RAS Mapper Dam Breach Geometry Workshop

1 Objective

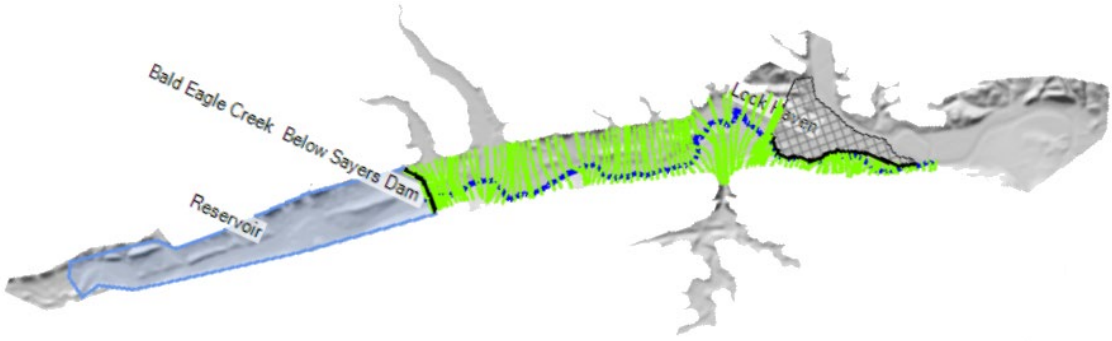
In this workshop, you will learn how to create an HEC-RAS model from a digital terrain model (DTM). The general process will teach you how to create geospatial data in RAS Mapper to represent the river system and floodplain area specifically for performing a dam breach analysis with HEC-RAS.

Once the geometric data has been created, you will identify data that requires correction and enter remaining data to complete the RAS model.

NOTE: While this data is from an actual river system, the model and results of this workshop do not represent current or future conditions of the river. The United States Army Corps of Engineers has granted access to the information in this model for instructional purposes only. Do not copy, forward, or release the information without United States Army Corps of Engineers approval.

2 Background

You will be working on Bald Eagle Creek near Lock Haven, PA. A flow hydrograph will be used to simulate inflows to into the reservoir behind Sayer's Dam. The water surfaces will then be used in the GIS to perform floodplain mapping.



This workshop is comprised of two parts: geometric data development using HEC-RAS Mapper; and completion of the data in the HEC-RAS Geometric Editor.

Work quickly, but thoughtfully, and be sure to read each part carefully. When you have questions, don't hesitate to ask! Lastly, don't get too carried away with being accurate – this is a workshop. It is intended to highlight the general use of using HEC-RAS Mapper for data development and editing.

3 Start a new HEC-RAS Project with Terrain

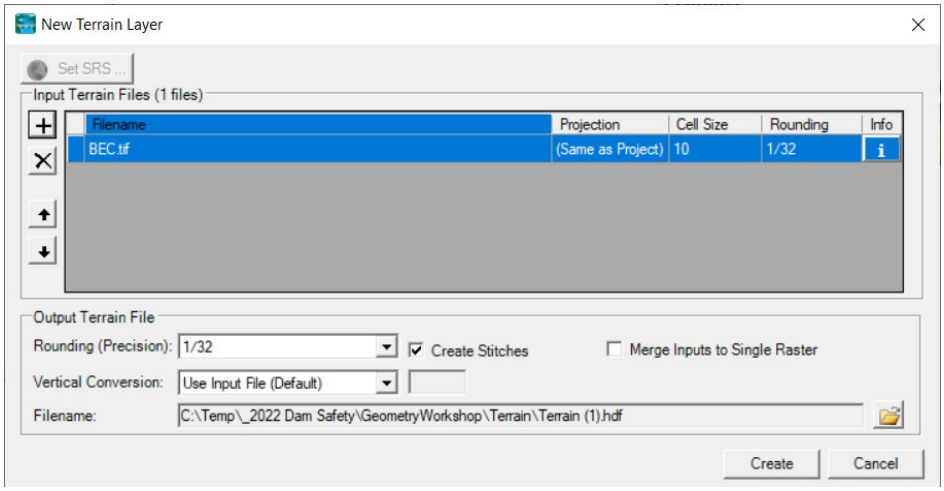
You will be starting from scratch with a new HEC-RAS project.

3.1 Create a new HEC-RAS Project

1. Create a **NEW** HEC-RAS project and give it a Name.
2. Go to the Geometric Data Editor and select **File | New Geometry Data**. Provide a name and press **OK**.

3.2 Import the Terrain Model

1. Open **RAS Mapper** and set the Projection for the project, using the **Tools | Set Projection for Project** menu item. Browse to the "**GISData**" folder in the workshop folder and select the "**projection.prj**" file.
2. Create a new terrain model using the **Tools | New Terrain** menu item.
3. Click to **+** button to add the terrain file. Use the "**BEC.tif**" file located in the "**GISData**" folder.



4. Press the **Create** button to import the terrain data.
5. **Close** the dialog once the Terrain has been created.

4 Geometry Development

Use the RAS Mapper Editing Tools to create a 1D RAS model geometry. Pay attention to using the correct tool to **Add New** versus **Select / Edit** on the **selected layer**. A summary of Editing Tool capabilities is provided below.

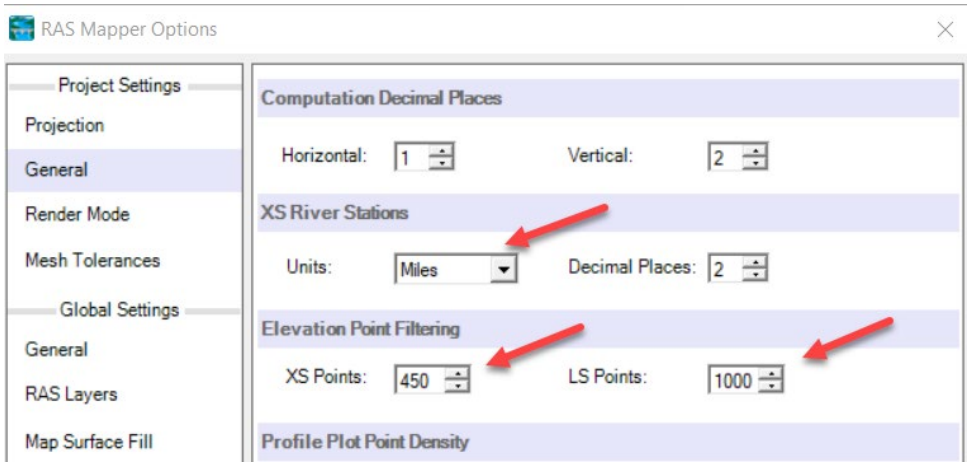
--- Editing Tools Guide ----------

- **Start Editing** - Right-click on the Geometry named "XS Layout – River" or the XS layer and select "**Edit Geometry**".
- **New Feature** - Use the **Add New** tool to begin drawing a cross section.
- **Edit Feature** - Use the **Select / Edit** tool to
    a. select a line of interest,
    b. double-click it to open it for editing,
    c. single-click on a point to move or delete,
    d. single-click to insert a point,
    e. and double-click (off of the line) to close it.
- **Pan** - Use the **Shift** key to *Pan* while in edit mode.
- **Zoom** - Use the **Mouse Wheel** to *Zoom in* and *out* while in edit mode.
- **Preview Plot** - Use the **Profile Plot** tool show display a station-elevation plot of a selected cross section.
- **Stop Editing** - When finished editing, right-click on a RAS Layer or the Geometry and choose "**Stop Editing**".
- **View Attributes** - Double-click on the **XS** Layer or right-click and select the **Layer Properties** menu item. Then click on the **Features** tab to see attribute that are populated on the newly created cross sections.
- **Label Features** - Open the **Layer Properties** dialog, turn on the "**Label Features with Attribute Columns**" option.
    a. Click on the "**Edit**" button and choose "**River Station"** for the "Attribute Text".
    b. Press **OK** to dismiss the dialog.

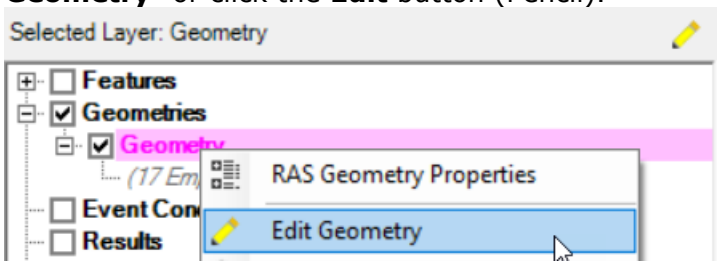
4.1 Open the Geometry for Editing

6. Open **RAS Mapper**.

7. Set the parameters for extracting data by selecting the Tools | Options menu item.



8. In RAS Mapper, Select the new Geometry layer, right-click and choose "**Edit Geometry**" or click the **Edit** button (Pencil).



4.2 Create the River Network

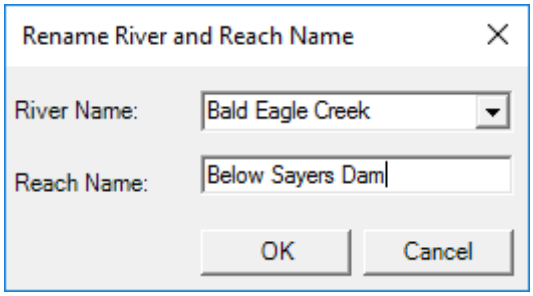
9. Click on the **Rivers** layer.

10. Draw the river network (as shown above) for Bald Eagle Creek – Below Sayers Dam.

    a. Left-click to add points

    b. Double-click to end the line

11. Provide a name for the River and Reach when prompted.



4.3 Creak Bank Lines

12. Expand the **Rivers** layer to see sub layers.

13. Click on the **Bank Lines** layer.

14. Create a line for the Left Bank and Right Bank for the River. The bank lines should define the main channel from the overbank areas. This is often important because the main channel is may not be in the terrain model. Therefore, you would use aerial photography to identify the main channel.

4.4 Create Flow Path Lines – SKIP THIS -

15. **Skip this step**. By now you should know how to edit features in RAS Mapper. However, if you were to create flow paths, you only need to do so in the Left Overbank and Right Overbank for the center-of-mass of flow for each River. The lines should be created in the downstream direction.

    This layer is ideally created prior to digitizing the cross section locations. This is because the flow path centerlines will show you how flows will move through the river system, thereby assisting you in digitizing each cross section perpendicular to the flow paths. Using the terrain model for a background, you can try and visualize how water would flow.

4.5 Layout Cross Sections

16. Click on the **Cross Section** layer.

17. Create cross sections to resonably represent 1D river/floodplain flow. Cross sections should be created left to right when looking downstream.

    We are not looking for hydraulic perfection. Specifically, make sure to lay out cross sections with these considerations:

    a. Sayer's Dam – make sure use 2 cross sections above the dam location as the reservoir will be modeled with a Storage Area. Cross sections should be placed near the toe of the dam.

    b. Lock Haven – will be modeled with a 2D Flow Area, so lay out cross sections appropriately.

18. As cross sections are laid out, they will automatically be populated with pertinent data (River Name, Reach Name, Reach Lengths, Bank Stations, etc). An abbreviated version of the table is shown below.

Verify that the data is being attributed "correctly".

Cross Sections - Layer Properties (Geometry)

Visualization and Information | Features

Source: C:\Temp_Examples\Breach Workshop\Geometry Workshop\GeometryWorkshop.g01.hdf

FID	River	Reach	River Station	Length LOB	Length Channel	Length ROB	Left Bank	Right Bank	Steady Contr. Coef.	Steady Expan. Coef.
3	Bald Eagle Creek	Below Sayers Dam	2993	1040.2002	1040.2002	1040.2002	95.97003	390.920135	0.1	0.3
4	Bald Eagle Creek	Below Sayers Dam	3511	518.144043	518.144043	518.144043	86.81015	382.100647	0.1	0.3
5	Bald Eagle Creek	Below Sayers Dam	3924	412.4825	412.4825	412.4825	51.1598625	400.0989	0.1	0.3
6	Bald Eagle Creek	Below Sayers Dam	4730	806.3101	806.3101	806.3101	650.66	1139.54	0.1	0.3
7	Bald Eagle Creek	Below Sayers Dam	5097	366.7595	366.7595	366.7595	354.0702	1030.08057	0.1	0.3

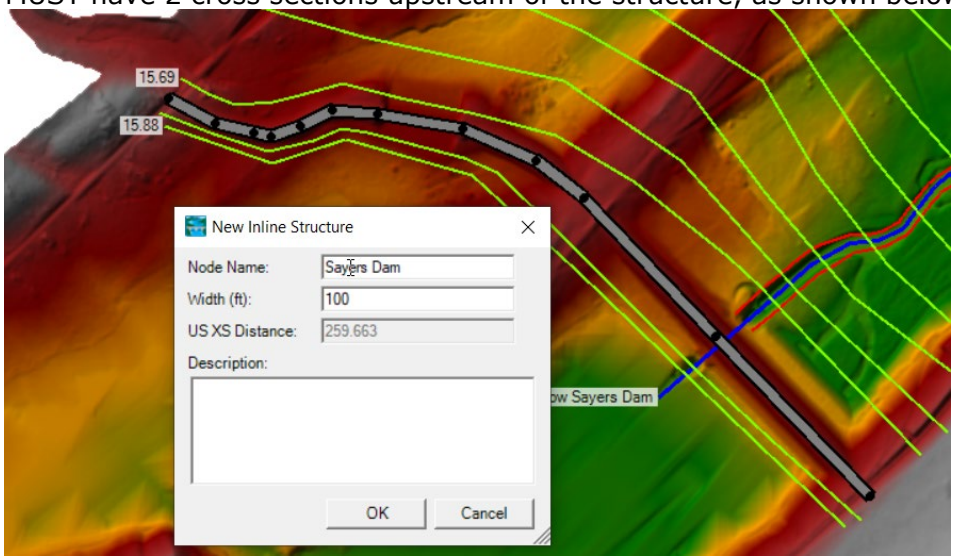
19. If data needs to be re-computed, right-click on the Cross Section layer and choose from the **Compute** options.

4.6 Manning's n Values

We are skipping this option today.

4.7 Inline Structure

20. Click on the **Inline Structure** layer
21. Layout the Inline Stucture (left to right when looking downstream). You MUST have 2 cross sections upstream of the structure, as shown below.



*You may need to override the Inline Structure weir in from the Inline Structure editor Geometric Editor. Breach information is also accessed from the Inline Structure editor.

4.8 Bridges

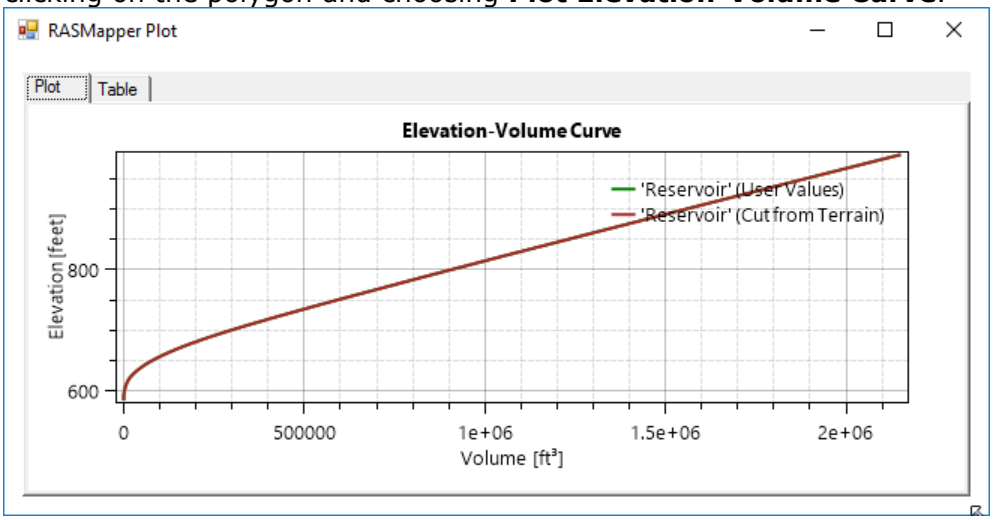
You will not be creating a bridge in this workshop.

4.9 Storage Area

22. Click on the **Storage Areas** node.

23. Create a polygon for the Foster Joseph Sayers **Reservoir** and provide a name.

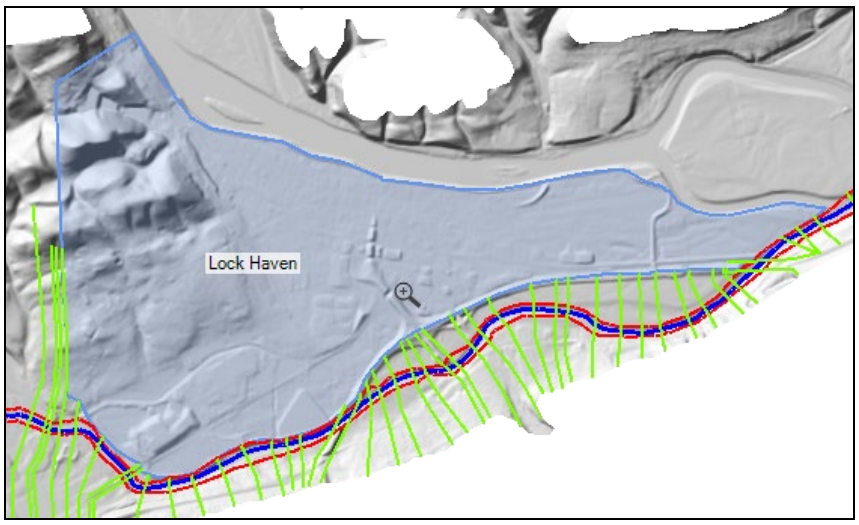
24. You can plot the Elevation-Volume relationship for the polygon but right-clicking on the polygon and choosing **Plot Elevation-Volume Curve**.



*Typically, you would want to override the Elevation-Volume relationship with pre-dam survey information, as most likely, the terrain in the reservoir pool is not correct.

4.10 2D Flow Area

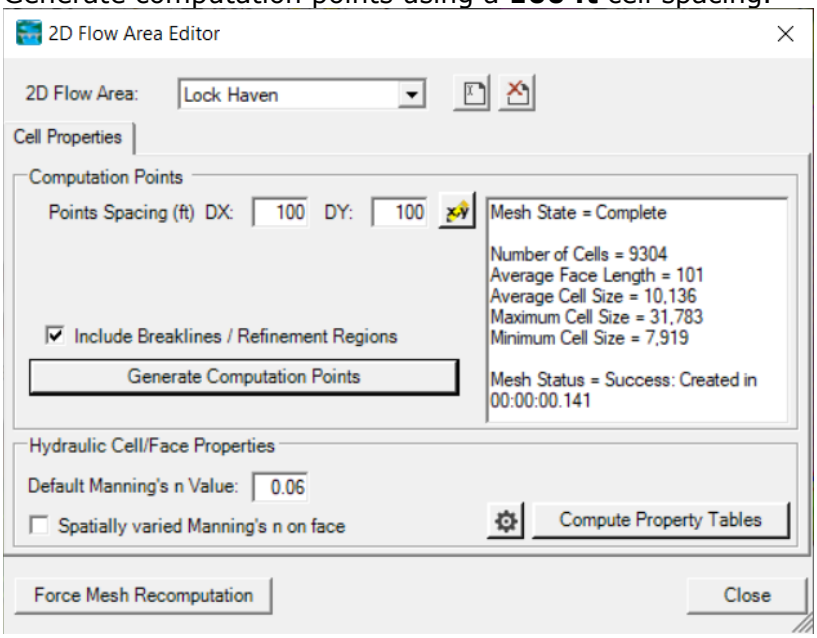
25. Create a **Perimeter** polygon for a 2D Area and provide a name for the Lock Haven area as shown below.



26. From the **2D Flow Area Editor**…

    a. Set the Manning's n value for the 2D Area to **0.06**.

    b. Generate computation points using a **100 ft** cell spacing.



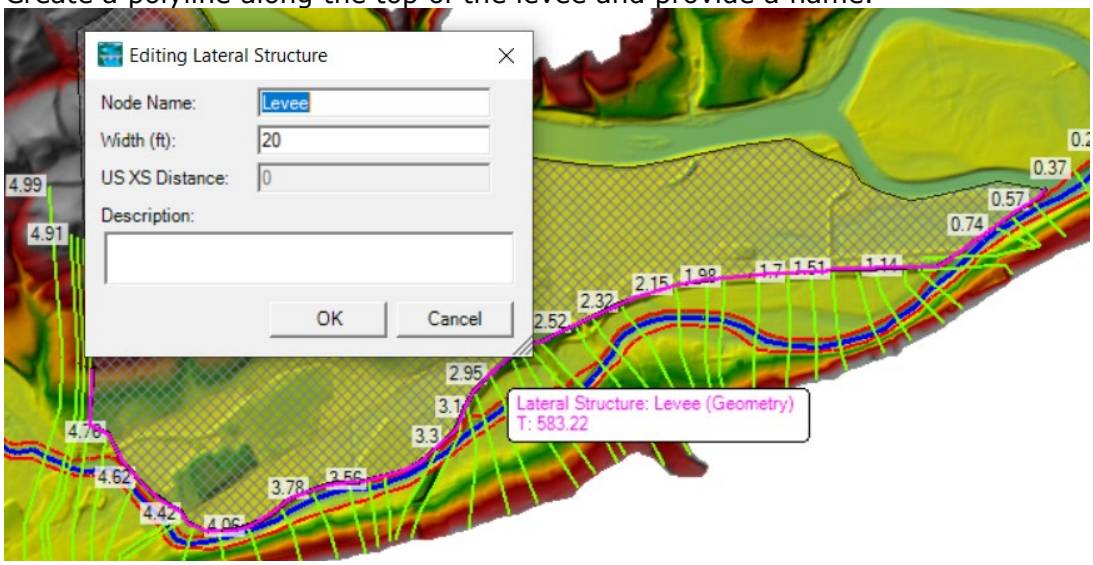
27. Move computation points, if desired.

4.11 Lateral Structures

Enter the Lateral Structure to connect the 1D and 2D portions of the model. You will have enter the Inline Structure from the Geometric Editor.

28. Click on the **Lateral Structures** layer.

29. Create a polyline along the top of the levee and provide a name.



*Typically, you would want to override the levee information with survey information. This is done from the Lateral Structure editor in the Geometric Schematic.

4.12 Ineffective Flow Areas, Blocked Obstructions, Levees

Skip these options.

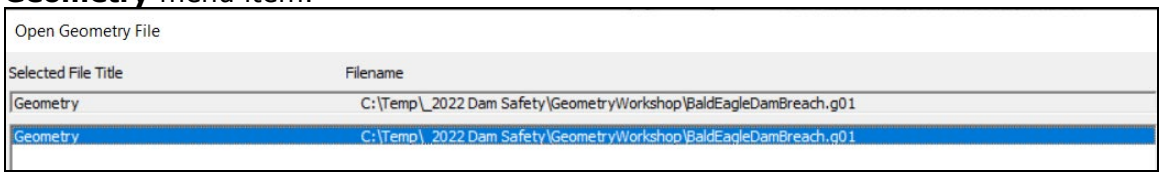
4.13 Stop Editing

30. When **FINISHED** created features, select the **Geometries Node | Stop Editing** menu item.
31. **Close RAS Mapper**.

5 Finish Entering Geometric Data

If you haven't already, close RAS Mapper and open the **Geometric Schematic**. Your geometry will not be loaded automatically.

32. **Open** the geometry you created using RAS Mapper using the **File | Open Geometry** menu item.



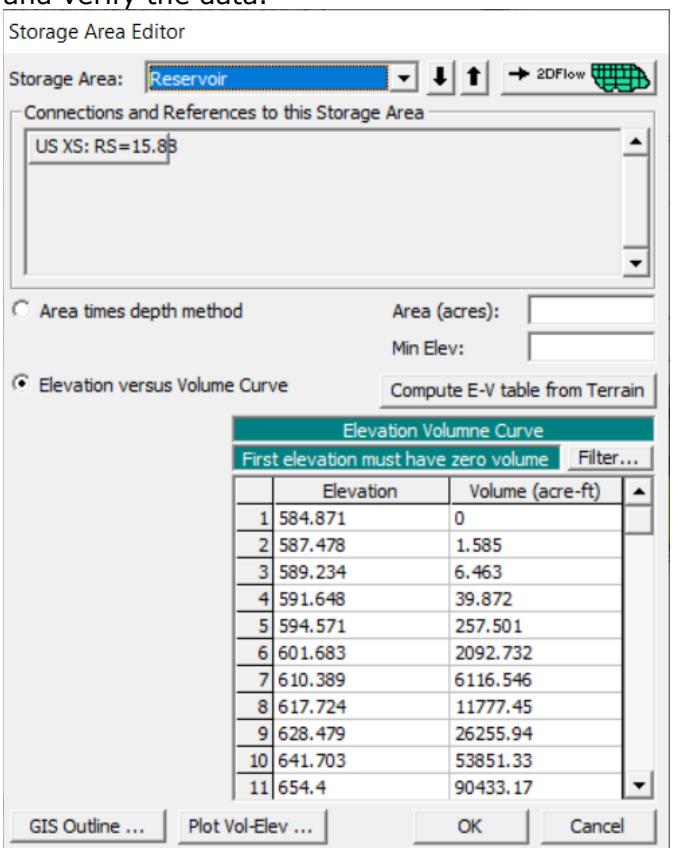
5.1 Cross Section Data

33. Open the Cross Section editor and verify the data.
34. Use the Tables in RAS to verify and **enter missing data**:
    a. **Manning's n values** (use 0.035 for the main channel and 0.05 for the overbanks).
        i. You will need to select the entire table and press the **Reduce to L Ch R button**.
        ii. Then select each column and set the values.
    b. Verify Bank Stations.
    c. Verify Reach Lengths.
    d. Verify Contraction/Expansion Coefficients.

35. **Save** the geometry.

5.2 Storage Areas

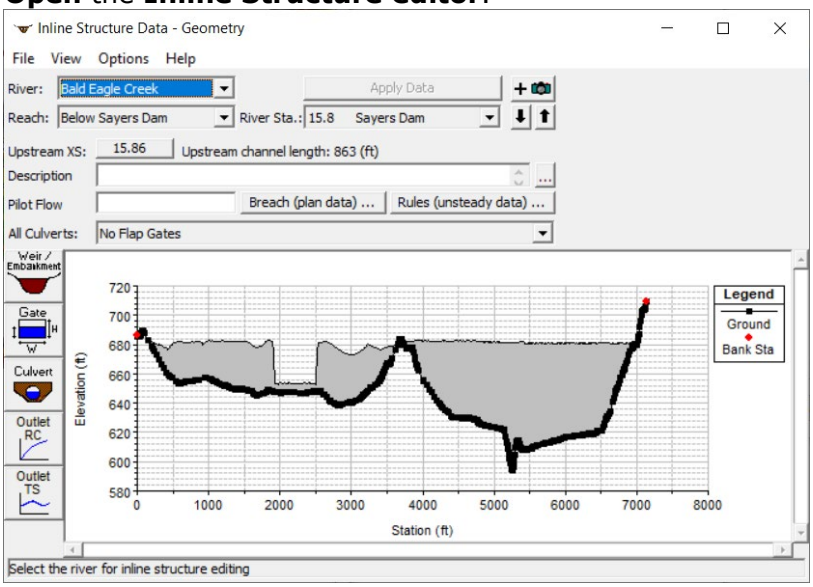
36. Select the **Elevation versus Volume Curve** method for the storage areas and verify the data.



37. You may also want to **filter** the points or replace with survey data.

5.3 Inline Structure

38. **Open** the **Inline Structure editor**.



39. **Override** the **weir** information.

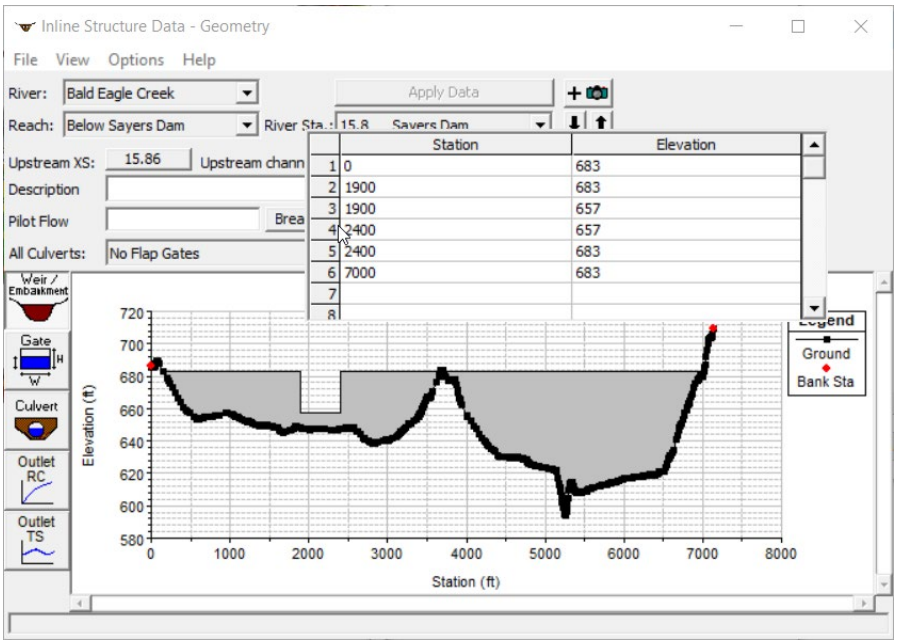
    e. **Dam Crest @ 683 ft**.

    f. **500-ft wide Auxiliary Spillway @ 657 ft** (on the left embankment)

40. Add a **low-level outlet** - locate it in the channel.

    g. **Invert Elevation @ 590 ft**.

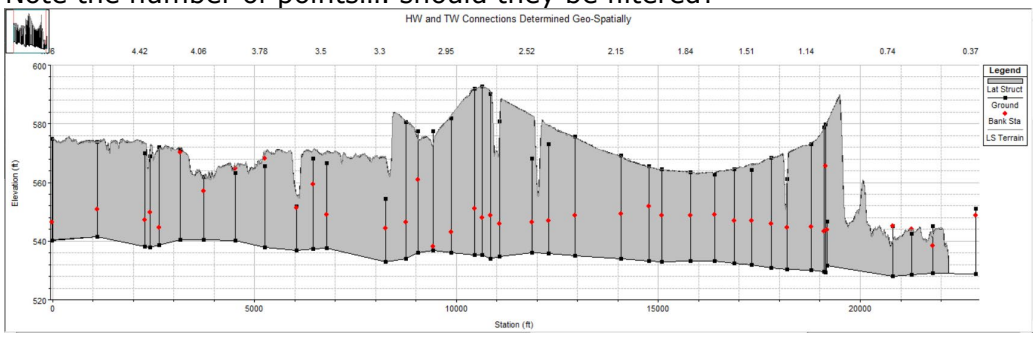
    h. Use a **circular culvert** with **2 ft** diameter.



5.4 Lateral Structure

Enter a lateral structure to protect the town of Lock Haven. It will connect the cross sections to the Lock Haven Storage Area.

41. **Open** the **Lateral Structure editor**.
42. Evaluate the weir information.
43. Note the number of points…. should they be filtered?



*Typically, you'd want to override the weir information with survey information.

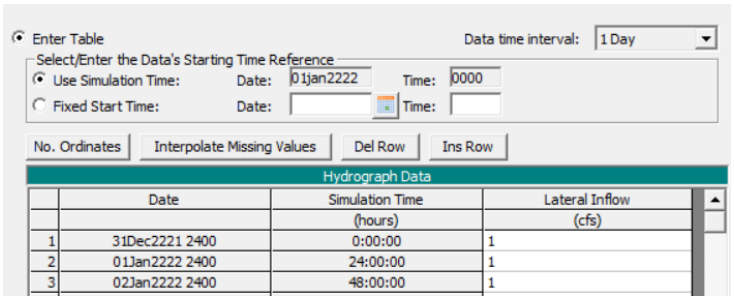
-----Bonus – If time allows----------

If you have time, create an unsteady flow simulation and try to run the model. This will allow you to see if the geometry has been input properly!

6 Flow Data

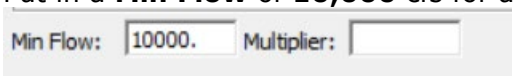
After you have created the Geometry, add flow data to the RAS project.

44. **Open** the **Unsteady Flow** data editor
45. Enter a **Lateral Flow Hydrograph** for the **Reservoir**.
    a. Enter a time series of data



	Date	Simulation Time (hours)	Lateral Inflow (cfs)
1	31Dec2221 2400	0:00:00	1
2	01Jan2222 2400	24:00:00	1
3	02Jan2222 2400	48:00:00	1

    b. Put in a **Min Flow** of **10,000** cfs for a steady profile.



46. Enter a **Normal Depth** boundary condition with a slope, **S=0.0004**.

47. Set the Storage Area Elevations to an appropriate value using the **Options | Set Storage Area Elevations**.

48. **Save** the flow data.

7 Simulate

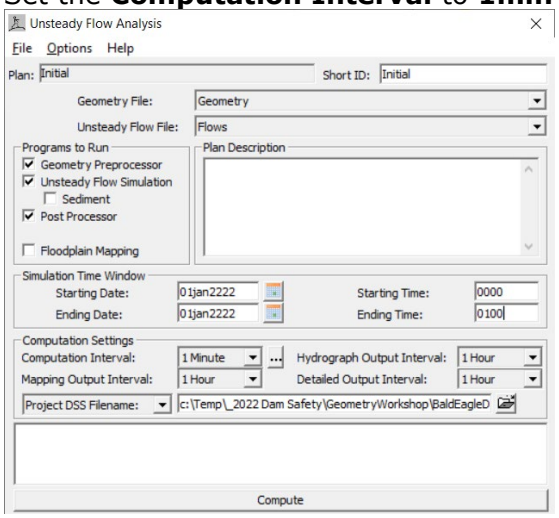
Run the steady-flow simulation.

49. Open the **Unsteady Flow** simulation dialog.

50. Create a new **Plan** with a name and Short ID.

    a. Set the **Simulation Time Window** to run for an hour.

    b. Set the **Computation Interval** to **1min**



51. **Compute** the water surface.

    !!! Read the error messages and work through data deficiencies!!!

52. When you get the model to run, plot the Profile Plot or RAS Mapper output to see your results.