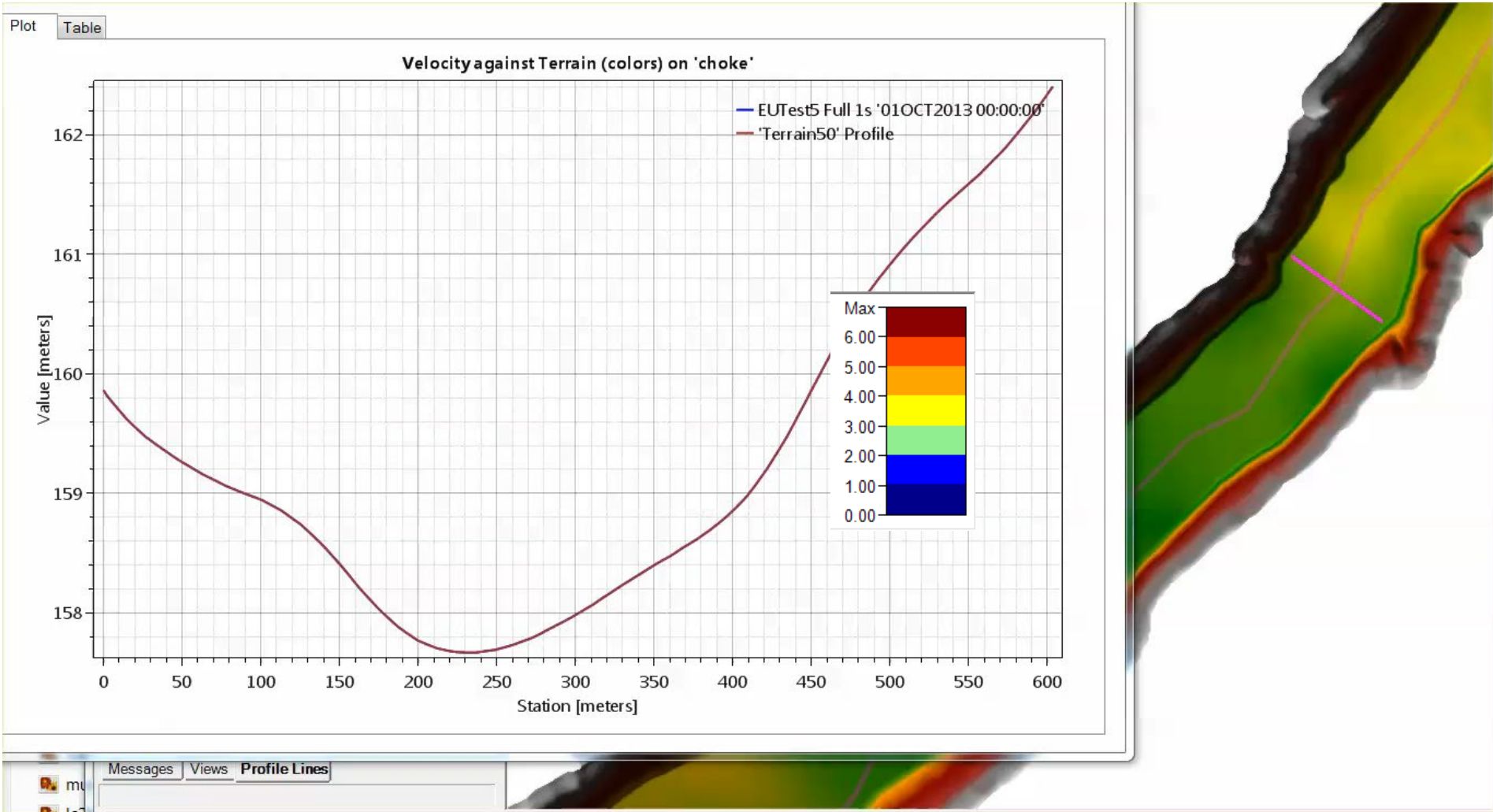


# Profile Lines + Spatial Results





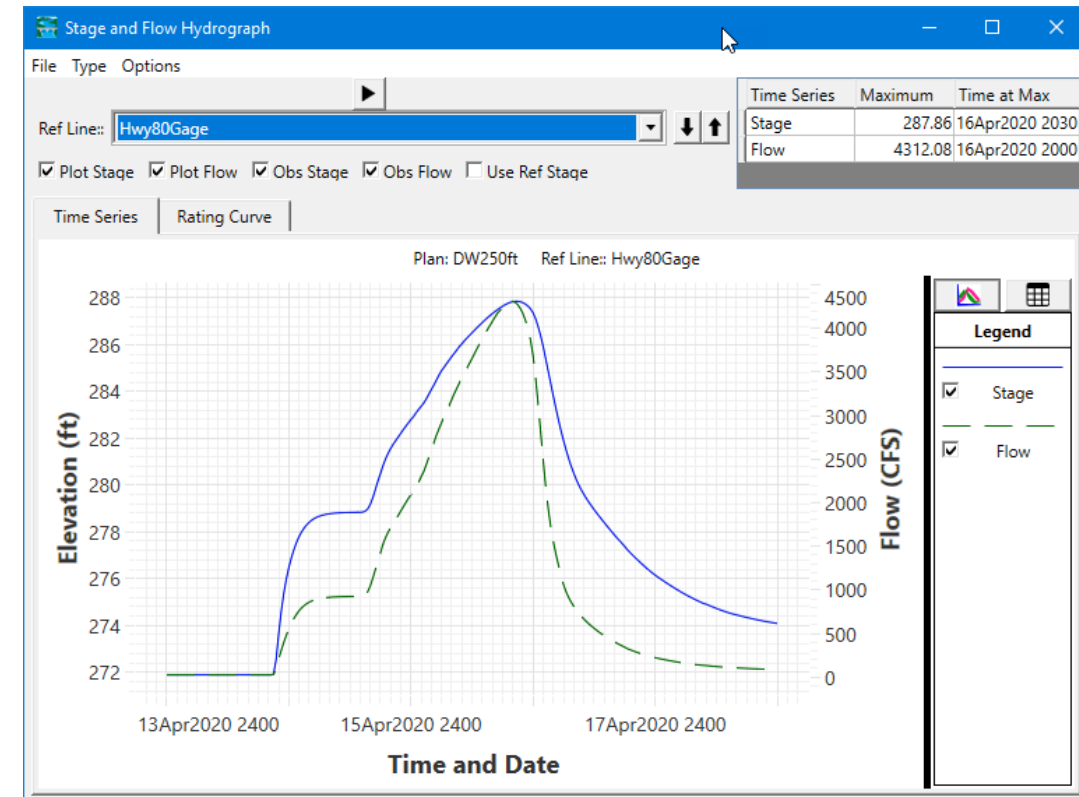
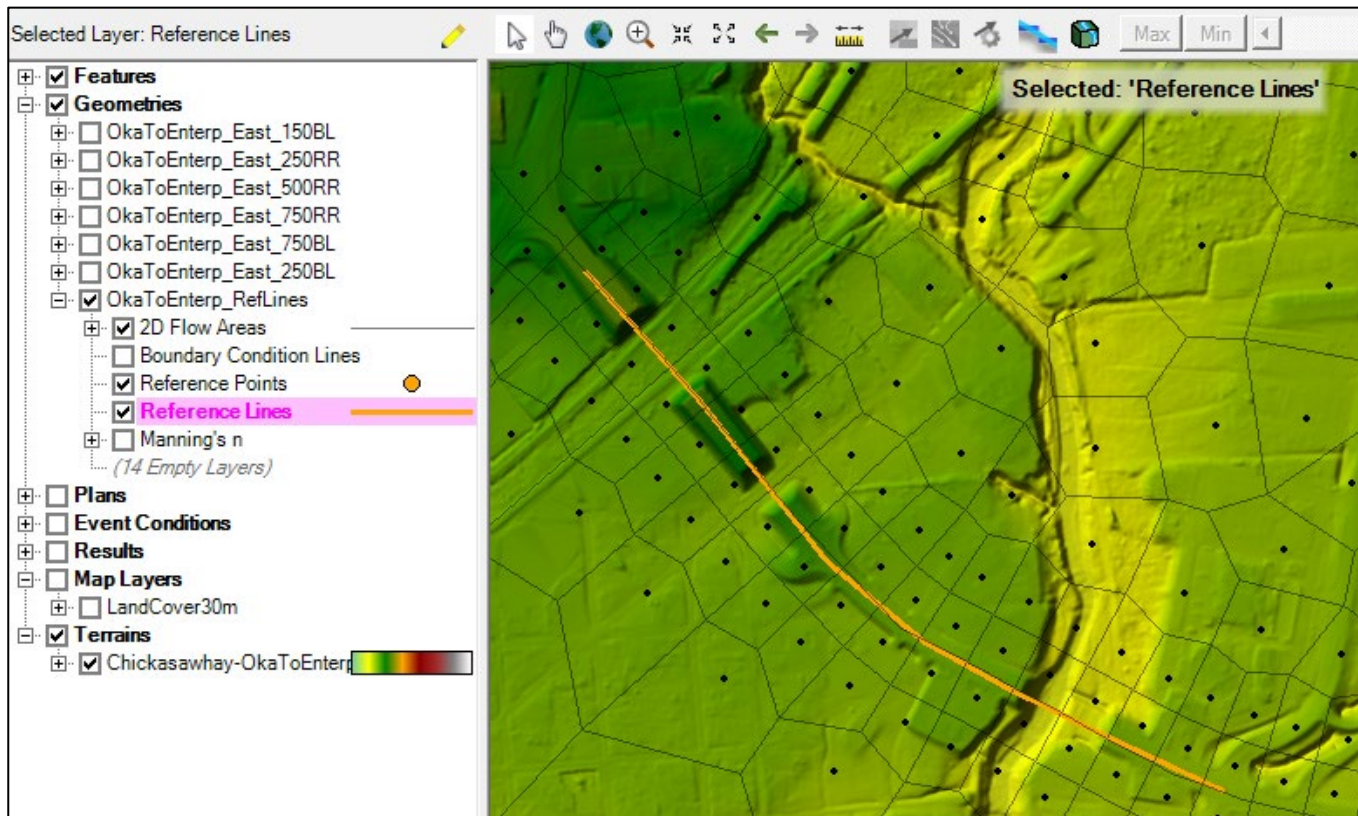
# Profile Lines – Velocity

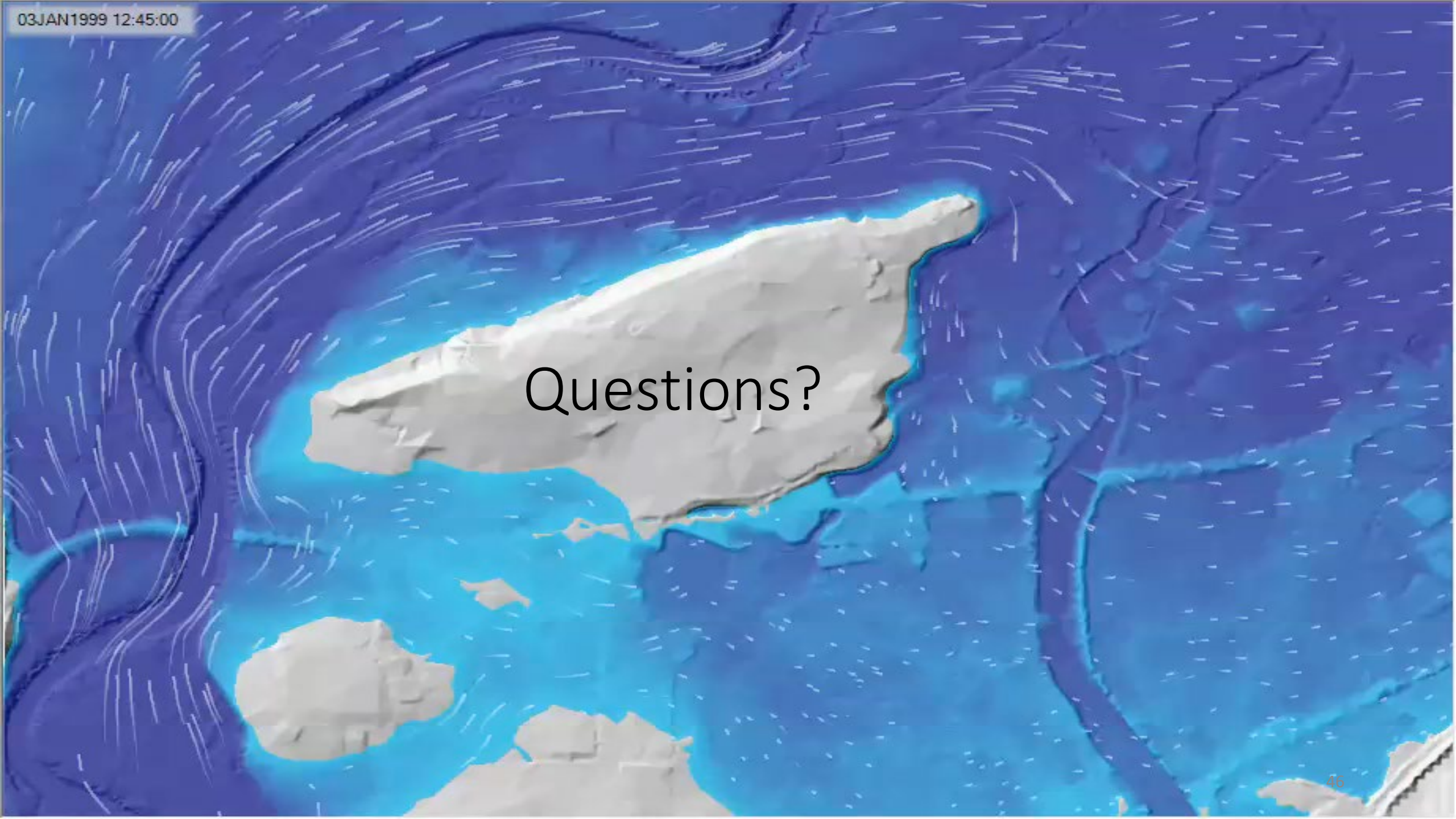




# Reference Lines + Points

- Compile results from compute engine for multiple cells
- Defined in geometry
- Results profile and time series





Questions?