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.

🔚 Total - Layer Properties	-		×
Visualization and Information Features Source Files			
Vector Additional Options Point: Line: Label Features with Attribute Column(s) Edit Surface Draw May Values Plot 2D Hydraulic Connectivity Prot 2D Water Surface Gradient (Arrow N Draw May Values Draw May Values Draw May Values Draw True Face Velocities Draw True Face Values (interpolated) Face Low-Elevation Centroid Stretched Edit Image: Stretched Edit Image: Stretched 100%	√SEL High->Ld)	
Contours / Hillshade Image: Plot Contours Interval: 2 Color:			

The concentration map should look something like this:



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

Total - Layer Properties	_	×
Visualization and Information Features Source Files		
Vector Point: Line: Fill: Label Features with Attribute Column(s) Edit Surface Velot S	WSEL High->Lo	
Contours / Hillshade I Plot Contours Interval: 2 ▼ Color: Edit		
Copy Symbology Paste Symbology Reset Symbology		

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

	✓ Total-load Capacity ✓ Total-(01MAY2019 00:00:00) ✓ FS (01MAY2019 00:00:00) ✓ MS (01MAY2019 00:00:00)		
E	CS (01MAY2019 00:00:00) Total - Layer Properties -		×
	isualization and Information Features Source Files -Vector -Vector -Vector Point: Line: Fill:)	
	Contours / Hillshade Plot Contours Interval: 5 Color: Edit Copy Symbology Paste Symbology Reset Symbology		

10. While having selected both the concentrations and capacities, click on the root

results node and move the Toggle Bar Max Min To the 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.



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 $\underbrace{\$}$.
- 13. Click on File | Save Sediment Data As... and save the data as "Lt 100ft"

V S	VSediment Data - Reach2 All MF10				
File	Options View Help				
	New Sediment Data				
	Open Sediment Data				
	Save Sediment Data				
	Save Sediment Data As				
	Rename Sediment Data				

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

🤟 Sediment Data - Lt 100ft						
File	Opti	ons	View	Help		
Initia		User Defined Grain Classes				
		Set Cohesive Options				
		Bed Change Options (1D)				
		Transport Methods				
	Calibrate Transport Function					

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

🖏 Transport Model and AD Parameters: 🛛 🗖	×			
1D Methods: Routing Method (1D): Continuity Sediment Junction Split Method: Flow Weighted Pool Pass Through Method: Upstream Capacity	• •			
2D Methods: AD Parameters Erosion Parameters				
Total Load: Total Length Total Length: 20.	▼ ft			
Suspended Adaptation Coefficient: Constant Coefficient Constant Coefficient Bed Load Adaptation Length: Constant Length				

- 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.



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 **V**.
- 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

🔁 Transport Model and AD Parameters: $ \Box$ \times				
1D Methods: Routing Method (1D): Continuity Sediment Junction Split Method: Flow Weighted Pool Pass Through Method: Upstream Capacity				
2D Methods: AD Parameters Erosion Parameters				
Total Load: Weighted Length 💌 Total Length: 20. ft				
Suspended Adaptation Coefficient: Constant Coefficient Constant Coefficient 1.				
Bed Load Adaptation Length: Constant Length 🗨 Length 200. ft				

- 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

🛱 Transport Model and AD Parar	meters: — 🗆 🗙			
1D Methods: Routing Method (1D): Sediment Junction Split Method: Pool Pass Through Method:	Continuity Flow Weighted Upstream Capacity			
2D Methods: AD Parameters Erosion Parameters				
Total Load:	Weighted Length Image: Comparison of the second s			
Suspended Adaptation Coefficient	Zhou and Lin			
Bed Load Adaptation Length:	Constant Length 🗨 Length 200. ft			

- 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

5	Transport Model and AD Parameters: X						
1D I F 9	Methods: Routing Method (1D): Sediment Junction Split Method: Pool Pass Through Method:	Continuity Flow Weighted Upstream Capacity					
2D I	2D Methods: AD Parameters Erosion Parameters						
	Adaptation Coefficent Fotal Load:						
Suspended Adaptation Coefficient: Armanini & di Silvio							
E	Bed Load Adaptation Length:	Constant Length 💽 Length 200. ft					

- 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?