



ILLINOIS STATE  
WATER SURVEY

PRAIRIE RESEARCH INSTITUTE

# HEC-GeoRAS Walkthrough Workshop

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# Welcome (Who is in the Audience?)

## Engineers

- HEC-RAS experts

## City Planners

## GIS Professionals

- GIS experts

## Flood Plain Managers

**Engineering + GIS = HEC-GeoRAS**



# Why Are We Here?

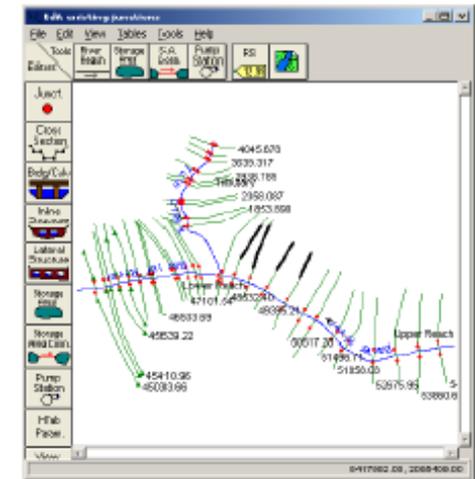
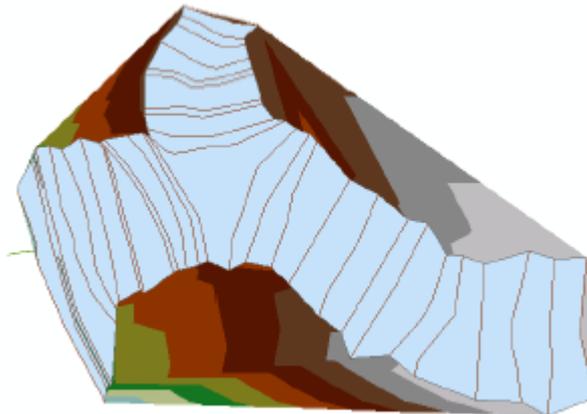
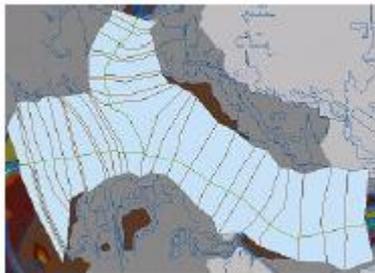


## Learn about:

- Data
- GIS
- Engineering
- Geo-RAS
- HEC-RAS
- TROUBLESHOOTING

## Geo-RAS Walkthrough

- Not a live DEMO
- Screenshots captured at each step



# Agenda

- Introduction to HEC-GeoRAS and Spatial Data
- Generating Required Data in HEC-GeoRAS
- HEC-GeoRAS to HEC-RAS
- Tools and Tips for modeling & managing spatial data in HEC-RAS
- HEC-RAS to HEC-GeoRAS
- Post Processing in GIS
- Additional HEC-GeoRAS capabilities (as time allows)

# Benefits of Using HEC-GeoRAS

- Spatial Relationships
  - Link input data, hydraulic modeling, and final floodplain mapping
- Better utilize detailed topographic information
  - Make use of LiDAR / survey data
  - Increase accuracy and precision in overbank
- Improve modeling efficiency
  - Quickly identify impacts of modeling changes and areas of concern
  - Utilize GIS staff to aid in model development and mapping
- Visualize results to improve model accuracy
  - Easily identify areas of basin interaction

# Software Requirements

- HEC-GeoRAS
  - HEC-GeoRAS 4.3.93 for use with ArcGIS 9.3
  - HEC-GeoRAS 10 for use with ArcGIS 10.0 (today's discussion)
  - HEC-GeoRAS 10.1 for use with ArcGIS 10.1 (just released)
- ArcGIS
  - Required Extensions
    - Spatial Analyst
    - 3D Analyst
- HEC-RAS
  - Full functionality of HEC-GeoRAS 4.3.93 requires HEC-RAS 4.0 or later
  - RAS Mapper Utility requires HEC-RAS 4.1.0

# Identify the Scope of Work

## Type \ Level of Analysis

- Regulatory Use
  - Detailed Floodplain Study
  - Approximate Floodplain Study
- Sediment Transport
- Research and Scientific Analysis

## Study *Extents*

- Upstream and downstream extents, tributaries, etc.
- Available data
- Access to survey data
- Metadata (digital data is useless without it!)

# Metadata, Metadata, Metadata

(We hate it until we need it)

## What is Metadata?

- Descriptive
- Data about data
- Content about content
- Data about content

## Why do you need Metadata?

- It answers questions about the integrity / quality of data used in modeling.
  - Where did it come from
  - Who created it
  - How was it created
  - When was it created
  - Why was it created
  - Who published the data
  - Was the data ever published
  - Did data go through a QA/QC process
  - What is the RMS \ Error

# Digital Data Creation - Flowchart

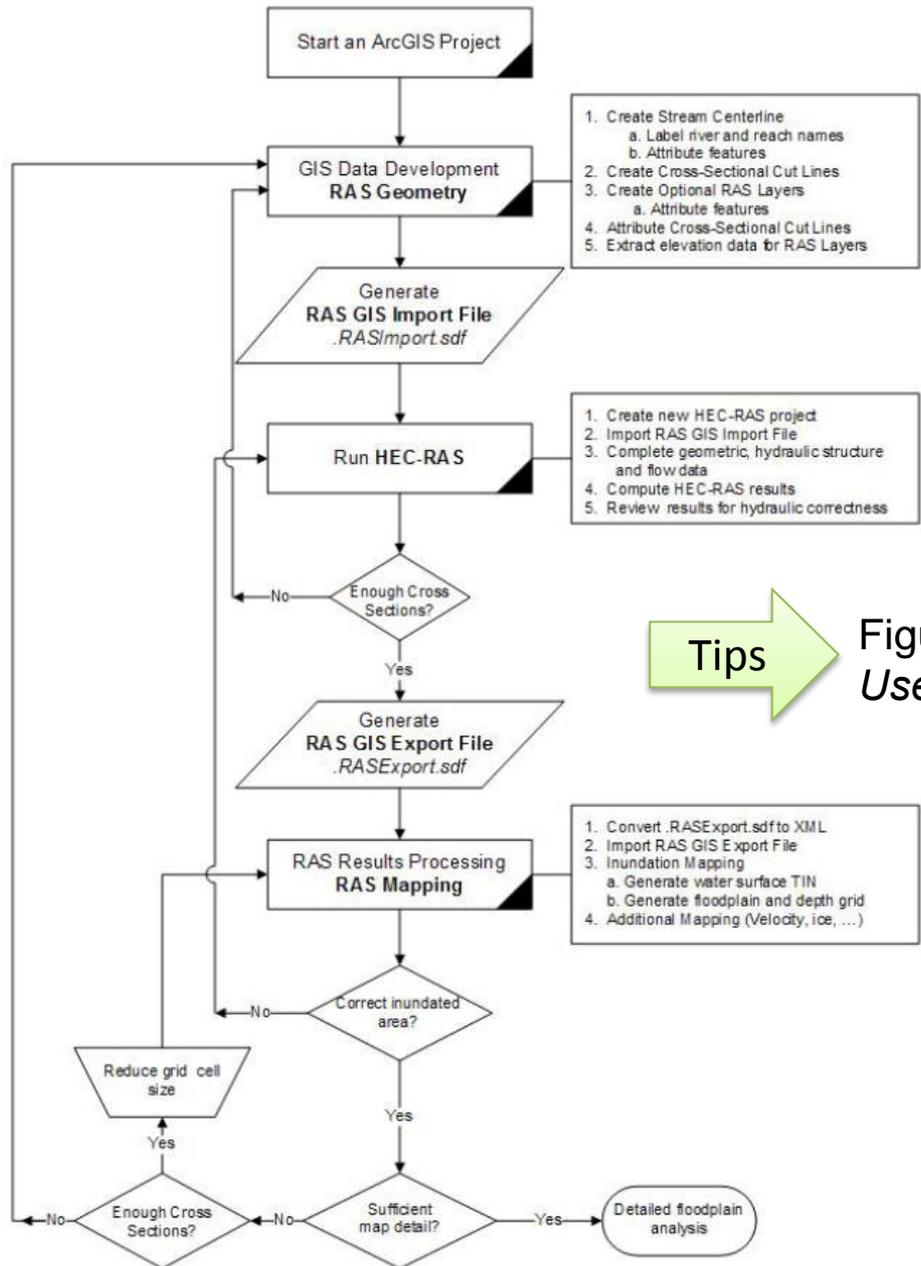


Figure 3-1 from *HEC-GeoRAS User's Manual v10*

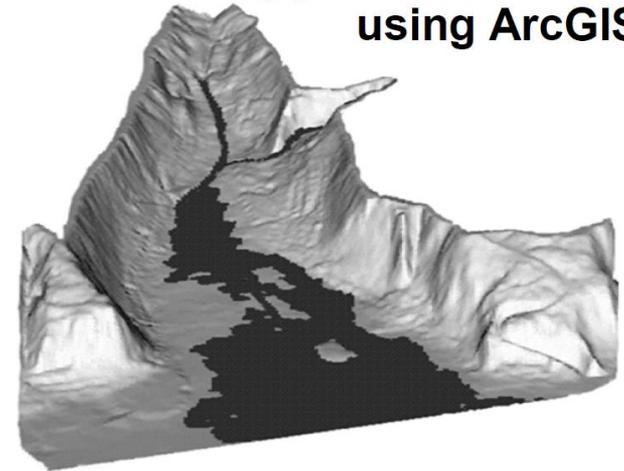
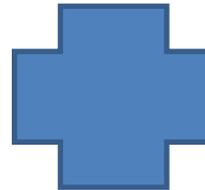
# GIS Geo-RAS Walkthrough



US Army Corps  
of Engineers  
Hydrologic Engineering Center

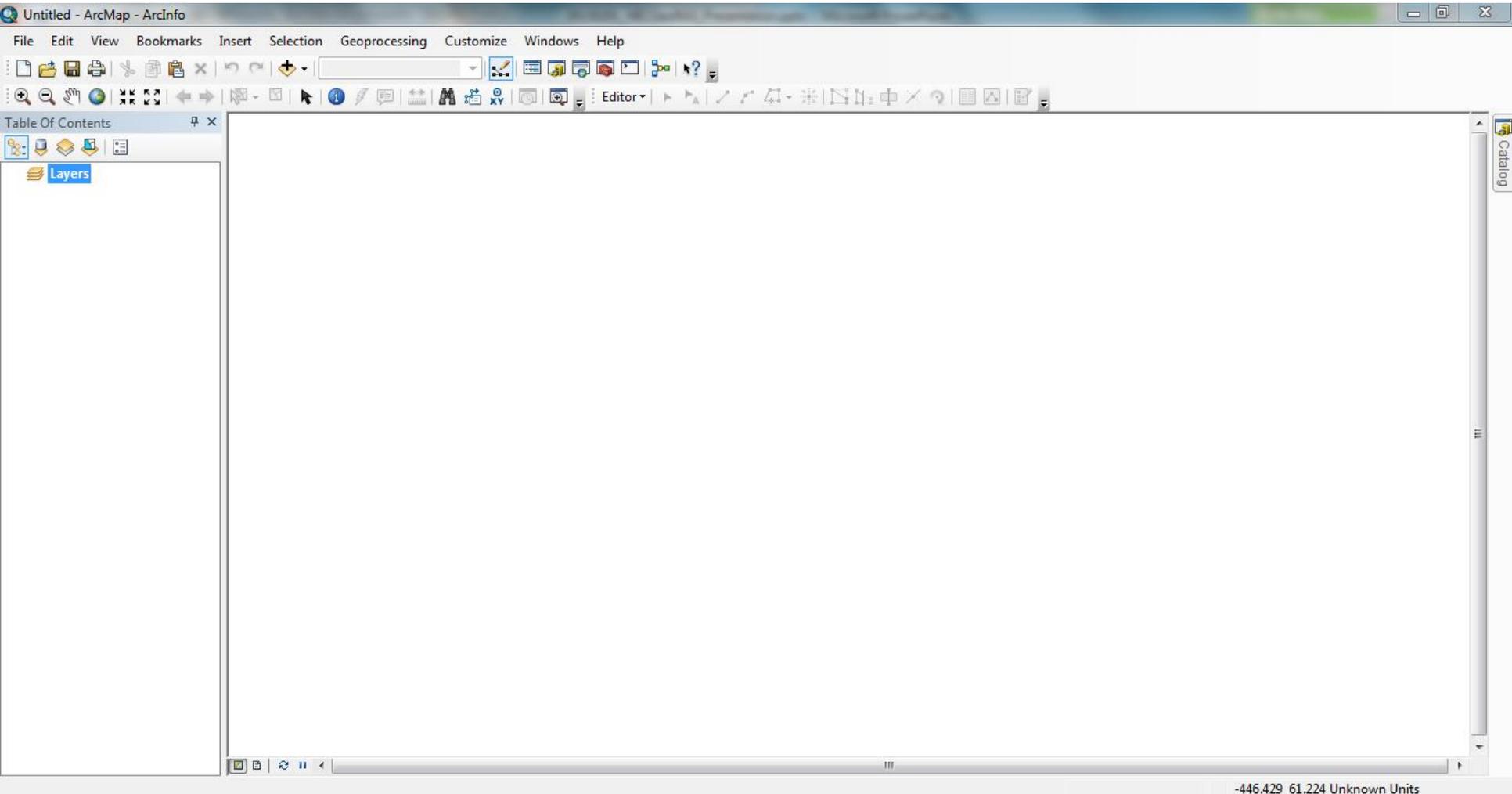


## HEC-GeoRAS GIS Tools for Support of HEC-RAS using ArcGIS®

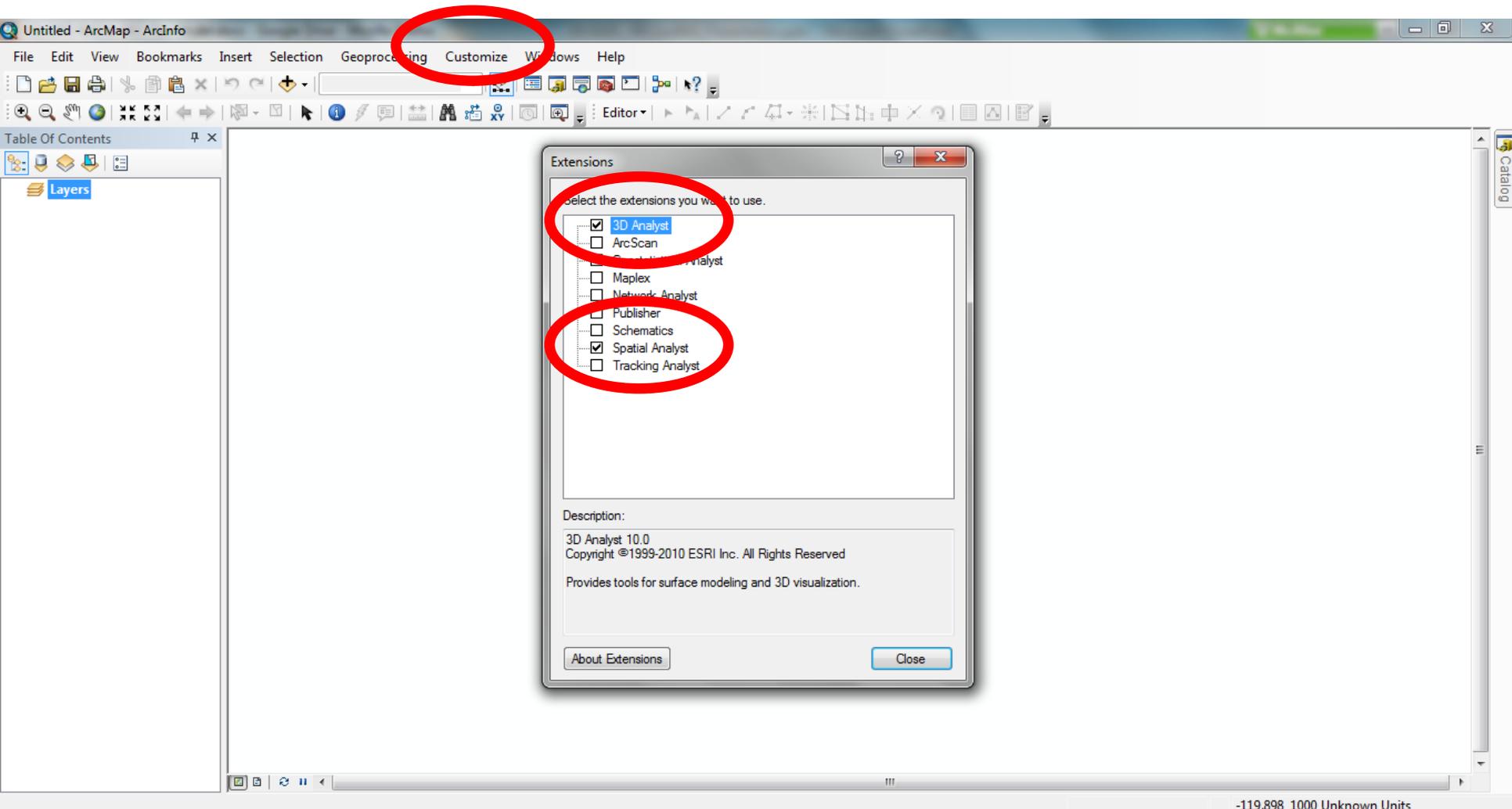


Version 10.0

# New MXD

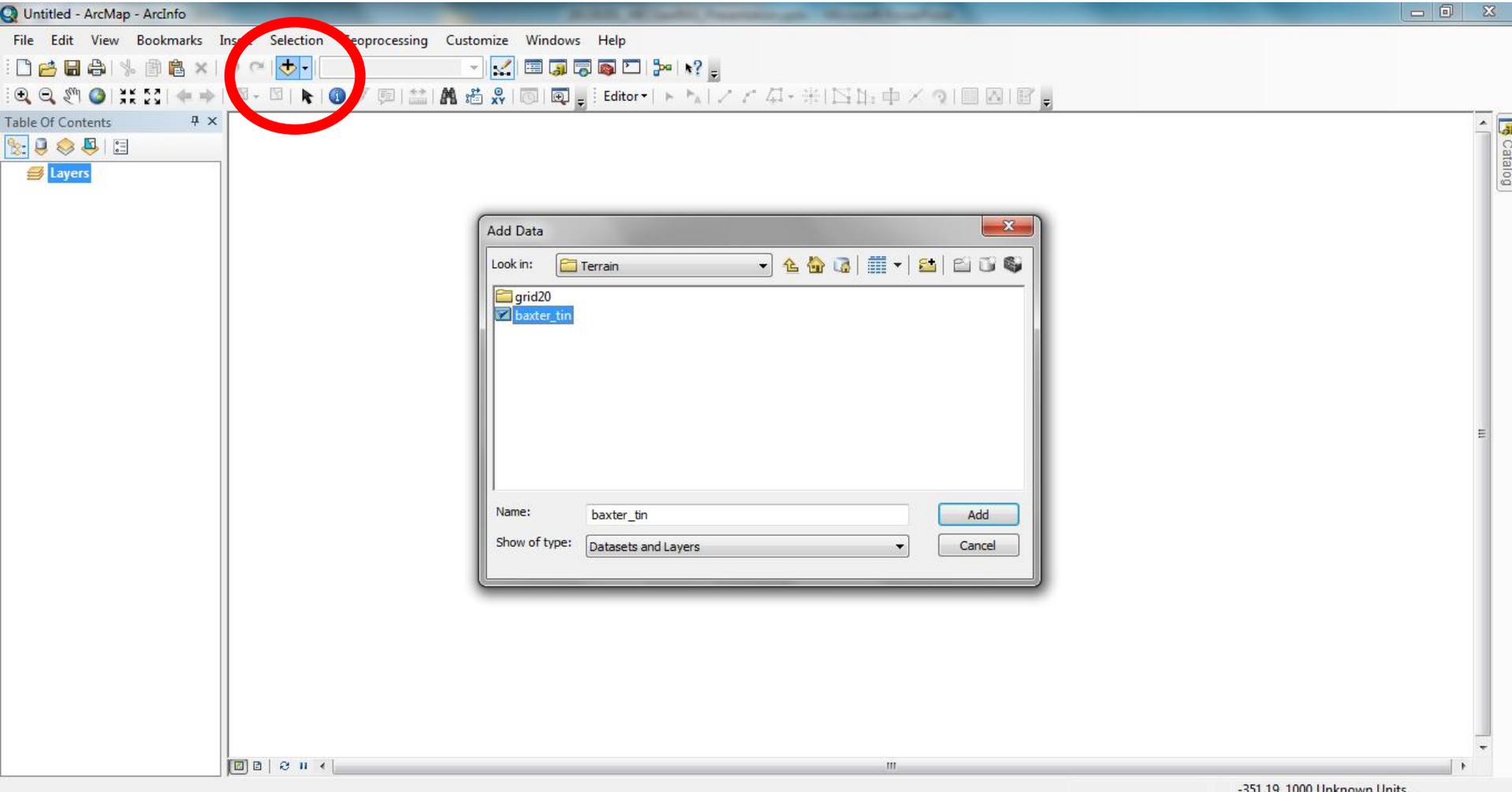


# Turn on Extensions



-119.898 1000 Unknown Units

# Add Data



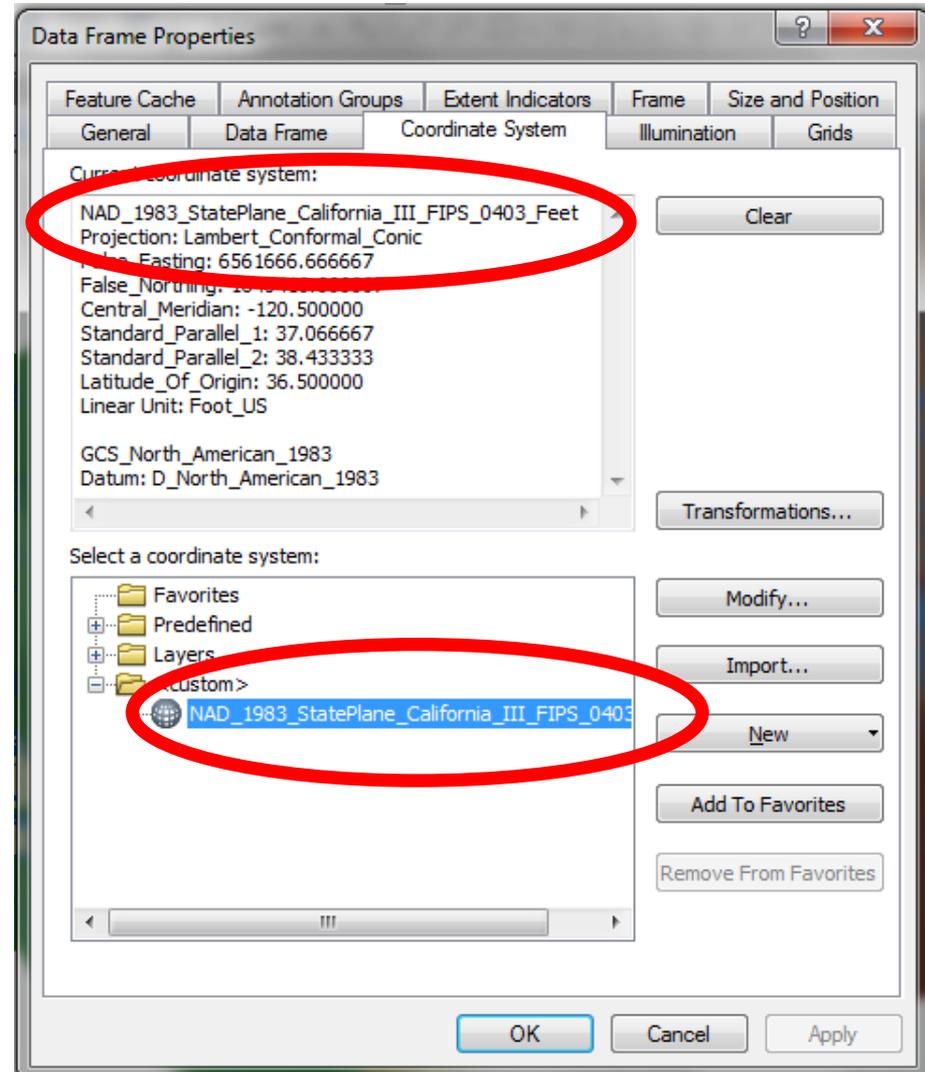
# Digital Data Creation

## Projections \ Coordinate Systems

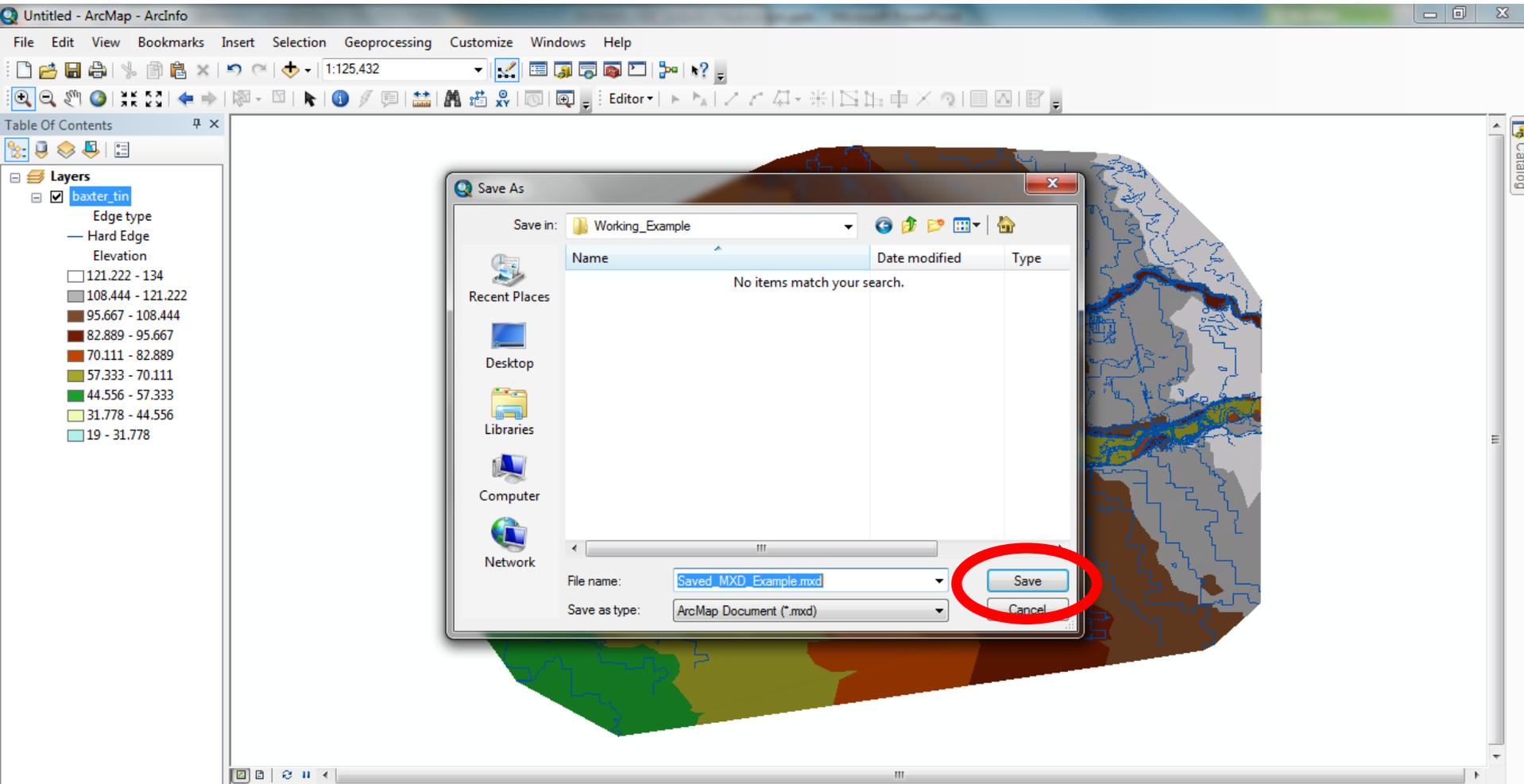
- Units
  - Feet
  - Meters

## File Management

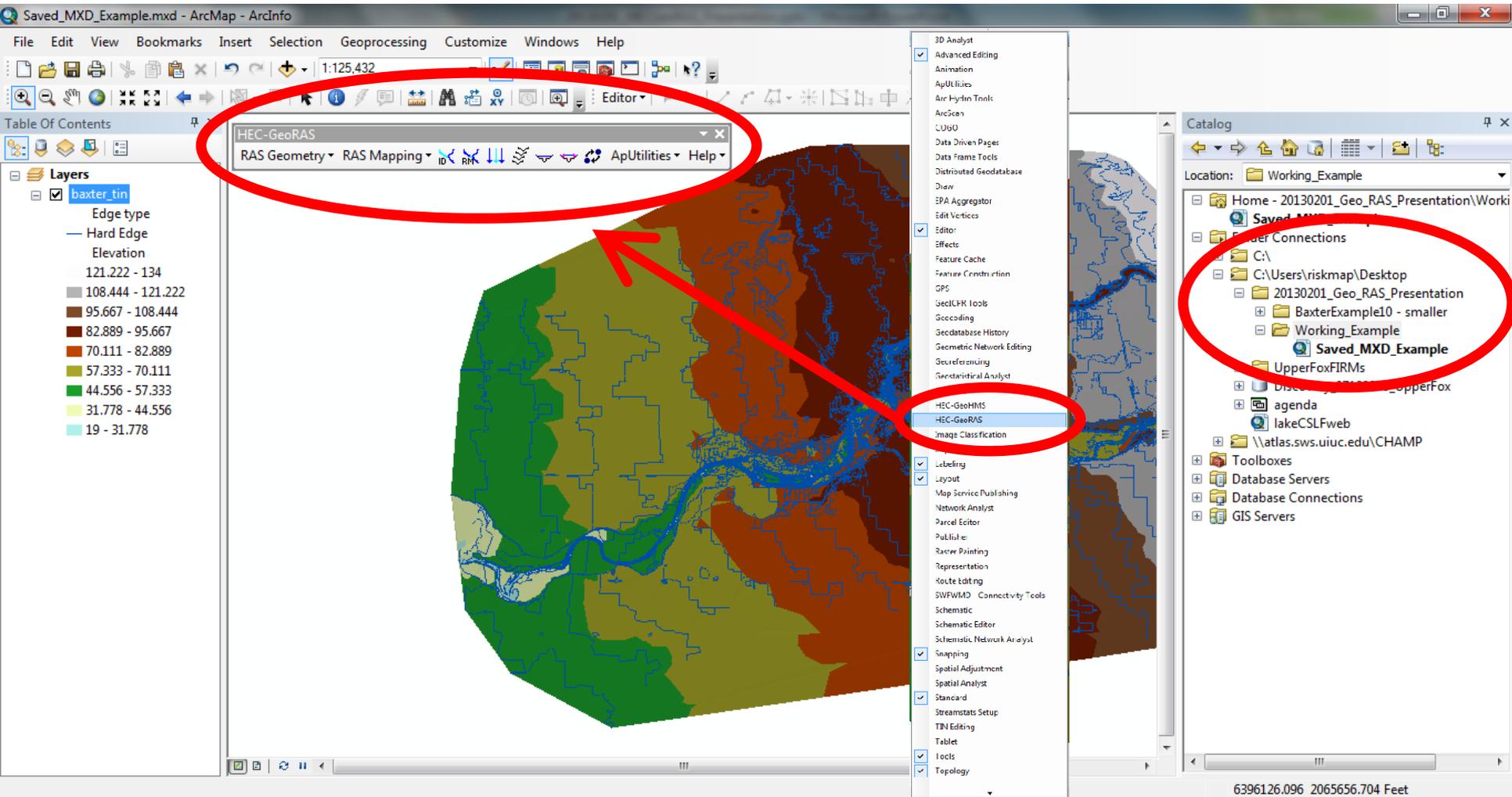
- File location affects processing time
- File paths are limited to <128 characters with no “wildcard” characters



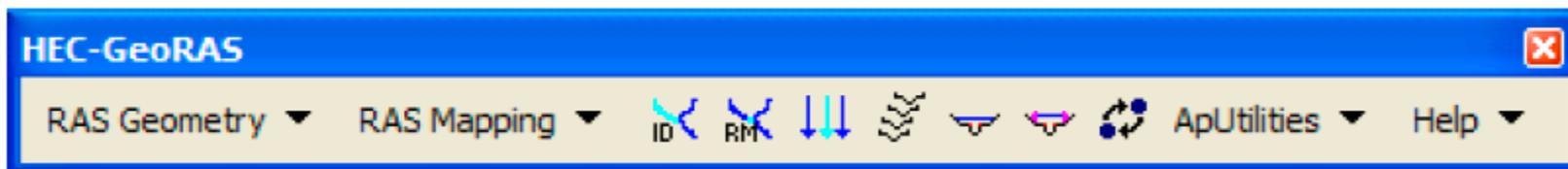
# Save MXD – Set File Path



# Turn on Hec-GeoRAS Toolbar



# HEC Geo-RAS Toolbar



- Create RAS Layers ▶
- Layer Setup
- Stream Centerline Attributes ▶
- XS Cut Line Attributes ▶
- Manning's n Values ▶
- Levees ▶
- Ineffective Flow Areas ▶
- Blocked Obstructions ▶
- Bridges/Culverts ▶
- Inline Structures ▶
- Lateral Structures ▶
- Storage Areas ▶
- Storage Area Connections ▶
- Export RAS data
- Terrain Tiles ▶
- Utilities ▶

- Layer Setup
- Import RAS Data
- Inundation Mapping ▶
- Velocity Mapping
- Ice Mapping
- Shear Stress Mapping
- Stream Power Mapping
- Visualization ▶
- Postprocessing Utilities ▶

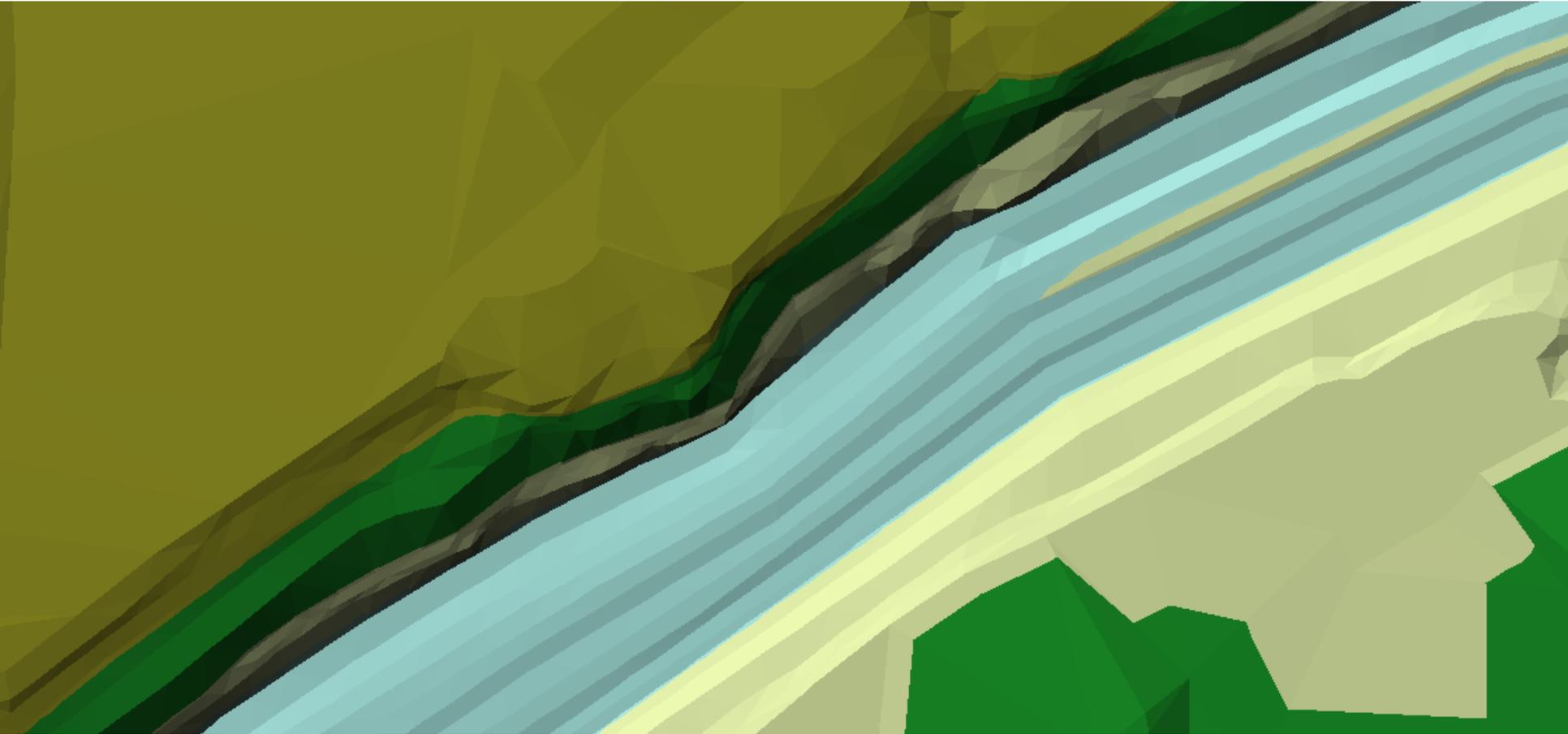
-  Allows the user to assign *River* and *Reach* names to the stream network.
-  Allows the user to assign station values to a stream endpoint.
-  Assigns a *LineType* (Left, Channel, Right) value to the Flow Paths feature class.
-  Generates cross-sectional cut lines perpendicular to a stream centerline at a specified interval.
-  Interactively plots a selected cross section.
-  Assigns elevation values to a levee alignment for interpolation.
-  Converts HEC-RAS output in SDF format to XML file. Necessary prior to post-processing RAS results.

# Digital Data Creation

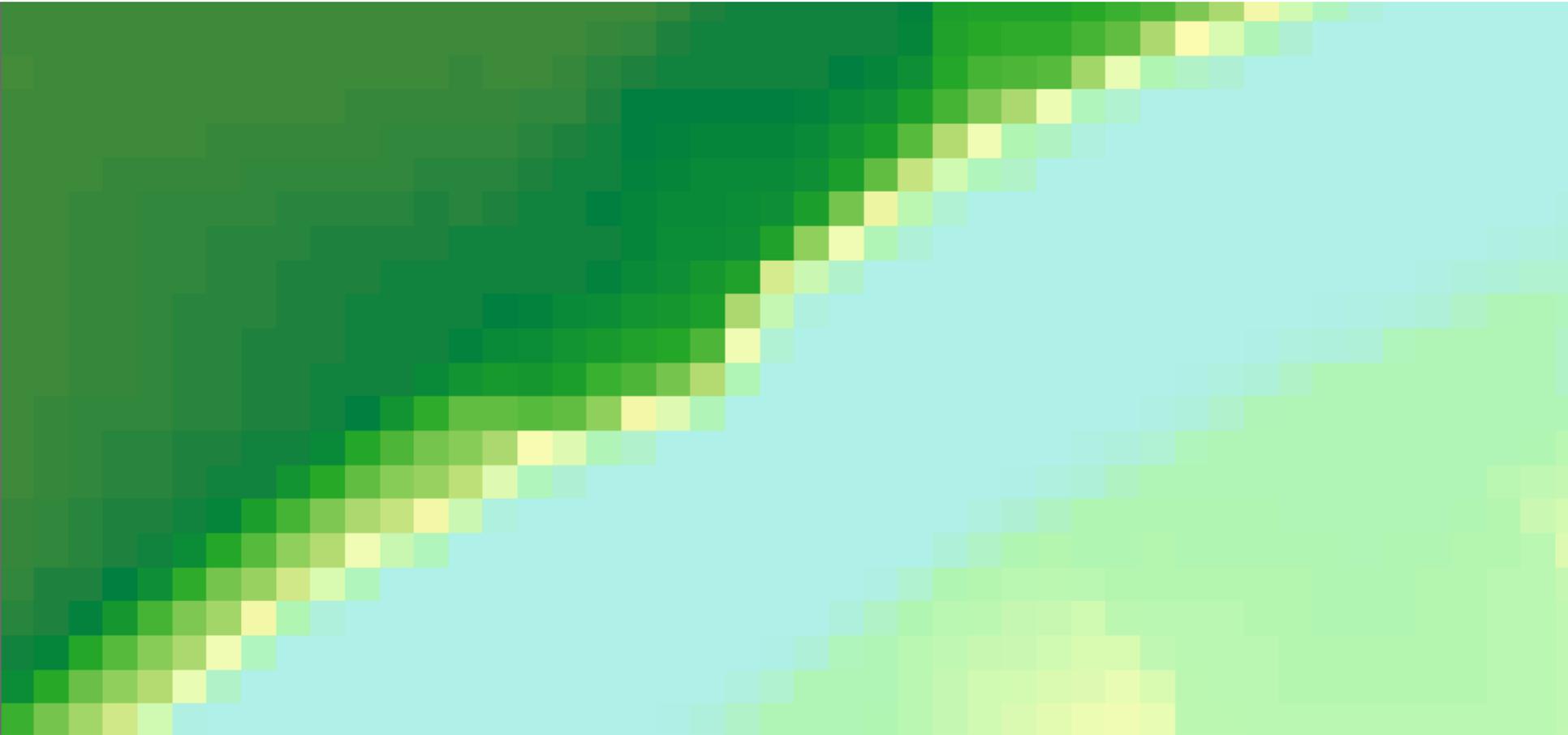
## Supported topographic data

- DTM
  - DEM \ GRID
    - Can be tiled to improve processing
  - TIN
    - May allow for faster processing over large areas
    - Should be generated from the LiDAR points
- Survey Points
  - Supplement the DTM within the channel
- Manual Elevations
  - For lateral structures (with interpolation between points), ineffective flow areas, blocked obstructions, levees

# TIN



# DEM

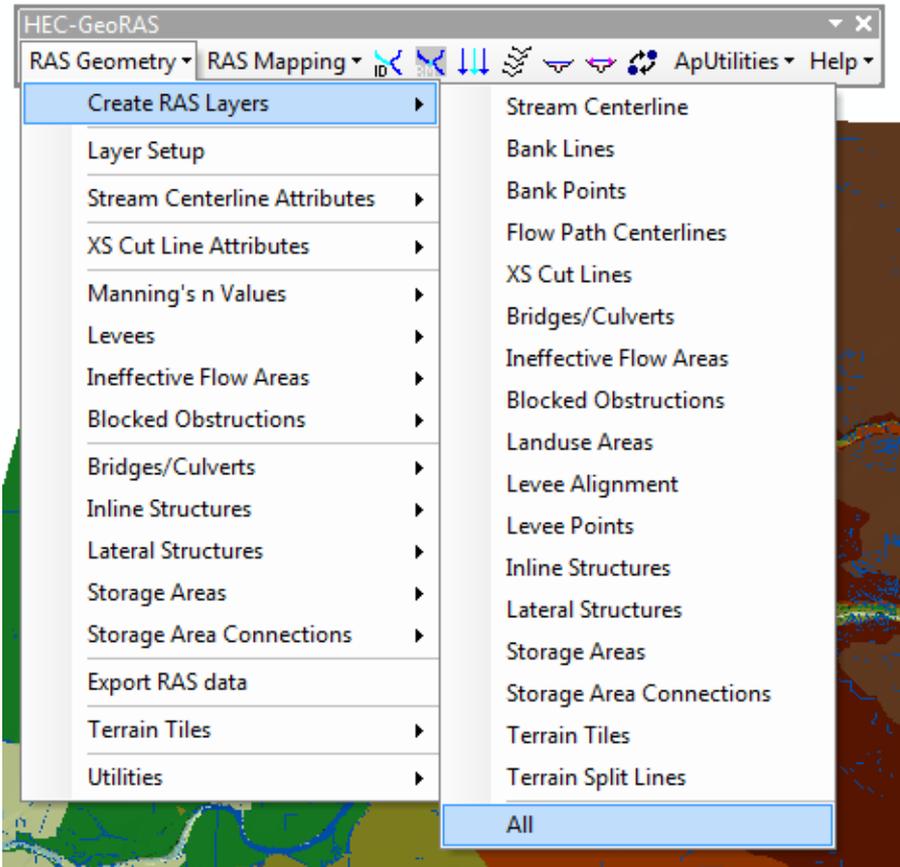


# Orthophoto



# Create RAS Layers

*“make it if you need it”* (walk through) or *“all at once”* (this slide only)



And it didn't do anything?!?

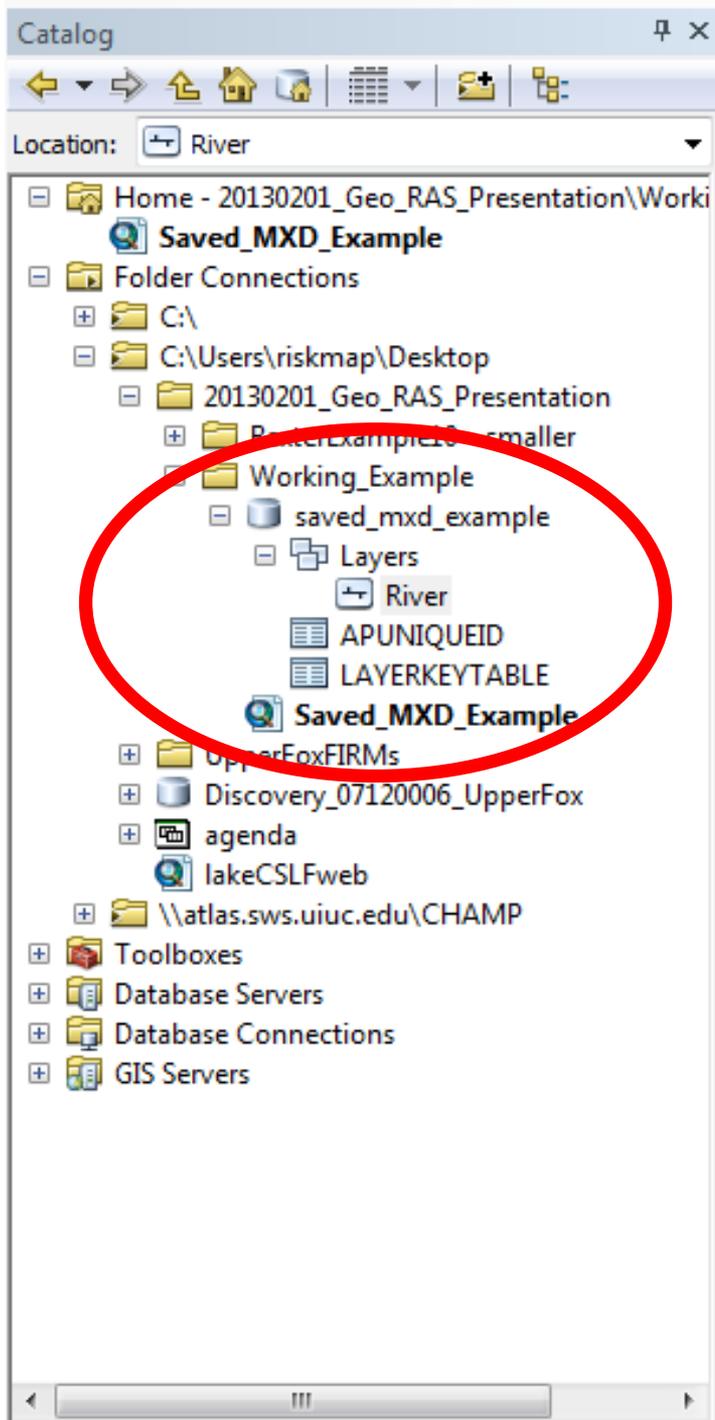


# Layer Name and Filepath

The screenshot displays the ArcMap interface with the following components:

- Table of Contents:** Lists layers including 'baxter\_tin', 'Edge type', 'Hard Edge', 'Elevation', and several elevation ranges (e.g., 121.222 - 134, 108.444 - 121.222).
- Map View:** Shows a map with a stream network overlaid on a terrain background.
- Dialog Box:** 'Create Stream Centerline Layer' with 'River' entered in the 'Stream Centerline' field. Buttons: OK, Help, Cancel.
- Success Message:** 'Stream Centerline layer created successfully! Complete layer by digitizing features.' Button: OK.
- Catalog:** Shows the file path: 'Working\_Example' > 'Saved\_MXD\_Example'.

6397214.917 2039198.359 Feet



# Create XS Cut Lines Layers

The screenshot displays the ArcGIS interface with the HEC-GeoRAS extension. The 'RAS Geometry' menu is open, and the 'XS Cut Lines' option is highlighted with a red circle. The map shows a river network overlaid on a terrain elevation model. The 'Table of Contents' on the left lists layers: BankPoints, Banks, River, and baxter\_tin. The 'Catalog' on the right shows the project structure, including the 'Saved\_MXD\_Example.mxd' file and its associated layers and tables.

**Table of Contents:**

- Layers
- BankPoints
- Banks
- River
- baxter\_tin
  - Edge type
  - Hard Edge
  - Elevation
  - 121.222 - 134
  - 108.444 - 121.222
  - 95.667 - 108.444
  - 82.889 - 95.667
  - 70.111 - 82.889
  - 57.333 - 70.111
  - 44.556 - 57.333
  - 31.778 - 44.556
  - 19 - 31.778

**HEC-GeoRAS Menu:**

- RAS Geometry
- RAS Mapping
- ApUtilities
- Help
- Create RAS Layers
  - Stream Centerline
  - Bank Lines
  - Flow Path Centerlines
  - XS Cut Lines**
  - Bridges/Culverts
- Layer Setup
- Stream Centerline Attributes
- XS Cut Line Attributes
- Manning's n Values
- Levees
- Ineffective Flow Areas
- Blocked Obstructions
  - Blocked Obstructions
  - Landuse Areas
  - Levee Alignment
  - Levee Points
- Bridges/Culverts
  - Inline Structures
  - Lateral Structures
- Storage Areas
  - Storage Areas
  - Storage Area Connections
- Export RAS data
- Terrain Tiles
- Utilities
  - Terrain Split Lines
  - All

**Catalog:**

- Home - Geo\_Ras\_Presentation\_Data\Working\_Example
- Saved\_MXD\_Example.mxd
- Folder Connections
- C:\Users\
  - Default
  - kingsley
  - owner
  - Public
  - rmeekma
  - idlerc
  - AppData
  - Contacts
  - Desktop
- Geo\_Ras\_Presentation\_Data
  - BaxterExample10 - smaller
  - Working\_Example
    - saved\_mxd\_example.mdb
      - Layers
        - BankPoints
        - Banks
        - River
      - APUNIQUEID
      - LAYERKEYTABLE
    - Saved\_MXD\_Example.mxd
      - Workflows
      - Export\_Output.shp
      - Documents
      - Downloads
      - Favorites
      - Links
      - Lync Recordings
      - Music
      - Pictures
      - Saved Games
      - Searches
      - Tracing

Name	Type
Layers	Personal Geodatabase Feature Class
APUNIQUEID	Personal Geodatabase Table
LAYERKEYTABLE	Personal Geodatabase Table

XS Cut Lines

6375342.861 2076294.778 Feet

# Layer Name and Filepath

The screenshot displays the ArcMap interface with the following elements:

- Table of Contents:** Lists layers including BankPoints, Banks, River, and baxter\_tin. The baxter\_tin layer is expanded to show Edge type (Hard Edge) and Elevation ranges: 121.222 - 134, 108.444 - 121.222, 95.667 - 108.444, 82.889 - 95.667, 70.111 - 82.889, 57.333 - 70.111, 44.556 - 57.333, 31.778 - 44.556, and 19 - 31.778.
- HEC-GeoRAS Tools:** A toolbar with various tools for RAS Geometry, RAS Mapping, and ApUtilities.
- Dialog Box:** A 'Create XS Cut Lines' dialog box is open, with the 'Cross-sectional Cut Lines' field set to 'XSCutLines'. The OK, Help, and Cancel buttons are visible.
- Success Message:** A message box states: 'Cross-sectional Cut Lines layer created successfully! Complete layer by digitizing features.' with an OK button.
- Catalog:** Shows the project location as 'River' and a tree view of folders and files, including 'Saved\_MXD\_Example'.
- Status Bar:** Displays the coordinates '6361937.123 2075020.563 Feet'.

# What Have We Created?

The screenshot shows the ArcCatalog interface. The Catalog Tree on the left displays a project structure under 'Geo\_Ras\_Presentaion\_Data' > 'Working\_Example' > 'saved\_mxd\_example.mdb' > 'Layers'. The 'Layers' folder is circled in red and contains 'BankPoints', 'Banks', 'River', and 'XSCutLines'. The main window shows a table preview for the 'River' layer. The table has columns: Shape \*, OID \*, Shape\_Length, HydroID, RiverCode, and ReachCode. The table is currently empty. The 'RiverCode' column is circled in red. The status bar at the bottom indicates 'Personal Geodatabase Feature Class selected'.

Shape *	OID *	Shape_Length	HydroID	RiverCode	ReachCode
---------	-------	--------------	---------	-----------	-----------

# Geo-RAS Data Requirements

## Minimum Requirements

- **DTM** (single or multiple)
- Stream Centerline
- Cross Section Cut Lines

## Optional Data

- Flow Path Centerlines
- Main Channel Banks
- Land Use (for Manning's n)
- Bridges/Culverts
- Inline Structures
- Levee Alignments
- Ineffective Flow Area
- Lateral Structures
- Storage Areas
- Storage Area Connections



Tips

Existing Data can be loaded / copied to blank feature classes

# Digital Data Creation

## General Editing Rules

- Stream centerlines and flow paths are digitized upstream to downstream
- Cross sections, inline structures, and bridges/culverts are digitized from left to right looking downstream



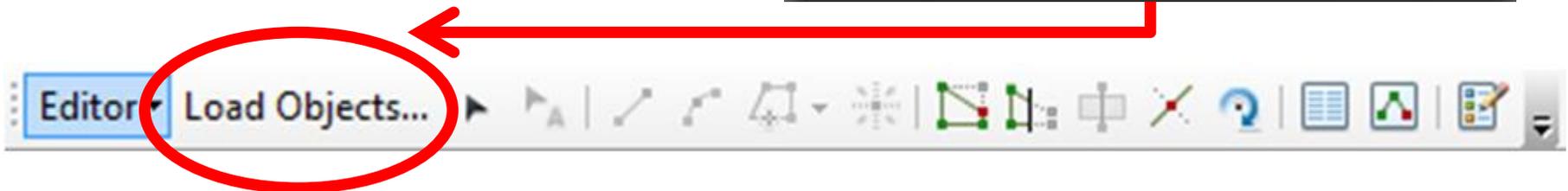
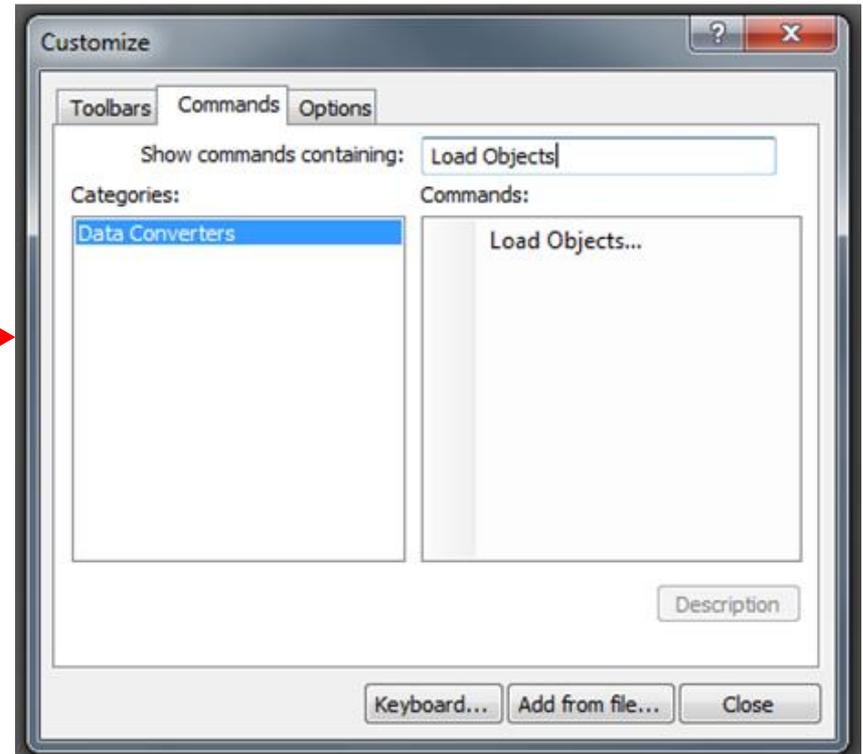
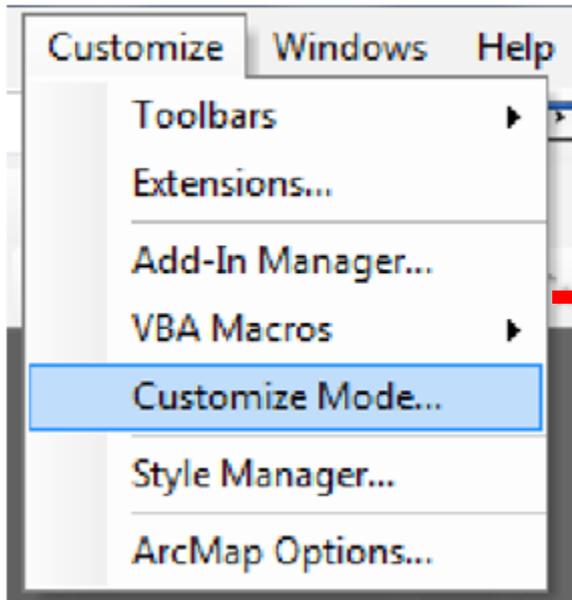
### Tips

- Use directional symbology for cross sections and stream centerlines during digitization
  - Layer Properties -> Symbology -> Symbol -> Arrow at End
- Flip reversed cross sections rather than re-digitizing

# Developing Stream Centerline

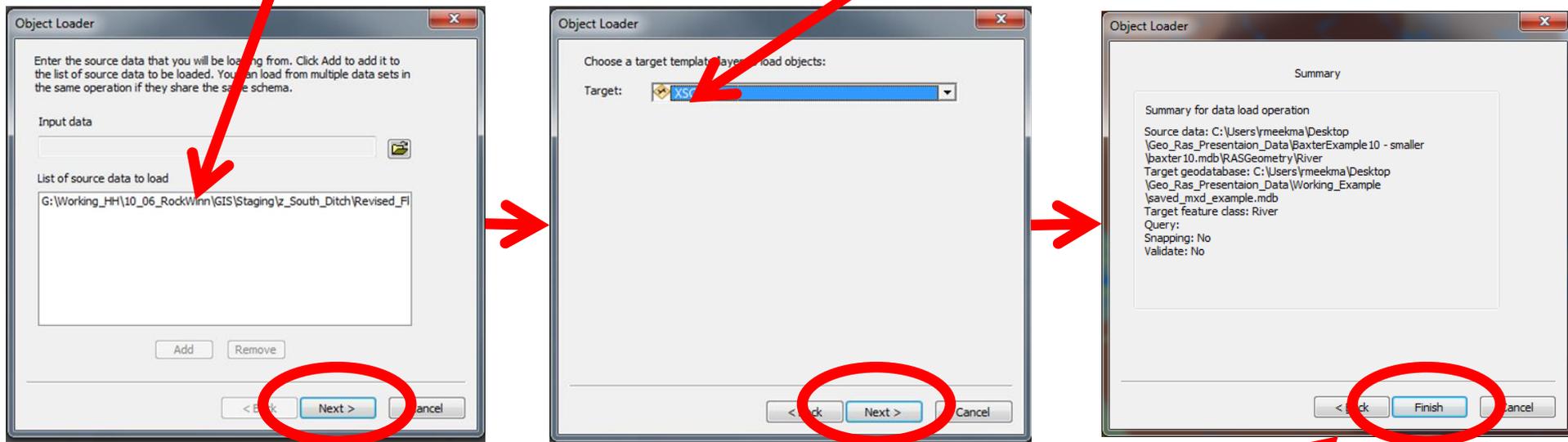
- River stationing is based on the Stream Centerline
  - Use the most up to date aerial photography available to check for development since the most recent orthophotography
  - Ensure agreement between the aerial photography and DTM
- Junctions (aka confluences)
  - Snapping
- River \ Reach naming
- Downstream reach lengths are based on the Flow Path Centerlines (Profile Baseline), which may or may not follow the Stream Centerline for large events

# Simple Data Loader



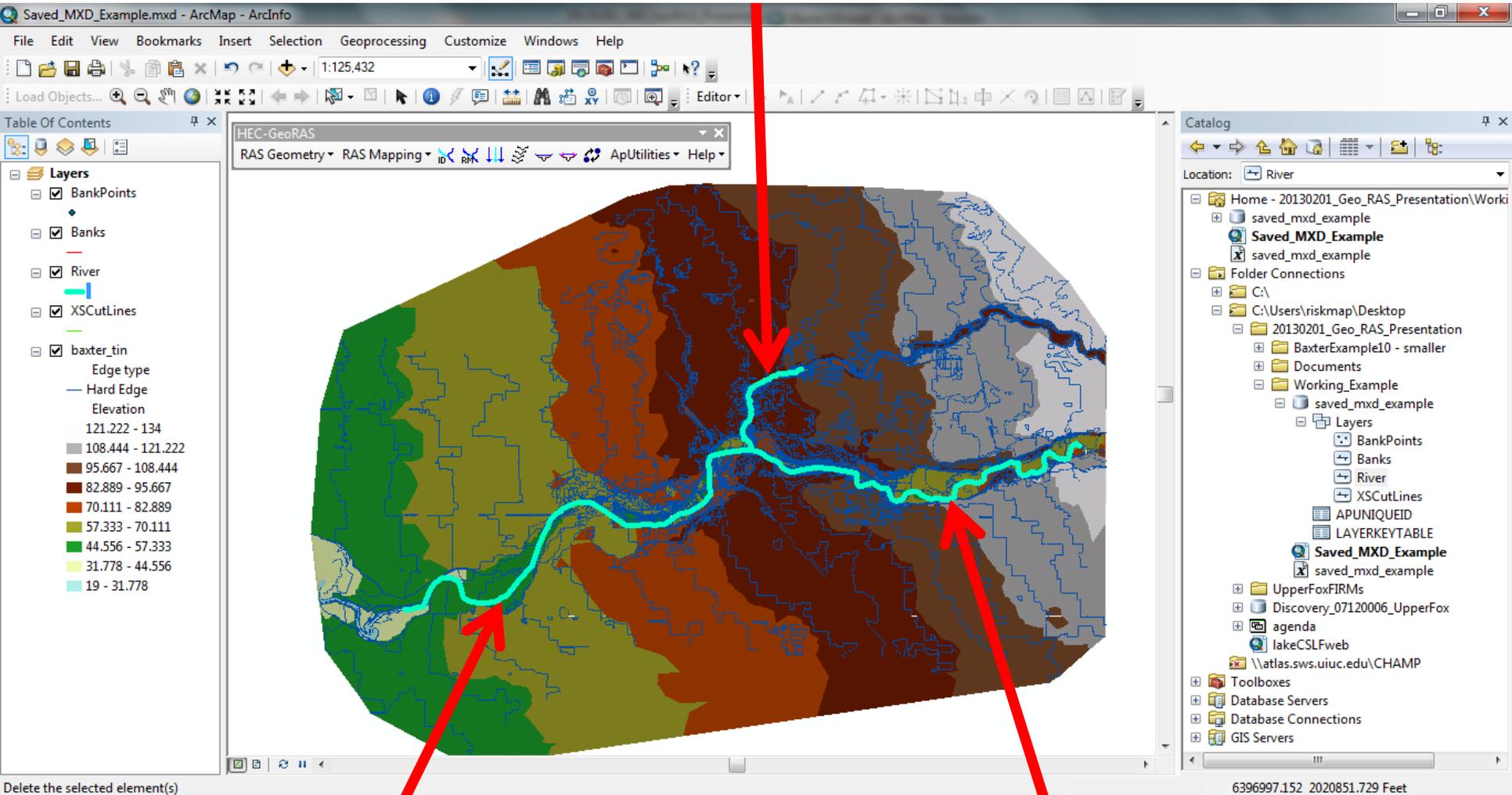
# Simple Data Loader

- Start ArcMap Edit session
- Select your “Input data”
- Select your “Target”
  - River



- Object Loader Summary
- & Repeat for other Layers

# Tule Creek - Tributary

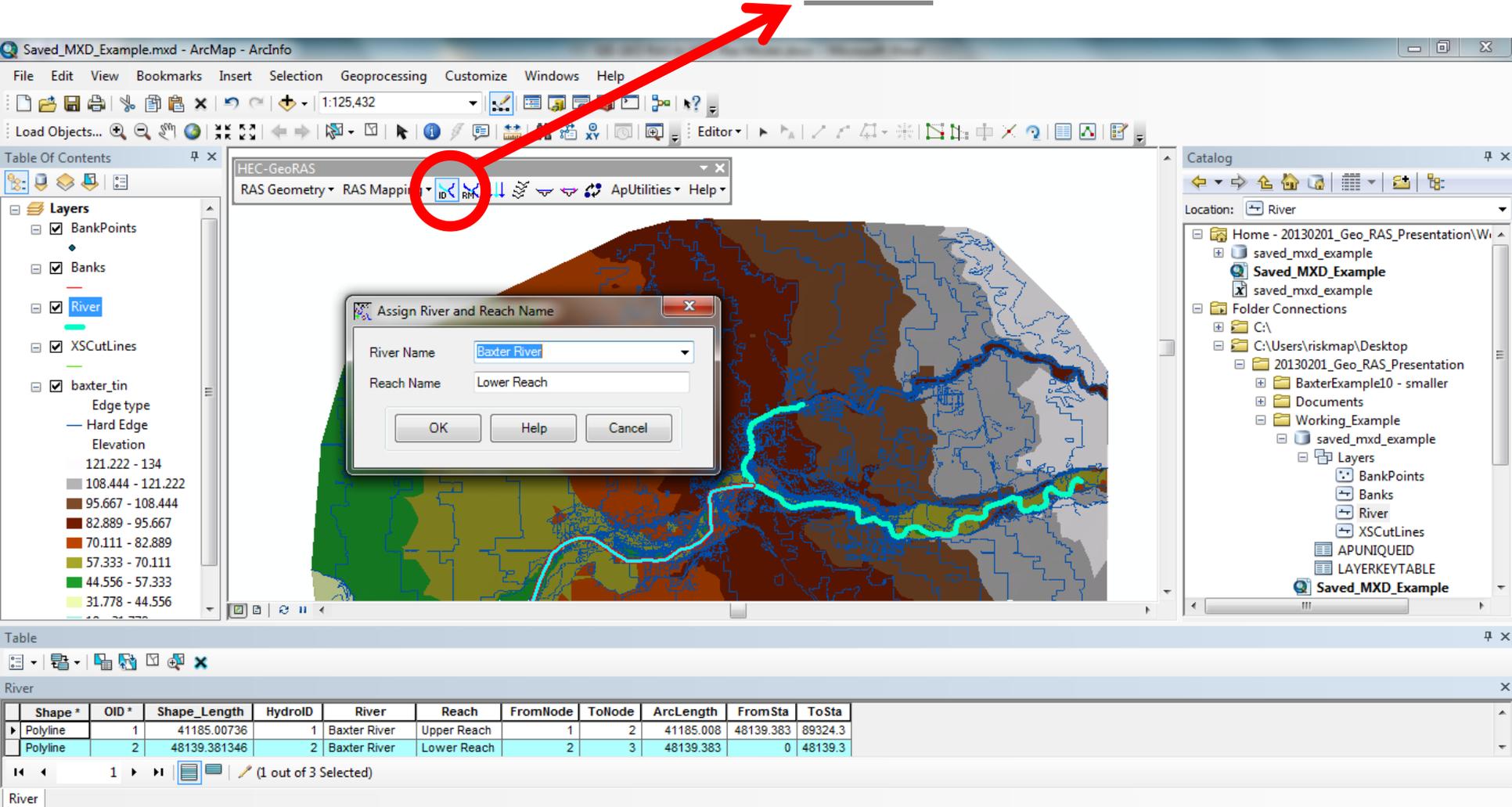


Baxter River – Lower Reach

Baxter River – Upper Reach

# Assign River and Reach Names

- Flow Path ID Icon



HEC-GeoRAS

RAS Geometry ▾ RAS Mapping ▾ **Flow Path ID** ▾ ApUtilities ▾ Help ▾

Assign River and Reach Name

River Name: Baxter River

Reach Name: Lower Reach

OK Help Cancel

Table of Contents

Layers

- BankPoints
- Banks
- River**
- XSCutLines
- baxter\_tin
  - Edge type
    - Hard Edge
  - Elevation
    - 121.222 - 134
    - 108.444 - 121.222
    - 95.667 - 108.444
    - 82.889 - 95.667
    - 70.111 - 82.889
    - 57.333 - 70.111
    - 44.556 - 57.333
    - 31.778 - 44.556

Catalog

Location: River

- Home - 20130201\_Geo\_RAS\_Presentation\W...
- saved\_mxd\_example
- Saved\_MXD\_Example
- saved\_mxd\_example
- Folder Connections
- C:\
- C:\Users\riskmap\Desktop
- 20130201\_Geo\_RAS\_Presentation
  - BaxterExample10 - smaller
  - Documents
  - Working\_Example
    - saved\_mxd\_example
      - Layers
        - BankPoints
        - Banks
        - River**
        - XSCutLines
        - APUNIQUEID
        - LAYERKEYTABLE

Table

River

Shape *	OID *	Shape_Length	HydroID	River	Reach	FromNode	ToNode	ArcLength	FromSta	ToSta
Polyline	1	41185.00736	1	Baxter River	Upper Reach	1	2	41185.008	48139.383	89324.3
Polyline	2	48139.381346	2	Baxter River	Lower Reach	2	3	48139.383	0	48139.3

1 (1 out of 3 Selected)

River

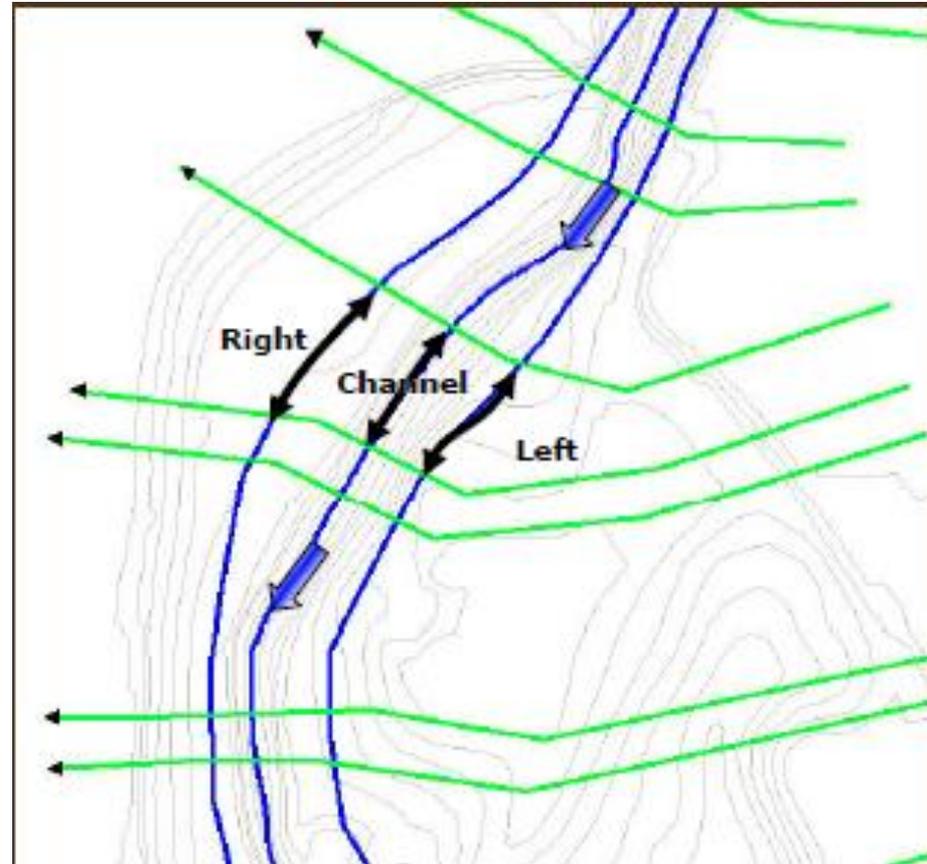
# Line Direction and Label



# Developing Cross Section Data

## Manual Cross Sections

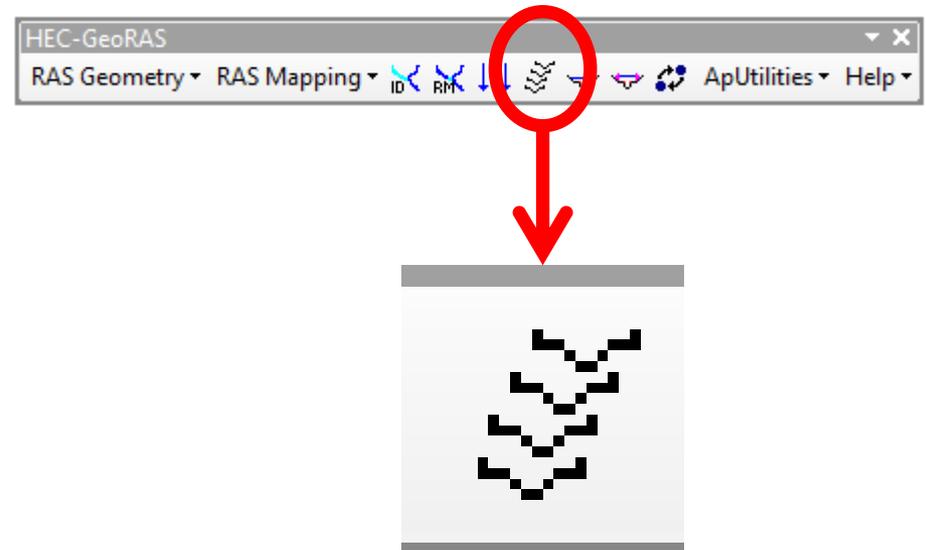
- Digitized left to right looking downstream
- Perpendicular to the direction of flow (cross sections can have bends)
- Must not intersect
- Cross the stream line only once
- Must be contained within DTM
- Can be imported from previously digitized data



# Developing Cross Section Data

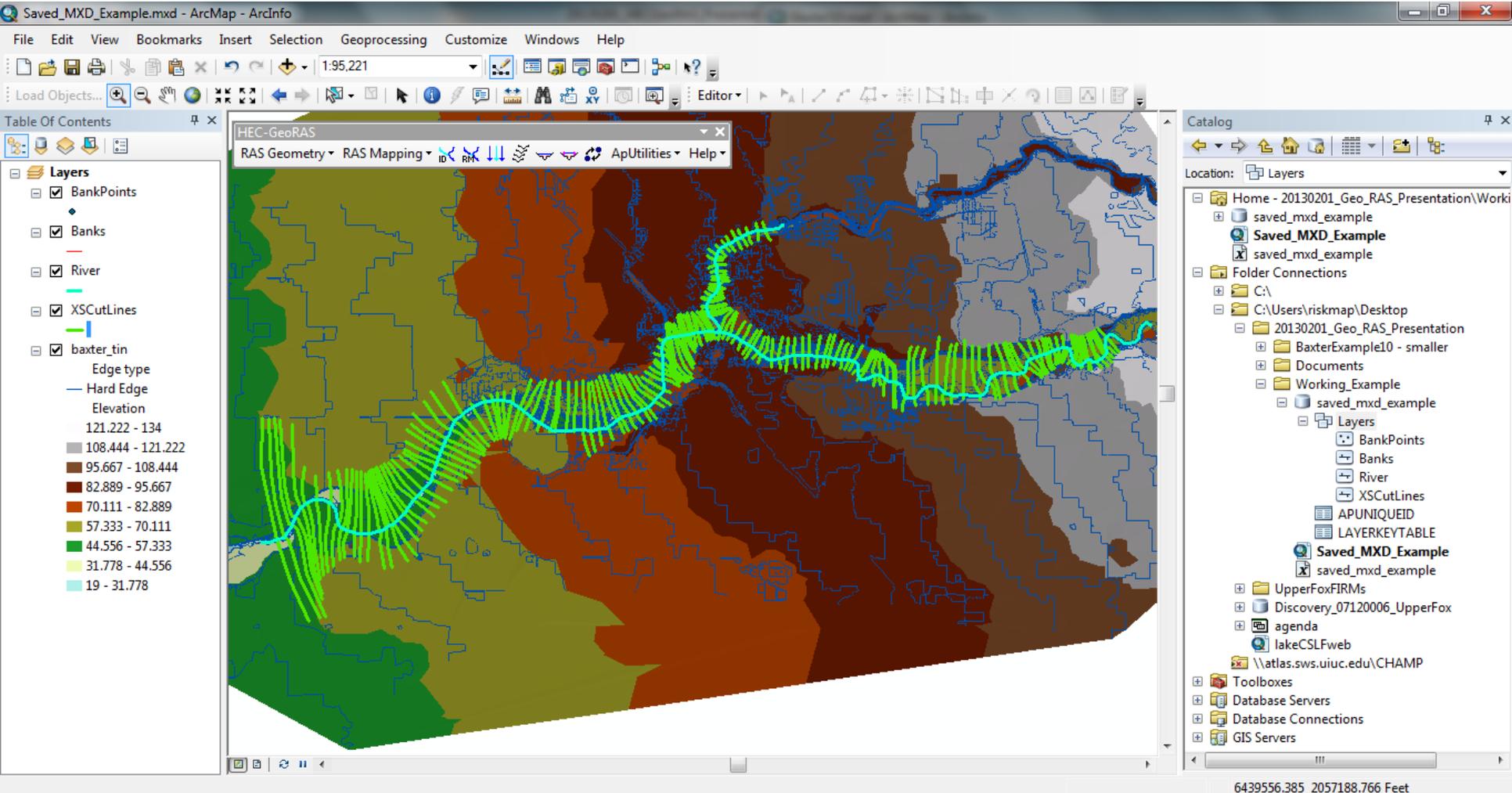
## Automated Cross Sections

- Specified interval and width
- Perpendicular to stream centerline
- “This is NOT the preferred method and should be used with caution because the lines are not generated following the guidelines necessary for modeling one-dimensional flow.” - *HEC-GeoRAS User’s Manual v10*



# Load Cross Sections

(using simple data loader, same process as Stream Centerline)

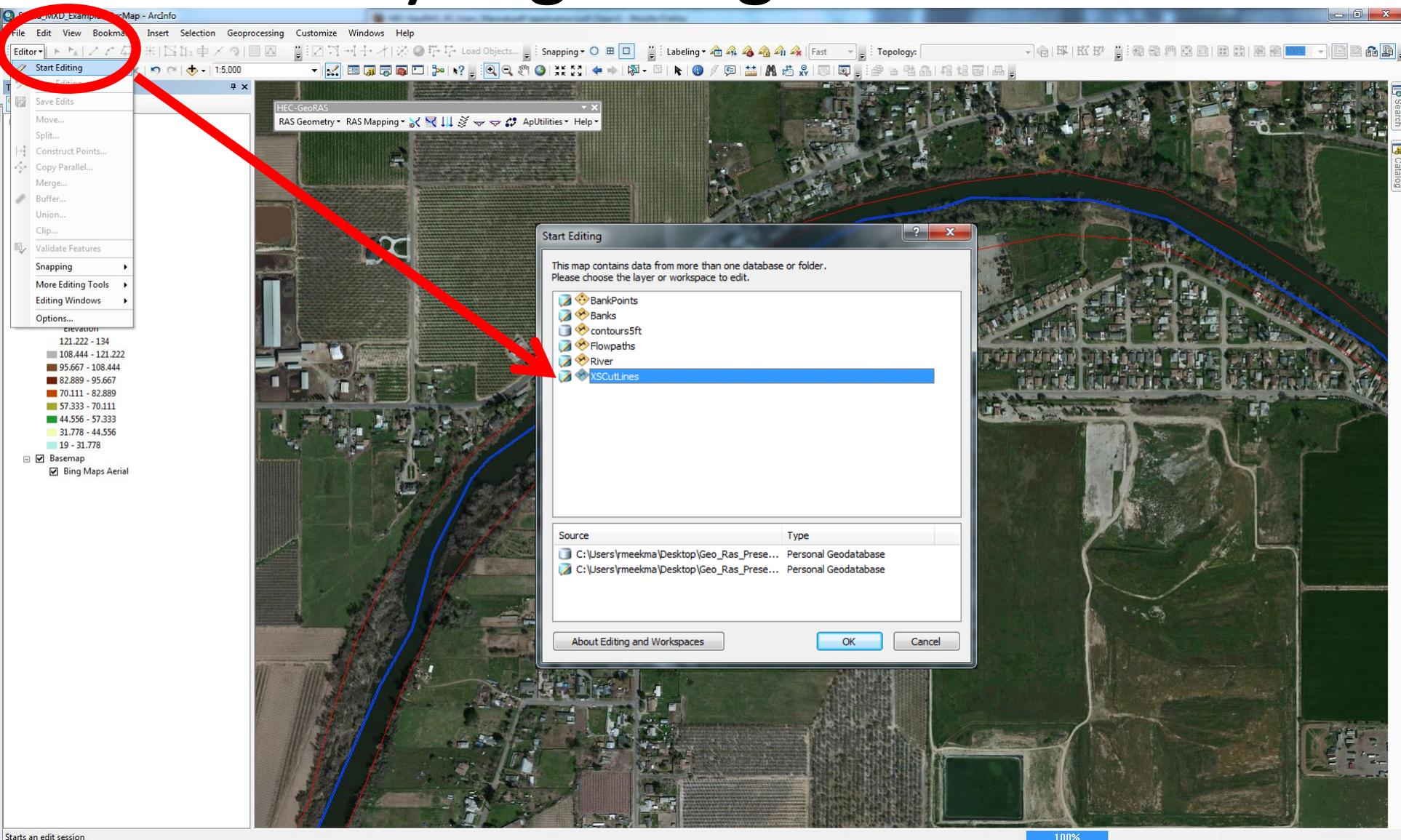


# Line Direction and Label



- NOTE: XS has not been attributed yet

# Manually Digitizing Cross Sections

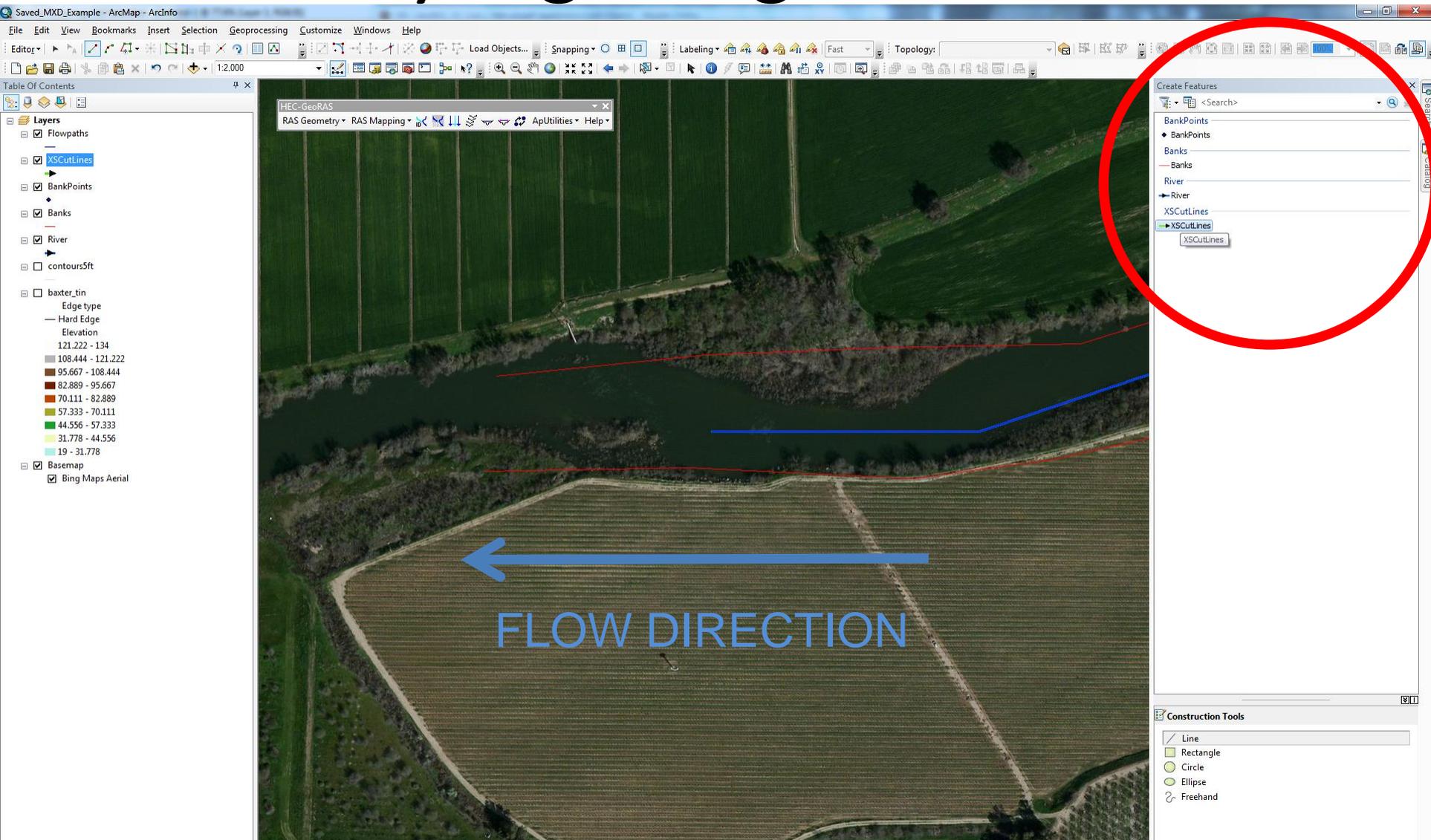


Starts an edit session

100%

- Begin Edit Session
- Choose Layer to Edit

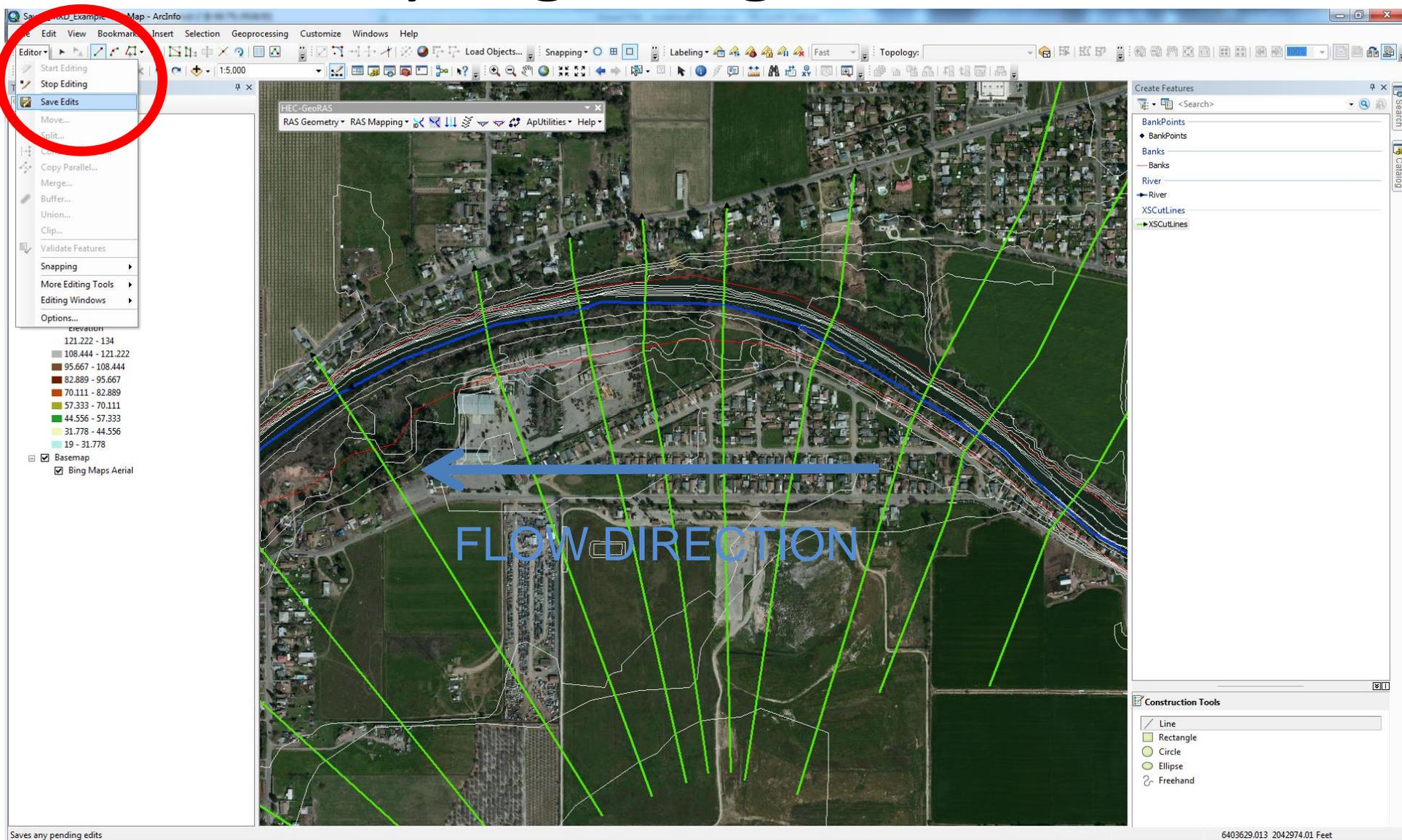
# Manually Digitizing Cross Sections



6388399.588 2036140.602 Feet

- Click on XSCutlines
- Begin Digitizing

# Manually Digitizing Cross Sections



- Double Click to End Sketch
- Save Edits

# Developing Flow Path Centerlines

(optional ... sort of)

- Necessary for downstream reach length extraction
- May specify either:
  - Main channel flow path
  - Main channel, left overbank, right overbank flow paths
- **Main channel flow path may utilize stream centerline**
- Consider the flow path over the range of discharges to be modeled

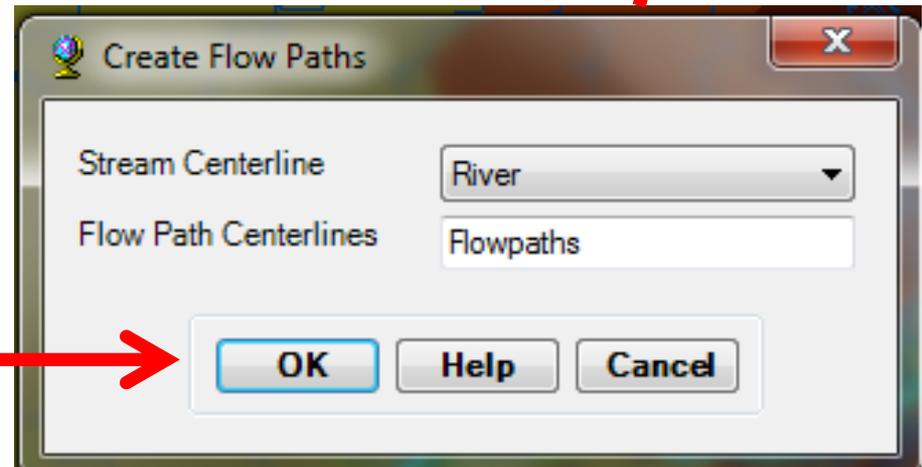
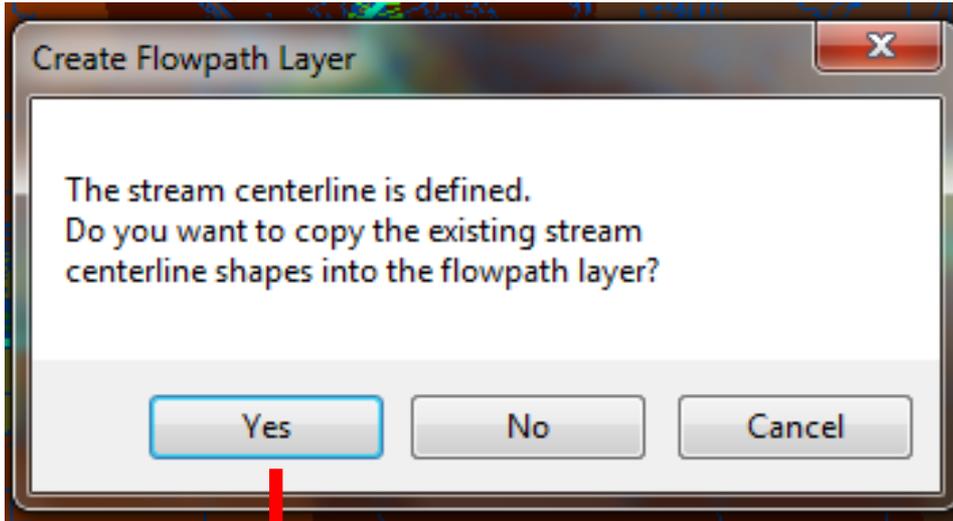
# Create Flow Path

Flow Path Centerlines

6382789.635 2079659.241 Feet



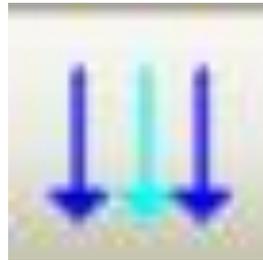
# Flow Path Layer



# Select Flowpath & Linetype button

## Types of Flowpaths

- Three types of lines
  - Centerline
  - Left overbank
  - Right overbank



## Flowpath Usage

- Defines the downstream reach lengths between cross-sections in the main channel and over bank areas



# Developing Channel Bank Data

(optional)

Bank Lines = **RED**

Bank Points = **YELLOW**

(Bank points are created where bank lines intersect cross section line)



# Finished Creating RAS Layers

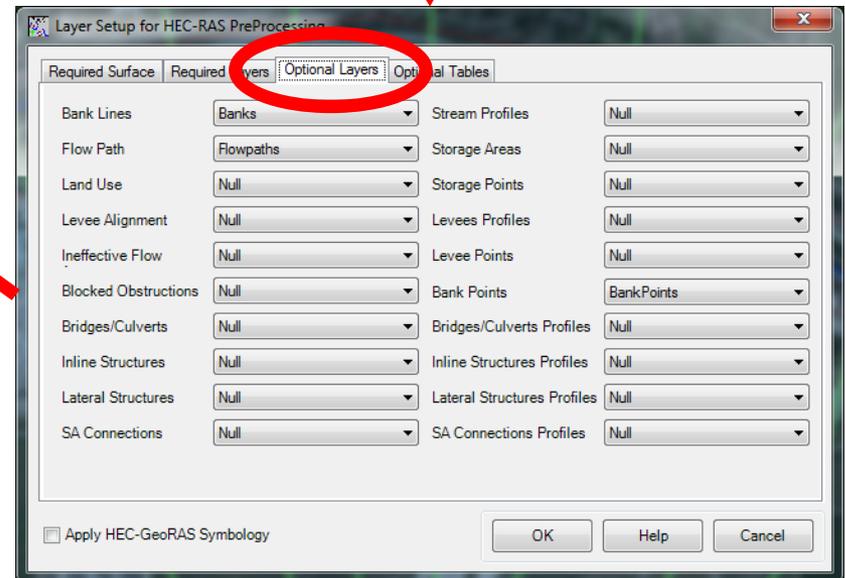
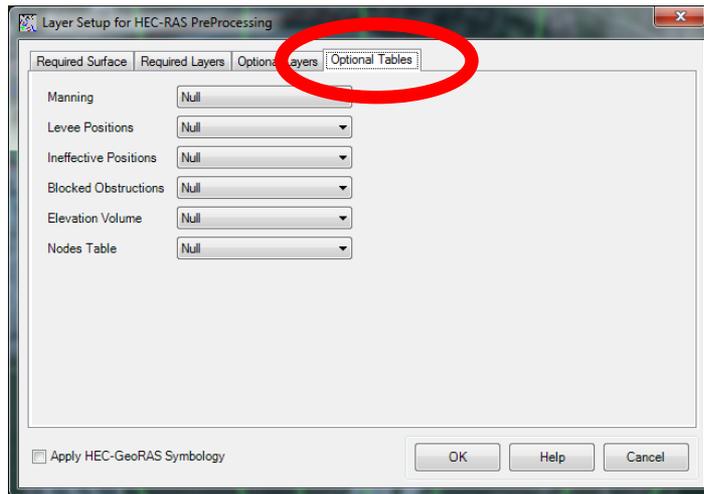
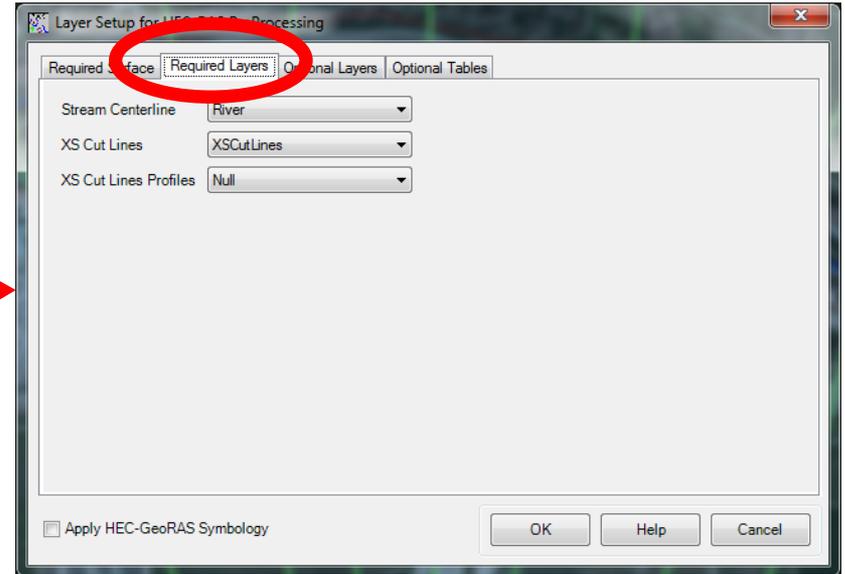
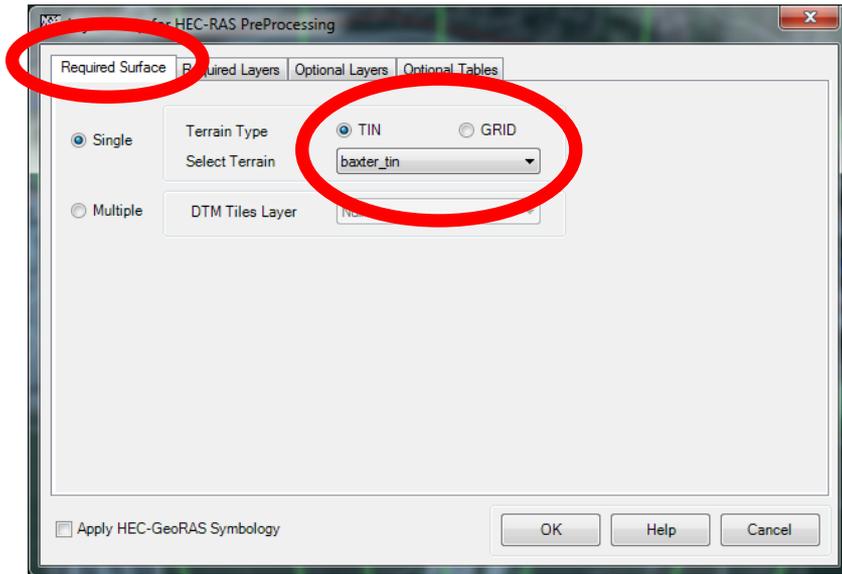
The screenshot displays the ArcMap interface with the 'RAS Mapping' menu open. The 'Layer Setup' option is circled in red. A red arrow points from this option to the 'Layer Setup for HEC-RAS PreProcessing' dialog box. The dialog box has the 'Required Surface' tab selected, showing the 'Single' radio button chosen. Under 'Terrain Type', the 'TIN' radio button is selected, and the 'Select Terrain' dropdown is set to 'Null'. The 'Multiple' radio button is unselected, and its 'DTM Tiles Layer' dropdown is also set to 'Null'. At the bottom of the dialog, there is an unchecked checkbox for 'Apply HEC-GeoRAS Symbology' and 'OK', 'Help', and 'Cancel' buttons.

RAS Layer Setup

6402769.638 2047158.038 Feet

- Layer Setup

# RAS Layer Setup



# Stream Centerline Attributes

The screenshot shows the ArcMap interface with the 'Stream Centerline Attributes' menu open. The 'All Stream Tools' dialog box is open, showing the following settings:

- Stream Centerline: River
- Terrain: baxter\_tin
- Stream Profiles: River3D

The 'All Stream Tools' dialog box has 'OK', 'Help', and 'Cancel' buttons. A success message dialog box is also open, displaying the text: 'Batch process on stream tools completed successfully!' with an 'OK' button.

6387898.111 2066146.753 Feet

- Layer Name = River (feature class name)
- Terrain = Source selected in Layer Setup (TIN)

# What Have We Created for the Water Line?

- RiverCode
- ReachCode
- FromNode
- ToNode
- FromSta (From Station)
- ToSta (To Station)

Shape *	OID *	Shape_Length	HydroID	RiverCode	ReachCode	FromNode	ToNode	ArcLength	FromSta	ToSta
Polyline	1	41185.0073598126	1	Baxter River	Upper Reach	1	2	41185.01	48139.38	89324.39
Polyline	2	48139.3813461552	2	Baxter River	Lower Reach	2	3	48139.38	0	48139.38
Polyline	3	12506.9489725563	3	Tule Creek	Tributary	4	2	12506.95	0	12506.95



# XS Cut Line Attributes

The screenshot displays the ArcMap interface with the following elements:

- Table of Contents:** Lists layers including XSCutLines3D, Flowpaths, River3D, XSCutLines, BankPoints, Banks, River, contours5ft, baxter\_tin, Basemap, and Bing Maps Aerial.
- HEC-GeoRAS Menu:** The 'RAS Mapping' menu is open, with 'XS Cut Line Attributes' selected. A red circle highlights this menu item, and a red arrow points to the 'All Cross-Section Tools' dialog box.
- All Cross-Section Tools Dialog:** A dialog box with the following settings:
  - Stream Centerline: River
  - Bank Lines: Banks
  - Flowpaths: Flowpaths
  - XS Cutlines: XSCutLines
  - Terrain: baxter\_tin
  - XS Cutlines Profiles: XSCutLines3DButtons for OK, Help, and Cancel are visible.
- Success Message Dialog:** A smaller dialog box with the text "Batch process on Cross-section tools completed successfully!" and an OK button.

6390372.069 2066363.767 Feet

- Only showing Required Layers above

# What Have We Created for the XS Layer?

## (EVERYTHING! To get started with modeling at least...)

Shape *	OID *	Shape_Length	HydroID	ProfileM	RiverCode	ReachCode	LeftBank	RightBank	LLength	ChLength	RLength	NodeName
Polyline	1	2385.42611004266	10	47341.08	Baxter River	Lower Reach	0.2320041	0.3491059	0	254.5117	0	
Polyline	2	3625.61291418831	11	43370.52	Baxter River	Lower Reach	0.8811635	0.921231	0	634.7012	0	
Polyline	3	4054.21629516504	12	43813.12	Baxter River	Lower Reach	0.8224729	0.9195772	0	442.6034	0	
Polyline	4	2528.99248964729	13	41353.68	Baxter River	Lower Reach	0.5281703	0.6126689	0	427.0851	0	
Polyline	5	3645.95587154191	14	38999.21	Baxter River	Lower Reach	0.1892742	0.2407814	0	700.7122	0	
Polyline	6	4272.96509071099	15	37930.35	Baxter River	Lower Reach	0.2103818	0.2583597	0	576.7894	0	
Polyline	7	4486.93116613369	16	36795.45	Baxter River	Lower Reach	0.2343741	0.2752751	0	651.6782	0	
Polyline	8	4668.10963853476	17	35811.23	Baxter River	Lower Reach	0.1922656	0.2493992	0	848.8646	0	
Polyline	9	3854.7159056844	18	32317.51	Baxter River	Lower Reach	1.258031E-02	8.125903E-02	0	599.9683	0	
Polyline	10	3810.85880528305	19	30535.93	Baxter River	Lower Reach	5.038665E-02	0.1214577	0	886.4666	0	
Polyline	11	3452.67475957464	20	26389.31	Baxter River	Lower Reach	0.7563735	0.8601218	0	468.6689	0	
Polyline	12	4194.32063625726	21	28106.68	Baxter River	Lower Reach	0.3715049	0.428724	0	390.5627	0	
Polyline	13	3421.21199689804	22	25920.64	Baxter River	Lower Reach	0.7616481	0.8792181	0	393.059	0	
Polyline	14	6013.39974123862	23	21600.63	Baxter River	Lower Reach	0.4753043	0.5358933	0	793.0063	0	
Polyline	15	5822.67952760415	24	19791.64	Baxter River	Lower Reach	0.4499364	0.4974848	0	555.5542	0	
Polyline	16	6390.6861060829	25	13611.56	Baxter River	Lower Reach	0.2912195	0.3397141	0	512.7276	0	
Polyline	17	7467.59618776127	26	12784.37	Baxter River	Lower Reach	0.3806371	0.4127015	0	367.1151	0	
Polyline	18	7516.90076458007	27	12417.26	Baxter River	Lower Reach	0.3745977	0.4113203	0	546.7901	0	
Polyline	19	6592.59749577053	28	11078.69	Baxter River	Lower Reach	0.295545	0.3384417	0	620.2083	0	
Polyline	20	6499.9726644101	29	9977.704	Baxter River	Lower Reach	0.2615629	0.3022763	0	598.1946	0	
Polyline	21	6951.93810706039	30	8998.785	Baxter River	Lower Reach	0.3343608	0.3751281	0	532.4047	0	
Polyline	22	7609.40560852313	31	6756.076	Baxter River	Lower Reach	0.6751778	0.7154278	0	991.2301	0	
Polyline	23	8726.16243572662	32	4906.474	Baxter River	Lower Reach	0.6618853	0.6907241	0	521.7406	0	
Polyline	24	14265.9159453121	33	3550.27	Baxter River	Lower Reach	0.4532575	0.4784853	0	673.7538	0	
Polyline	25	15784.4246732439	34	1858.401	Baxter River	Lower Reach	0.4078268	0.4330727	0	686.4758	0	
Polyline	26	5092.25422755774	35	15892.35	Baxter River	Lower Reach	0.2967086	0.3612061	0	436.0033	0	
Polyline	27	5603.616660307026	36	14652.94	Baxter River	Lower Reach	0.2912767	0.3270018	0	444.8954	0	
Polyline	28	2563.40404641879	37	42093.07	Baxter River	Lower Reach	0.678942	0.7533616	0	372.5734	0	
Polyline	29	4793.46964665737	38	34241.54	Baxter River	Lower Reach	0.2088515	0.2746628	0	652.4493	0	
Polyline	30	2367.30500868542	39	84762.11	Baxter River	Upper Reach	0.5417203	0.6313727	0	814.6006	0	
Polyline	31	2659.77581266978	40	81867.62	Baxter River	Upper Reach	0.2142992	0.3492356	0	200.9608	0	
Polyline	32	2124.56810045358	41	79037.7	Baxter River	Upper Reach	0.5169015	0.618249	0	424.6483	0	
Polyline	33	2402.92721431298	42	77866.79	Baxter River	Upper Reach	0.4635276	0.5729238	0	230.7679	0	
Polyline	34	2522.67722056891	43	77636.02	Baxter River	Upper Reach	0.4603144	0.5607281	0	410.6801	0	
Polyline	35	3068.04318899281	44	76338.7	Baxter River	Upper Reach	0.4444283	0.546317	0	725.3594	0	
Polyline	36	3816.14469080963	45	75057.3	Baxter River	Upper Reach	0.2675146	0.3416504	0	595.4948	0	
Polyline	37	4090.97483677502	46	73707.44	Baxter River	Upper Reach	0.3872696	0.4683503	0	853.7266	0	
Polyline	38	4466.62023654799	47	72164.27	Baxter River	Upper Reach	0.2986413	0.365611	0	1279.964	0	
Polyline	39	4319.83658213149	48	70884.3	Baxter River	Upper Reach	6.173877E-02	0.1186184	0	1237.056	0	
Polyline	40	4409.4405673074	49	69647.25	Baxter River	Upper Reach	3.327393E-02	0.1024007	0	908.4877	0	
Polyline	41	5090.00384691071	50	67439.83	Baxter River	Upper Reach	0.2321038	0.2875602	0	878.2062	0	
Polyline	42	4461.67796037319	51	65410.33	Baxter River	Upper Reach	7.426728E-02	0.1519662	0	840.962	0	
Polyline	43	5042.14432412349	52	64769.37	Baxter River	Upper Reach	0.2069289	0.2366251	0	1502.523	0	
Polyline	44	4204.85046630928	53	63266.84	Baxter River	Upper Reach	0.4507527	0.4777469	0	144.7351	0	
Polyline	45	3156.51136160043	54	62480.29	Baxter River	Upper Reach	0.379128	0.4327502	0	531.0543	0	
Polyline	46	2475.32400032809	55	61949.23	Baxter River	Upper Reach	0.2734742	0.3481379	0	470.2292	0	
Polyline	47	2700.52694720728	56	60330.6	Baxter River	Upper Reach	7.780459E-02	0.1293979	0	558.2018	0	
Polyline	48	2190.56789445913	57	58888.4	Baxter River	Upper Reach	0.3438624	0.4002528	0	487.7868	0	
Polyline	49	2007.74856205432	58	57996.54	Baxter River	Upper Reach	0.3184963	0.4013508	0	559.9416	0	
Polyline	50	2538.12374521945	59	56976.13	Baxter River	Upper Reach	0.2296745	0.324212	0	350.9986	0	
Polyline	51	2465.29460730781	60	56083.74	Baxter River	Upper Reach	0.3263625	0.4210567	0	622.0948	0	
Polyline	52	2483.4941133375	61	55036.83	Baxter River	Upper Reach	0.3750848	0.4839594	0	685.9155	0	
Polyline	53	2531.03627857658	62	53840.34	Baxter River	Upper Reach	0.3696082	0.4768925	0	594.1134	0	
Polyline	54	2179.41061615471	63	52656.83	Baxter River	Upper Reach	0.2405843	0.3966975	0	818.1044	0	
Polyline	55	2151.4347542767	64	51838.72	Baxter River	Upper Reach	0.2477212	0.3596867	0	361.4491	0	
Polyline	56	2488.77548086253	65	50851.57	Baxter River	Upper Reach	0.331898	0.4650413	0	353.6066	0	
Polyline	57	2098.89721488775	66	50497.97	Baxter River	Upper Reach	0.2702278	0.4174466	0	515.7763	0	

# Export RAS Data

The screenshot shows the ArcMap interface with the 'Export RAS Data' menu option highlighted in red. Two dialog boxes are open:

- Export GIS Data:** A small dialog box with the message "GIS data for RAS exported successfully!" and an "OK" button.
- Export RAS Data:** A larger dialog box with the "RAS File" path set to "C:\Users\vmeeckma\Desktop\Geo\_Ras\_Presentation\_Data\Working\_Example\GIS2RAS". It contains a "Messages" table with the following data:

Start Time	Message Type	Message
4:13 PM	Informative	XSCutLines has been exported
4:13 PM	Informative	River3D has been exported
4:13 PM	Informative	NodesTable has been exported
4:13 PM	Informative	XSCutLines3D has been exported
4:13 PM	Informative	GIS data from geodatabase successfully exported.
4:13 PM	Informative	Intermediate XML created : C:\Users\vmeeckma\Desktop\Geo_Ras_Pres...
4:13 PM	Informative	RAS XML created at: C:\Users\vmeeckma\Desktop\Geo_Ras_Presentation...
4:13 PM	Informative	RAS SDF created at: C:\Users\vmeeckma\Desktop\Geo_Ras_Presentation...
4:13 PM	Informative	GIS data for RAS exported successfully

Extract GIS data

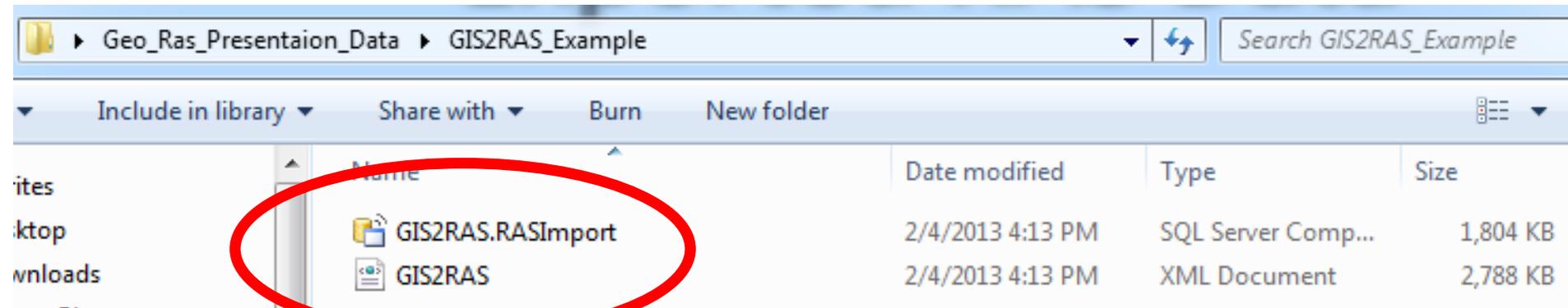
6391457.138 2066320.364 Feet

- Select Output Folder
- Name File

# Exported RAS Data

**Two files were created:**

- Next step is importing data into a HEC-RAS model



# Transitioning from Geo-RAS to RAS

**Gregory Byard, P.E., CFM**

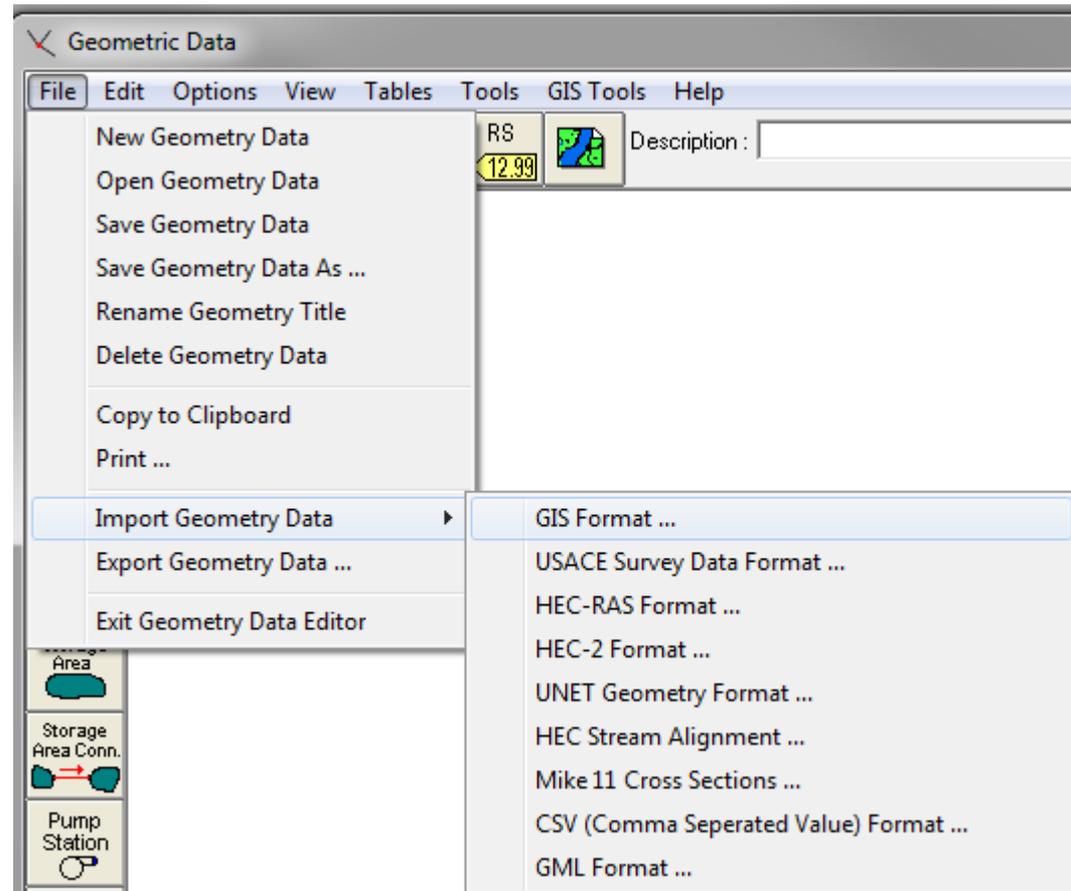
**[byard@illinois.edu](mailto:byard@illinois.edu)**

**(217) 244-0360**

# Transitioning from Geo-RAS to RAS

## Open HEC-RAS

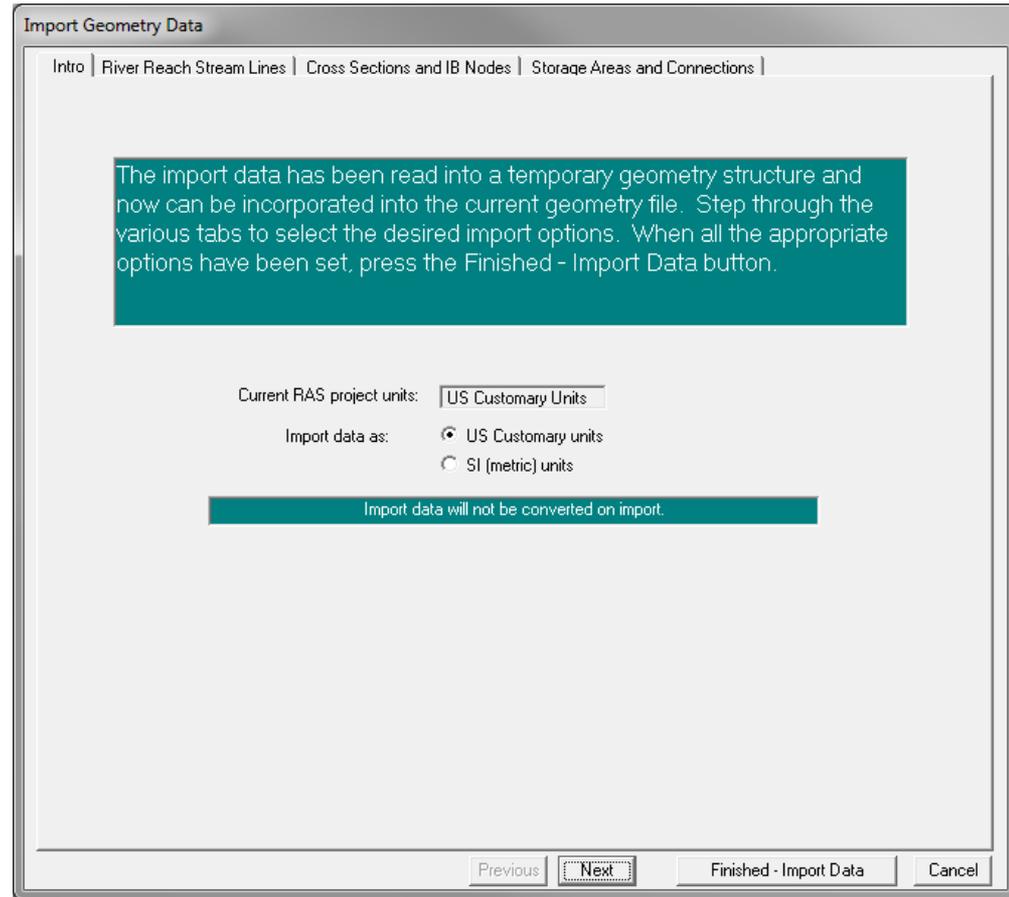
- Start a new project in HEC-RAS
- From the Geometric Data Editor, import the RAS GIS Import File
- Select the appropriate .sdf file



# Import Geometry Data

## Select Unit System

- Consider the linear units of the DTM
- Consider units of data with which to merge
  
- Select 'Next'



# Import Geometry Data

## River Reach Stream Lines

- Revise river and reach names as necessary
- Select which stream lines to import
- Select the merge mode
- Select 'Next'

Import Geometry Data

Intro | River Reach Stream Lines | Cross Sections and IB Nodes | Storage Areas and Connections |

The river reach stream lines found in the file or generated while reading it are listed below. Check the reaches you want to import, and modify the import name and way existing stream lines are merged. (A range of reaches can be checked/unchecked with the space bar)

	Import File	Import File	Invert	Import As	Import As	Import	Import	Merge Mode
	River	Reach	#Points	River	Reach	Status	Stream Lines	
1	Baxter River	Upper Reach	107	Baxter River	Upper Reach	new	<input checked="" type="checkbox"/>	Replace
2	Baxter River	Lower Reach	90	Baxter River	Lower Reach	new	<input checked="" type="checkbox"/>	Replace
3	Tule Creek	Tributary	44	Tule Creek	Tributary	new	<input checked="" type="checkbox"/>	Replace

Replace  
Replace  
Append Upstream  
Append Downstream

Previous Next Finished - Import Data Cancel



# Import Geometry Data

## Storage Areas and Connections

- Choose which to import
- Assign names
- Select volume-elevation or outline
- Select 'Finished-Import Data'
- Save geometry file

Import Geometry Data

Intro | River Reach Stream Lines | Cross Sections and IB Nodes | Storage Areas and Connections

Storage Areas and their Status			
	Import File	Import As	Import
	Storage Area	Storage Area	Status SA
1	560	560	new <input checked="" type="checkbox"/>
2	561	561	new <input checked="" type="checkbox"/>

Available Connections and their Status			
	Import File	Import As	Import
	SA Conn	SA Conn	Status SA Conn
1			

Check only the new storage areas

Select Storage Areas Properties to Import

Outline

Volume Elevation Relationship

Check only the new storage area connections

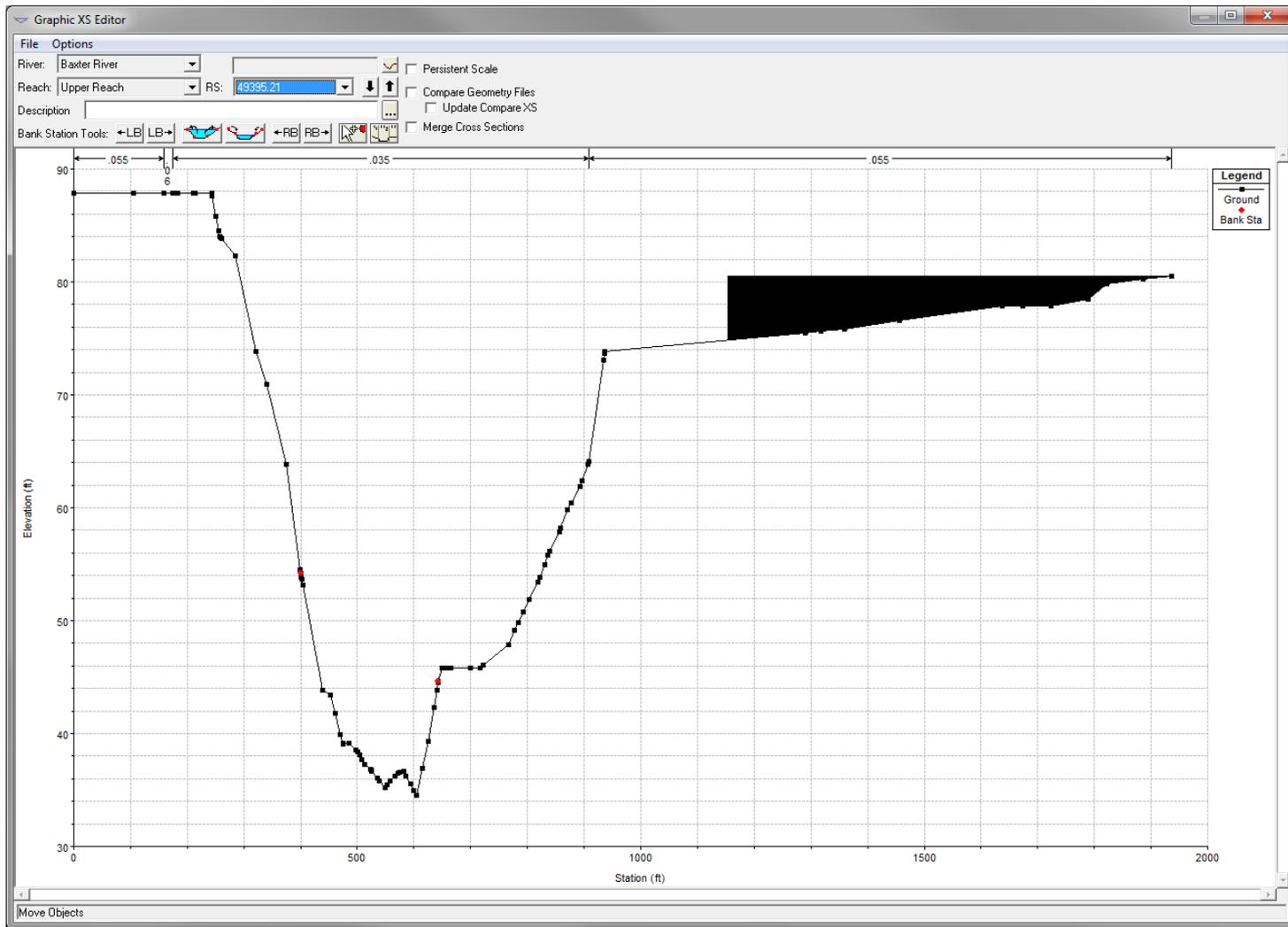
Previous Next Finished - Import Data Cancel

# Review Imported Data

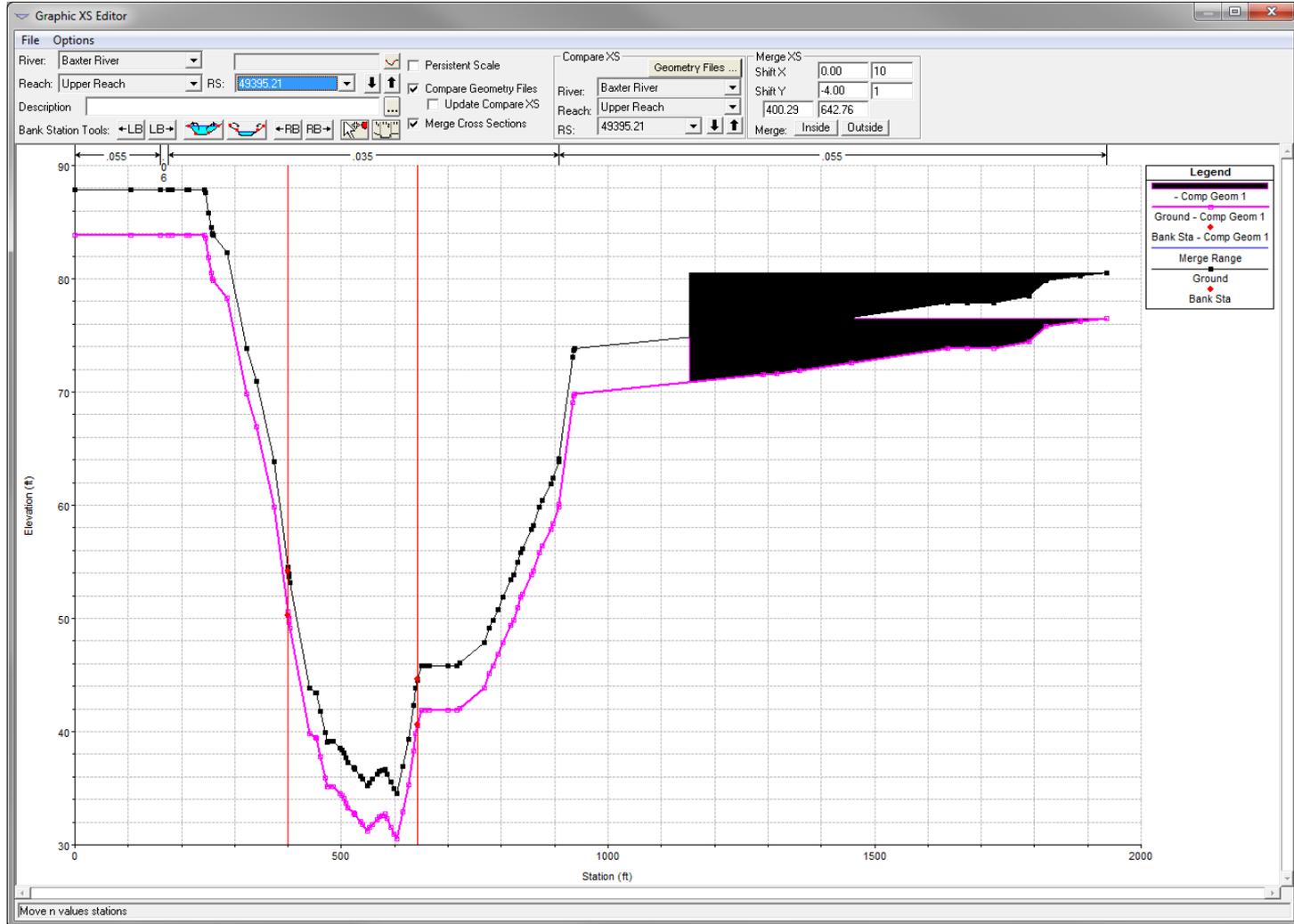
## Things to review

- Expanse of Manning's n values
- Location of bank station data
- Add/move/delete ground points (check for gaps, erroneous data)
- Add/move/delete levees, ineffective flow areas, and blocked obstructions
- Compare and merge cross section elevation data
- Junction connection and length

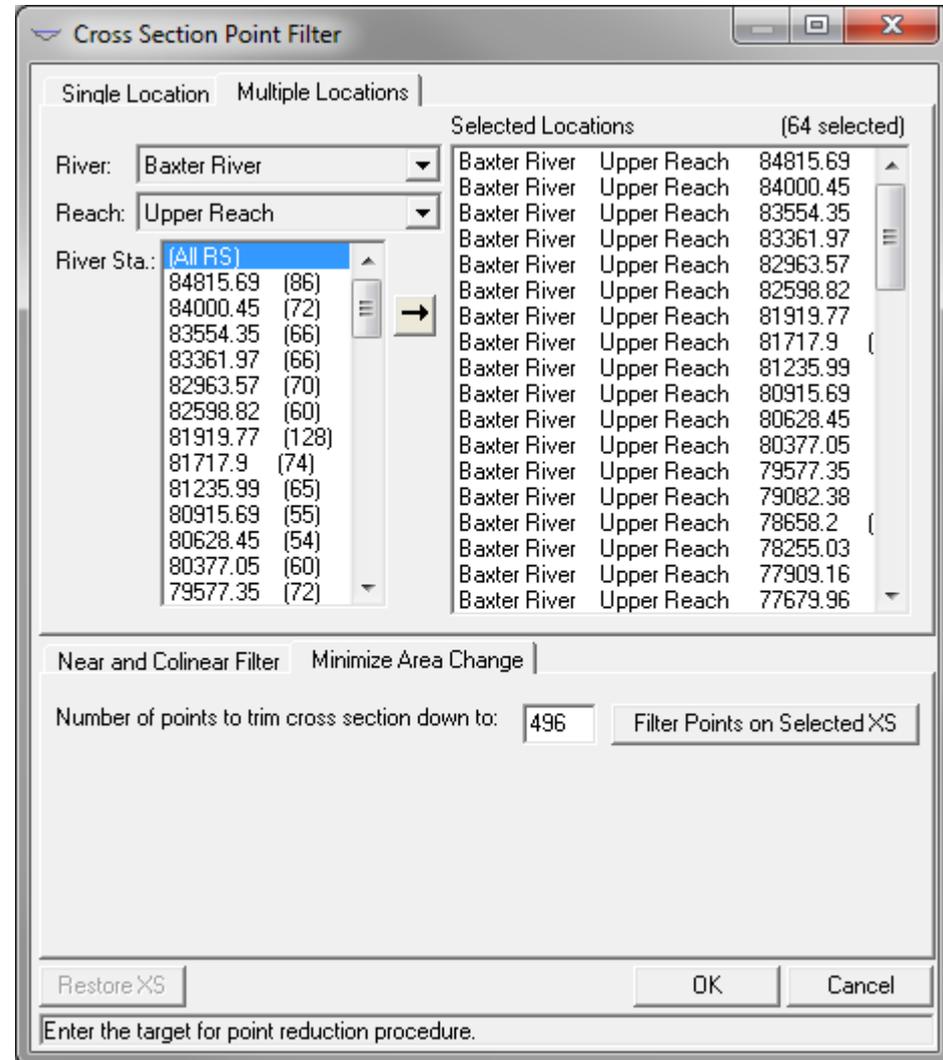
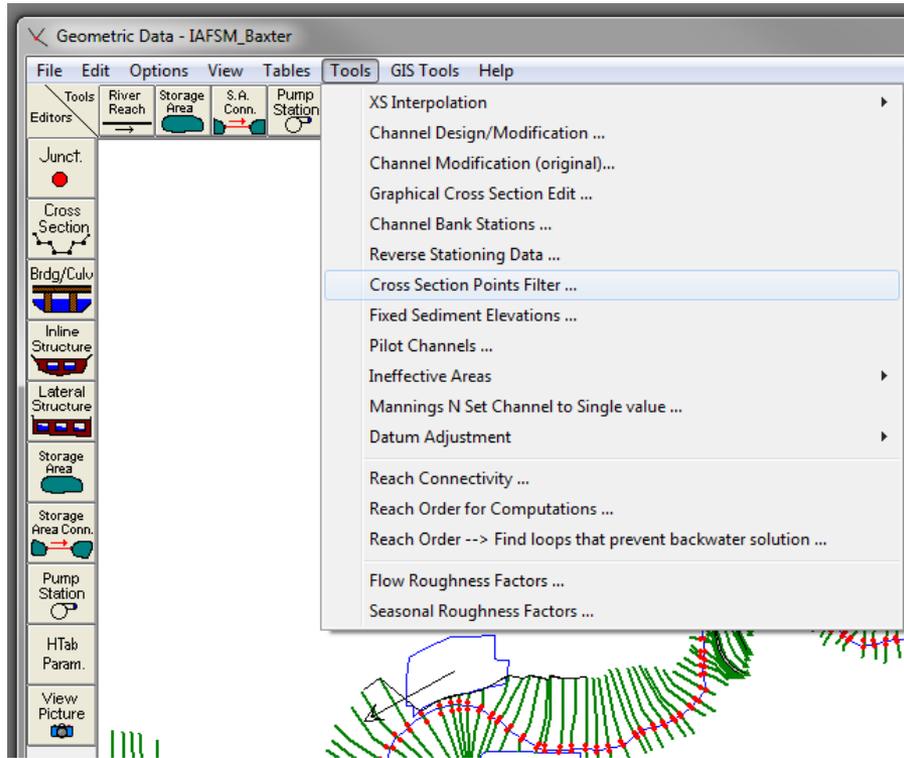
# Graphical Cross Section Editor



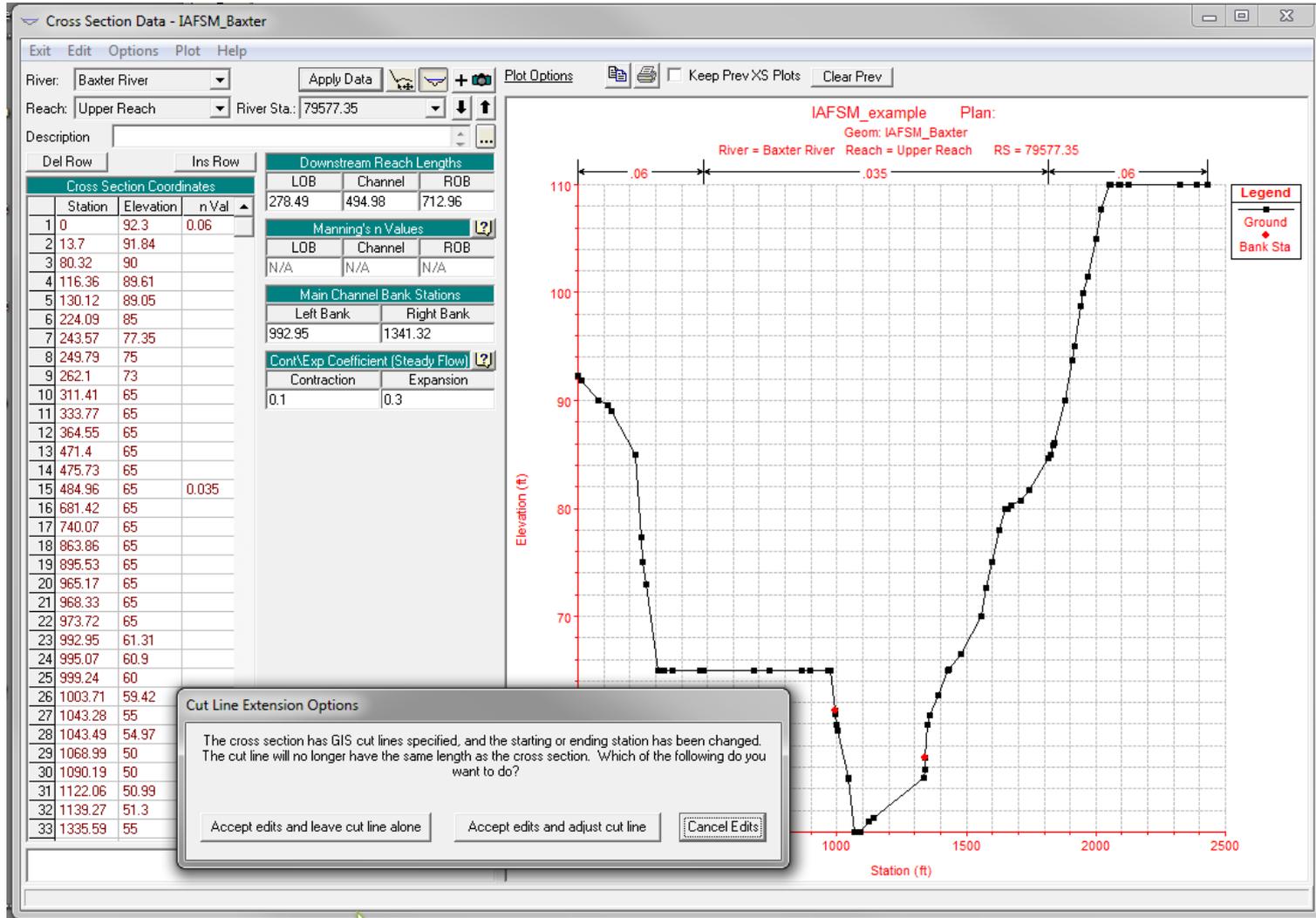
# Graphical Cross Section Editor



# Cross Section Points Filter



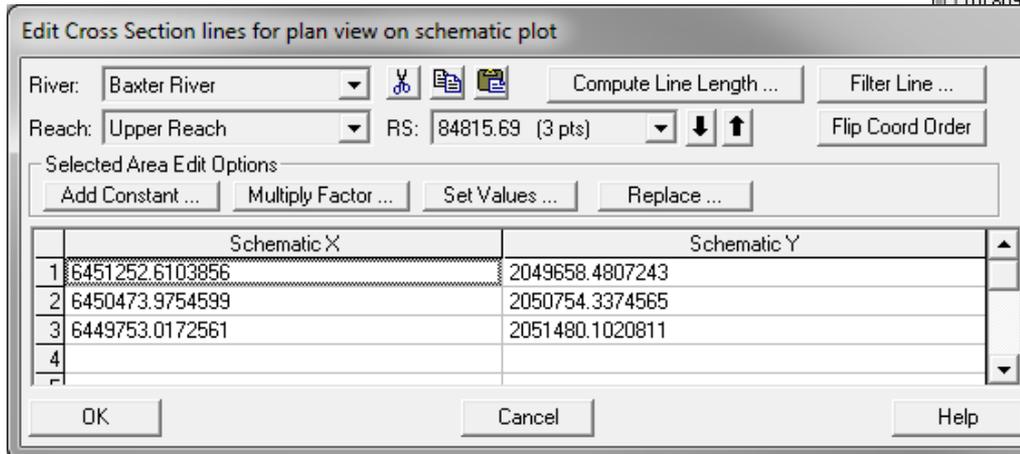
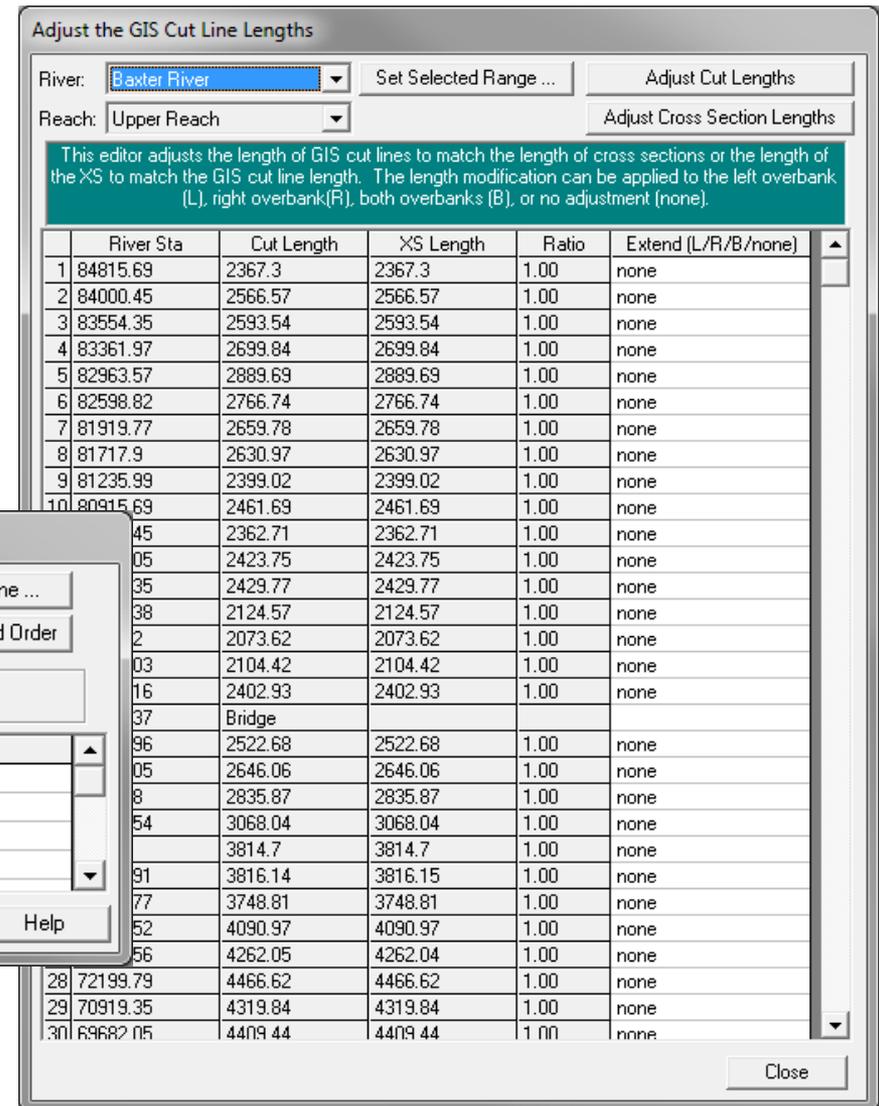
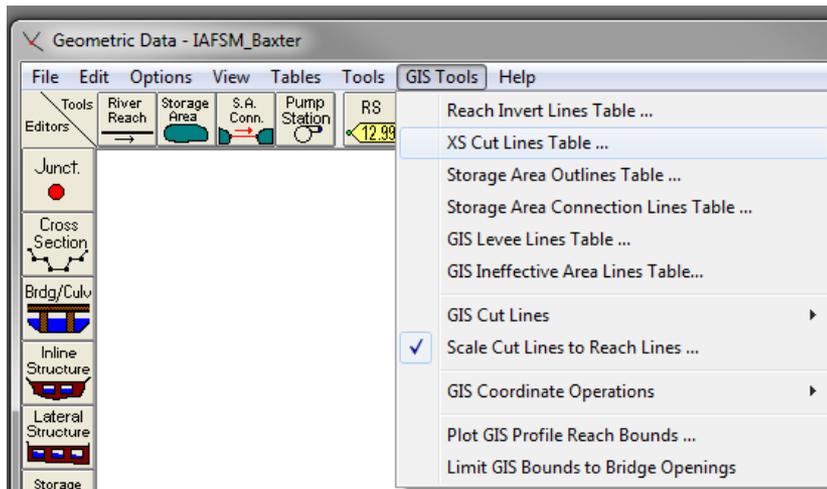
# Modifying Cross Section Extents



Very important for proper floodway mapping

# Modifying Cross Section Extents

(If you choose 'Accept edits and leave cut line alone')



# From Import to Running Model

## What still needs to be added?

- Data purposefully omitted from Geo-RAS
- Hydraulic structure data
  - Opening geometry, connections
- Additional levee, ineffective flow, block obstructions data
  - Opening geometry, revised elevations, etc.
- Detailed channel geometry
- Flow data (with boundary conditions)

Reminder:

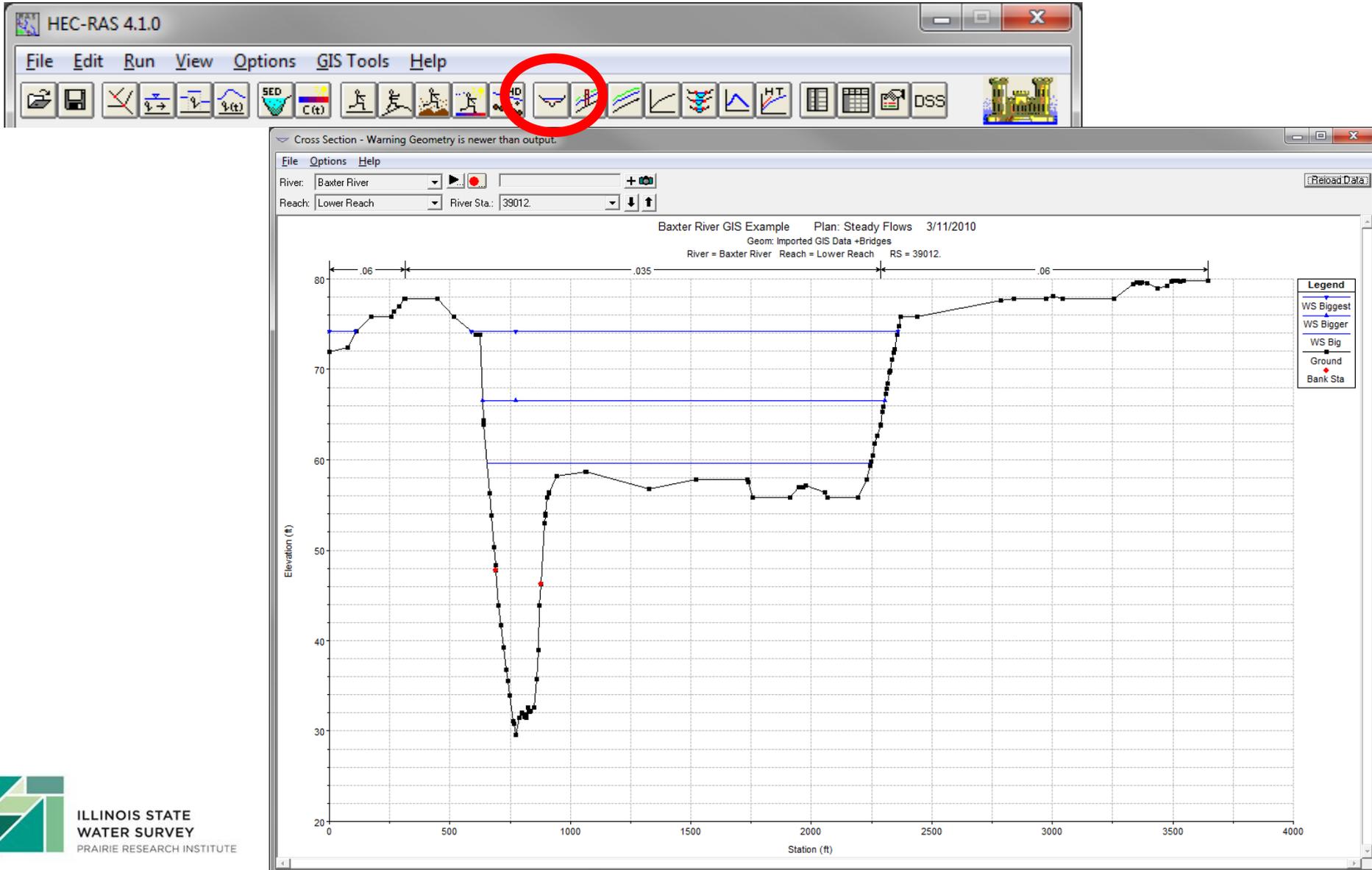
*“Importing data generated from GIS layers will not create a complete river hydraulics model”*

# Initial Review of Results

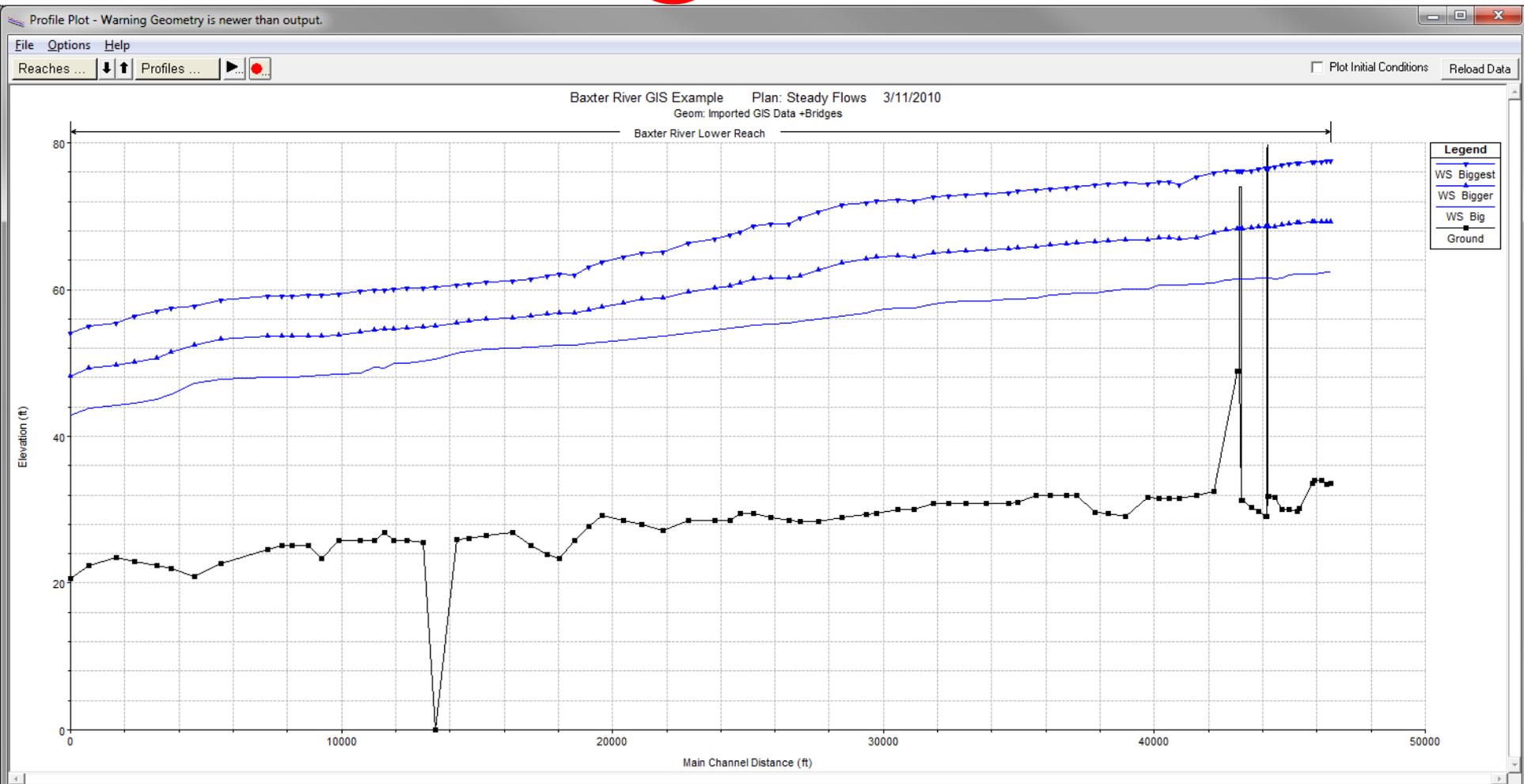
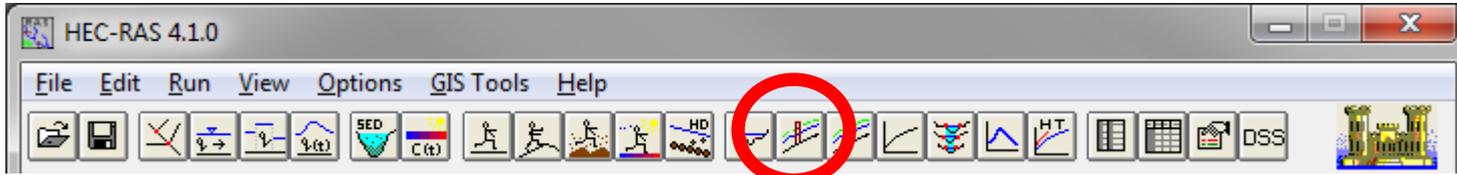
## Compute the Steady or Unsteady Flow Analysis

- Review the results and adjust your model as necessary
  - Check especially for
    - Cross sections that cannot contain the range of flows
    - Consistent levee overtopping
    - Ineffective areas around bridges / natural floodplain constrictions
- Tools for review
  - View Cross Sections
  - View Profiles
  - View 3D Multiple Cross Section Plot
    - Set Azimuth Angle to 90

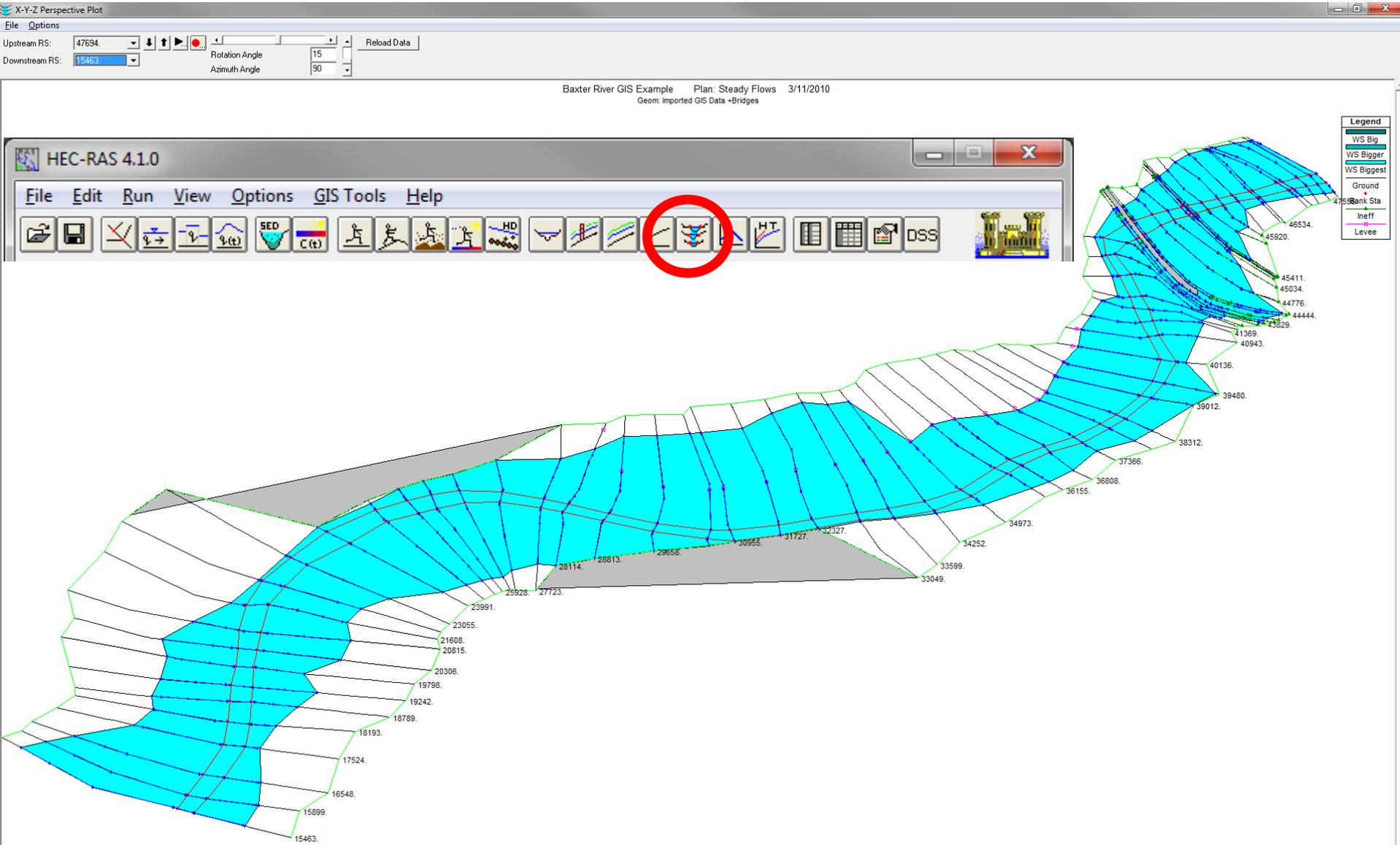
# View Cross Sections



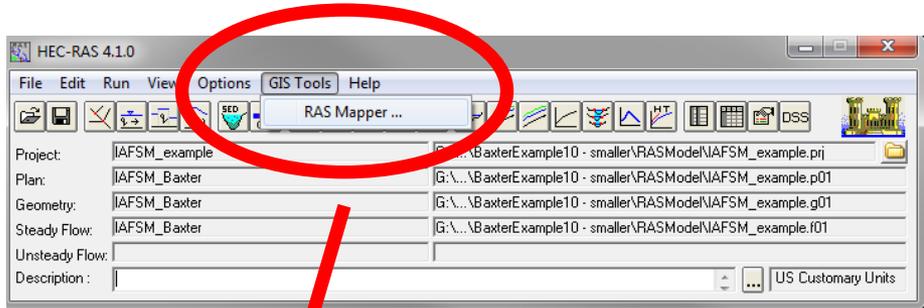
# View Profiles



# View 3D Multiple Cross Section Plot

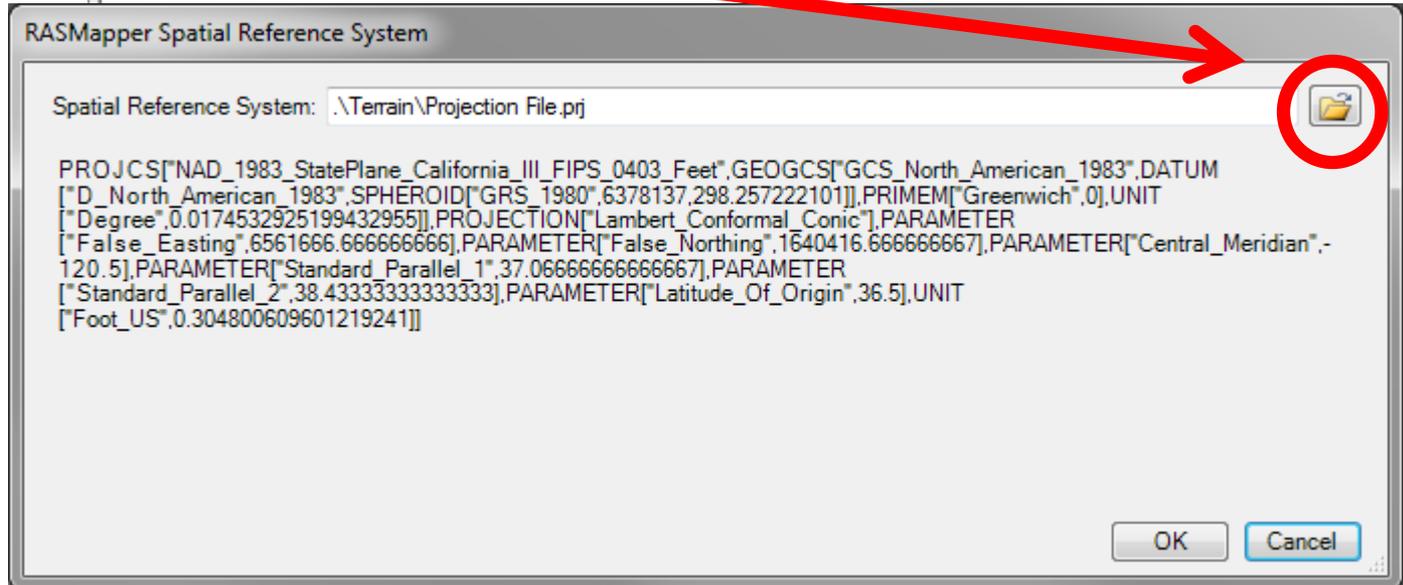
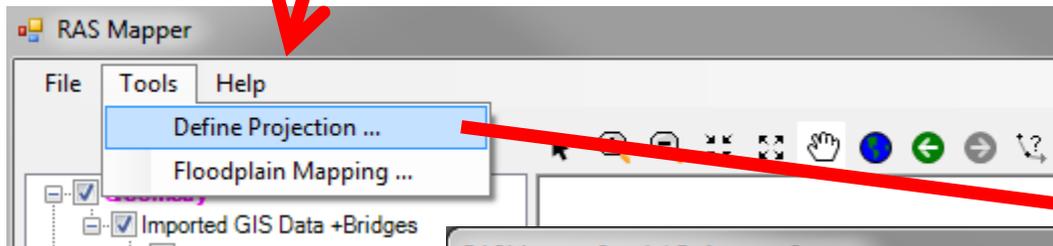


# RAS Mapper

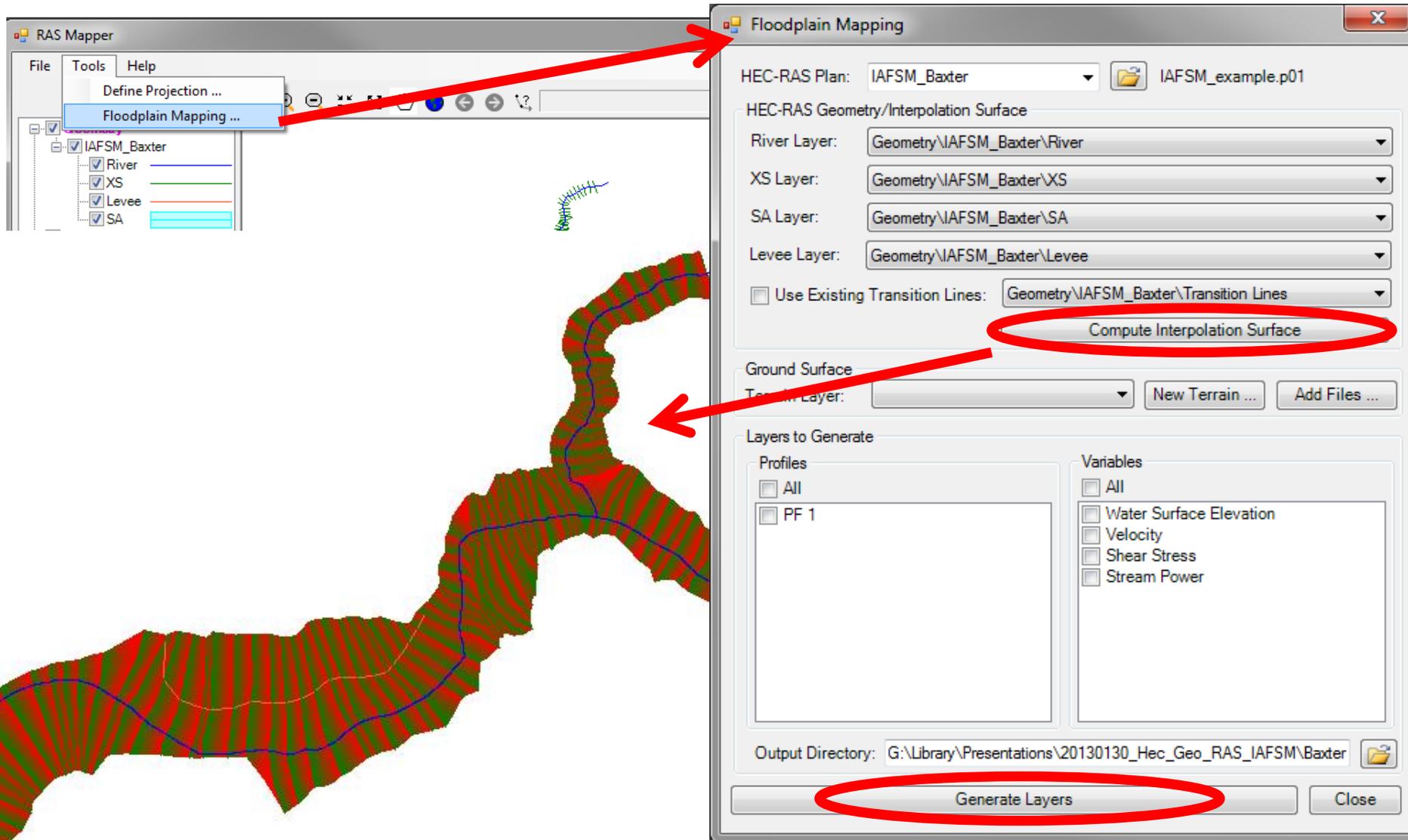


Note: Need DTM in float (.flt) format

To convert a DEM, use “Raster to Float (Conversion)” tool in ArcMap



# RAS Mapper



# RAS Mapper

The screenshot displays the RAS Mapper software interface. The main window shows a map with a river channel (cyan), floodplains (orange and red), and various layers. A context menu is open over the 'Big Floodplain' layer, with the following options:

- Remove Layer
- Move Layer
- Zoom to Layer
- Add File to Layer ...
- Save Layer As ...
- Layer Properties ...

The layer list on the left is organized into three main sections:

- Geometry**
  - Imported GIS Data +Bridges
    - River
    - XS
    - Levee
    - SA
    - Transition Lines
    - Interpolation Surface
    - Transition Lines 1
    - Transition Lines 2
- Results**
  - Steady Flows
    - Big Floodplain
- Terrain**

The status bar at the bottom shows the following log of operations:

```
Creating transition lines...(Done 1 sec)
Creating interpolation surface...(Done 0.5 sec)
Processing WS Profile: Big
  Depth Grid and Boundary ... (Done 5 sec)
Creating color ramp: Geometry 0.00 sec
Creating color ramp: Big Floodplain 0.00 sec

Creating transition lines...(Done 1 sec)
Creating interpolation surface...(Done 0.5 sec)
Processing WS Profile: Big
  Depth Grid and Boundary ... (Done 6 sec)
Creating color ramp: XS 0.02 sec
Creating color ramp: Levee 0.02 sec
```

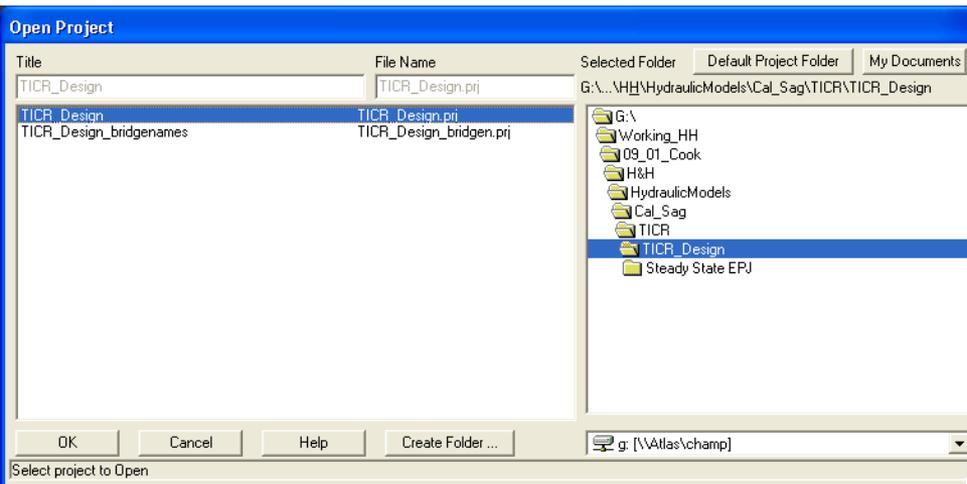
Note: Remove layers and reload following edits, they do not update automatically

# Processing HEC-RAS Results

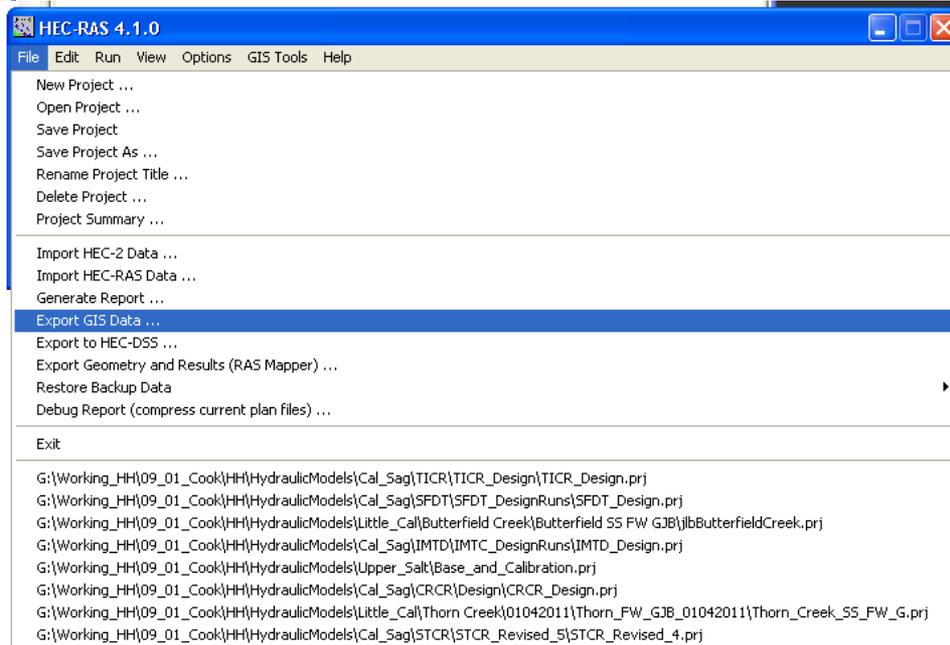
**Ryan Meekma, GISP**  
**[rmeeckma@illinois.edu](mailto:rmeeckma@illinois.edu)**  
**(217) 244-6627**

# Export GIS Files from HEC-RAS

## 1.) Open HEC-RAS Model



## 2.) File\Export GIS Data...



# Export GIS Files from HEC-RAS

## 3.) GIS Export (complete fields)

**GIS Export**

Export File: G:\Working\_HH\09\_01\_Cook\H&H\HydraulicModels\Ca\_L\_Sag\TICR\TICR\_Design\TICR\_ Browse ...

Reaches and Storage Areas to Export

Select Reaches to Export... Reaches (6/6)

Select Storage Areas to Export ... Storage Areas (0/0)

Results Export Options

Water Surfaces  Water Surface Extents Select Profiles to Export ...

Profiles to Export: Max WS

Flow Distribution (only averaged LOB, Chan and ROB values available) Additional Information

Velocity  Ice Thickness (where available)

Shear Stress

Stream Power

Geometry Data Export Options

River (Stream) Centerlines

Cross Section Surface Lines	Additional Properties
<input checked="" type="checkbox"/> User Defined Cross Sections (all XS's except Interpolated XS's)	<input checked="" type="checkbox"/> Reach Lengths
<input checked="" type="checkbox"/> Interpolated Cross Sections	<input checked="" type="checkbox"/> Bank Stations (improves velocity, ice, shear and power mapping)
<input checked="" type="radio"/> Entire Cross Section	<input checked="" type="checkbox"/> Levees
<input type="radio"/> Channel only	<input checked="" type="checkbox"/> Ineffective Areas
	<input checked="" type="checkbox"/> Blocked Obstructions
	<input checked="" type="checkbox"/> Manning's n

Export Data Close Help

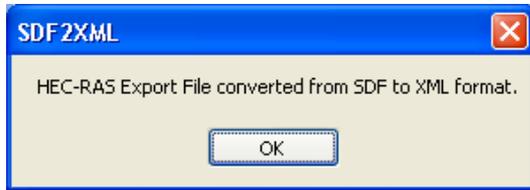
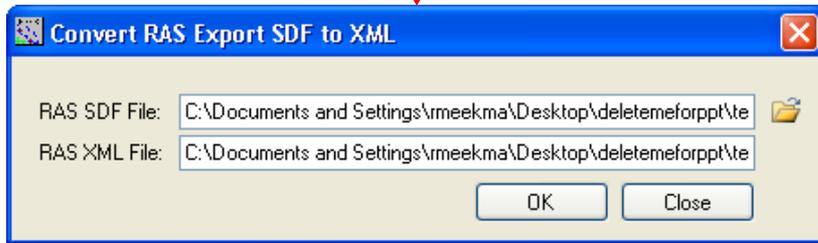
## 4.) Turn On HEC-GeoRAS Toolbar in ArcMap 10



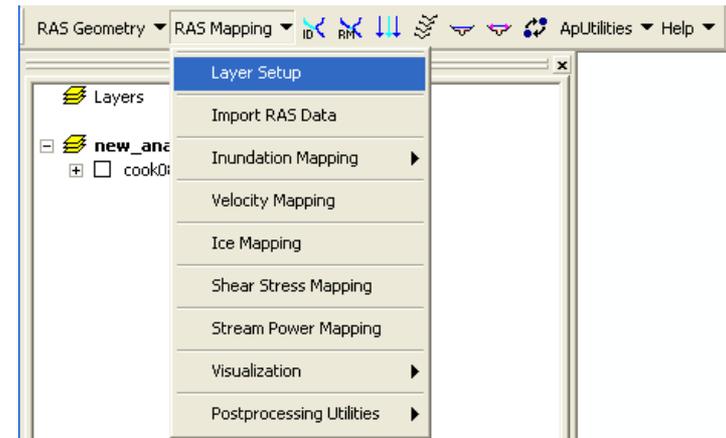
# Export GIS Files from HEC-RAS

Extract GIS Data from Hec-RAS using the Geo-RAS Tool in GIS

## 5.) Importing the RAS GIS Export file \ SDF Conversion to XML



## 6.) Save MXD \ RAS Mapping \ Layer Setup



# Export GIS Files from HEC-RAS

Extract GIS Data from Hec-RAS using the Geo-RAS Tool in GIS

## 7.) Complete Dialog Box

- Point to RAS GIS Export File
- Set file path to DTM
- Set Output Directory

Layer Setup

Analysis Type

Existing Analysis

New Analysis

new\_analysis\_ppt\_test

RAS GIS Export File

C:\Documents and Settings\rmeekma\Desktop\deletemef

Terrain

Single

Multiple

Terrain Type

TIN

GRID

Terrain

\\Atlas\Nidar\3\_DEMS\Cook\_LAS\cook081a

DTM Tiles Layer

Output Directory

C:\Documents and Settings\rmeekma\Desktop\deletemef

Geodatabase

new\_analysis\_ppt

Rasterization Cell Size

3 (map units)

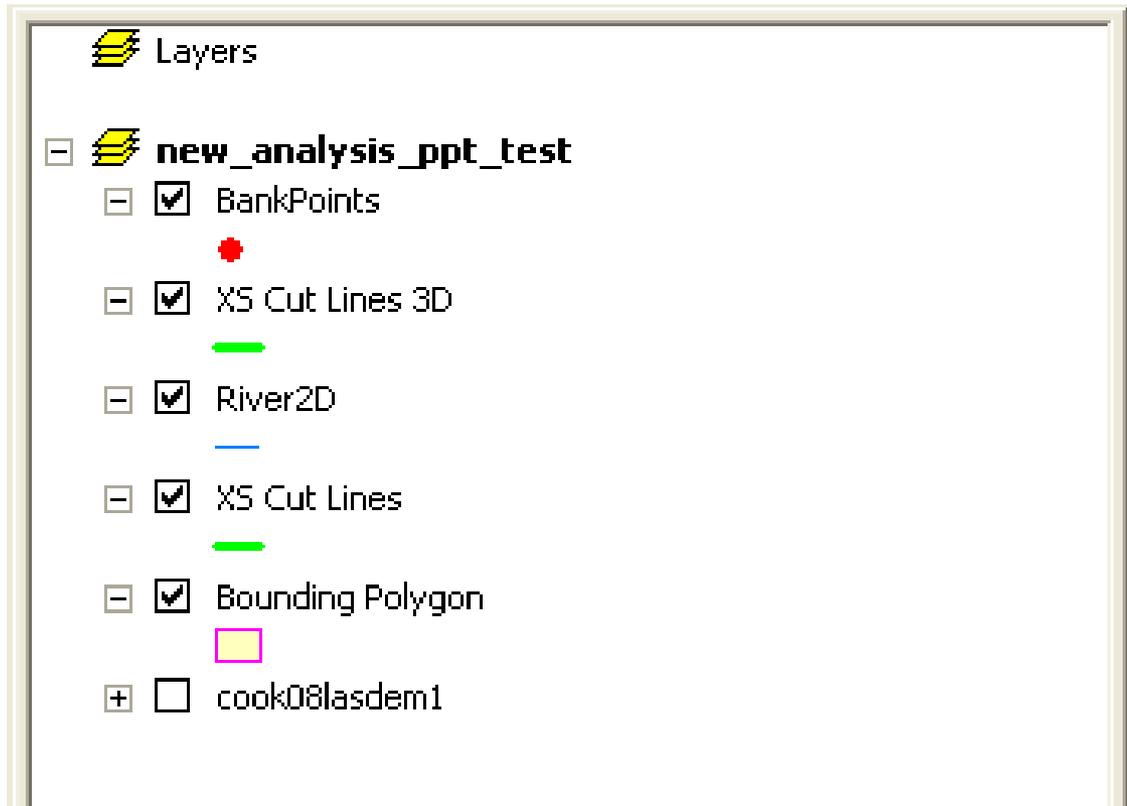
OK Help Cancel



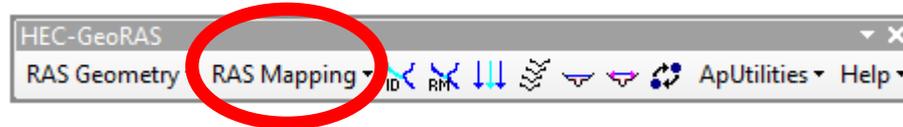
# Export GIS Files from HEC-RAS

Extract GIS Data from Hec-RAS using the Geo-RAS Tool in GIS

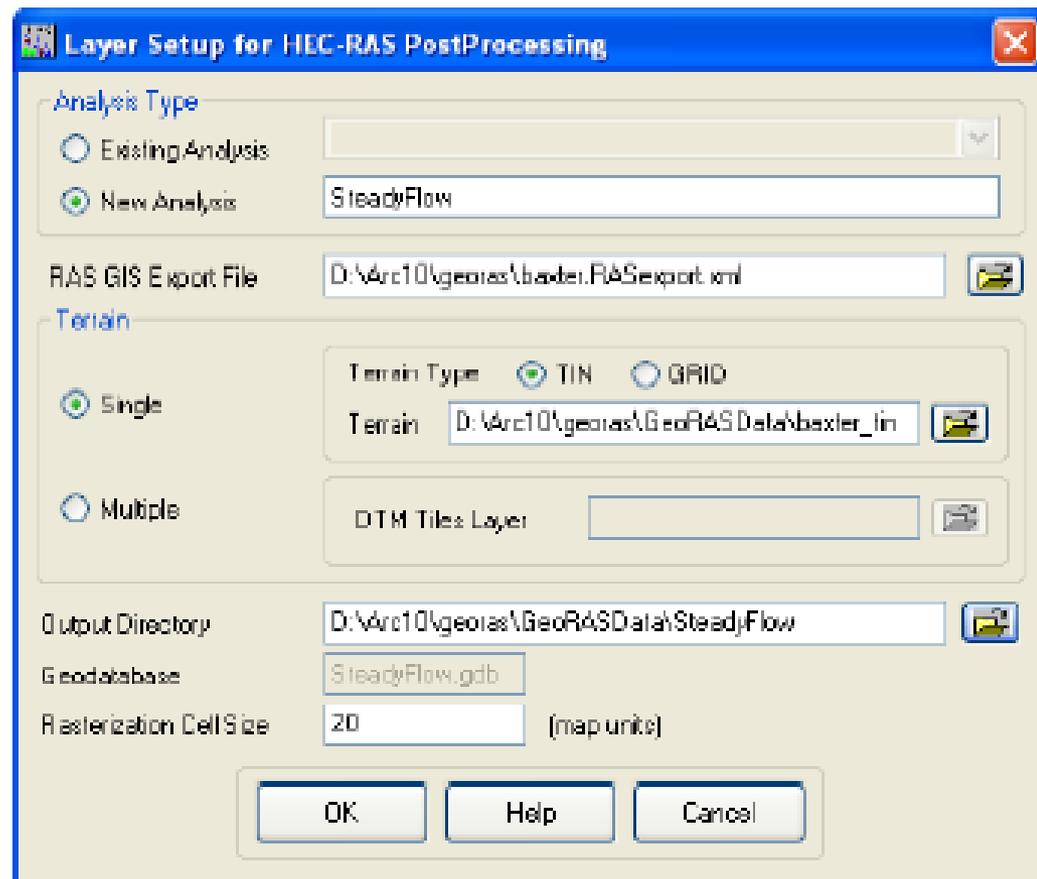
## 9.) Data Processing Completed



# Inundation Mapping Using GeoRAS

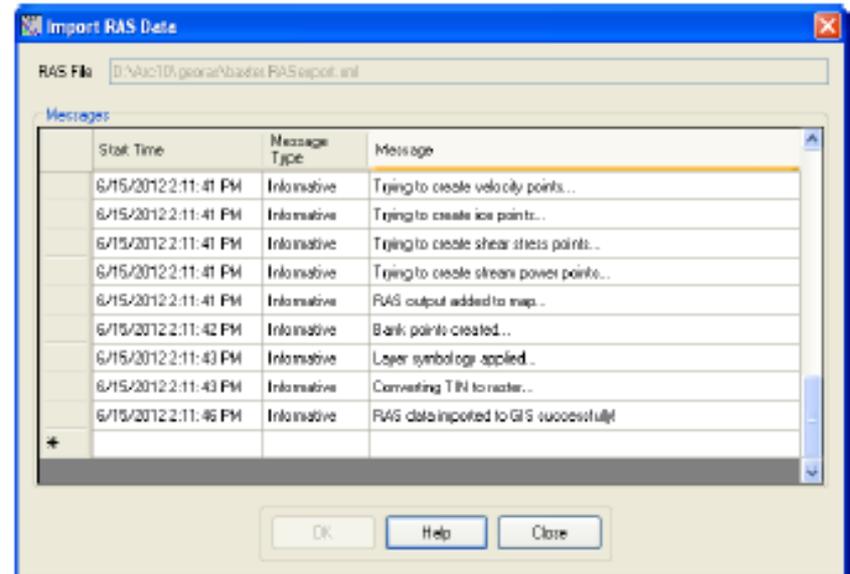


- To begin click
  - RAS Mapping
  - Layer Setup
    - Populate post processing layer menu



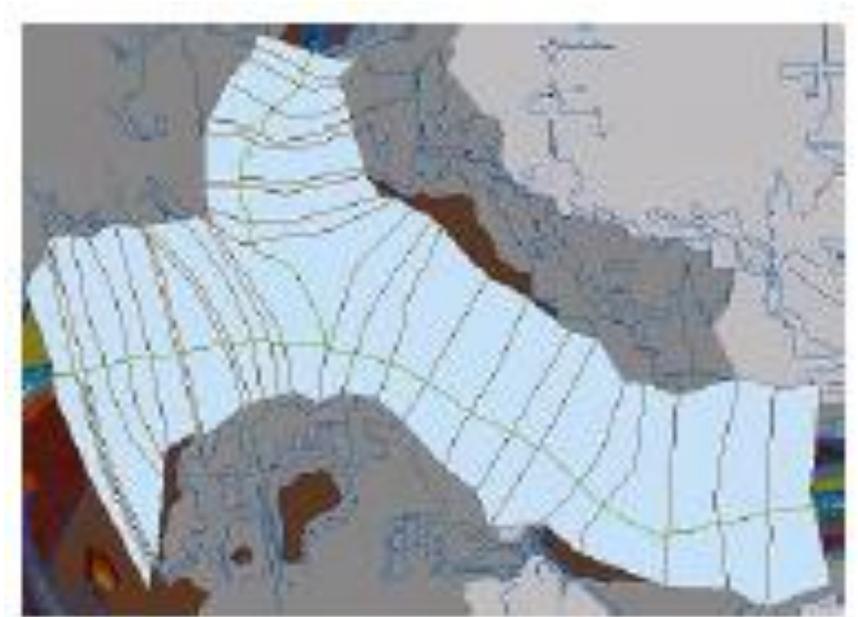
# Inundation Mapping Using GeoRAS

- Next Step
  - RAS Mapping
  - Import RAS Data



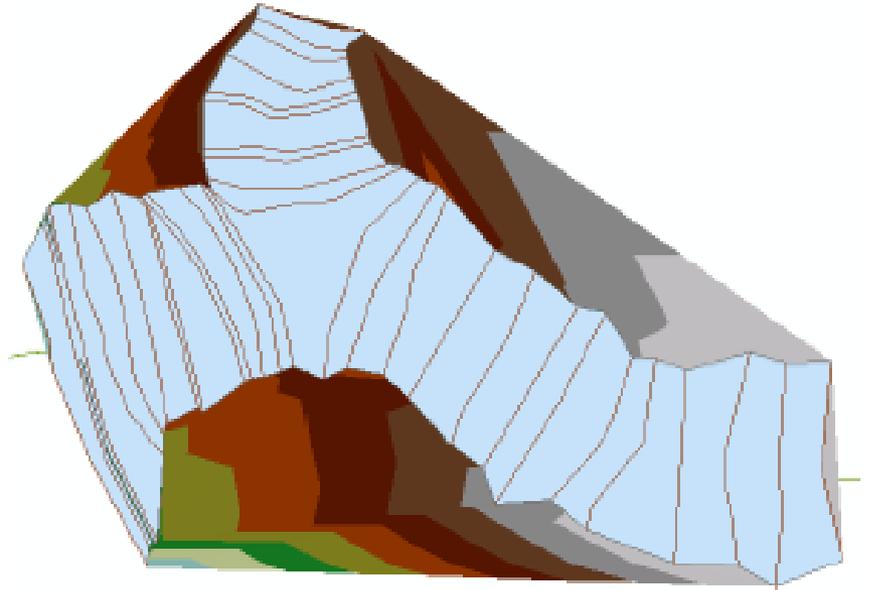
# Inundation Mapping Using GeoRAS

- Bounding Polygon Created
- Defines analysis extent for inundation mapping



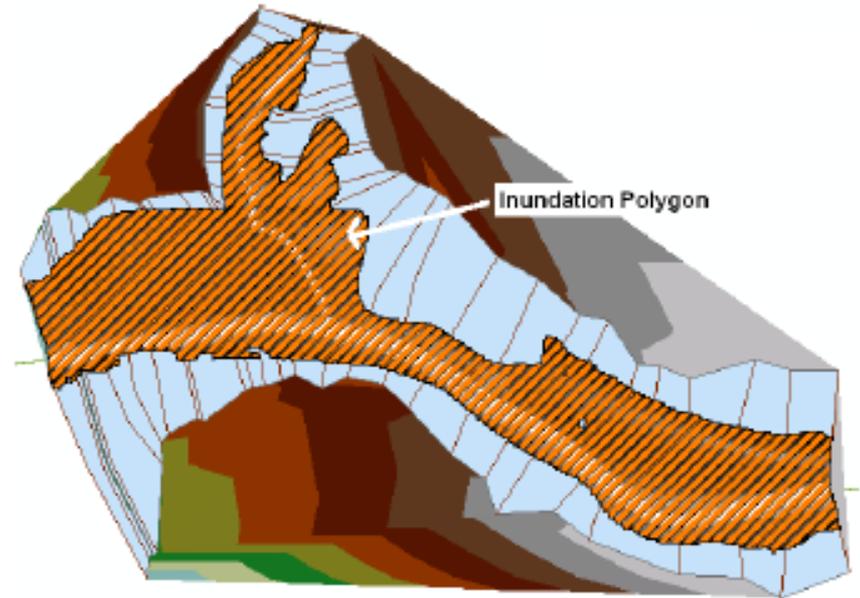
# Inundation Mapping Using GeoRAS

- RAS Mapping
  - Inundation Mapping
    - Water Surface Generation
      - Pick a profile



# Inundation Mapping Using GeoRAS

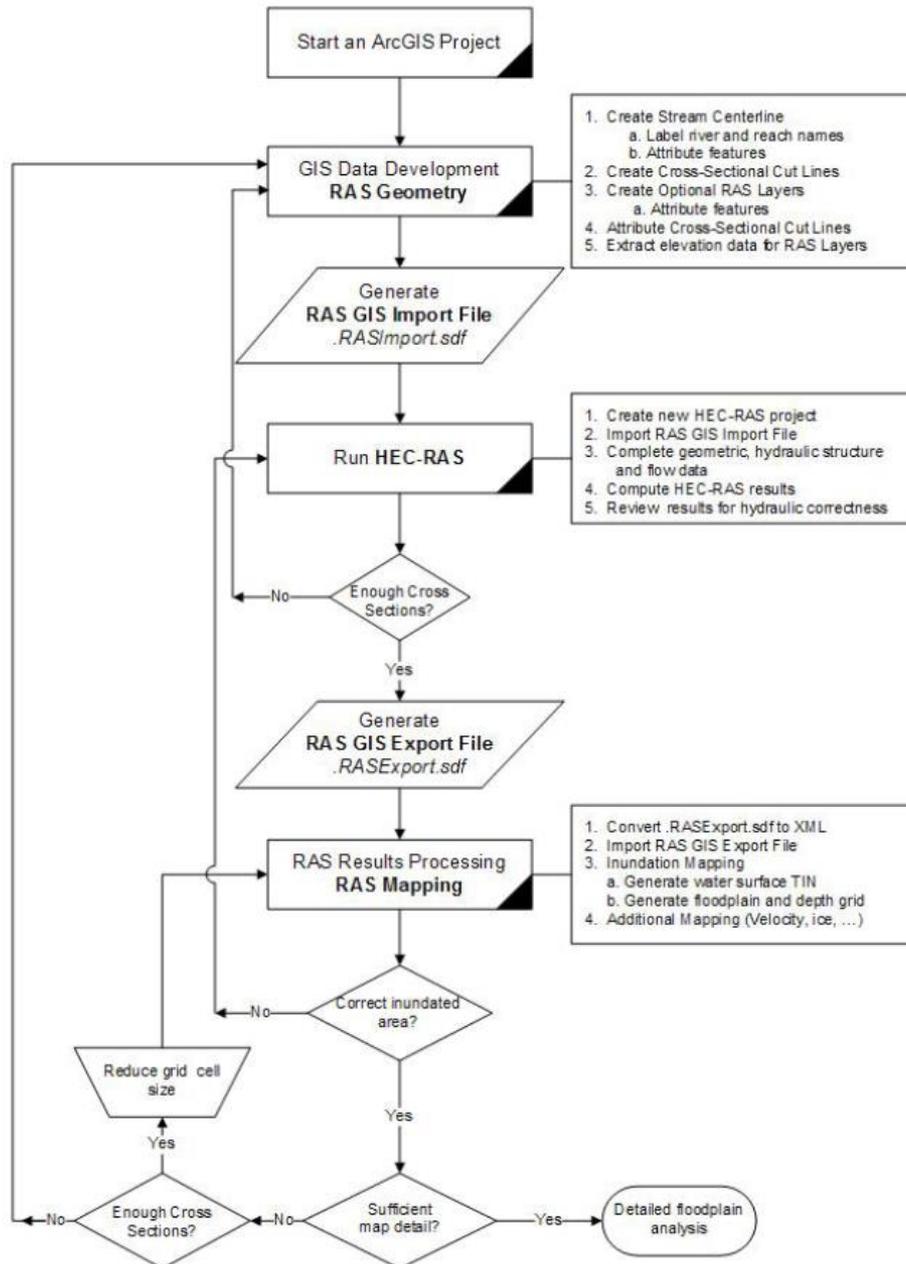
- RAS Mapping
  - Inundation Mapping
    - Floodplain Delineation using Rasters
      - Pick a profile
- DTMGRID – Water Surface
  - Positive Numbers
    - Water surface is higher than terrain (flooding)
  - Negative Numbers
    - Results are dry



# Inundation Mapping Using GeoRAS

- **WARNING:** refinement of flood inundation results is not covered in Geo-RAS!
- The ability to judge quality of terrain and flood inundation polygons comes with the knowledge of study area and experience.
- Smoothing floodplains does not count as creating hydraulically correct output.
  - It induces error

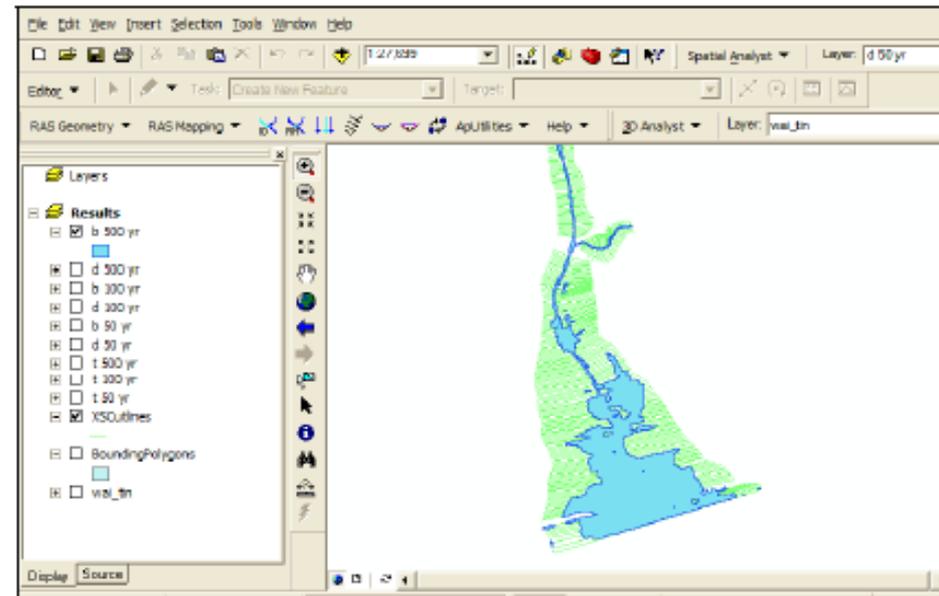
# GIS to RAS, RAS to GIS



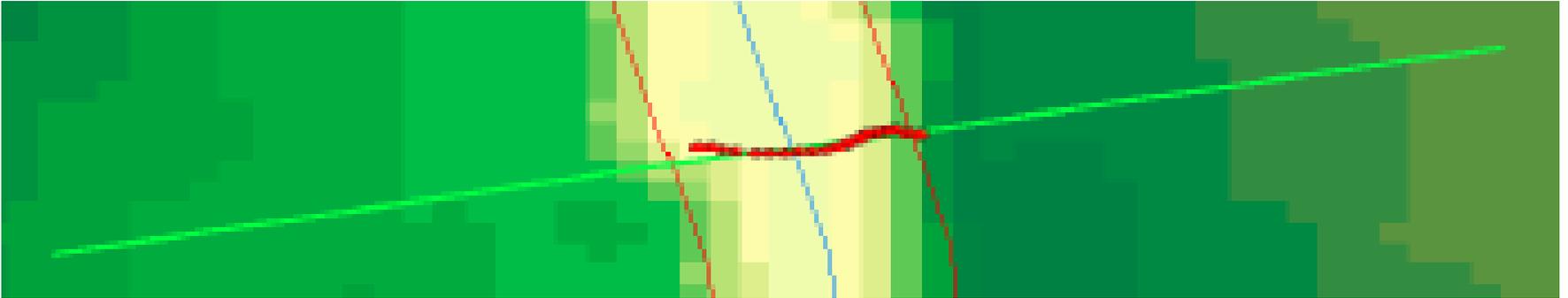
# GIS Approach to Mapping Floodplains

## Using “3D Analyst” and “Spatial Analyst” Extensions in ArcMap

- Extending Cross sections (Manually editing a copy of layer)
- Creating a TIN from extended Cross Sections
- Convert a TIN to Raster = WSEL Raster
- WSEL – Land Surface = floodplain
- Reclassify raster results
- Convert raster to feature
- Clean up the features
- Create Topology Rules
- Attribute Flood Hazard Lines



# Update Elevations



*Figure 4-10. Bank lines define the limit of elevation replacement by point data on a cross section.*

- Incorporate Survey Points into 3D XS feature class
- XS must have previously extracted elevation from the land surface (DTM or DEM, TIN)

# Update Elevations

- Elevation Update Tool
  - Requires:
    - Point feature class
    - Field of elevation values

**Update XS Cutoff Profiles**

XS Cutoffs: XSCutoffs

XS Cutoff Profiles: XSCutoffs3D

Bathymetry Points: BathymetryPoints

Elevation Field: ELFTNAVD88

Select interpolation limits

Bank Extents

Interpolation Area: Channel

Bank Lines: Banklines

Bank Points: Null

XS Tolerance: 100 (maps units)

Bathymetry Extents

Bathymetry Extents: Null

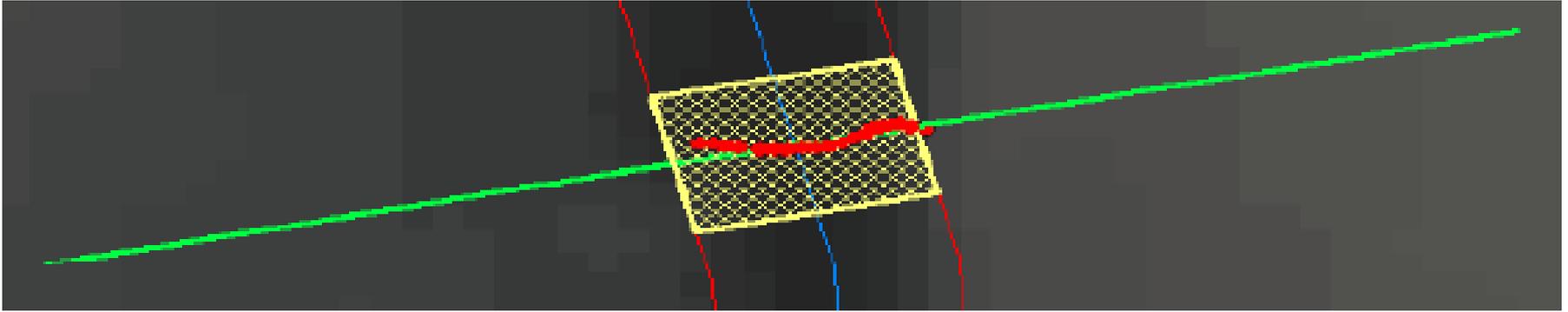
XS Extents: Null

Updated XS Profiles: XSCutoffs3DUpdated

Draw graphics

OK Help Cancel

# Update Elevations



*Figure 4-12. Elevation points used in the update process are highlighted along with the extents used for point inclusion.*

- XSCutlines3D feature class
- Elevation Points
- “ElevUpdate” field is added and includes a “1” if point is used

# Update Elevations

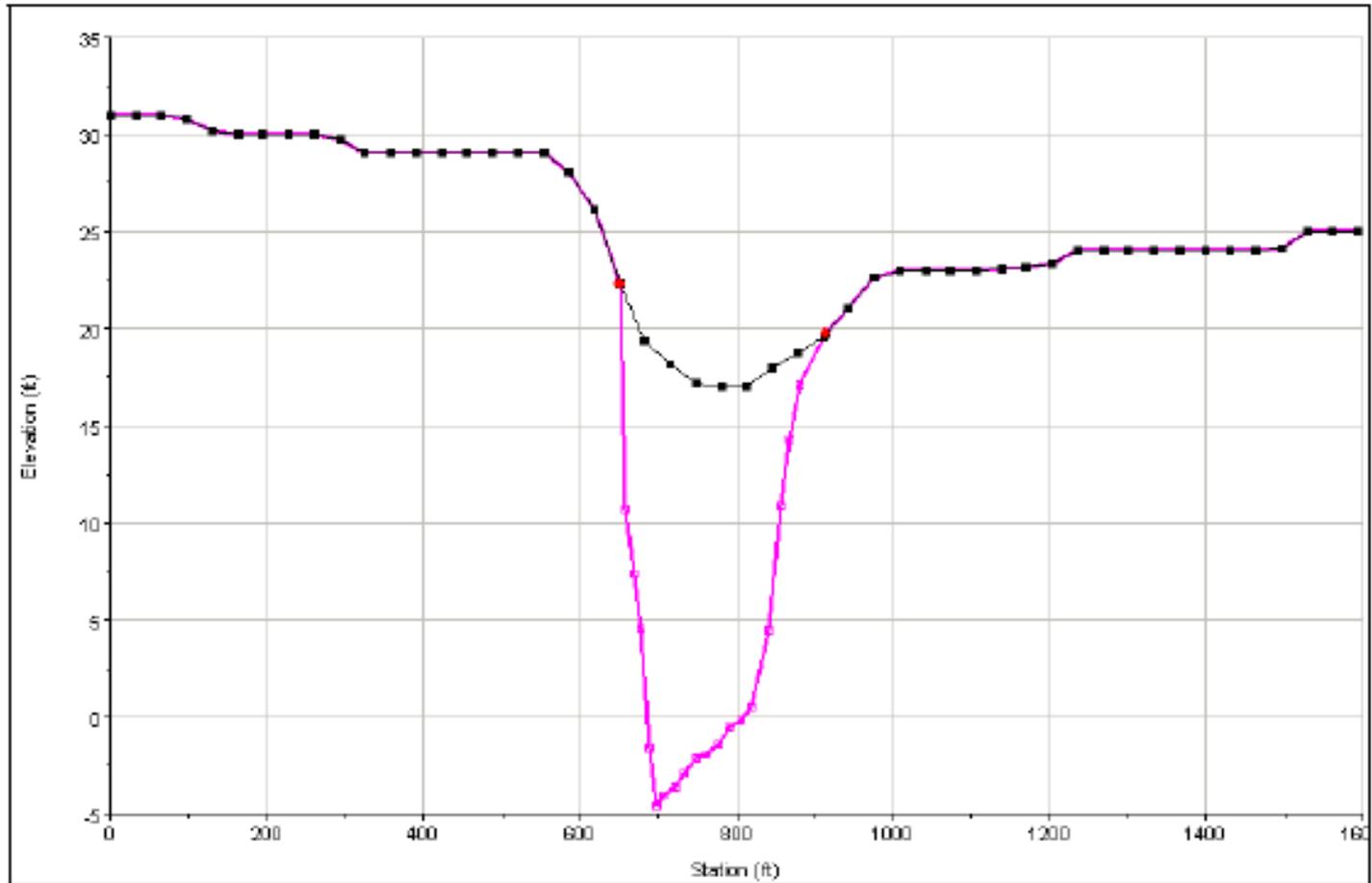


Figure 4-13. Comparison of original cross section with updated profile with channel data.



# Developing Bridge \ Culvert Data

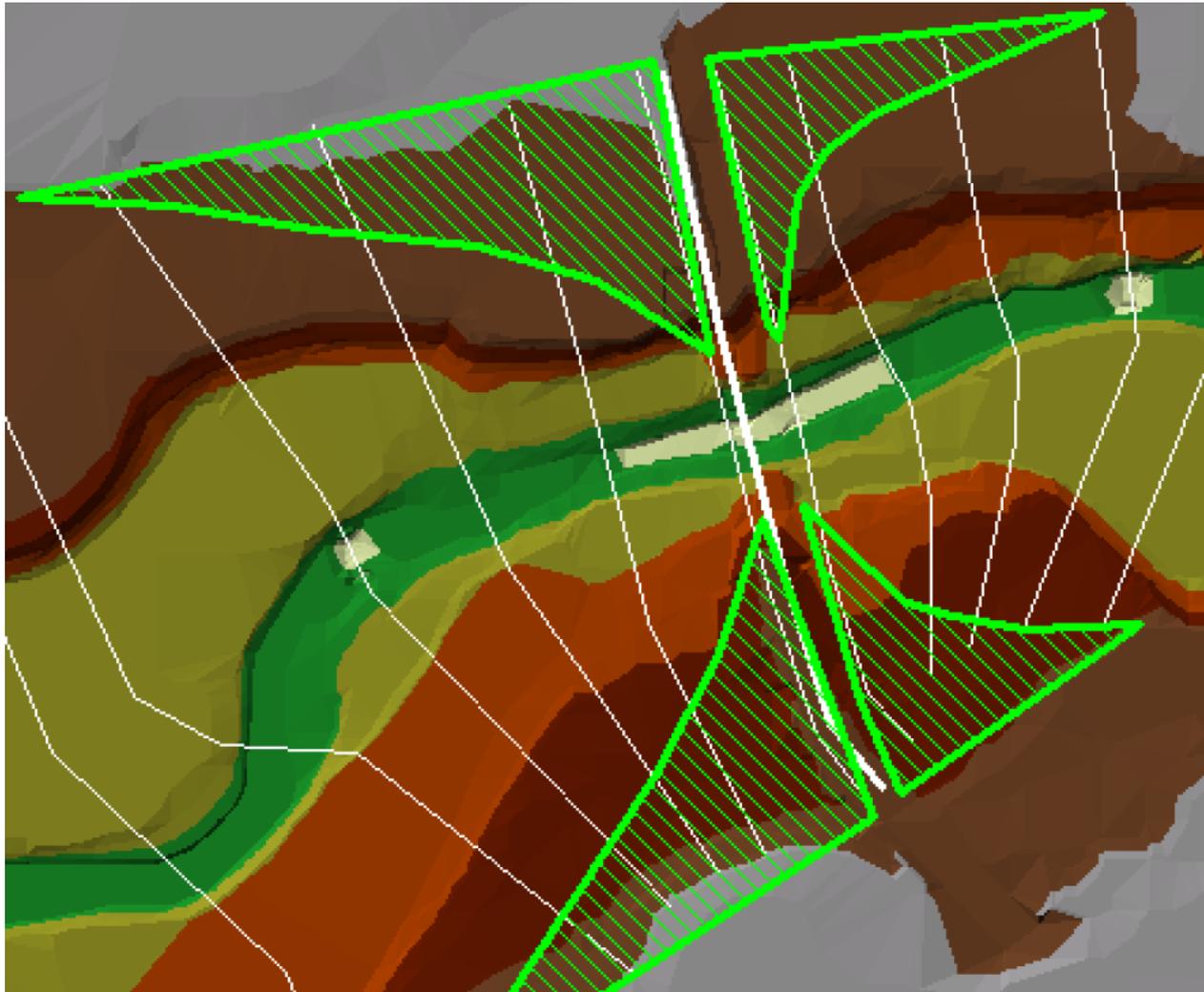
(optional) Same method for Inline Structures



RAS Geometry | Bridges / Culverts| River/Reach Names  
Stationing  
Elevations

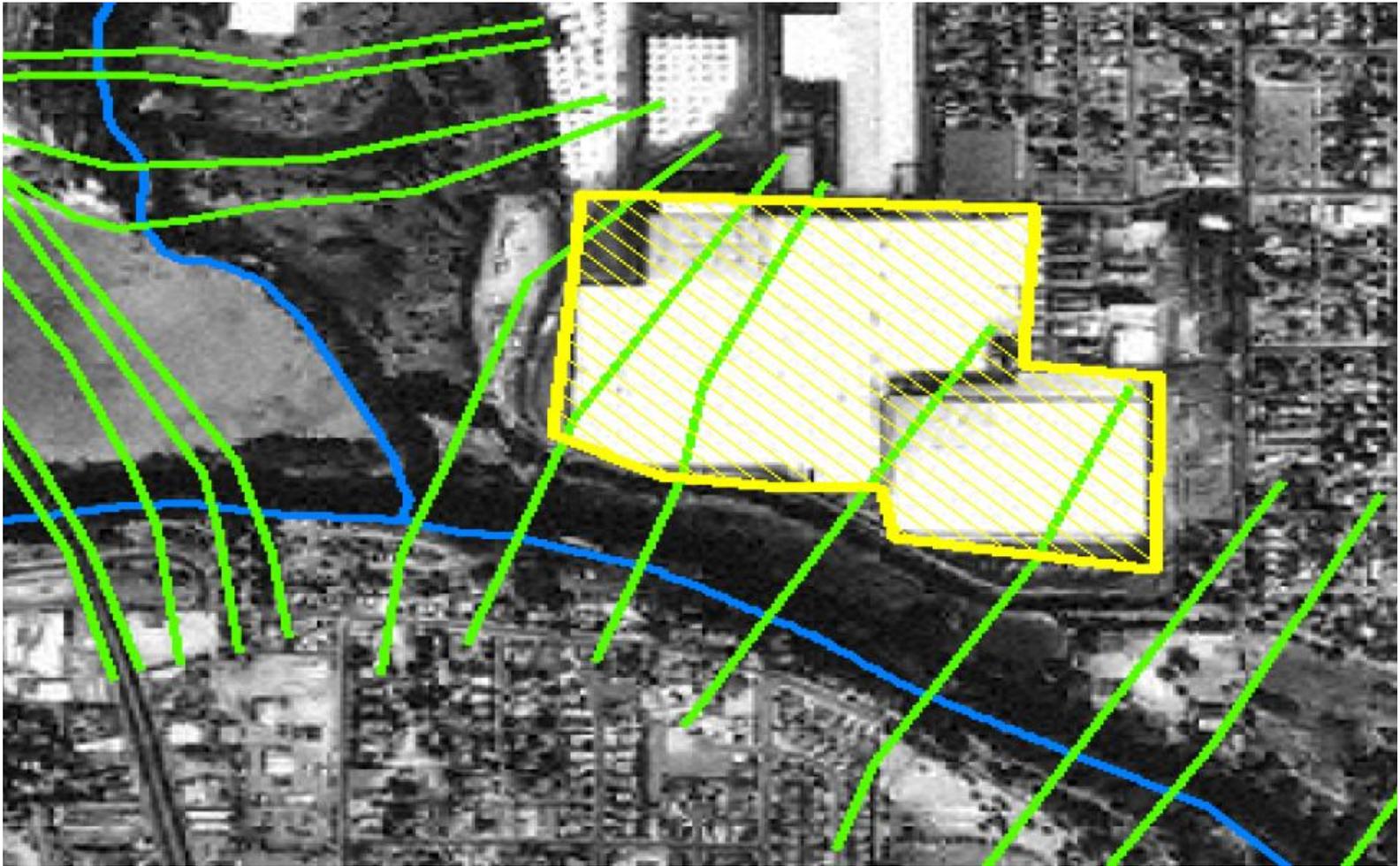
# Developing Ineffective Flow Areas

(optional)



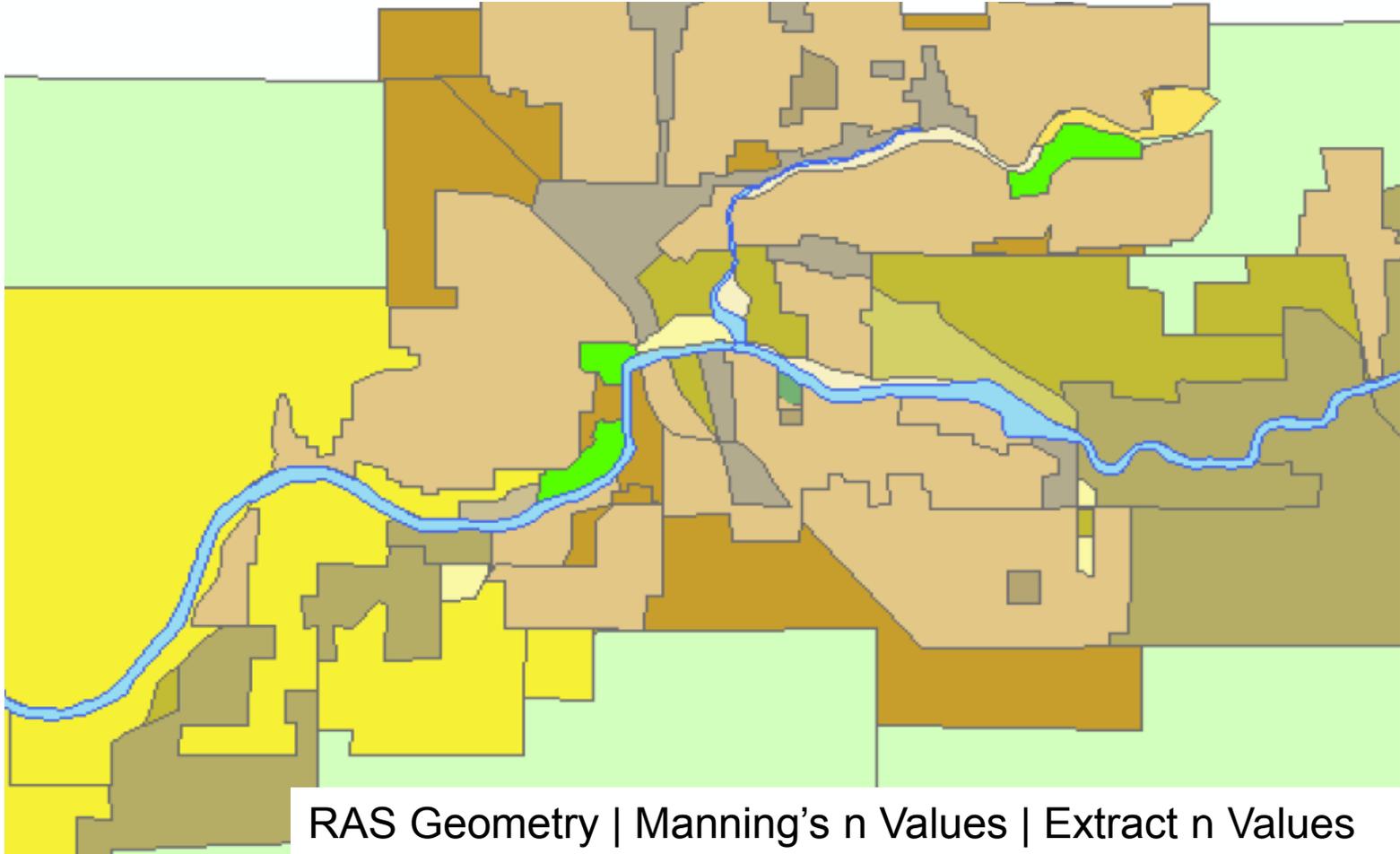
# Developing Blocked Obstructions

(optional)



# Developing Manning's 'n' from Land Use Data

(optional)



# Developing Levee Data

(optional)

The screenshot displays the HEC-GeoRAS interface. A map shows a pink levee line with several brown circular markers. A dialog box titled "Assign Levee Elevation" is open, showing "Spot Elevation" as 65.631 and "User Elevation" as 70. A red arrow points from the "User Elevation" field to a marker on the map. Below the map is a table titled "LeveePoints" with the following data:

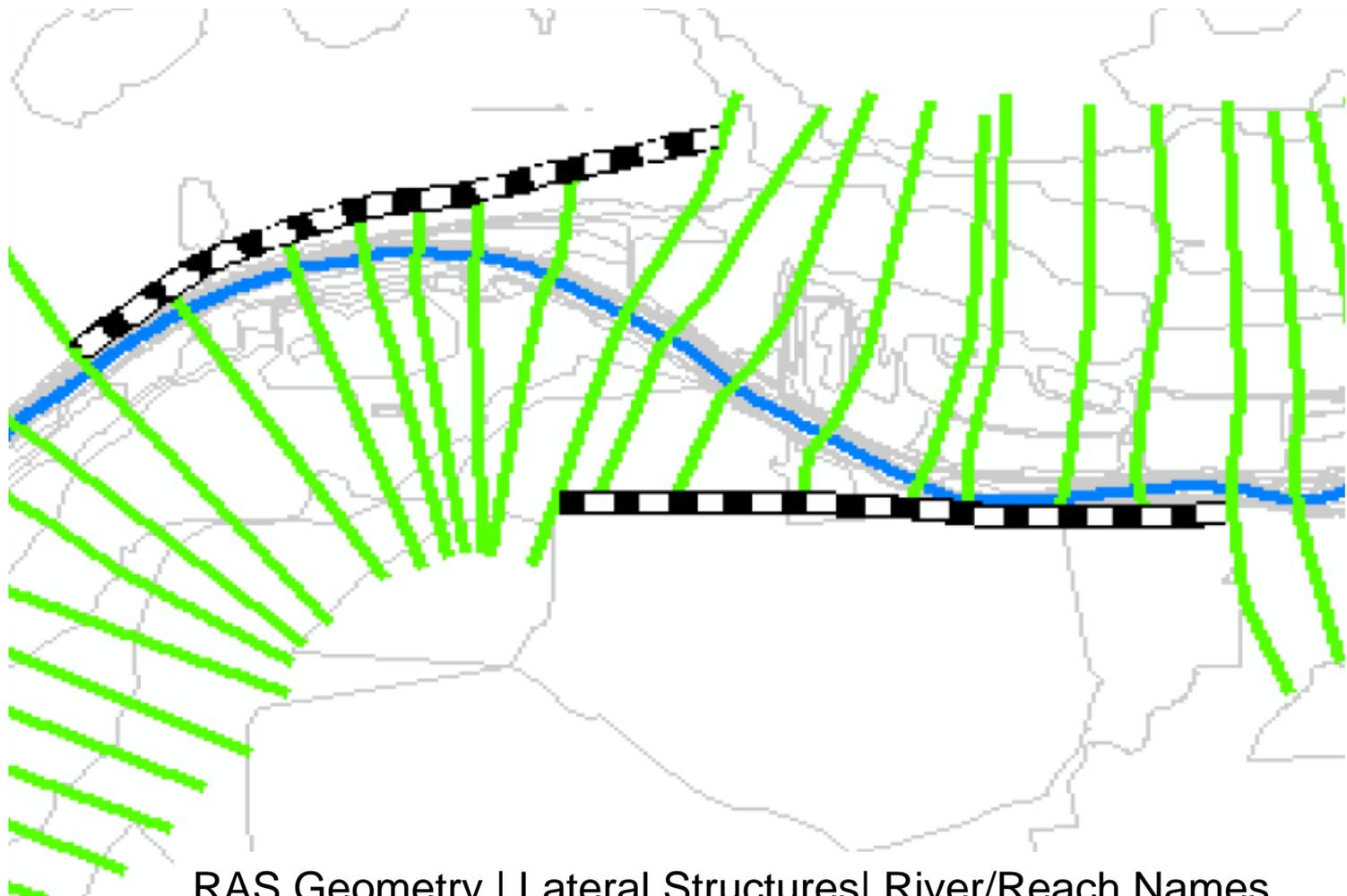
Shape *	OID *	LeveeID	Station	Elevation
Point	1	556	118.36	80
Point	2	556	1981.744	75
Point	3	556	5180.528	72

At the bottom, the HEC-GeoRAS toolbar is visible, with a red circle highlighting the "Levee" icon.

RAS Geometry | Levee | Profile Completion  
Positions

# Developing Lateral Structures

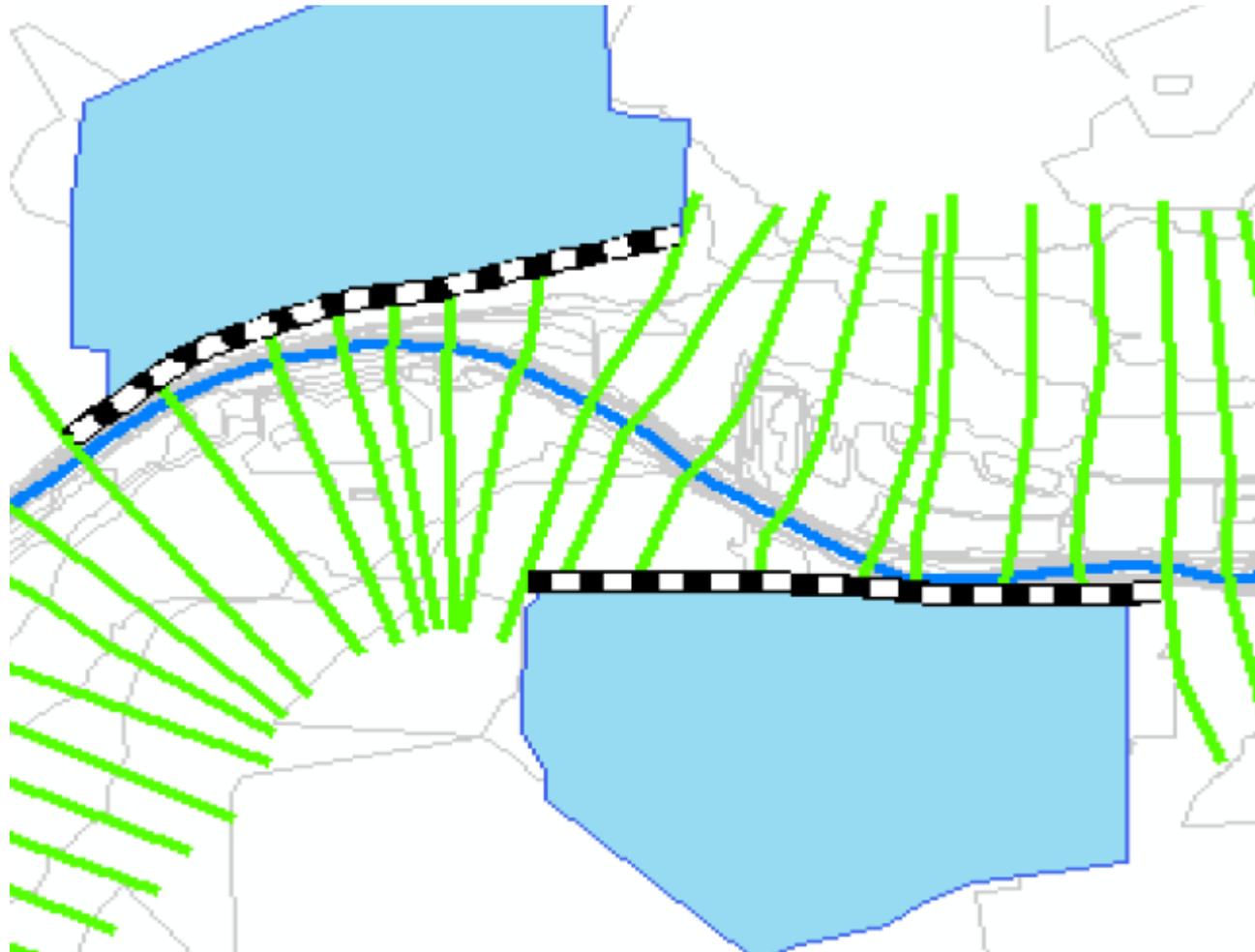
(optional)



RAS Geometry | Lateral Structures | River/Reach Names  
Stationing  
Elevations

# Developing Storage Areas

(optional)



RAS Geometry | Storage Areas |

Elevation Range  
Elevation-Volume Data



# Developing Tiled Terrain Data

(optional)

- Need a terrain tiles feature class to serve as a look up table
- Each RAS layer feature must be contained within one terrain tile polygon feature
- DTMs should overlap to properly represent the terrain at the edges when using TIN models
- DTMs should break at straight river reaches and not confluences
- All of Chapter 9 of the GeoRAS Users Manual is devoted to this topic

# Additional Reference Materials

- <http://www.hec.usace.army.mil/>
- HEC-GeoRAS User's Manual v10
- HEC-GeoRAS 10 Example Data Sets
- HEC-RAS 4.1 User's Manual, Applications Guide, and Hydraulic Reference Manual
- *Tutorial on using HEC-GeoRAS with ArcGIS 10 and HEC RAS Modeling* by Venkatesh Merwade, Purdue University



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