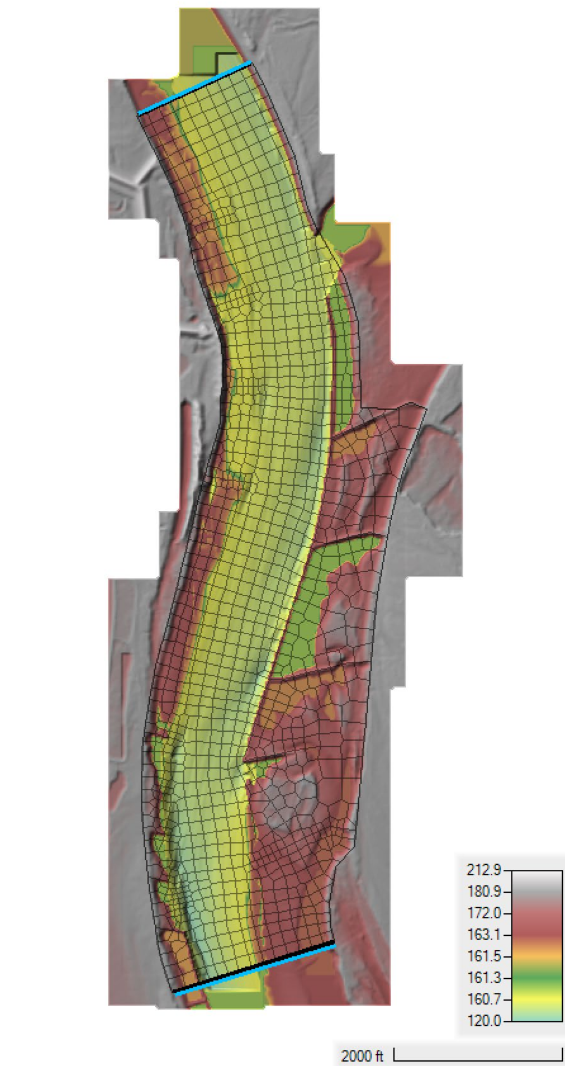
Adaptation Parameters
Workshop

1 Objective

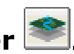
The goal of this workshop is to gain an understanding of how the adaptation parameters change the sediment transport results so that they can be used to calibrate the model.

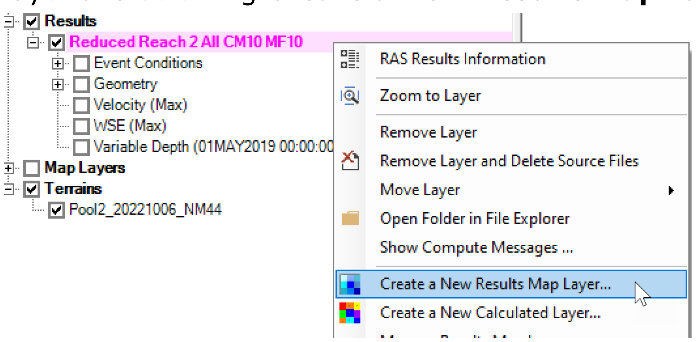
2 Introduction

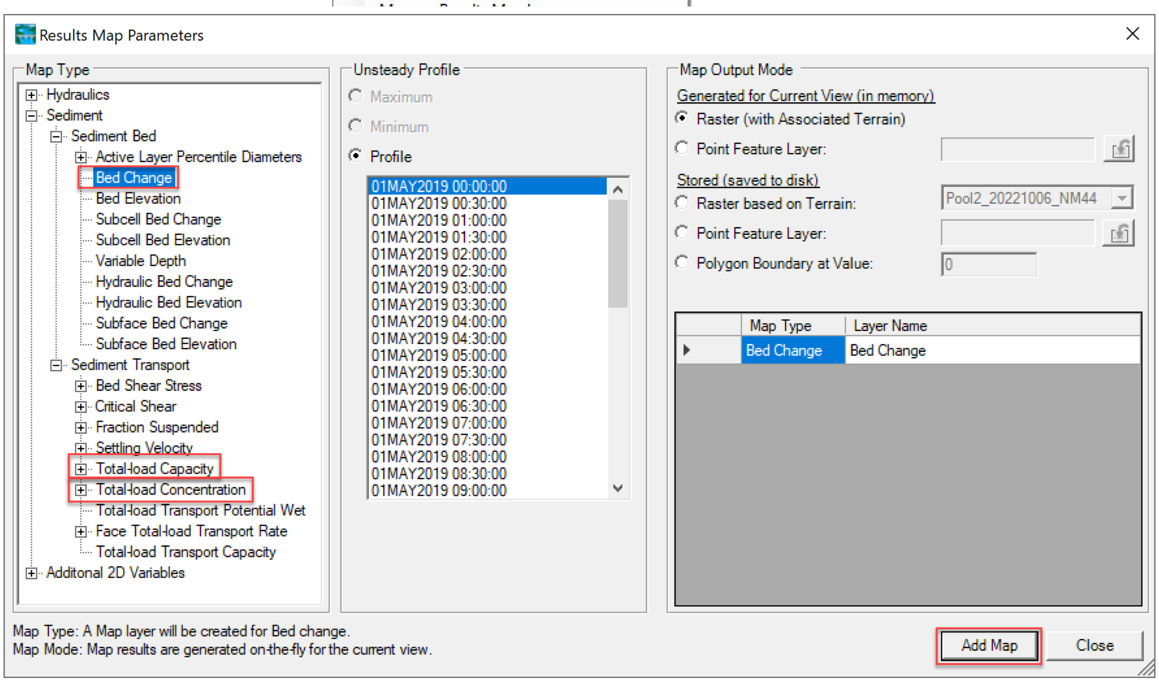
The model is based on a small reach of the White River in Arkansas. For computational speed, the model has been setup with a relatively small model extent and coarse resolution. The computational mesh, boundary condition lines, and terrain are shown in the figure below.



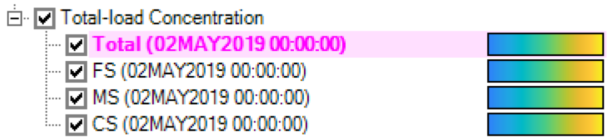
The base model has a constant flow upstream of 70,000 cfs, and a constant stage downstream of 172.936 ft. A morphologic acceleration factor of 10 is utilized to simulate 10 days of bed change over one day of simulation time. With this model setup, each run takes about 10 seconds to run which good for sensitivity analysis. It is important to note, that though the current model setup may not be good for final production runs of a project, the sensitivity analysis as applied here with a fast model setup is useful and recommended for projects.

1. **Start HEC-RAS**.
2. **Open** the HEC-RAS project names “Arkansas2019.prj” in the “Adaptation Parameters” Workshop.
3. **Open** the **Unsteady Flow Analysis**  editor, and run the base plan.
4. After the simulation is complete, open **RAS Mapper** .
5. Add the following variables to **Ras Mapper** by clicking on the Plan Results layer and selecting **Create a New Results Map Layer…** as shown below

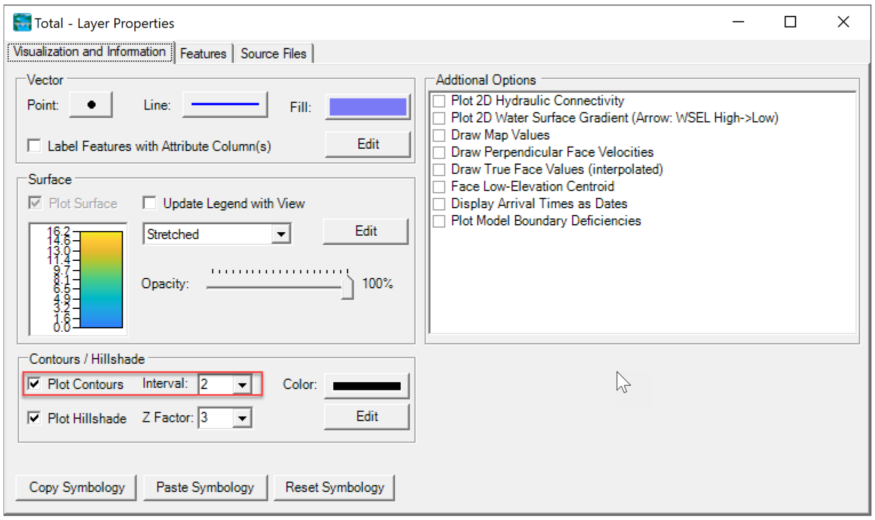




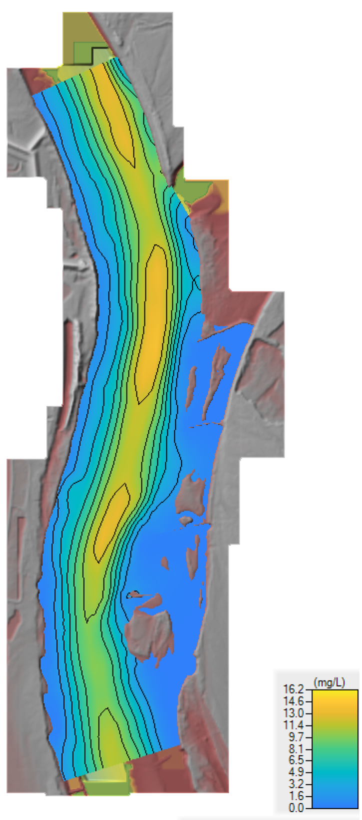
6. **Double-click** on the **Total Total-load Concentration** color ramp and



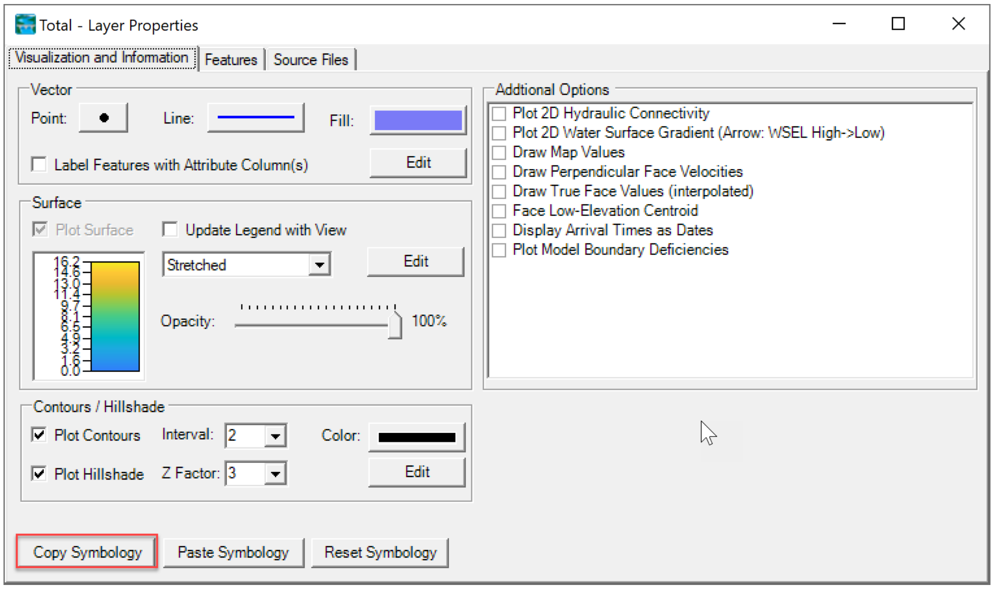
7. Adds Contour lines at a 1-2 mg/L interval.



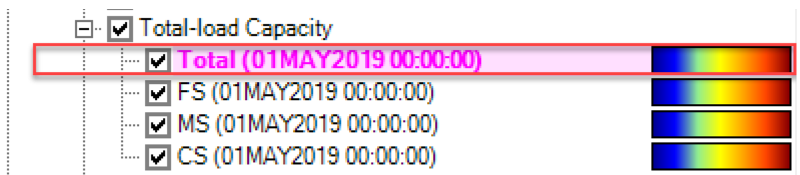
The concentration map should look something like this:

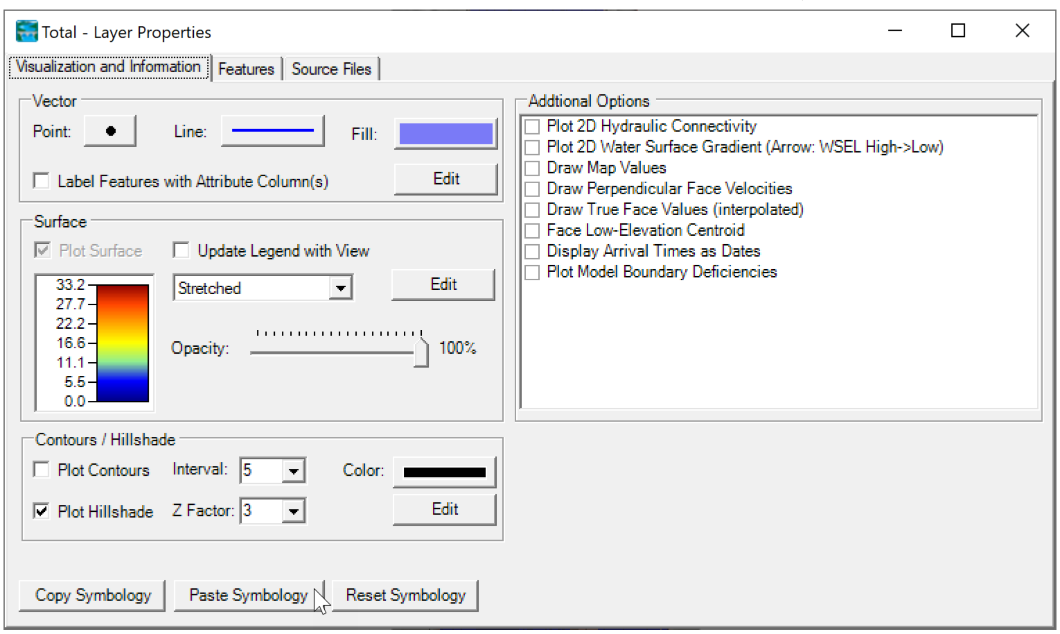


8. **Copy** the **Total Total-load Concentration** layer symbology as shown below.

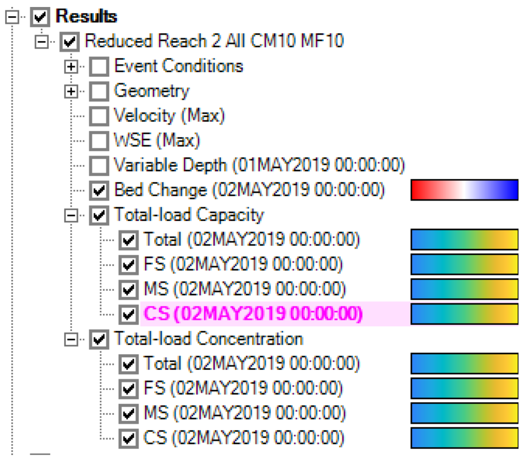


9. **Double-click** on **Total Total-load Capacity** and paste the symbology as shown below.



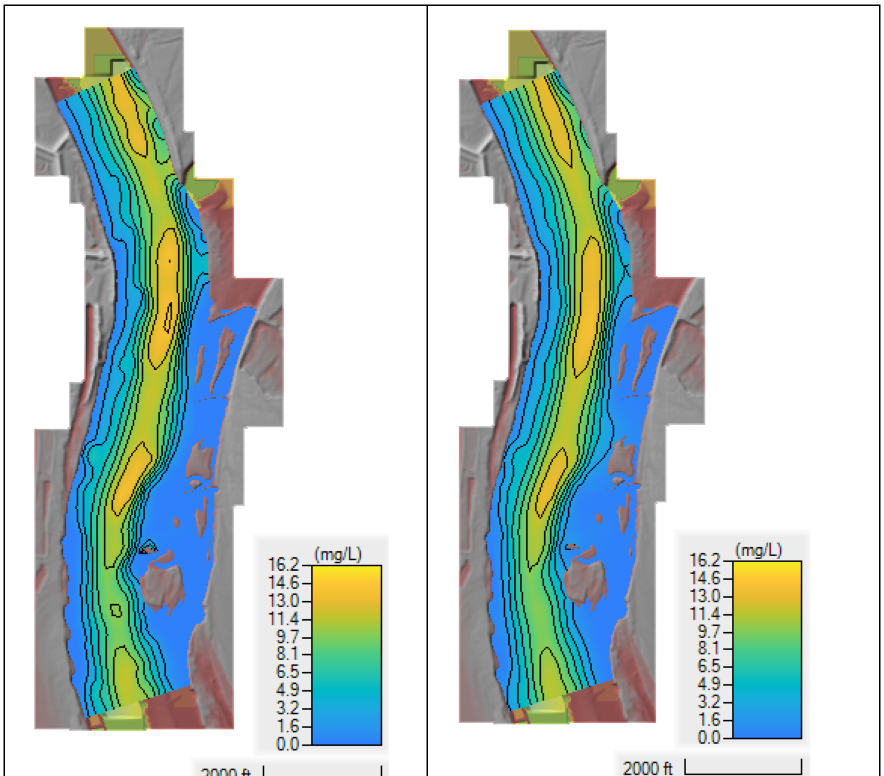


10. While having selected both the concentrations and capacities, click on the root results node and move the Toggle Bar  to the time to the end of the simulation (i.e. right side).



Now the both the capacities and concentrations have the same symbology, are synced in time, and can be compared. Follow this same procedure for comparing results in subsequent sections of the workshop.

11. **Toggle** between the **Total Total-load Capacity** and **Total Total-load Concentration**. Note the differences in the fields. The layers should look something like the images below.



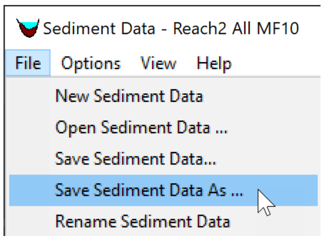
Total Total-load Capacity | Total Total-loadConcentration

3 Total-load Adaption Length

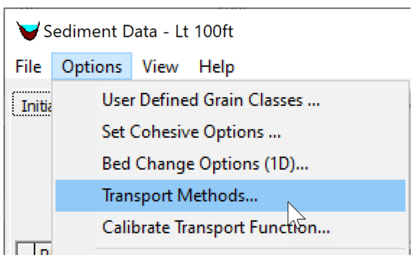
The default adaptation approach in HEC-RAS is the total-load adaptation length. For this reason, we'll begin by performing some sensitivity on this parameter.

12. **Open** the **Sediment Data** editor .

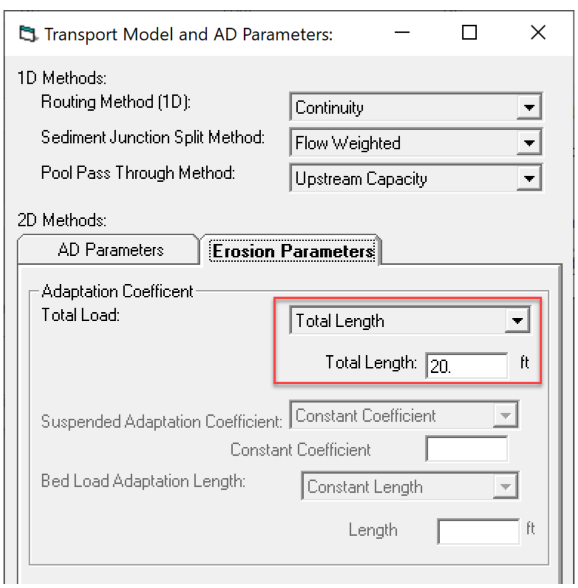
13. **Click** on **File | Save Sediment Data As…** and save the data as "Lt 100ft"



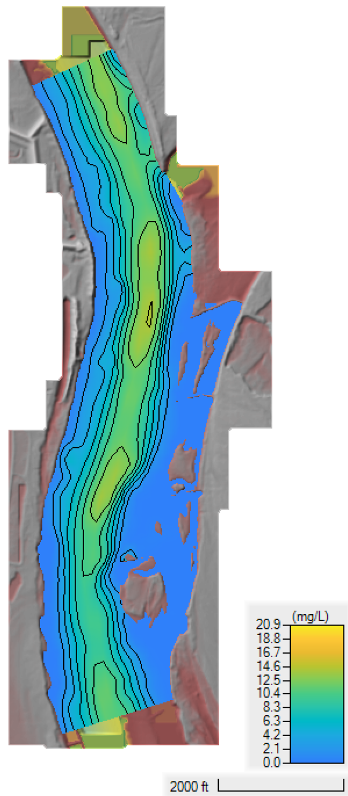
14. **Click** on the menu **Options | Transport Methods** as shown below



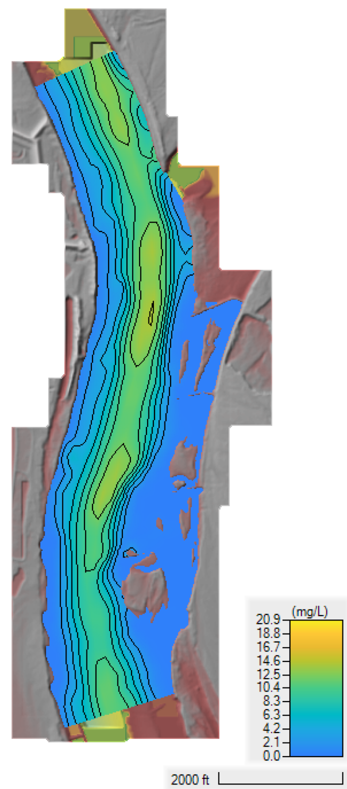
15. In the **Erosion Parameters** tab, set the **Total-load Adaptation Length** to **100 ft** as shown below.



16. **Save** a new Plan with **Title** and **Short ID** "Lt 20ft".
17. **Run** the plan.
18. **Add** the same sediment results layers as in the previous plan.
19. **Compare** the Total Total-load Concentrations and Capacities as in the previous plan. Remember to copy-paste the layer symbology so that the result maps being compared have the same color ramp and data limits. Below is an example of the what the fields should look at the end of the simulation.



Total Total-load Capacity

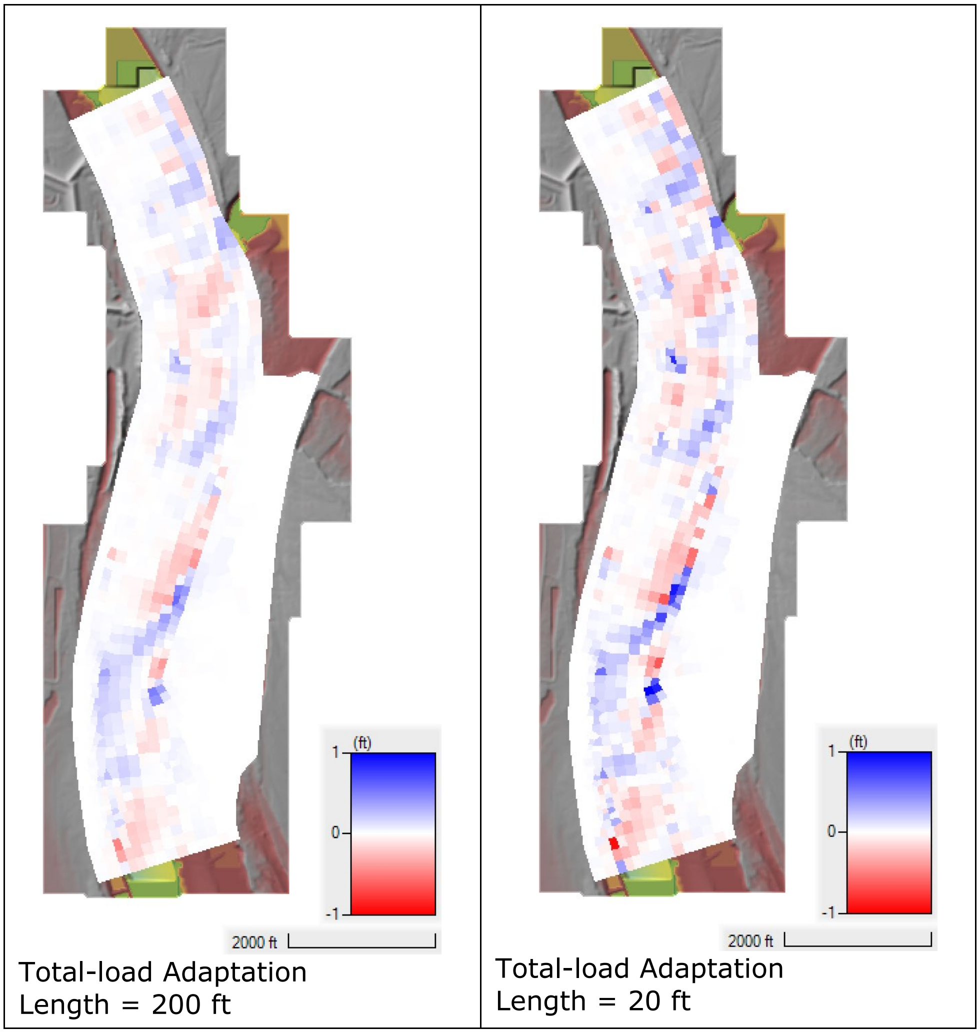


Total Total-load Concentration

Question: Does reducing the adaptation length, make the actual concentrations more similar to the capacities and why?

Question: What would happen if the adaptation length is set to a very small number?

20. **Compare** the bed change for the plans with 20-ft and 200-ft adaptation lengths. Remember to copy-paste the colormap limits so that the results can be compared directly. Toggle quickly between the two get a better understanding of the differences. The results should look something like the figure below



Question: What effect did reducing the adaptation length cause on the bed change results?

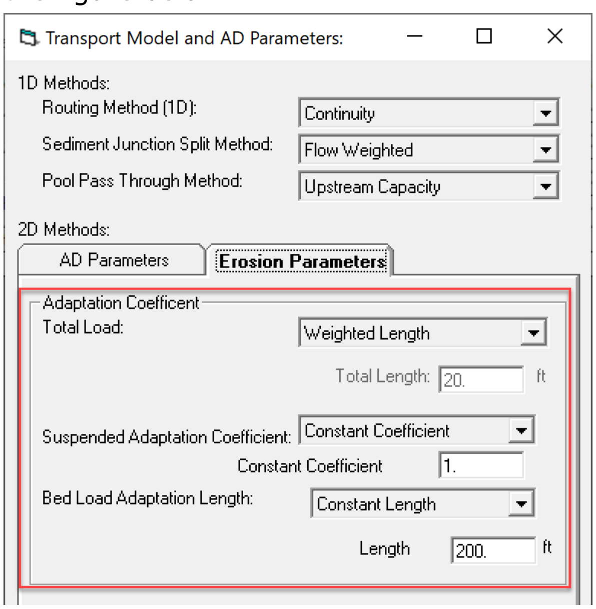
4 Weighted Bed- and Suspended-Load Lengths

A more physically accurate to compute the total-load adaptation length is as a weighted average of the bed- and suspended-load adaptation lengths. More specifically, weighted harmonic mean is utilized to compute the total-load adaptation length where the weights are based on the fraction of bed and suspended loads. In this section, the different options for both the bed- and suspended-load adaptation coefficients.

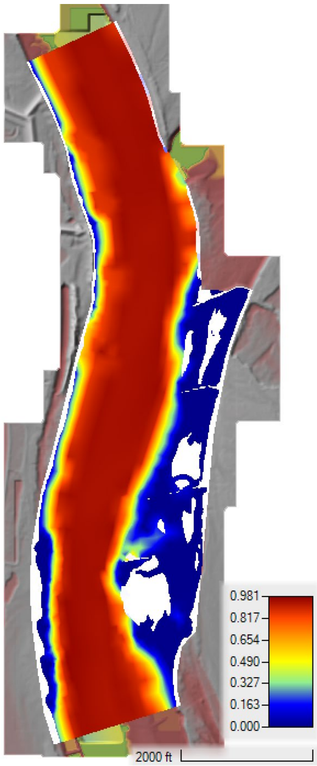
4.1 Constant Suspended Adaptation Coefficient

In this section, a new plan will be created with the total-load adaptation length computed as a weighted harmonic mean of the bed- and suspended-load adaptation lengths.

21. **Open** the **Sediment Data** editor 
.
22. **Click** on **File | Save Sediment Data As...** and save the data as "as 1 and Lb 100ft" as done in the previous section.
23. **Click** on the menu **Options | Transport Methods** as done in the previous section.
24. In the **Erosion Parameters** tab, **set** the adaptation parameters as shown in the figure below



25. **Save** the plan with the Title and Short ID "as 1 and Lb 100ft".
26. **Run** the plan.
27. In **RAS Mapper, Add** the same results layers as in the previous section, and in addition add the "Fraction Suspended" layer. This last layer indicates the fraction of suspended-load to total-load. The fraction of suspended sediments should look something like the image below.



Question: From the fraction of suspended sediment, most of the sediment transported is in suspension. This makes sense since most of the transport is due to fine sand. What does this mean in terms of the sensitivity of the adaptation parameters for bed and suspended load?

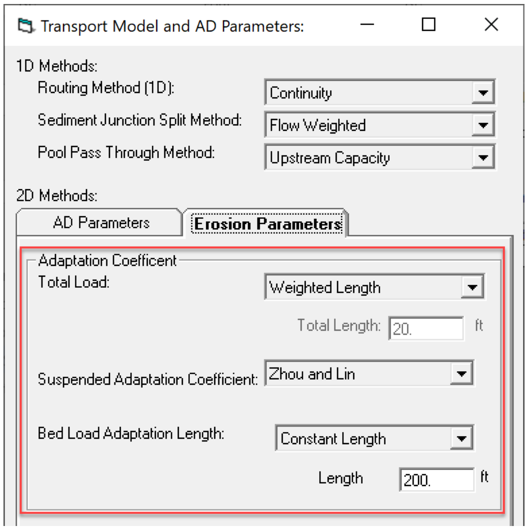
28. **Compare** the sediment concentrations and bed change to the previous results using the methods described in the previous sections.

    Question: What does the suspended-load adaptation coefficient of 1 mean in terms of the near-bed sediment concentration and depth averaged concentrations?

    Question: For natural rivers, is a suspended-load adaptation coefficient of 1 more appropriate for fine sand or coarse gravel?

4.2 Zhou and Lin Suspended-load Adaptation Coefficient

29. **Create** a new **Sediment Data** files called "as ZL and Lb 200ft" and adaptation parameters as shown in the figure below



30. **Save** the plan with the Title and Short ID "as ZL and Lb 100ft"

31. **Run** the plan

32. **Compare** the results with the previous plans using the methods described in the previous sections.

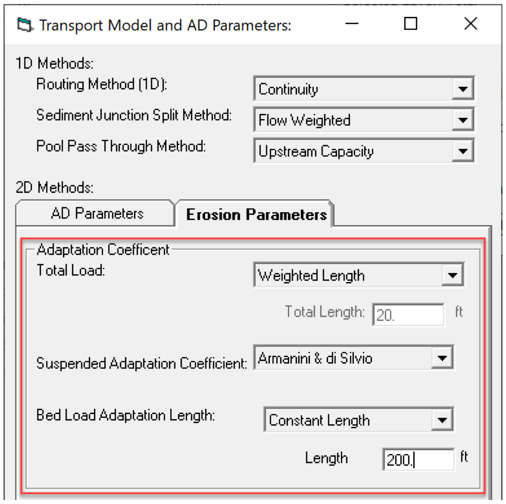
    Question: Based on the comparing the Zhou and Lin results with the previous plan, what can you say about the adaptation coefficient? Is it larger or smaller than 1.0?

    Question: Does a larger adaptation coefficient make the concentration field more or less smooth?

    Question: Does a smoother concentration field produce a smoother morphology change and explain why?

4.3 Armanini and di Silvio Suspended-load Adaptation Coefficient

33. **Create** a new **Sediment Data** files called "as AD and Lb 200ft" and adaptation parameters as shown in the figure below



34. **Save** the plan with the Title and Short ID "as AD and Lb 100ft"

35. **Run** the plan

36. **Compare** the results with the previous plans using the methods described in the previous sections.

Question: Comparing the Armanini and di Silvio results to the Zhou and Lin results, which produced larger adaptation coefficients?

Question: True or false. The adaptation coefficient and lengths are inversely related.

Question: Does increasing the adaption coefficient generally increase or decrease the bed change?

Question: If a model is unstable, does it help to increase or decrease the adaptation coefficient and why?