

Final 2D Sediment Modeling Workshop

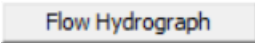
Over the course of this class, you have developed the tools you need to build and evaluate a sediment transport model. The objective of this workshop is to guide you through the process of building a realistic mobile-bed model to evaluate the relative effect of navigation structures.

Warning: The models in this workshop are intended for pedagogical purpose only. They have been simplified and modified to fit into a brief workshop and should not be used for scientific or engineering analysis.

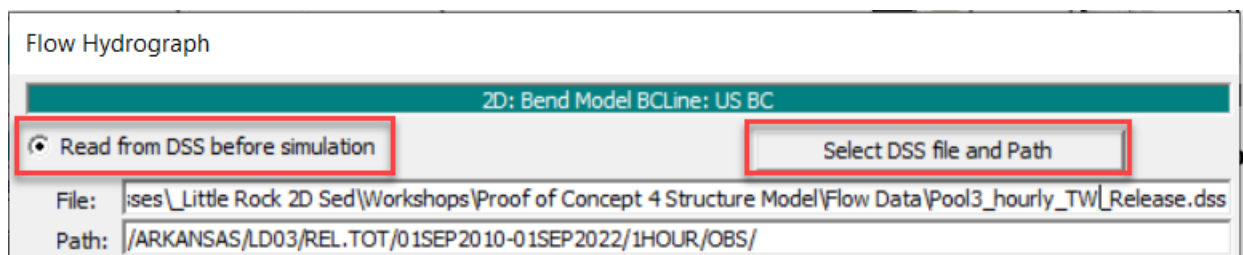
Part 1: Evaluate and Improve Your Mesh

We have provided you a terrain and mesh. The mesh is adequate for this exercise.¹ But open it and make any edits you would like. You can continue to edit the mesh through the hydraulic analysis, but after you associate the mesh with a second geometry and terrain, it is more difficult to make changes.

Part 2: Build a Flow File and Run Hydraulics

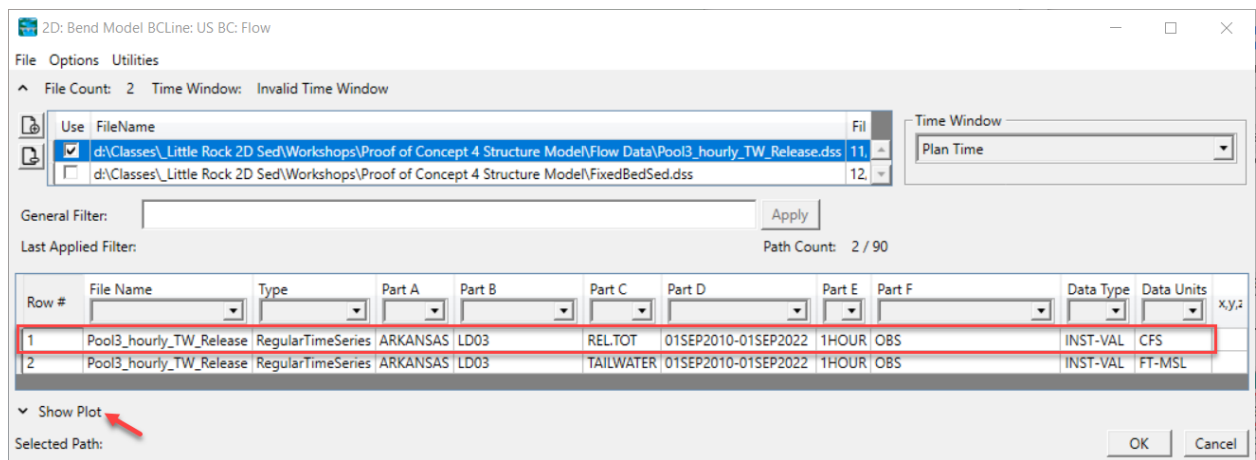
1. **Define a Flow Hydrograph for Your Upstream Boundary Condition.** Open the unsteady flow file. Select the Upstream Boundary condition already associated with the geometry. Select the **Flow Hydrograph** button  to define upstream flows.
2. **Set an EG Slope:** Set the **EG Slope for distributing flow along BC Line**. Set it a little higher than you might expect. Then click the **TW check** which will drive the boundary condition.
3. **Select the DSS flow file:** The flows for this pool are in the DSS file **Pool3_hourly_TW_Release.dss** in the **Flow Data** folder. Select the **Read from DSS before simulation** radio button and press the **Select DSS file and Path** button.

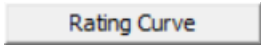



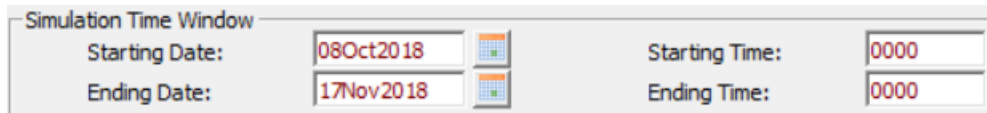


¹ Note: the cell size is probably too large for an engineering analysis. But we developed this mode for workshop-appropriate runtimes.

This DSS file only has two “paths.” One is a stage, the other is a flow series. Select the flow series **REL.TOT**. Press the **Show Plot** option at the bottom of the editor to view the data.



4. **Set the Downstream Boundary Condition:** Choose the field associated with the downstream boundary condition. Select the **Rating Curve** option.  Enter the Rating Curve data from the excel data file provided. (Note: These data came from the steady flow model.)
5. **Save your flow data.** Call it “October 2019.”
6. **Create an Unsteady Plan:** Open the Unsteady Analysis (plan) Editor . Choose a simulation that isolates one of the modest flow events in fall of 2018 (early WY 2019).’



Choose and appropriate time step and select your hydraulic computational options. Select the **Options**→**Computation Options and Tolerances** menu. Make sure you either initialize or warmup the model, select appropriate hydraulic and turbulence equations and parameters, and set **Solver Cores** to **4 Cores**.

7. **Simulate and Evaluate Hydraulics.** Before you add sediment, simulate and evaluate the hydraulics. Make any mesh updates before you add a second geometry that will replicate this mesh. Runtimes should be between 2-4 minutes. If it looks like it is going to run for a long time, re-evaluate some of your simulation parameters.

Part 3: Add Sediment Data and Run Sediment Model

8. **Add Sediment Data and Parameters.** Open the sediment file, add sediment data, and set sediment parameters. Use your best judgement and the parameter summary here:

<https://www.hec.usace.army.mil/confluence/rasdocs/h2sd/ras2dsed/latest/summary-of-2d-sediment-parameters-and-options>

Make sure to update the following:

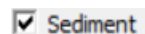
Bed Gradation (see data in spreadsheet)	Transport Function
Sediment Boundary Condition*	Mixing Algorithm
Bed Mixing Options (e.g. Hiding and Active Layer)	Adaptation Coefficient

*This is gage 07263620 (AR River@David D Terry...) if you want to look at sediment loads – open the Hydraulic Design Editor, select the Type→Sediment Rating Curve tool, and press the

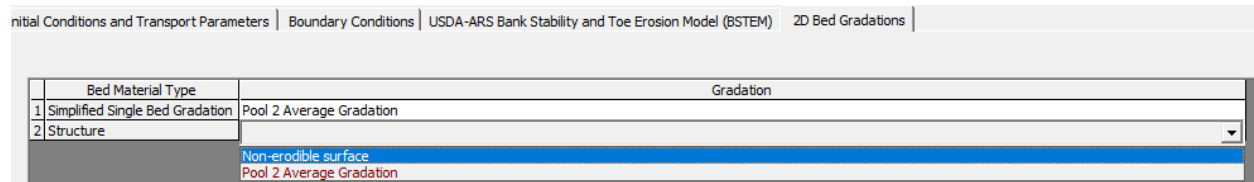


button to download the sediment data from the USGS.

Check the **Sediment** box in the plan editor, add the sediment file to your plan, and simulate.



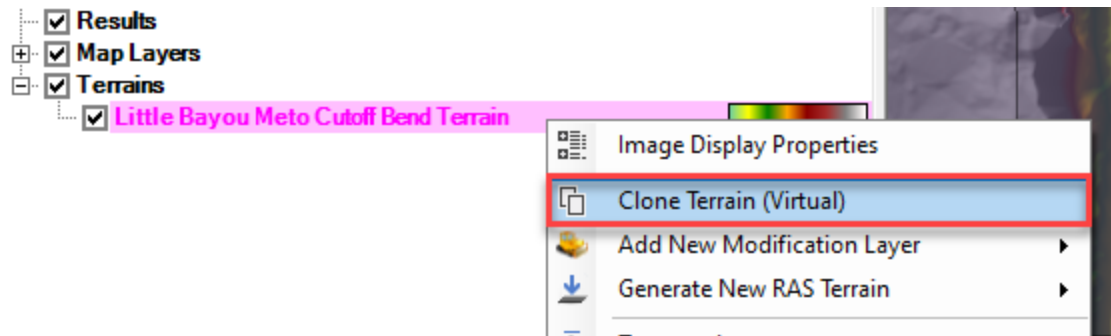
The Sediment Bed Gradation Layer in Mapper does have Structures defined. You can set these to Non-Erodible Surfaces in the **2D Gradation** editor.



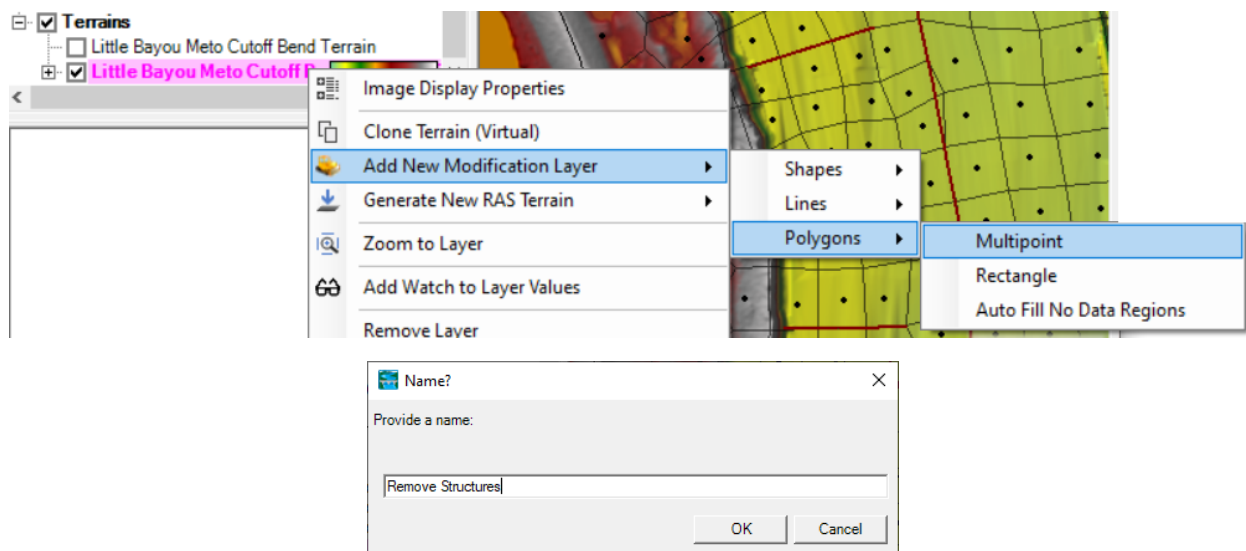
Part 4: Clone and Mod Your Mesh to Remove the Structures

This analysis will be inverted from most study models. Generally, a study team adds proposed structures to a mesh to simulate the results of these structures. But in this case, we have a terrain with structures that we know prevented deposition. In this case comparison requires us to remove the structures from the mesh.

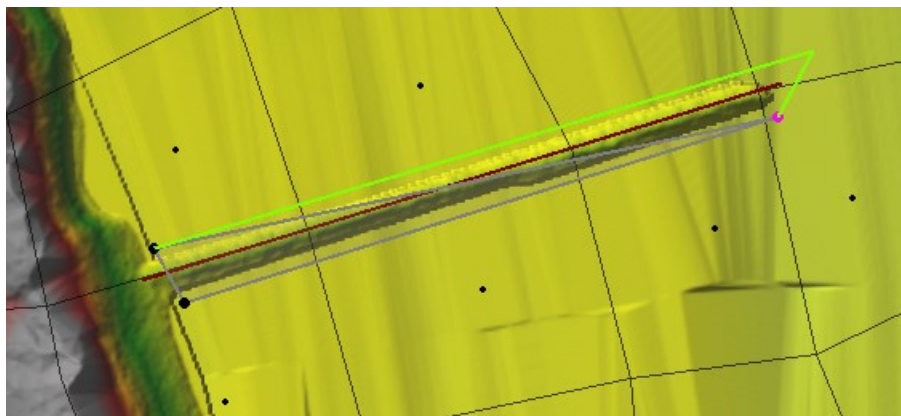
9. **Clone Your Terrain.** Instead of copying the terrain and adding another large file to your dive, RASMapper allows users to “clone” the terrain, which just points to the original terrain and keeps track of modifications.
10. **Add Sediment Data and Parameters.** Open the sediment file, add sediment data, and set sediment parameters.



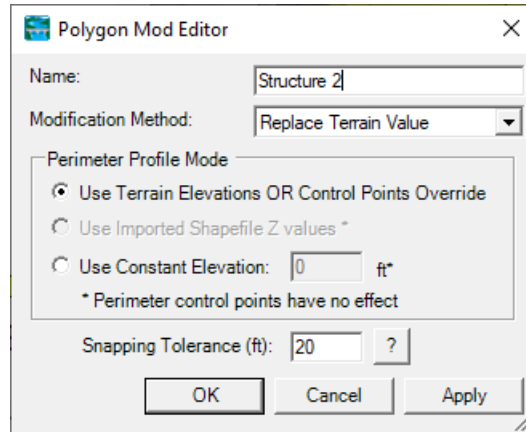
11. **Remove Structures from Cloned Terrain:** Right click on the cloned terrain and select **Add New Modification Layer**. Choose **Polygon → Multipoint**. Give it a name (e.g. Remove Structures).



Trace the outline of the structures with the multi-point polygon tool. Double click to finish.

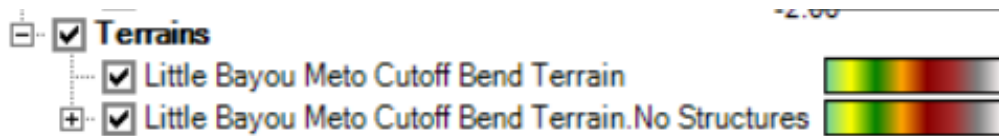


You will use the defaults in the Polygon Mod editor. Give the mod a name (I named the them "Structure 1," "Structure 2", etc from upstream to downstream.



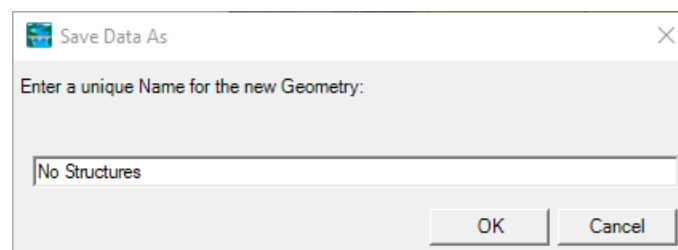
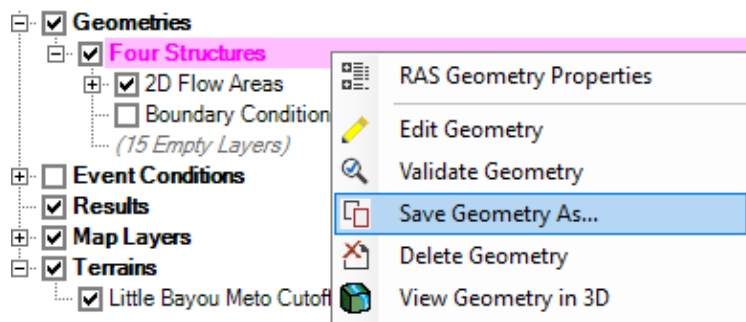
You will **Use Terrain Elevations** from the perimeter to override the terrain in the polygon, and use the **Replace Terrain Value** Modification Method. Press OK. Your structure should disappear.

Note: If your structure does not seem to disappear, you may still have your original terrain visible over top your modified clone. Make sure you turn off the original.

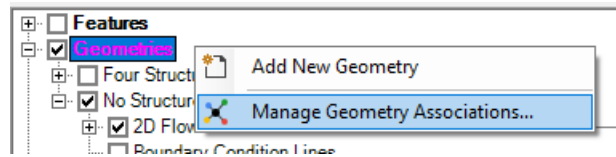


Part 5: Copy Geometry File and Associate New Terrain and Layers

12. **Copy Geometry File:** To compare the effect of the structures we want to keep the mesh the constant, but switch the terrain and roughness. Right click on the Geometry and choose **Save Geometry As...** Give the new geometry a descriptive name like “No Structures”.



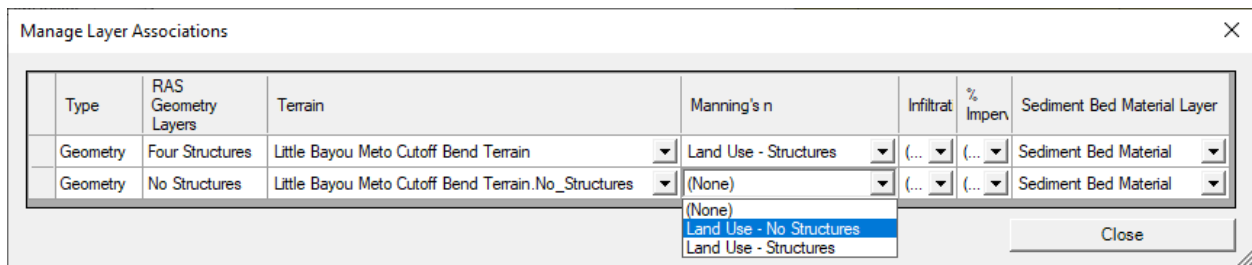
13. **Associate Appropriate Layers with New Geometry:** Right Click on the **Geometries** heading and select **Manage Geometry Associations** to associate the new terrain and appropriate layers with your new geometry.



The project has two **Land Use Layers** including one with and one without structures. We associated a n-value of 0.07 with the structures. So it is important not just to remove the structures but also the n-values in the new project.

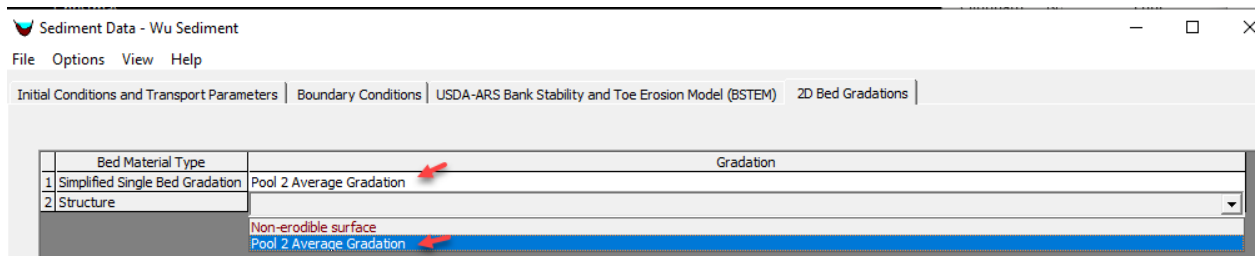


Change the Terrain and Manning's n Land Use to the "No Structure" options. The Sediment Bed Material has structures in it, but you can just switch that from Non-Erodible Surface to the gradation in the "No Structure" Model.



Part 6: Create a New Sediment File

14. **Update Structure Bed Gradation:** The only change you should have to make in your sediment file is the structure bed gradation. You could make a new Sediment Bed Material layer in mapper with no structures in it. But you can also just set the bed gradation in the no-structure sediment file to the model gradation (see next figure). Switch this gradation and save the sediment file as a no-structure file.

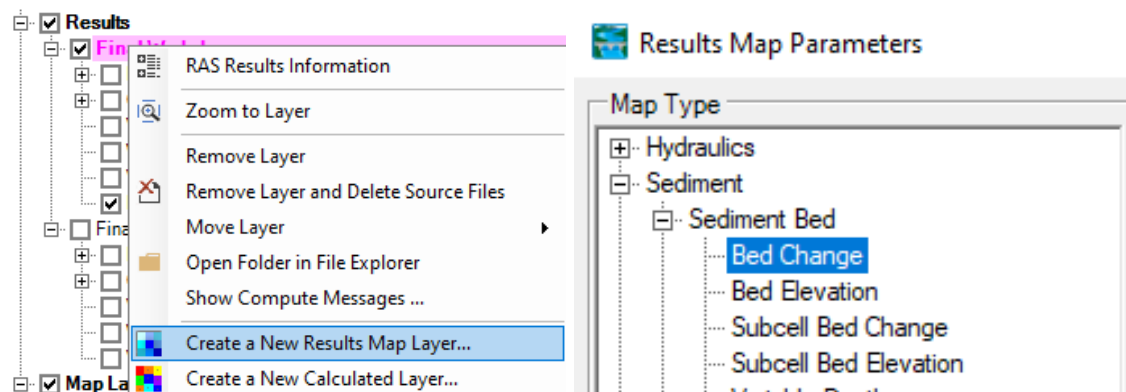


Part 7: Run No-Structure Plan

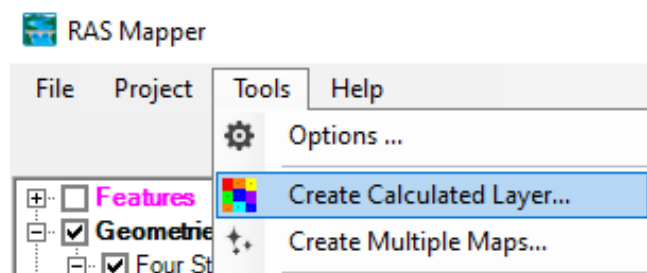
15. **Run No-Structure Plan:** You should not have to change the flow file or sediment file. Make a new plan, switch the geometry file, and simulate.

Part 8: Compare Results With and Without Structures

16. **Add Bed Change Results to Both Plan Results:** Right Click on each plan result (with and without structures) and select **Create a New Results Map Layer**. Add **Bed Change**.

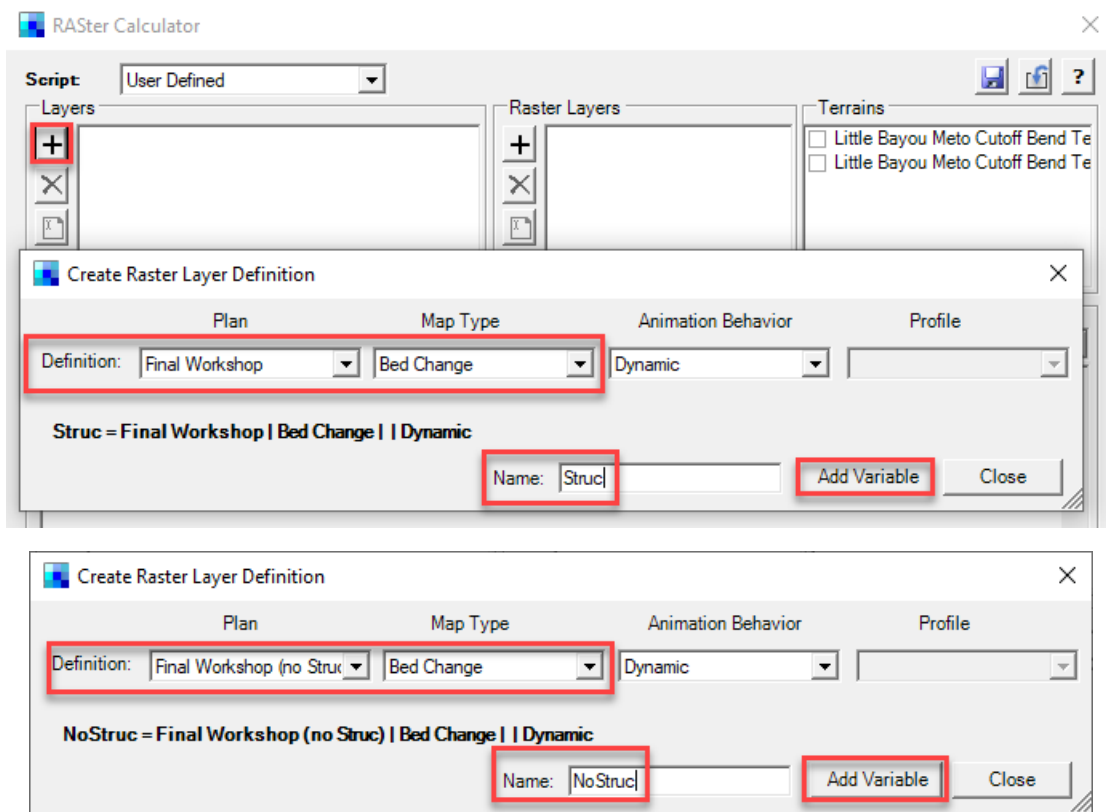


17. **Create a Calculated Map Layer:** Sediment models are mostly useful for *relative* results rather than absolute results. The difference in bed change with and without the structures will be much more informative than the absolute change. So you will use the **Raster Calculator** to compare the bed change results (to generate a Δ Change map).



Select the **Tools**→**Create Calculated Layer** tool.

18. **Define Bed Change Results as Variables:** Press the “+” button to add each bed change result as a variable. Select the plan name and **Bed Change** map type. Give them descriptive names that indicate whether they have the structures or not.

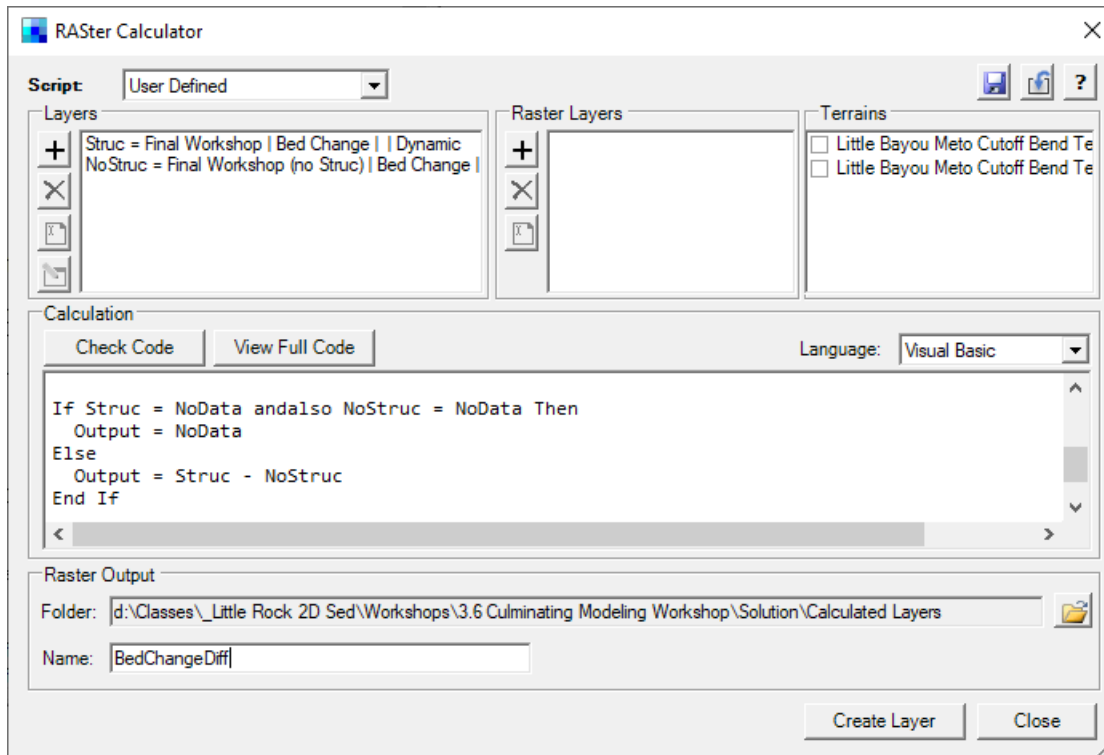


19. **Write No Data Statement:** The RASter calculator writes a default If loop to handle no data cases. You will add your second result to so it reads like the right hand code below.

<pre> If Struc = No Data Then Output = No Data Else Output = Struc End If </pre>	<pre> If Struc = No Data andalso NoStruc = No Data Then Output = No Data Else Output = Struc End If </pre>
--	--

20. **Write Math Statement:** The first statement of the No Data Loop catches the No Data Case (which we should not have because our meshes are identical, but it is still good practice). So we want to difference the results in the second statement.

Output = $Struc - NoStruc$



Give the result a descriptive **Name** and press **Create Layer**.

- 21. Select a Good Display Color Ramp for Difference Result:** Right click on your calculated result and select **Image Display Properties** and press the **Edit** Button. Use the **Bed Change** color ramp, and set symmetrical **Max** and **Min**. Then press the **Create Ramp Values**. I also like to set **Alpha** of the white 0.00 to 0, so it is transparent. You can also set a narrower band of transparency by adding values.

22. Evaluate Results, Make Adjustments, Rerun.

