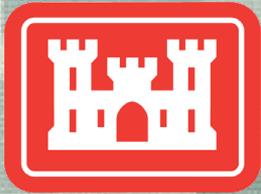


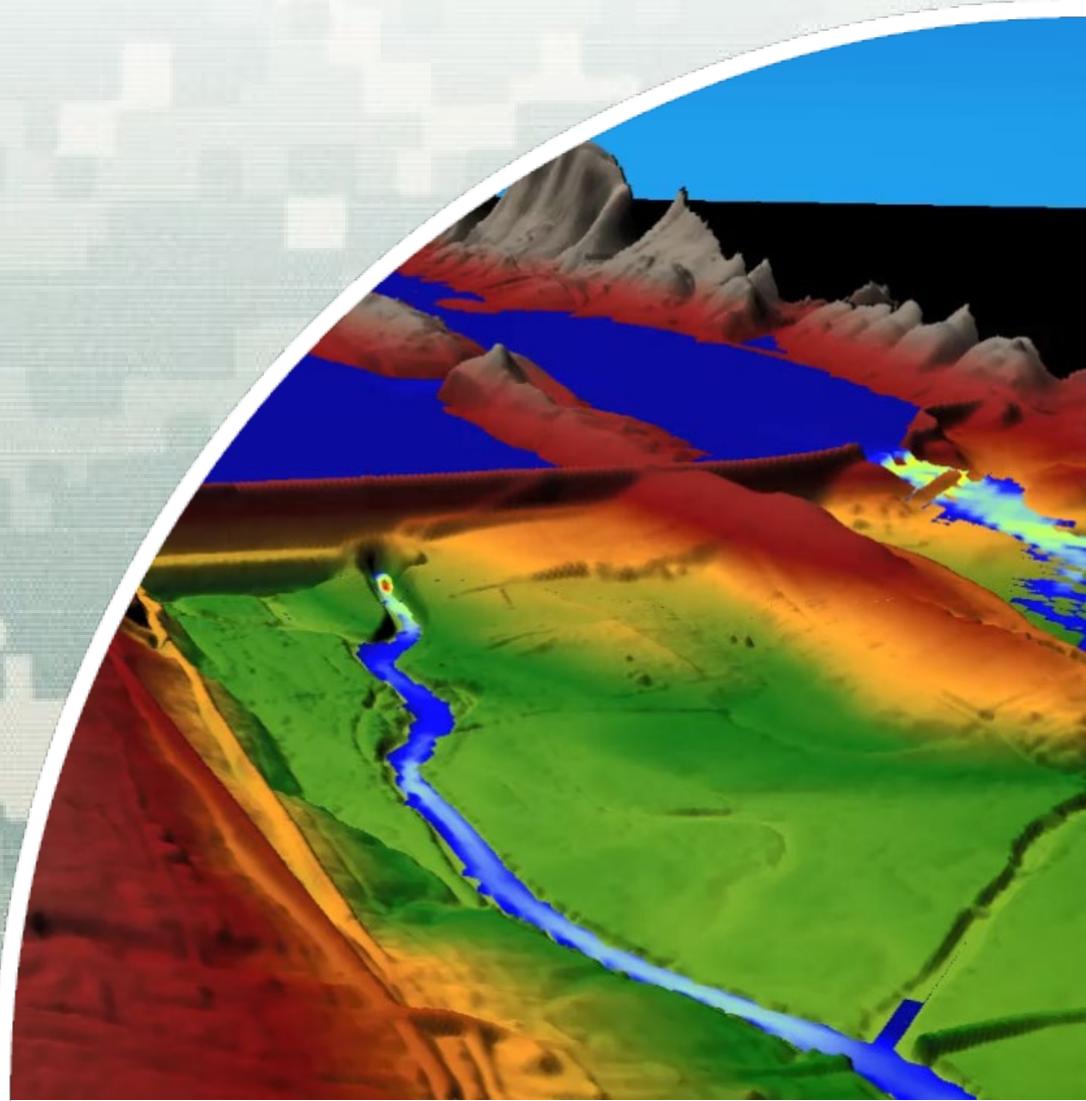
New RAS Mapper Capabilities 5.1

Cameron Ackerman, PE, D.WRE



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US Army Corps of Engineers
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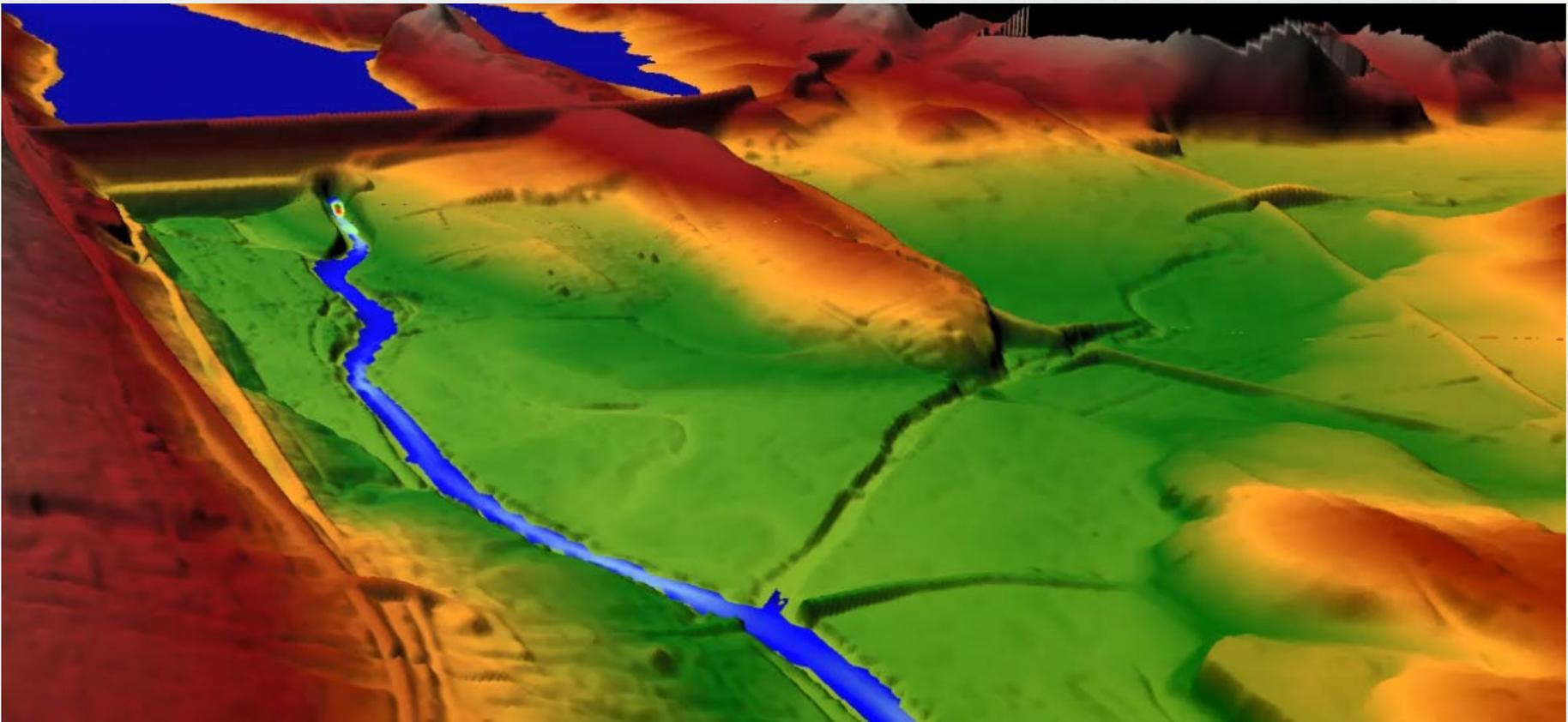
Overview

- Terrain Modifications
- Elevation Update Tool
- Watch Layer List
- RASter Calculator
- 3D KML Export



Terrain

- Development of a good 1D or 2D river hydraulics model starts with a terrain model representative of the ground surface elevations. Often we don't have that ...



Terrain Modification

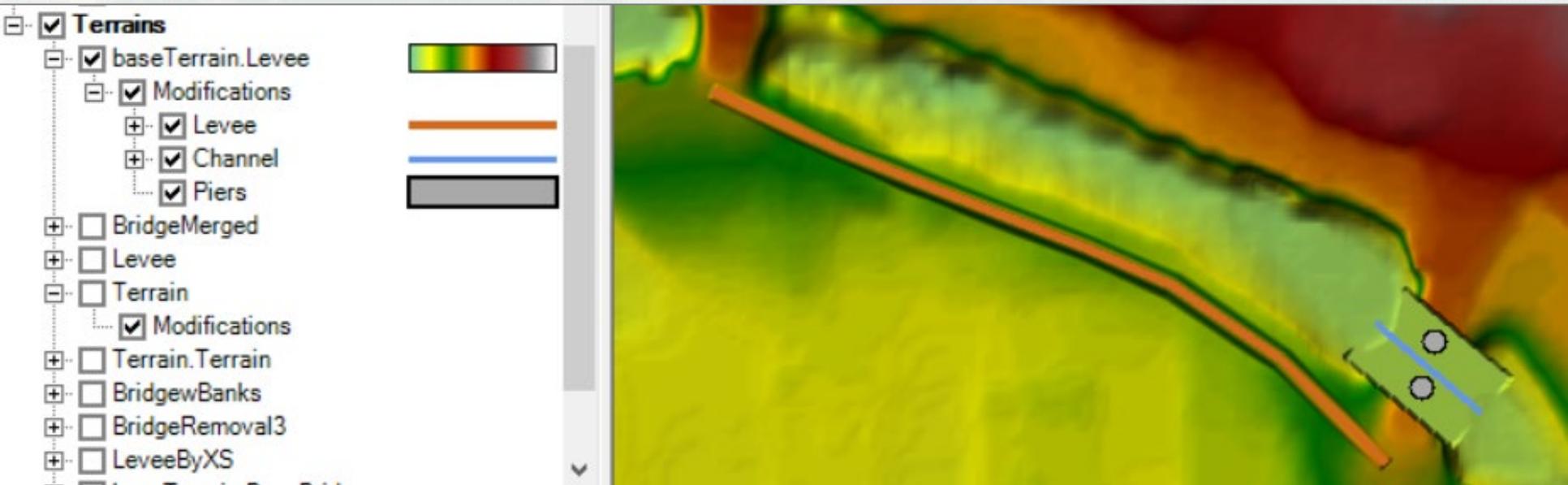
- Terrain Replacement Using RAS Cross Sections
- **NEW** Vector Overrides to Terrain Layer
 - ▶ Simple Shapes (Piers)
 - Circle, Rectangle, Ellipse
 - ▶ Line (Channel, Roads, Levees)
 - ▶ Polygon (Areas, Buildings)

 - ▶ Use existing Editing Tools!



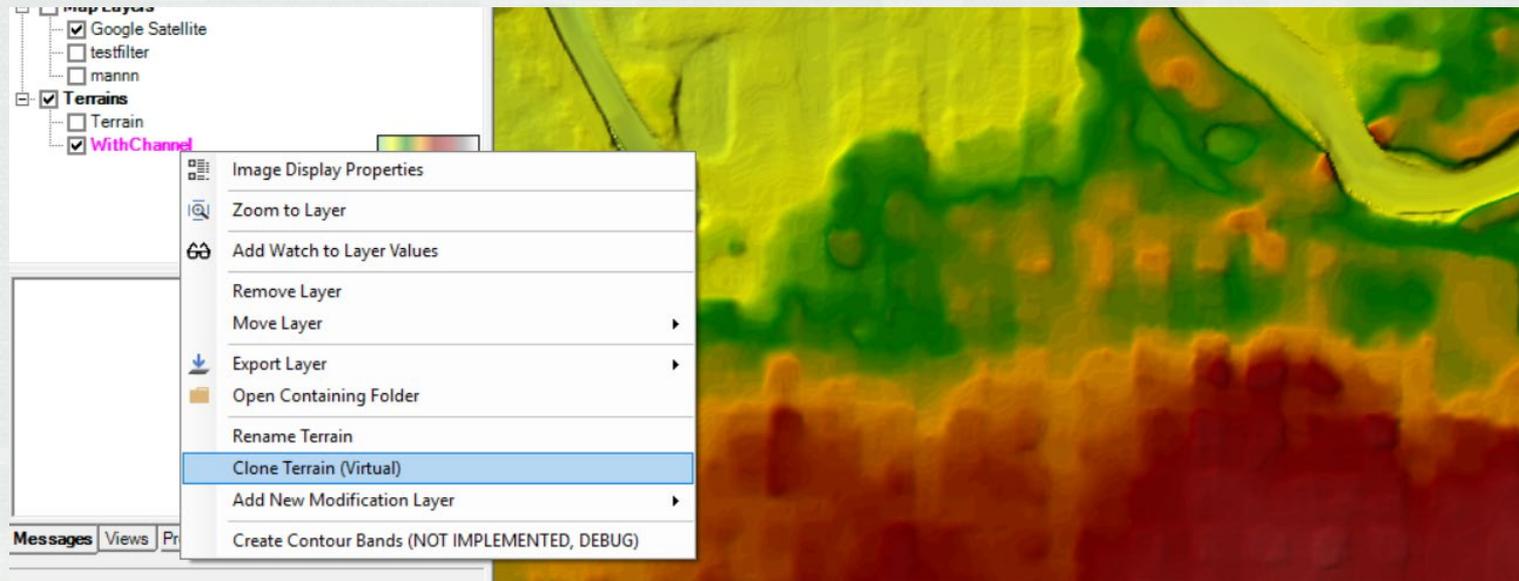
Vector Modifications

- Multiple Vector additions with a Terrain Layer
- Modifications are used for visualization and for all computations.
- Re-use Vector Features in other Layers



Step 1: Clone the Terrain!

- Virtual copy of the Terrain
- No duplication of large dataset
- Vector additions stored in a separate file



Vector Modifications

The screenshot displays the RAS Mapper application interface. The main window shows a terrain map with a color scale ranging from 911.6 (green) to 975.6 (red). A context menu is open over the map, listing various actions for the selected layer 'baseTerrain.Example'. The 'Add New Modification Layer' option is highlighted, and its sub-menu is also open, showing 'Shapes', 'Lines', and 'Polygons'. The 'Lines' option is further expanded, showing 'High Ground' and 'Channel' as sub-options. The left sidebar shows a tree view of layers, with 'baseTerrain.Example' selected under the 'Terrains' category. The top menu bar includes 'File', 'Tools', and 'Help'. The bottom status bar shows 'Messages', 'Views', 'Profile Lines', and 'Active Features'.

RAS Mapper

File Tools Help

Selected Layer: baseTerrain.Example

Selected: 'baseTerrain.Example'

- Image display properties ...
- Zoom to Layer
- Remove Layer
- Move Layer
- Export Layer
- Open Containing Folder
- Rename Terrain
- Clone Terrain (Virtual)
- Add New Modification Layer**
 - Shapes
 - Lines**
 - High Ground
 - Channel
 - Polygons
- Create Contour Bands (NOT IMPLEMENTED, DEBUG)

975.6
956.0
951.5
946.9
943.5
939.3
933.2
911.6

Messages Views Profile Lines Active Features

Vector Modifications

- Simple Shapes
 - ▶ Circle/Ellipse
 - ▶ Square/Rectangle
- Lines
 - ▶ High Ground/Levee
 - ▶ Channel
- Polygons
 - ▶ Free Hand
 - ▶ Rectangle
- Replace Terrain Value
- Higher of Terrain / User Value
- Lower of Terrain / User Value
- Replace NoData Values
- Add Value to Terrain



Shapes - Piers

The screenshot displays the RAS Mapper application window. The title bar reads "RAS Mapper" and the menu bar includes "File", "Tools", and "Help". The "Selected Layer: Piers" is indicated at the top left. A toolbar with various navigation and editing tools is visible. The main map area shows a terrain visualization with a red "Editing: 'Piers'" label. A dialog box titled "Ellipse Editor" is open, allowing the user to define an ellipse shape. The dialog includes radio buttons for "Circle" and "Ellipse", with "Ellipse" selected. The "Name (Optional):" field contains "Ellipse". The "Modification Type:" dropdown is set to "Replace Terrain Value". The "Elevation:" field is set to "945", "Major Radius:" to "50", "Minor Radius:" to "12", and "Rotation Angle (Degrees):" to "0". An "OK" button is at the bottom of the dialog. In the background, a pink ellipse is visible on the map with eight white handles for resizing. The bottom status bar shows coordinates "(406355.85, 1804969.02)" and a scale of "1 pixel = 1.25 feet".

RAS Mapper

File Tools Help

Selected Layer: Piers

Editing: 'Piers'

Ellipse Editor

Circle Ellipse

Name (Optional):

Modification Type:

Elevation:

Major Radius:

Minor Radius:

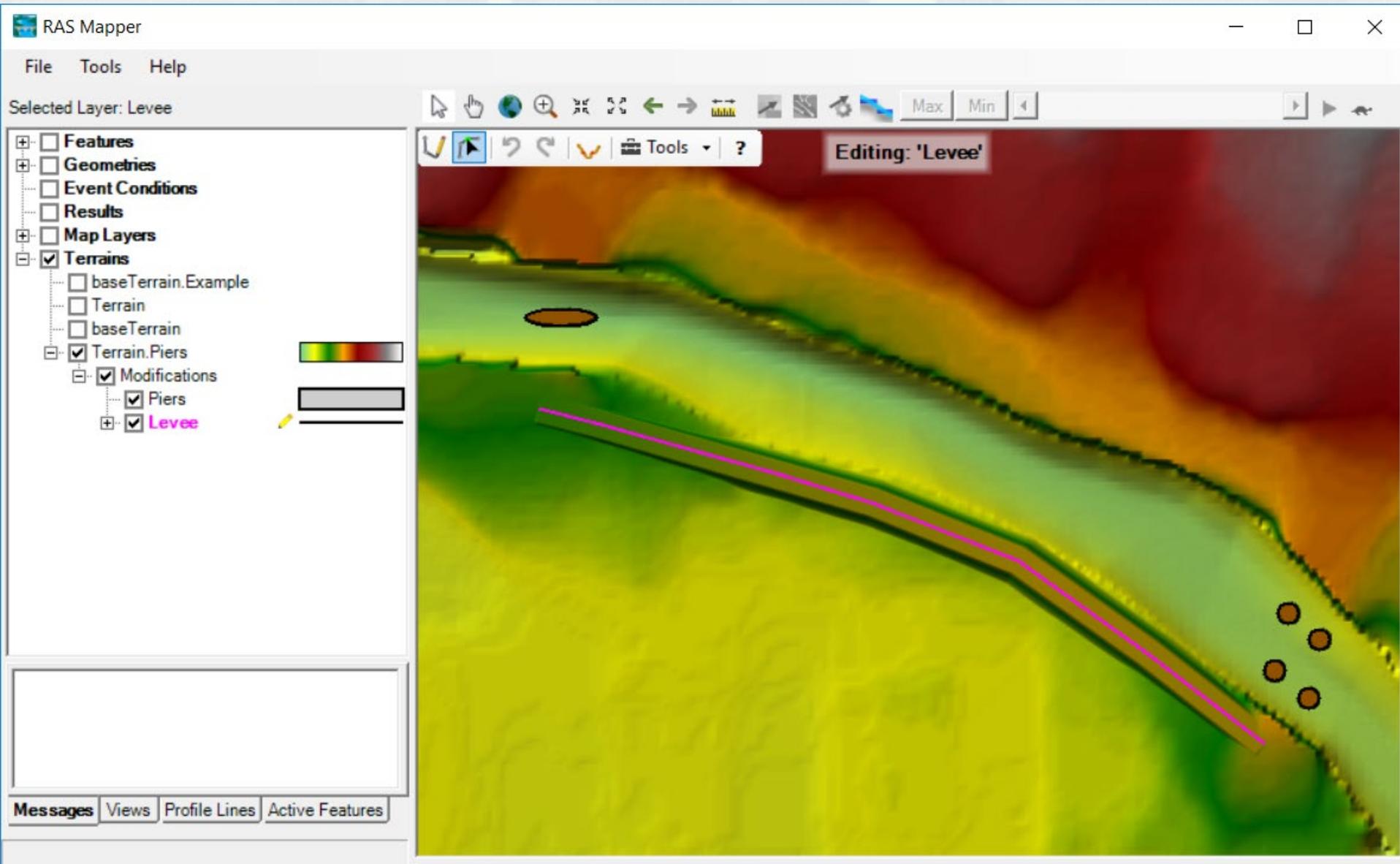
Rotation Angle (Degrees):

OK

Messages Views Profile Lines Active Features

(406355.85, 1804969.02 1 pixel = 1.25 feet)

Lines – High Ground



Lines – High Ground

Ground Line Editor

Name (Optional):

Modification Type:

Top Width:

Left Side Slope (H:V):

Right Side Slope (H:V):

Lateral Extent Limits:

Snapping Tolerance:

Polyline Length: 1161.64 (ft)

Station-Elevation

	X	Y
▶ 1	407417.38768188...	1804497.9113489...
2	407251.73357862...	1804628.6909041...
3	407065.73598900...	1804762.3766717...
4	406859.39491302...	1804846.65682952
5	406722.80293314...	1804887.3438022...
6	406469.962459758	1804959.9991106...
7	406379.86987728...	1804983.2488093...
*		

Plot

XS View

Plot | **Table**

Profile Plot

OK Cancel

Lines – Elevation Control Points

The screenshot displays the RAS Mapper software interface. The main window shows a terrain map with a color-coded elevation scale (green to red). A brown line representing a levee is drawn across the map. Several purple dots, representing elevation control points, are placed along the levee. A dialog box titled "Elevation Needed" is open, prompting the user to "Enter the elevation for this elevation point". The input field contains the value "941". The dialog box has "OK" and "Cancel" buttons. The software interface includes a menu bar (File, Tools, Help), a toolbar with various navigation and editing tools, and a layer list on the left. The layer list shows the following structure:

- Selected Layer: Control Points
- Features
- Geometries
- Event Conditions
- Results
- Map Layers
- Terrains
 - baseTerrain.Example
 - Terrain
 - baseTerrain
 - Terrain.Piers
 - Modifications
 - Piers
 - Levee
 - Control Points

The status bar at the bottom left shows the coordinates (406823.17, 1804841.66) and the scale (1 pixel = 2.12 feet).

Lines – Elevation Control Points

Ground Line Editor [Close]

Name (Optional):

Modification Type:

Top Width:

Left Side Slope (H:V):

Right Side Slope (H:V):

Lateral Extent Limits:

Snapping Tolerance:

Polyline Length: 1161.64 (ft)

Station-Elevation | X,Y Data

	Station	Elevation
1	0	943
2	143.51341941785...	944
3	269.12608846422...	944
▶ 4	400	942.5
5	800	942.5
6	823.32691655262...	941
7	970.59058152351...	941
8	1161.6400146484...	941
*		

Plot

XS View

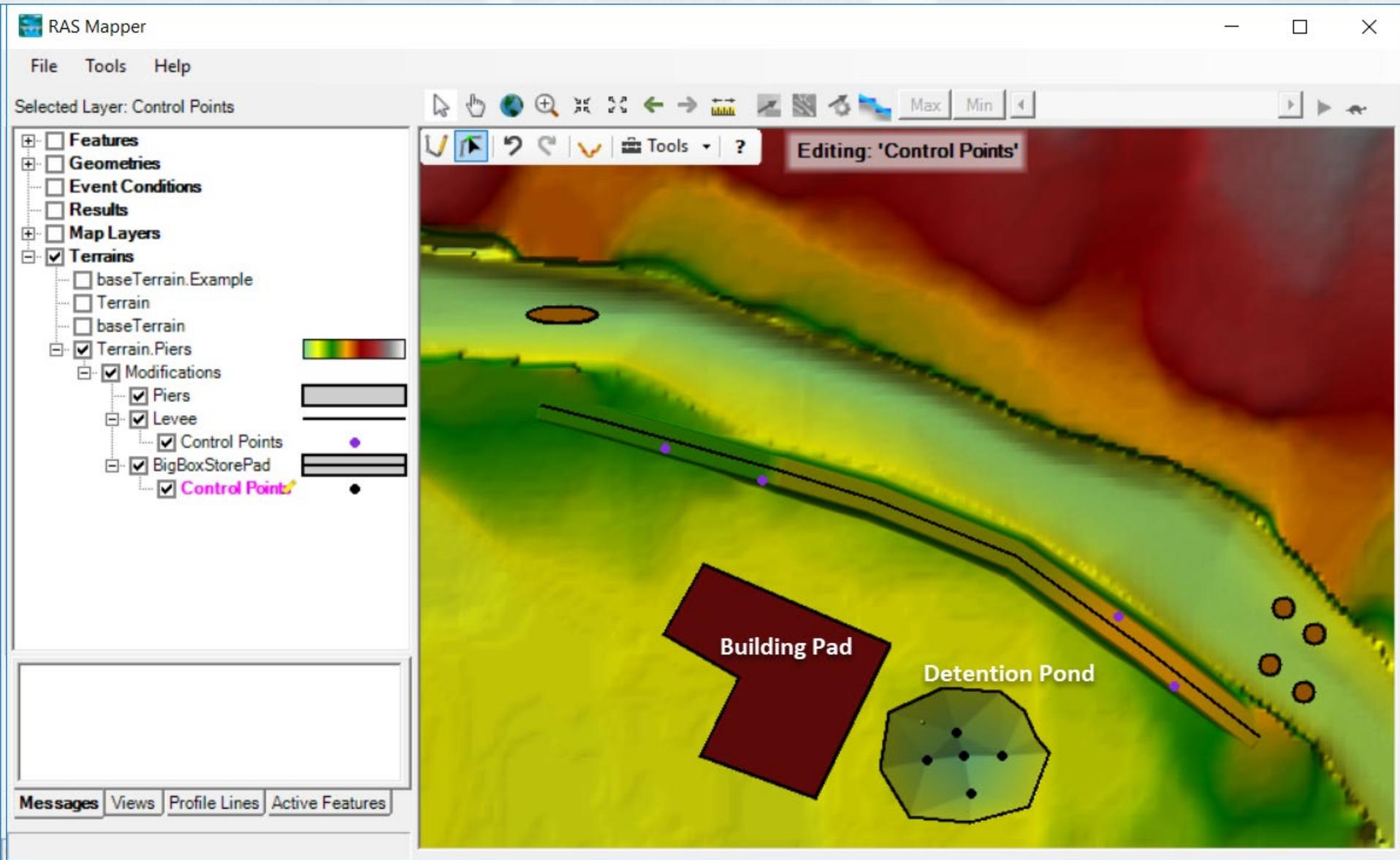
Station [feet]

Plot | **Table**

Profile Plot

Station [feet]

Polygons



XS Elevation Update

- Update of Cross Sections using Elevation Point Data.
- Allows for merging of bathymetric survey data and LiDAR data collection.
- Important for mobile bed river systems.
- Easy method for combining point data without requiring use of GIS.



Elevation Update

The screenshot displays the RAS Mapper interface. The 'Selected Layer: Cross Sections' is active. A context menu is open over the 'Cross Sections' layer in the layer list, with the 'Update' option selected. This opens a sub-menu with the following options:

- All XS Attributes Below (116 of 116)
- River Stations
- Bank Stations
- Reach Lengths
- Elevation Profiles from Terrain
- Elevation Profiles from Points** (highlighted by the mouse)
- Set Manning's n (DEBUG)
- Extract Manning's n (DEBUG)

The map area shows a river channel with elevation contours. Several numerical labels are visible on the map, indicating elevation values: 129126, 129992.8, 129902.8, and 128585.5. The interface includes a menu bar (File, Tools, Help), a toolbar with navigation and editing tools, and a status bar at the bottom with tabs for Messages, Views, Profile Lines, and Active Features.

Elevation Update Editor

Cross Section Update by Elevation Points

Elevation Point Layer:

Update Cross Sections:

Selected Area Edits

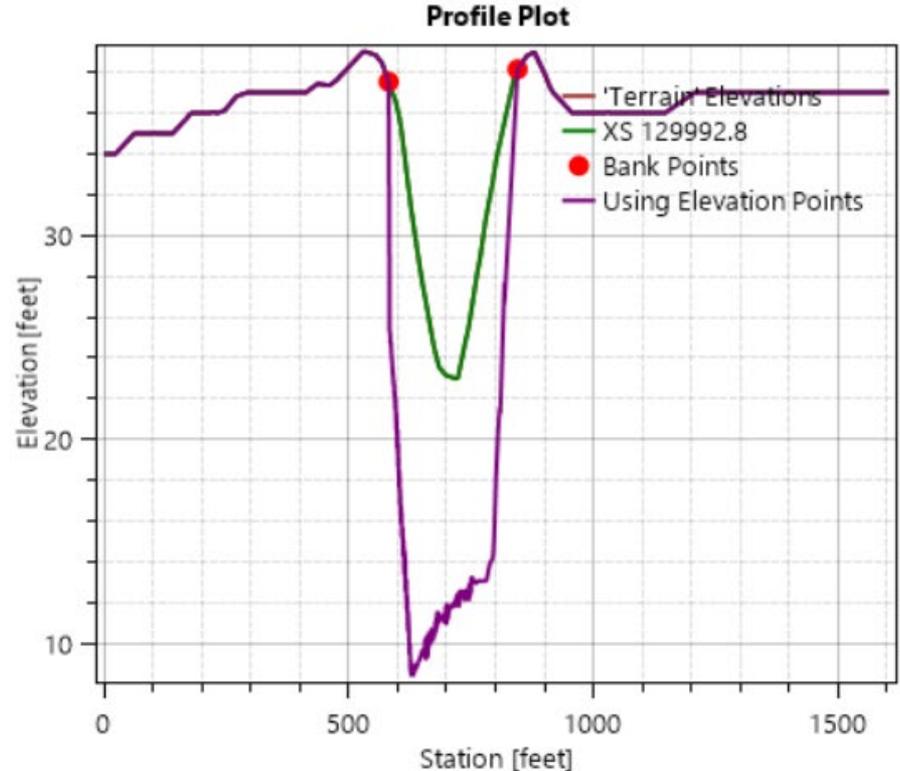


	River	Reach	RS	Elev Pt Tol (ft)	#Points	Update
▶ 1	Sacramento	Main	129992.8	100	187	<input checked="" type="checkbox"/>
2	Sacramento	Main	129902.8	100	195	<input checked="" type="checkbox"/>
3	Sacramento	Main	129126	100	88	<input checked="" type="checkbox"/>
4	Sacramento	Main	128585.5	100	92	<input checked="" type="checkbox"/>
5	Sacramento	Main	127252.7	100	122	<input checked="" type="checkbox"/>
6	Sacramento	Main	125931.5	100	114	<input checked="" type="checkbox"/>
7	Sacramento	Main	124679.7	100	104	<input checked="" type="checkbox"/>
8	Sacramento	Main	123372.7	100	125	<input checked="" type="checkbox"/>
9	Sacramento	Main	122044.5	100	106	<input checked="" type="checkbox"/>
10	Sacramento	Main	120729.1	100	119	<input checked="" type="checkbox"/>
11	Sacramento	Main	119404.5	100	107	<input checked="" type="checkbox"/>
12	Sacramento	Main	118104.7	100	236	<input checked="" type="checkbox"/>
13	Sacramento	Main	116750.2	100	121	<input checked="" type="checkbox"/>
14	Sacramento	Main	115661.4	100	118	<input checked="" type="checkbox"/>
15	Sacramento	Main	113070.7	100	143	<input checked="" type="checkbox"/>
16	Sacramento	Main	111993.1	100	108	<input checked="" type="checkbox"/>
17	Sacramento	Main	110681.8	100	133	<input checked="" type="checkbox"/>
18	Sacramento	Main	109379.1	100	119	<input checked="" type="checkbox"/>

Zoom to Selected XS

Export Points Used

Plot | Table



Update Cross Sections

Elevation Update Editor

Cross Section Update by Elevation Points

Elevation Point Layer: Update Cross Sections:

Selected Area Edits

	River	Reach	RS	Elev Pt Tol (ft)	#Points	Update
1	Sacramento	Main	129992.8	100	187	<input checked="" type="checkbox"/>
2	Sacramento	Main	129902.8	50	93	<input checked="" type="checkbox"/>
3	Sacramento	Main	129126	100	88	<input checked="" type="checkbox"/>
4	Sacramento	Main	128585.5	100	92	<input checked="" type="checkbox"/>
5	Sacramento	Main	127252.7	100	122	<input checked="" type="checkbox"/>
6	Sacramento	Main	125931.5	100	114	<input checked="" type="checkbox"/>
7	Sacramento	Main	124679.7	100	104	<input checked="" type="checkbox"/>
8	Sacramento	Main	123372.7	100	125	<input checked="" type="checkbox"/>
9	Sacramento	Main	122044.5	100	106	<input checked="" type="checkbox"/>
10	Sacramento	Main	120729.1	100	119	<input checked="" type="checkbox"/>
11	Sacramento	Main	119404.5	100	107	<input checked="" type="checkbox"/>
12	Sacramento	Main	118104.7	100	236	<input checked="" type="checkbox"/>
13	Sacramento	Main	116750.2	100	121	<input checked="" type="checkbox"/>

Zoom to Selected XS

Plot | Table

Profile Plot

Elevation [feet]

Station [feet]

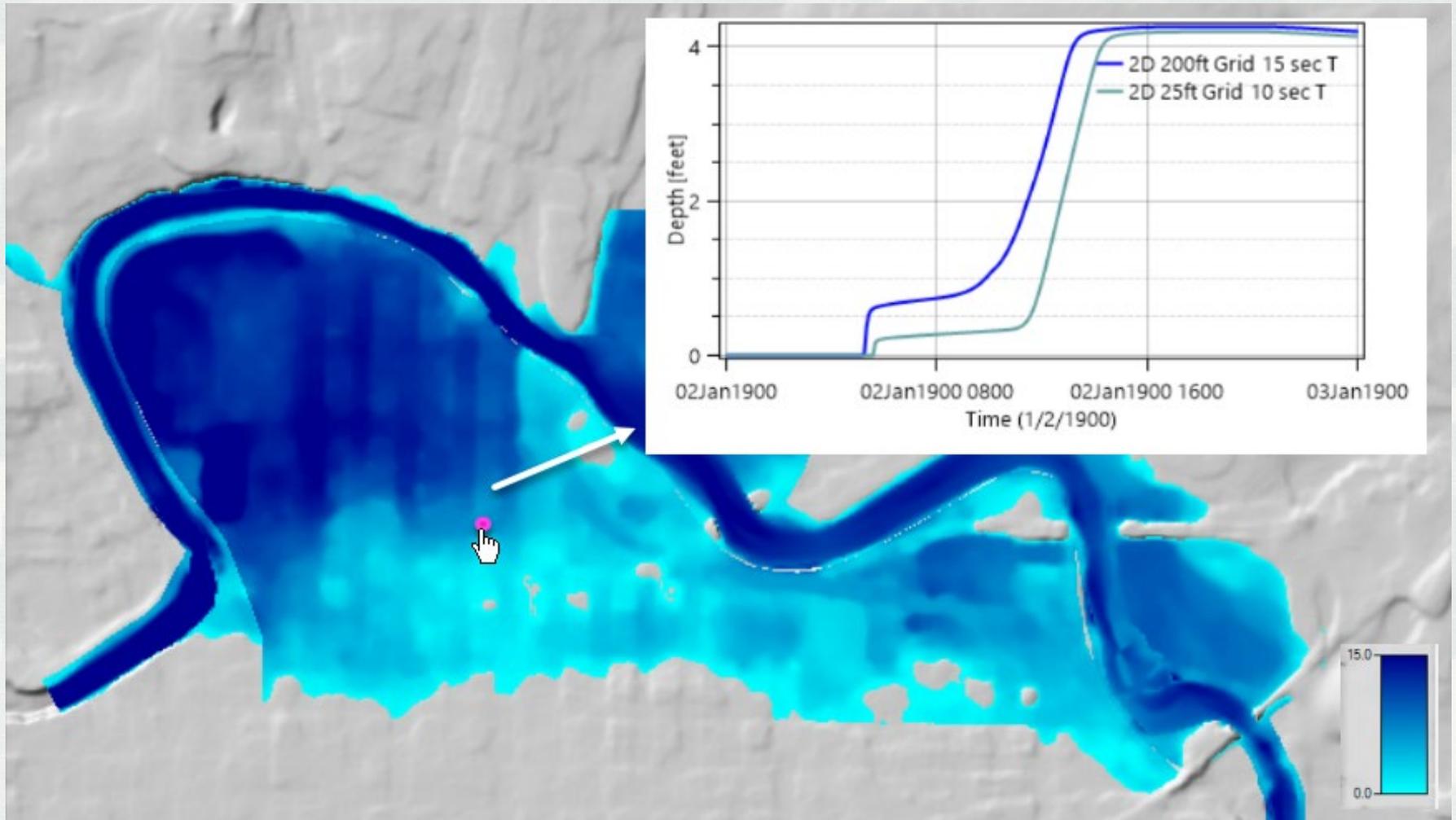
Legend:

- Terrain Elevations
- XS 129902.8
- Bank Points
- Using Elevation Points

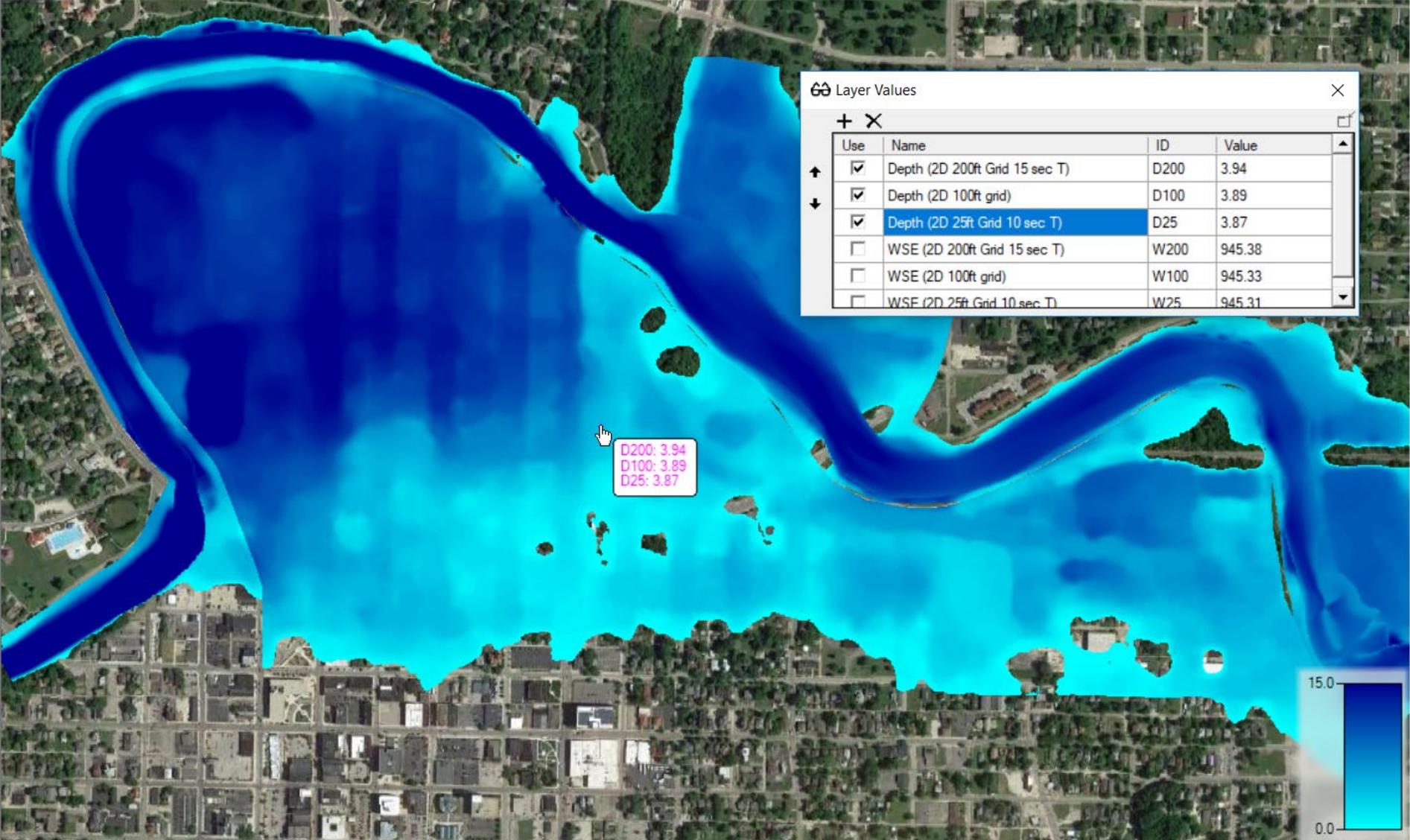
Update Cross Sections

Editing: 'Cross Sections'

Results Analysis



Layer Watch List



Use	Name	ID	Value
<input checked="" type="checkbox"/>	Depth (2D 200ft Grid 15 sec T)	D200	3.94
<input checked="" type="checkbox"/>	Depth (2D 100ft grid)	D100	3.89
<input checked="" type="checkbox"/>	Depth (2D 25ft Grid 10 sec T)	D25	3.87
<input type="checkbox"/>	WSE (2D 200ft Grid 15 sec T)	W200	945.38
<input type="checkbox"/>	WSE (2D 100ft grid)	W100	945.33
<input type="checkbox"/>	WSE (2D 25ft Grid 10 sec T)	W25	945.31

D200: 3.94
D100: 3.89
D25: 3.87



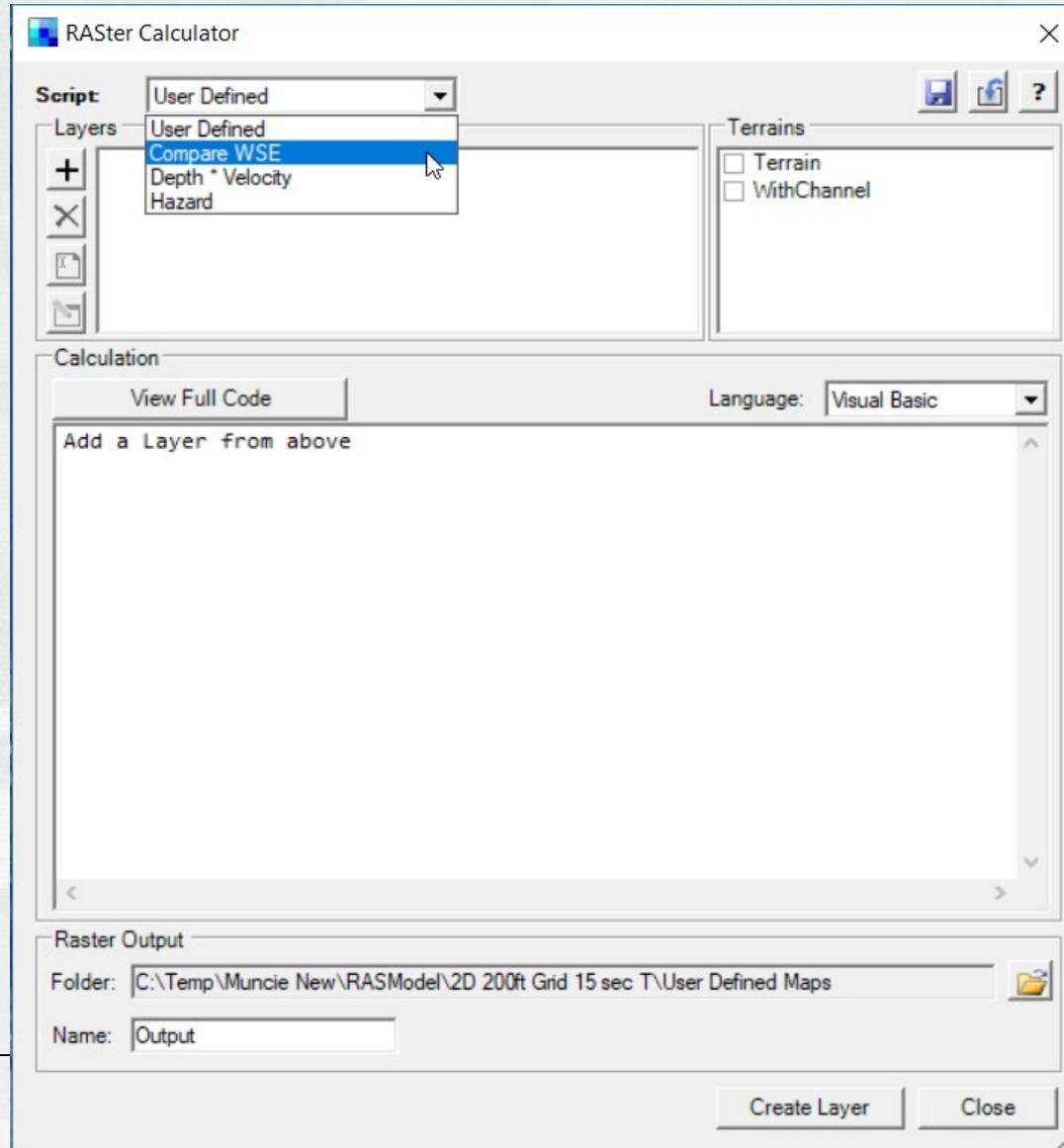
RAStEr Calculator

- The RAStEr Calculator is intended to allow users to perform mathematical and logical operations on HEC-RAS spatial results.
- User-defined variables are used in scripts to evaluate raster data.
- Variables defined by
 - ▶ Plan, Map Type, Animation Behavior, Profile
- Scripts can be saved/loaded



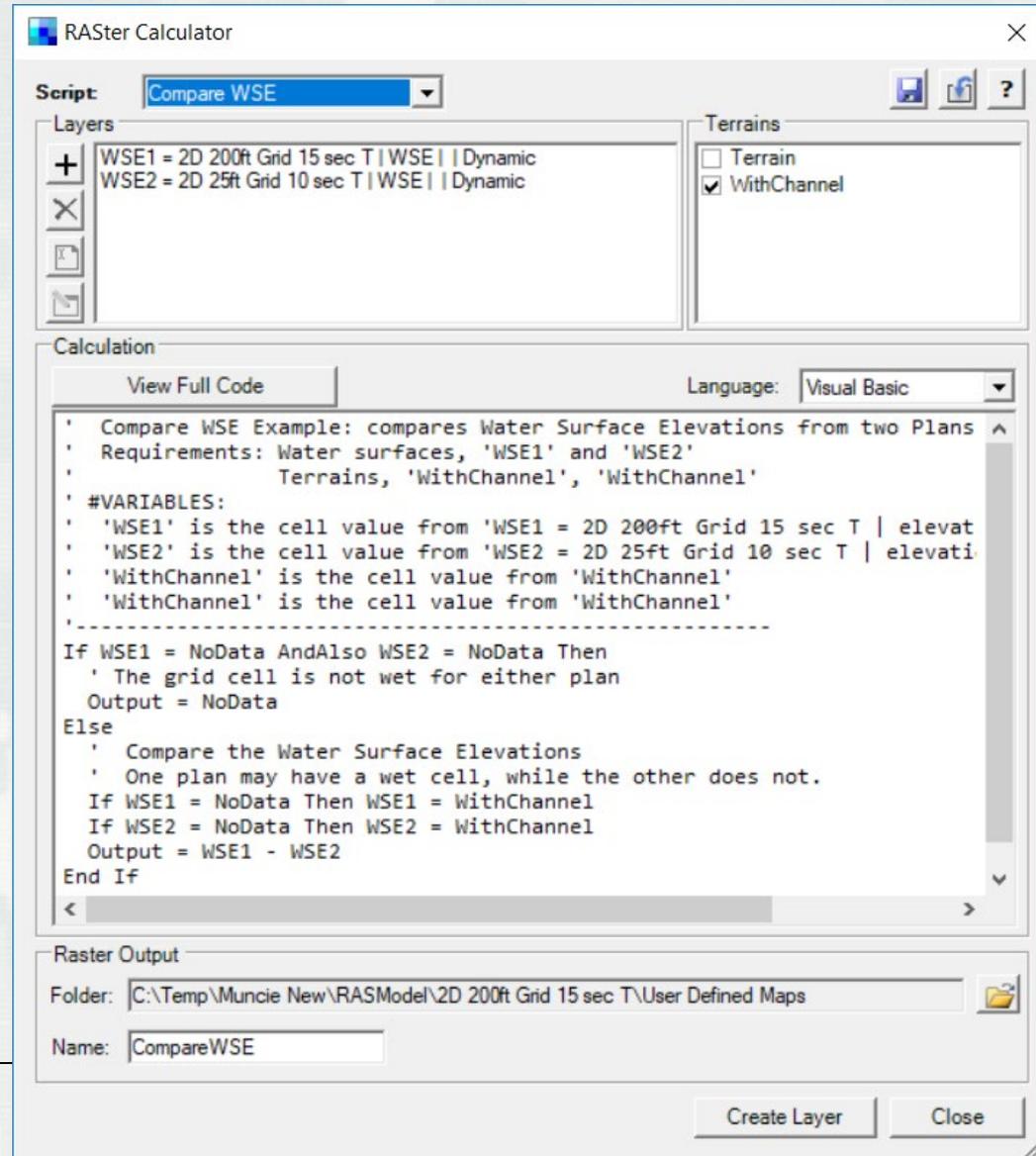
RAStEr Calculator

- Scripts
- Save/Load
- Variable Definition (Layers)
- Code



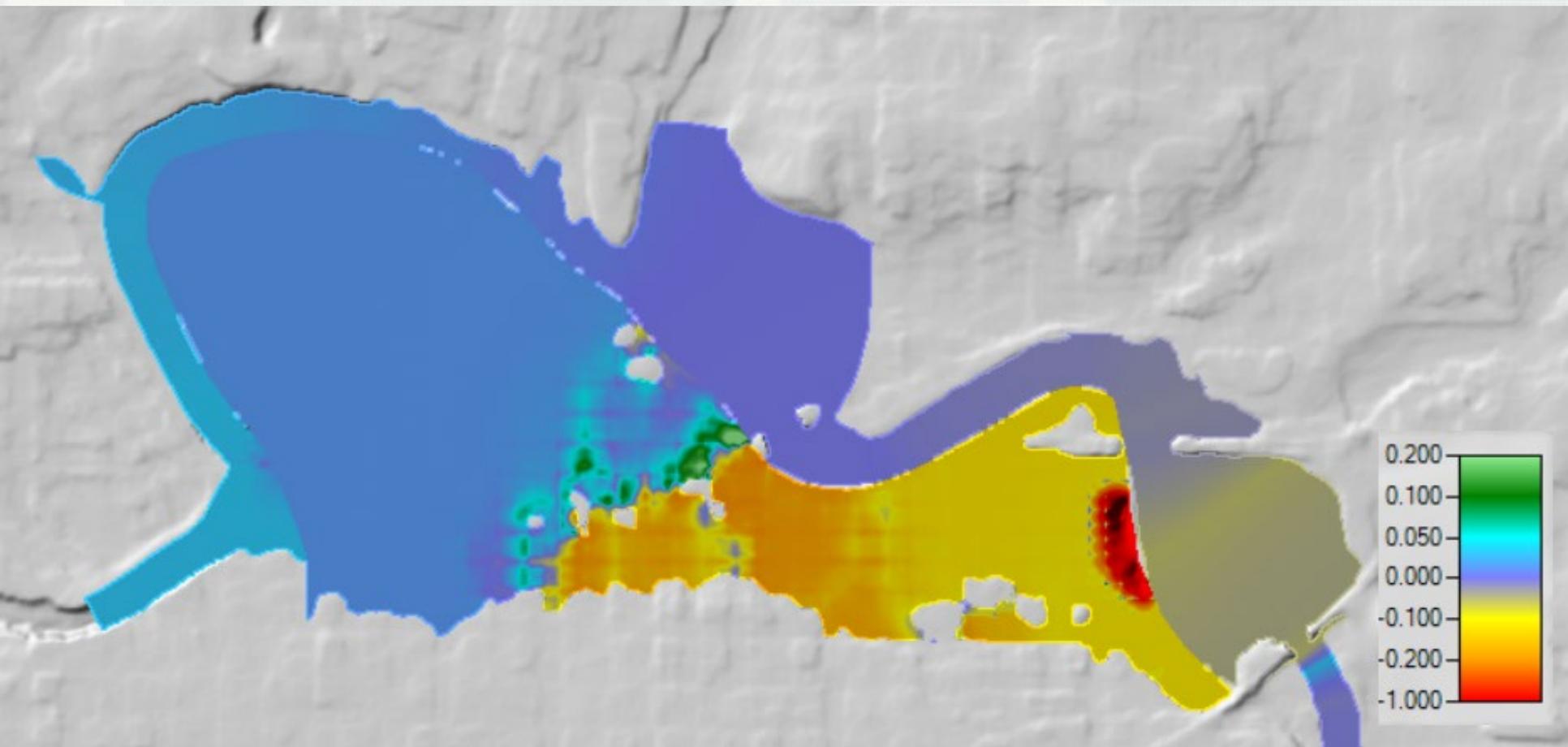
RAStEr Calculator

- Predefined Scripts
 - ▶ Compare WSE
 - ▶ Depth*Velocity
 - ▶ Hazard



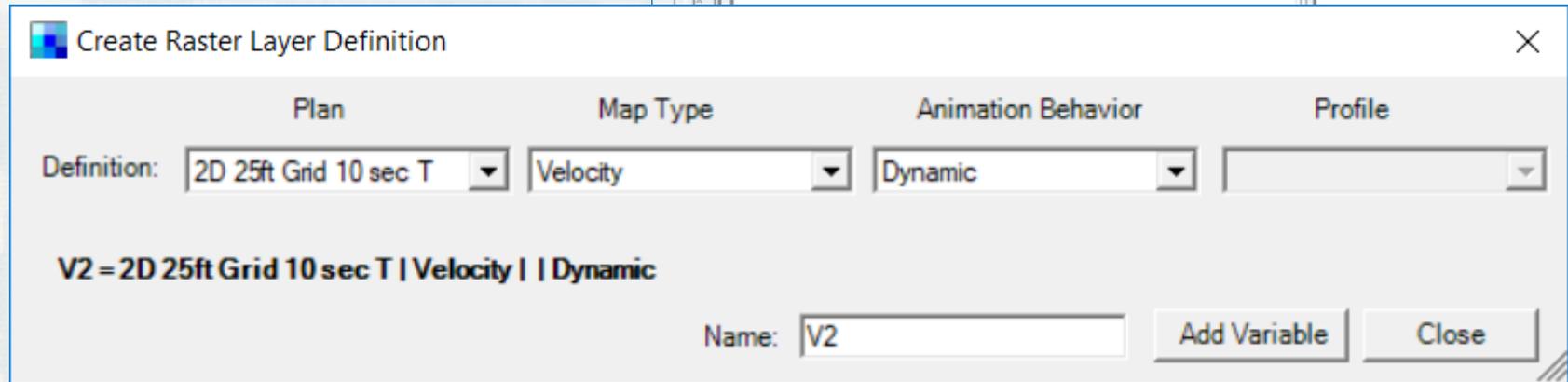
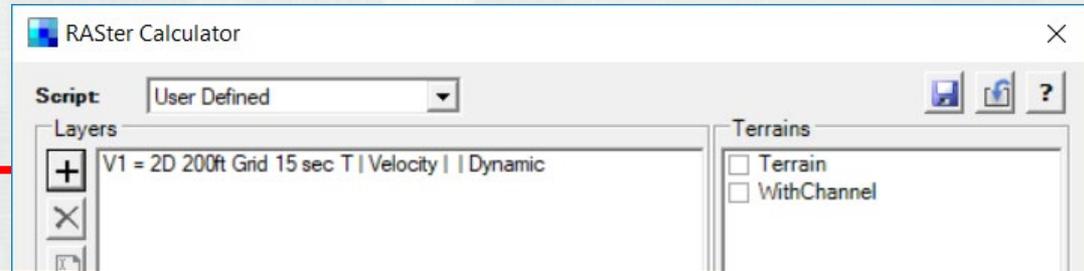
Water Surface Elevation Comparison

- Levee Breach WSE: WSE_Mesh200ft - WSE_Mesh25ft

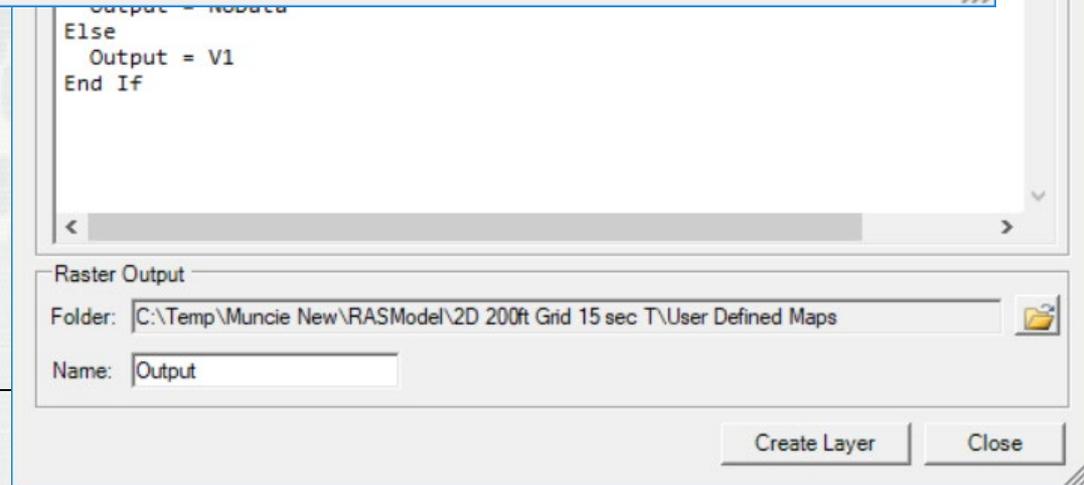


Velocity Comparison Example

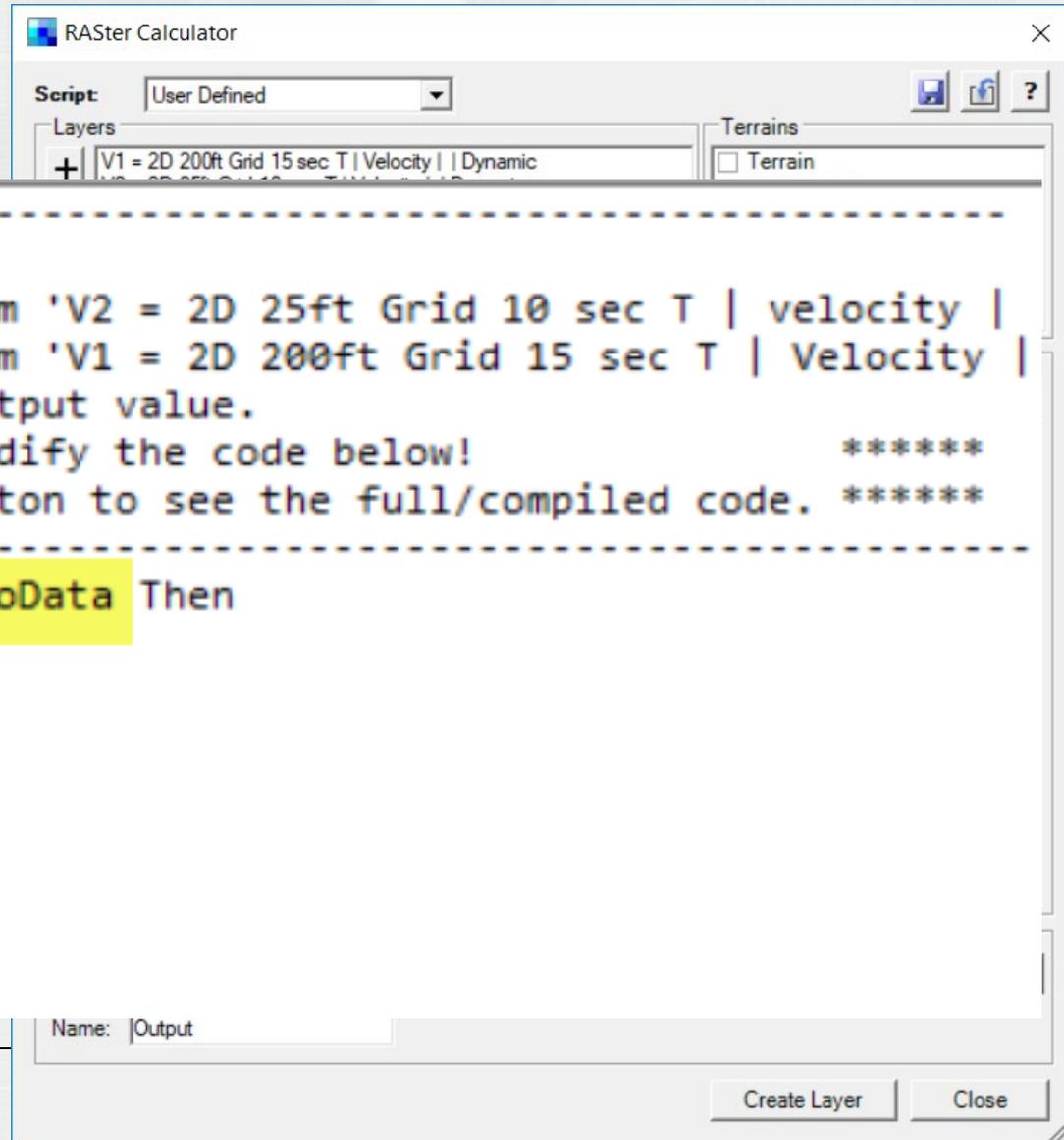
1. Add a Layer 1



2. Add Layer 2



Velocity Comparison Example



The screenshot shows the RASter Calculator window with a script for a velocity comparison. The script is as follows:

```
'-----  
' #VARIABLES:  
' 'V2' is the cell value from 'V2 = 2D 25ft Grid 10 sec T | velocity |  
' 'V1' is the cell value from 'V1 = 2D 200ft Grid 15 sec T | Velocity |  
' 'Output' is the desired output value.  
'***** Write/Modify the code below! *****  
'***** Use the View Code button to see the full/compiled code. *****  
'-----  
If V1 = NoData AndAlso V2 = NoData Then  
    Output = NoData  
Else  
If V1 = NoData Then V1 = 0  
If V2 = NoData Then V2 = 0  
    Output = V1 - V2  
End If
```

The calculator interface includes a 'Script' dropdown menu set to 'User Defined', a 'Layers' list with a '+' button and the entry 'V1 = 2D 200ft Grid 15 sec T | Velocity | | Dynamic', and a 'Terrains' section with a checkbox for 'Terrain'. At the bottom, there is a 'Name:' field containing 'Output' and two buttons: 'Create Layer' and 'Close'.

Velocity Comparison Example

The screenshot displays the RAS Mapper interface. The main window shows a map of a river system with a velocity comparison overlay. The overlay uses a color scale from blue (-2.00) to red (2.00) to represent velocity differences. A context menu is open over the 'DeltaV' layer, listing various actions such as 'Export Layer', 'Export Raster', and 'Export Values to Point Shapefile (DEBUG)'. The 'Export Raster' option is currently selected. The interface includes a menu bar (File, Tools, Help), a toolbar with navigation and tool icons, and a layer list on the left. The layer list shows 'DeltaV' as the selected layer. The bottom status bar includes 'Messages', 'Views', 'Profile Lines', 'Active Features', and 'Layer'.

Selected Layer: DeltaV

Selected: 'DeltaV'

Max

2.00

0.00

-2.00

- Image Display Properties
- Image Info ...
- Edit Script (DEBUG)
- Clone Calculated Layer (DEBUG)
- Zoom to Layer
- Add Watch to Layer Values
- Remove Layer
- Move Layer
- Export Layer
 - Export current image to TIF
 - Export current image to JPEG
 - Export Values to Point Shapefile (DEBUG)
 - Create Contour Polygon Bands (DEBUG)
 - Warp (DEBUG)
 - Export Raster
 - Export Raster Using Screen Extent
- Open Containing Folder

Messages Views Profile Lines Active Features Layer

RAStEr Calculator

- Code Compiler Check

```
Code Compiler Check

The Code Compiled Successfully!

0 Imports System
1 Imports System.Linq
```

```
The Code did NOT compile successfully!

Number of Errors Found: 3
Line 33: 'If' must end with a matching 'End If'.
Line 34: 'No' is not declared. It may be inaccessible due to its protection level.
Line 34: End of statement expected.

0 Imports System
1 Imports System.Linq
```

```
' -----
' #VARIABLES:
' 'V2' is the cell value from 'V2 = 2D 25ft Grid 10 sec T | velocity |
' 'V1' is the cell value from 'V1 = 2D 200ft Grid 15 sec T | Velocity |
' 'Output' is the desired output value.
'***** Write/Modify the code below! *****
'***** Use the View Code button to see the full/compiled code. *****
' -----

If V1 = NoData AndAlso V2 = NoData Then
    Output = NoData
Else
If V1 = No Data Then V1 = 0
If V2 = NoData Then V2 = 0
    Output = V1 - V2
End If
```

```
29 ' -----
30 If V1 = NoData AndAlso V2 = NoData Then
31     Output = NoData
32 Else
33 If V1 = No Data Then V1 = 0
34 If V2 = NoData Then V2 = 0
35     Output = V1 - V2
36 End If
37
38 #ENDSCRIPT:
```



Scripting Help

- Use, Syntax, and Examples

The image shows three overlapping windows of the RASter Calculator Help system. The windows are titled "RASter Calculator Help" and contain a table of contents on the left and a code example on the right.

Window 1 (Leftmost): Shows the "Overview" section with a table of contents:

- Overview
- +, -, *, /
- If ... Then ... Else
- Math Functions
- Logical Operators
- NoData
- Save, Load
- Compare WSE Example
- Hazard Example
- Delta WSE Example

Window 2 (Middle): Shows the "Logical Operators" section selected in the table of contents:

- Overview
- +, -, *, /
- If ... Then ... Else
- Math Functions
- Logical Operators
- NoData
- Save, Load
- Compare WSE Example
- Hazard Example
- Delta WSE Example

Window 3 (Rightmost): Shows the "Hazard Classification Example" section selected in the table of contents. The code example is as follows:

```
Hazard Classification Example

' This is an example for computing the human hazard due to
' water Depth And Velocity. Criteria are in m and m/s
' Constants are used for readability to categorize the hazard.
' Green = LOW Hazard
' Yellow = Moderate Hazard
' Red = Extreme Hazard

' d Is the layer of water Depth.
' v Is the layer of water Velocity.

Const GREEN as Single = 0
Const YELLOW as Single = 1
Const RED as Single = 2

If d = NoData OrElse v = NoData Then
  Output = NoData
Else
  ' Conversion to metric (assuming RAS run is in ft units)
  d = d * 0.3048
  v = v * 0.3048
  ' Evaluation of early exits for bounds
  If d > 1.2 Then
    ' Extreme Hazard upper Depth bound
    Output = RED
  ElseIf v > 3.0 Then
```

Visualization in Google Earth



3D KML Export

The image shows the RAS Mapper software interface. On the left, a tree view displays the project structure under 'Results', 'Map Layers', and 'Terrains'. The 'Inundation Boundary (Max Value_0)' layer is selected. A context menu is open over the map, with 'Export Layer' selected, and a sub-menu showing 'Save Inundation to 3D KML' as the active option. On the right, the '3D KML Export' dialog box is open, showing the filename 'Iel\2D 200ft Grid 15 sec T\Inundation Boundary (Max Value_0).kmz'. The 'Inundation Polygon Options' section includes 'Boundary Polygon Filter Tolerance (ft): 1', 'Interior Polygon (Cell) Size (ft): 40', and 'Number of Decimal Places: 1'. The 'Google Earth Options' section includes 'Interior Polygon Values: Sloping WSE' and 'Water Surface Plotting Method: Depths Relative To Ground'. There is an unchecked checkbox for 'Keep Intermediate Shapefile' and 'OK' and 'Cancel' buttons at the bottom.

3D KML Export

Filename: Iel\2D 200ft Grid 15 sec T\Inundation Boundary (Max Value_0).kmz

Inundation Polygon Options

Boundary Polygon Filter Tolerance (ft): 1

Interior Polygon (Cell) Size (ft): 40

Number of Decimal Places: 1

Google Earth Options

Interior Polygon Values: Sloping WSE

Water Surface Plotting Method: Depths Relative To Ground

Keep Intermediate Shapefile

OK Cancel

Context Menu:

- Layer Properties
- Open Attribute Table
- Edit Map Parameters
- Compute/Update Stored Map (Map files up to date.)
- Zoom to Layer
- Add Watch to Layer Values
- Remove Layer
- Move Layer
- Export Layer
 - Save Features to Shapefile
 - Save Features to KML
 - Save Inundation to 3D KML
 - Filtered Polygons
 - Exploded Polygons
- Open Containing Folder
- Copy All Features

Parameters/Options – Output File

- KMZ file
- Filter – Boundary
- Polygon Size
- Decimal Places

3D KML Export

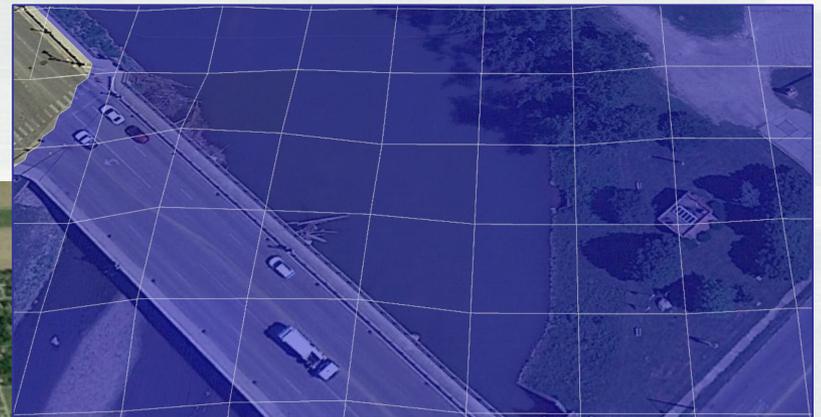
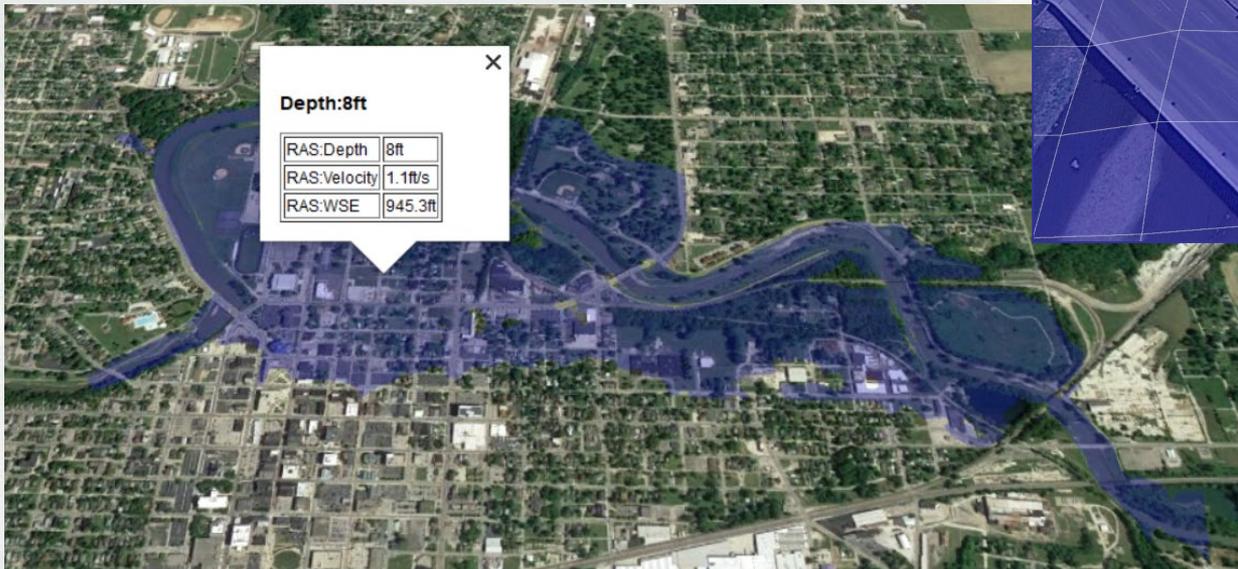
Filename: |e|\2D 200ft Grid 15 sec T\Inundation Boundary (Max Value_0).kmz 

Inundation Polygon Options

Boundary Polygon Filter Tolerance (ft):

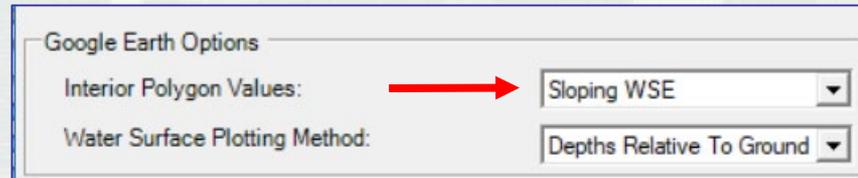
Interior Polygon (Cell) Size (ft):

Number of Decimal Places: 

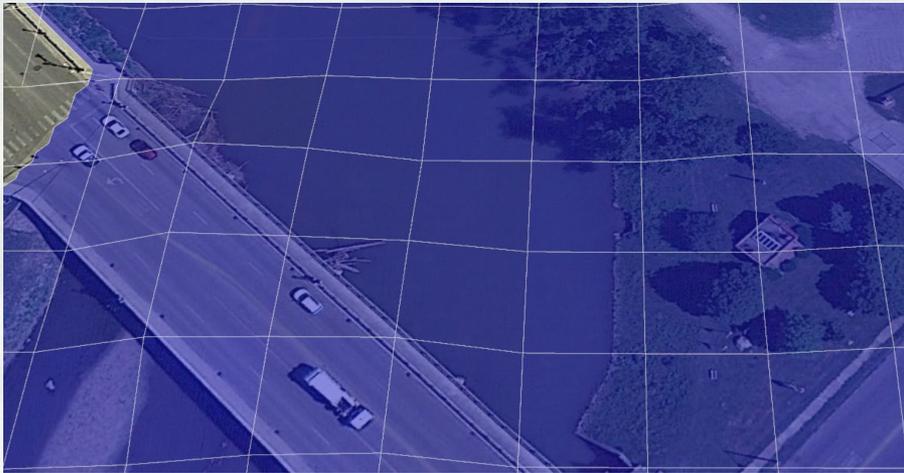


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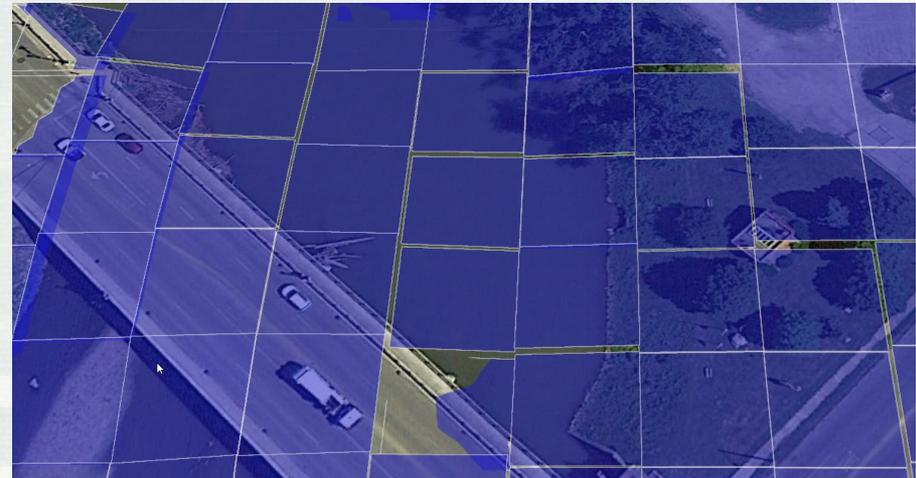
Parameters/Options – Polygon Values



- Sloping WSE

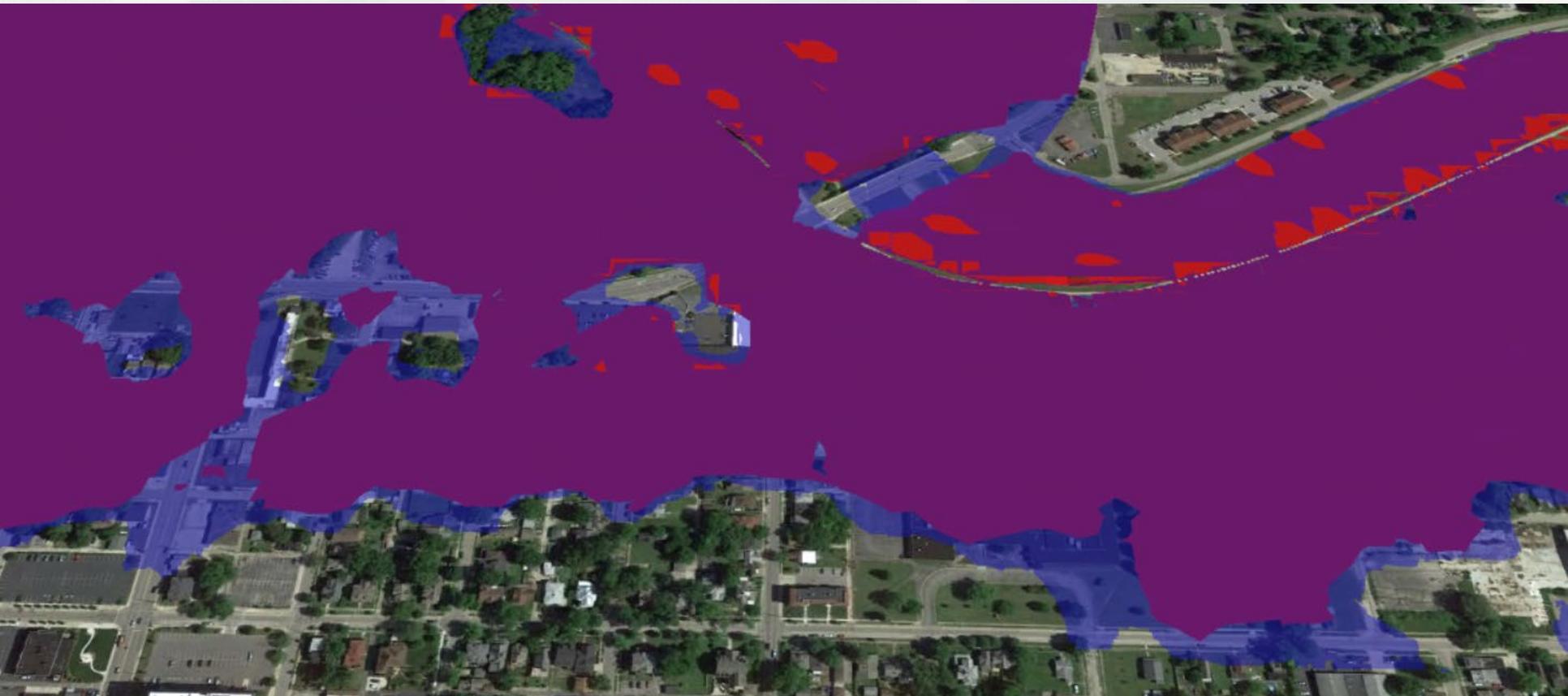
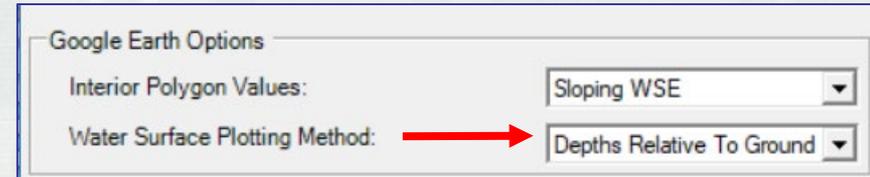


- Horizontal WSE



Parameters/Options – Plotting Method

- Depths Relative to Ground
- Computed WSE



Visualization in Google Earth Street View

- How bad is the flooding at your favorite Gas Station / BBQ joint?



Google Earth Visualization 3D Building



Summary

- Geospatial editing tools in HEC-RAS make modeling building and refinement more efficient.
- Terrain modification tools in HEC-RAS will improve the modeling process.
- RASter Calculator will simplify model evaluation for model improvement and refinement.
- RASter Calculator should result in more effective communication of model results.
- Google Earth export will allow visualization of model results to larger audience.

