

Adding 2D Sediment Data and Viewing Results



Stanford Gibson, PhD and Alex Sánchez, PhD

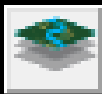
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Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

- I. Select Equations
- II. Sediment Boundary Conditions
- III. Define Bed Gradations



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

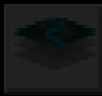
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Adding Sediment Data

HEC-RAS 6.1.0

File Edit Run View Options GIS Tools Help

Project: Chippewa_2D

Plan: Wu RC (GC hide 8k warmup)

Sediment Data - Wu Sediment Structures

File Options View Help

Boundary Conditions 2D Bed Gradations

Transport Function: van Rijn

Sorting Method: Active Layer

Fall Velocity Method: Soulsby

Define/Edit Bed Gradation ...

Define Layers... (2D)

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Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

I. Select Equations

Initial Conditions and Transport Parameters

→ 2D Bed Gradations

Boundary Conditions **2D Bed Gradations**

Transport Function: van Rijn

Sorting Method: Active Layer

Fall Velocity Method: Soulsby

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Transport Equations with Bed Gradations

Transport Function: Wu

Sorting Method: Active Layer

Fall Velocity Method: Wu and Wang

Equations

Gradations
Define Here
Use Later

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Initial Conditions and Transport Equations

Transport Function:	Wu
Sorting Method:	Active Layer
Fall Velocity Method:	Wu and Wang

Ackers-White
Engelund-Hansen
Laursen (Copeland)
Meyer Peter Muller
Toffaletti
MPM-Toffaletti
Yang
Wilcock-Crowe
Soulsby-van Rijn
van Rijn
Wu

Transport Function

2D sediment can work with any Transport Function
 But the Bottom three are 2D-Specific
 Use Caution applying 1D Functions in 2D Models
 This has little precedent and may be poorly Specified

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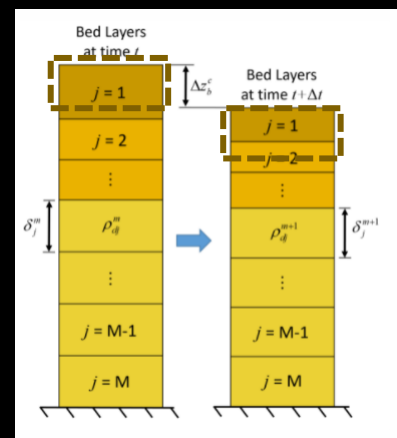
Initial Conditions and Transport Equations

Transport Function:	Wu
Sorting Method:	Active Layer
Fall Velocity Method:	Wu and Wang

Thomas (Ex5)
Active Layer
Copeland (Ex7)

Sorting/Mixing Method

- Thomas and Copeland are 1D Specific
- It Doesn't Matter What You Choose
- HEC-RAS will Use "Active Layer"
- But the 2D Active Layer \neq 1D Active Layer
- 2D Active Layer Model is Superimposed on a More Sophisticated Multi-layer Stratigraphy



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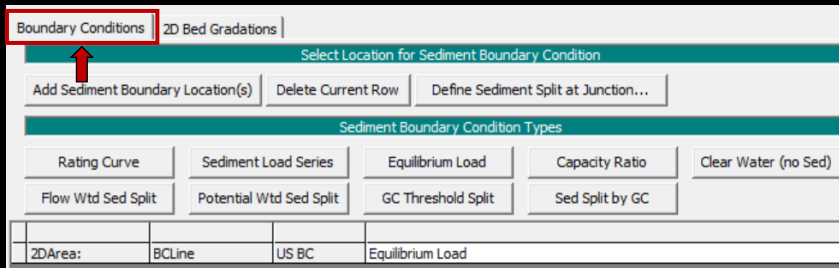
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Adding 2D Sediment Data

- I. Select Equations
- II. Sediment Boundary Conditions

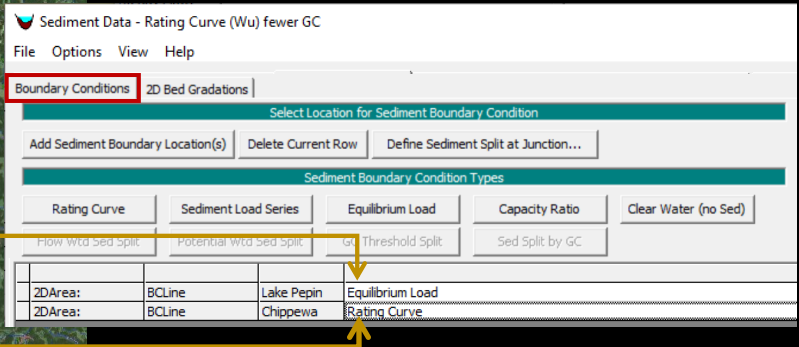
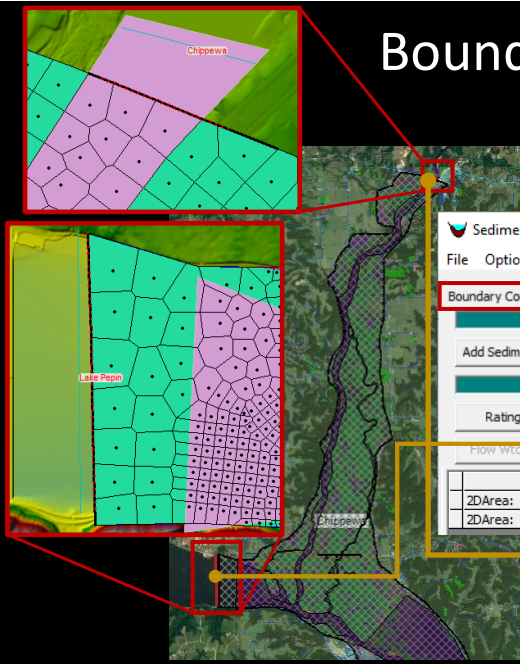
II. Sediment Boundary Conditions



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Boundary Conditions

Define a Sediment Boundary Condition for Each Hydraulic Boundary Condition



There are Four Sediment Boundary Conditions

- 1. Rating Curve
- 2. Time Series
- 3. Equilibrium
- 4. Capacity Ratio
- 5. Clear Water

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Rating Curve

Rating Curve for Kansasriver Kansasriver 143.00

Number of flow-load points: 4 sets

Flow (cfs)	100	1000	5000	25000
Total Load (tons/day)	9	150	1699	8030
Clay	14.5	14.5	14.5	14.5
VFM	1.5	1.5	1.5	1.5
FM	1.5	1.5	1.5	1.5
MM	3.7	3.7	3.7	3.7
CM	3.7	3.7	3.7	3.7
VFS	3.6	3.6	3.6	3.6
FS	10.8	10.8	10.8	10.8
MS	44.4	44.4	44.4	44.4
CS	11.9	11.9	11.9	11.9
VCS	4.3	4.3	4.3	4.3
VPS				
PS				
MG				
CG				
YCS				
SC				

Sediment Time Series

Sediment Load Series

Select/Enter the Data's Starting Time Reference

Use Simulation Time: Date: 01Apr2019 Time: 24:00

Read Load From DSS

Manual Entry | DSS

No.	Ordinates	Interpolate Values	Import Data	Del Row	Ins Row	Number of flow-load points	Gradation Rating Curve
Simulation	Time	Duration	Load				
	Time	(hours)	(tons)				
1	01Apr 2019 24:00					Total Load (tons/day)	
2	01Apr 2019 24:00					Clay (0.002-0.004)	
3	01Apr 2019 24:00					VFM (0.004-0.008)	
4	01Apr 2019 24:00					FM (0.016-0.032)	
5	01Apr 2019 24:00					MM (0.032-0.0625)	
6	01Apr 2019 24:00					CM (0.0625-0.125)	
7	01Apr 2019 24:00					FS (0.125-0.25)	
8	01Apr 2019 24:00					MS (0.25-0.5)	
9	01Apr 2019 24:00					CS (0.5-1)	
10	01Apr 2019 24:00					VCS (1-2)	
11	01Apr 2019 24:00					VFG (2-4)	
12	01Apr 2019 24:00					FG (4-8)	
13	01Apr 2019 24:00					MG (8-16)	
14	01Apr 2019 24:00					CG (16-32)	
15	01Apr 2019 24:00					VCG (32-64)	
16	01Apr 2019 24:00					SC (64-128)	
17	01Apr 2019 24:00					LC (128-256)	
18	01Apr 2019 24:00					SB (256-512)	
19	01Apr 2019 24:00					MB (512-1024)	
20	01Apr 2019 24:00					LB (1024-2048)	
21	01Apr 2019 24:00						
22	01Apr 2019 24:00						
23	01Apr 2019 24:00						
24	01Apr 2019 24:00						
25	01Apr 2019 24:00						
26	01Apr 2019 24:00						
27	01Apr 2019 24:00						

Both these boundary conditions require grain class fraction estimates

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Adding 2D Sediment Data and Viewing Results



Adding 2D Sediment Data

- I. Select Equations
- II. Sediment Boundary Conditions
- III. Define Bed Gradations

III. 2D Bed Gradations

Boundary Conditions: **2D Bed Gradations**

Transport Function: van Rijn [Define/Edit Bed Gradation ...]

Sorting Method: Active Layer [Define Layers... (2D)]

Fall Velocity Method: Soulsby [Define Layers... (2D)]

	Bed Material Type	Gradation
1	Simplified Single Bed Gradation	Pool 2 Average Gradation
2	Structure	Non-erodible surface

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Defining Bed Gradations (In 1D)

The screenshot shows the 'Geometric Data - TrimmedGeo' window with a river reach visualization. A table of bed gradation data is displayed below the visualization. A dialog box titled 'Bed Gradation' is open, showing a list of classes and a graph of % Finer vs Grain Size (mm).

River	Reach	RS	Invert	Max Depth	Min Elev	Left Sta	Right Sta	Bed Gradation
1	KansasRiver	KansasRiver	146.72	988.87	10	1580.37	2041.96	Sample 6 (146.72) mod
2	KansasRiver	KansasRiver	145.24	986.04	10	321.92	831.78	Sample 6 (146.72) mod
3	KansasRiver	KansasRiver	143.80	976.6	10	4774.85	5564.28	Sample 7 (143.8)
4	KansasRiver	KansasRiver	141.84	984.15	10	13284.2	14115.09	Sample 7 (143.8)
5	KansasRiver	KansasRiver	139.82	975.08	10	11589.7	12298.48	Sample 7 (143.8)
6	KansasRiver	KansasRiver	137.24	974.83	10	5622.53	6370.88	Sample 7 (143.8)
7	KansasRiver	KansasRiver	135.47	966.33	10	3992.74	4313.21	Sample 8 (135.47)
8	KansasRiver	KansasRiver	133.24	960.82	10	3220.36	3940.02	Sample 8 (135.47)
9	KansasRiver	KansasRiver	131.11	957.03	10	8443.46	9106.01	Sample 8 (135.47)
10	KansasRiver	KansasRiver	126.78	952.31	10	3242.9	4237.37	Sample 9 (126.78)
11	KansasRiver	KansasRiver	124.27	949.6	10	16734.6	17749.62	Sample 9 (126.78)

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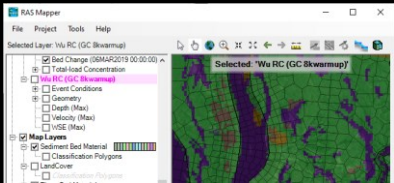
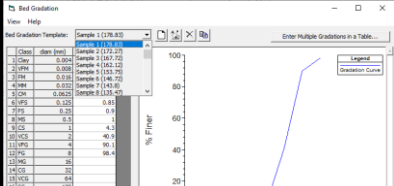
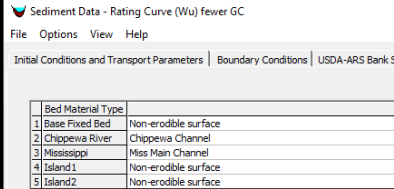
Defining Bed Gradations (In 2D)

The screenshot shows the 'RAS Mapper' window with a 2D river reach map. A dialog box titled 'Bed Gradation' is open, showing a list of classes and a graph of % Finer vs Grain Size (mm). Below the dialog box, a 'Sediment Data - Wu Sediment Structures' window is shown with '2D Bed Gradations' selected.

Bed Material Type	Gradation
1	Simplified Single Bed Gradation
2	Structure
	Non-erodible surface

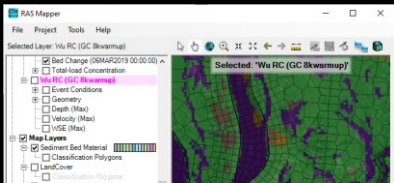
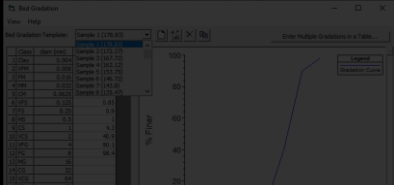
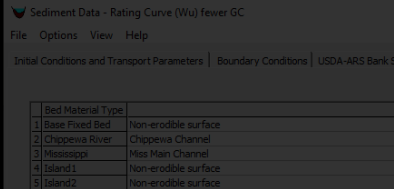
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Defining Bed Gradations

<p>1. Define Sediment Material Classification Layers in Mapper</p>													
<p>2. Input Bed Gradation Data and Stratigraphy</p>													
<p>3. Associate Bed Gradation Data with Mapper Layers</p>	 <table border="1" data-bbox="821 795 1156 888"> <thead> <tr> <th>Bed Material Type</th> <th></th> </tr> </thead> <tbody> <tr> <td>1 Base Fixed Bed</td> <td>Non-erodible surface</td> </tr> <tr> <td>2 Chippewa River</td> <td>Chippewa Channel</td> </tr> <tr> <td>3 Mississippi</td> <td>Miss Main Channel</td> </tr> <tr> <td>4 Island1</td> <td>Non-erodible surface</td> </tr> <tr> <td>5 Island2</td> <td>Non-erodible surface</td> </tr> </tbody> </table>	Bed Material Type		1 Base Fixed Bed	Non-erodible surface	2 Chippewa River	Chippewa Channel	3 Mississippi	Miss Main Channel	4 Island1	Non-erodible surface	5 Island2	Non-erodible surface
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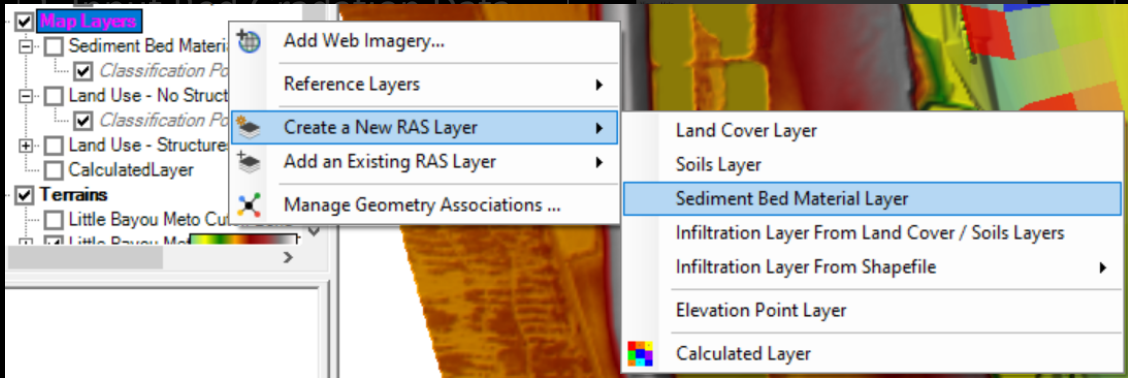
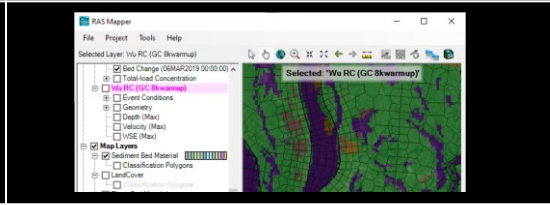
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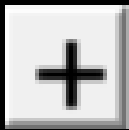
Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



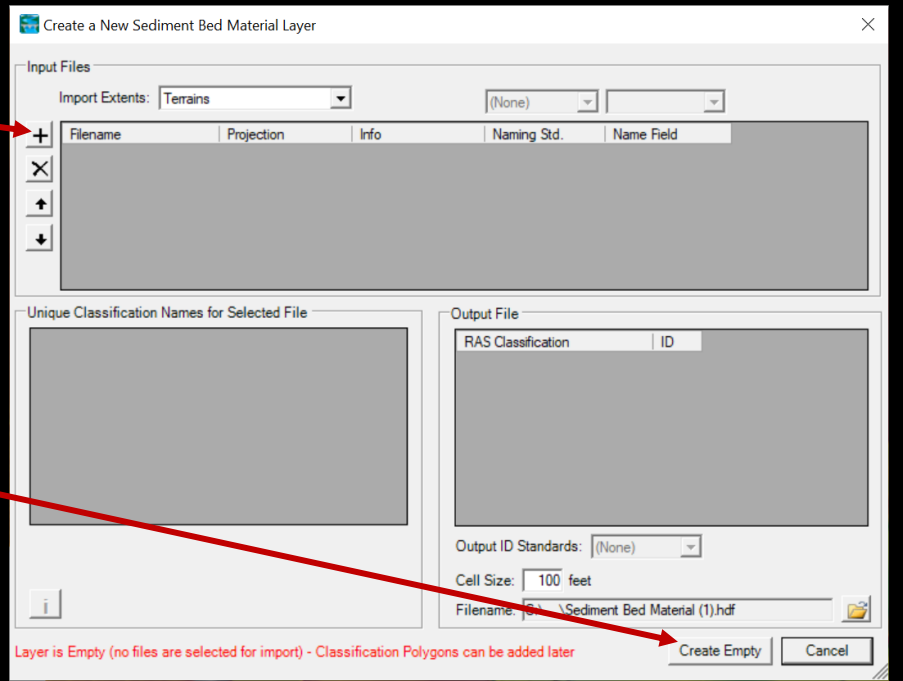
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If you want to import a classification file.



If you just want to draw polygons

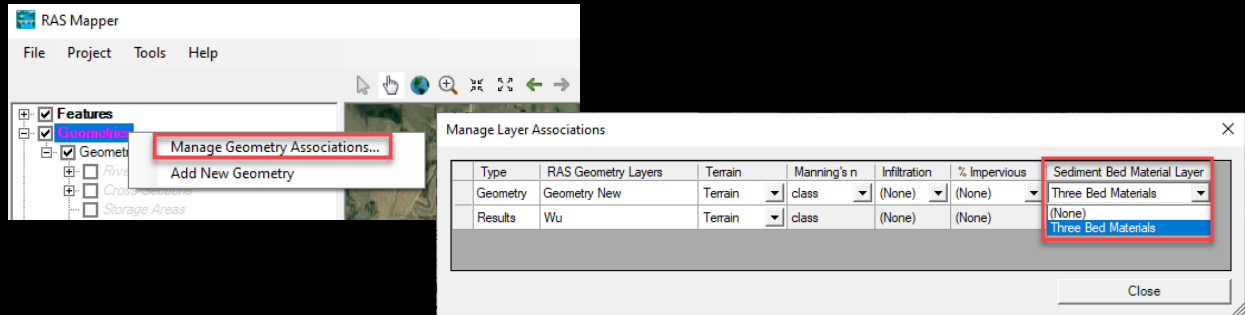
Create Empty



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Defining Bed Gradations

Associate Bed Material Layer with...a Geometry!?!?

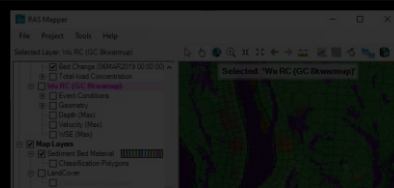


- This is the Most Overlooked Step
- Implications of Associating Bed Materials with Geometry

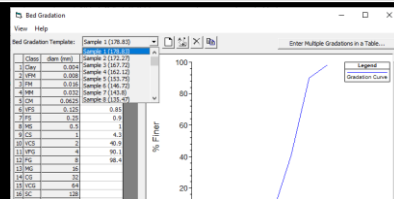
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Defining Bed Gradations

1. Define Sediment Material Classification Layers in Mapper



2. Input Bed Gradation Data and Stratigraphy



3. Associate Bed Gradation Data with Mapper Layers

Bed Material Type	Surface
1	Base Fixed Bed
2	Chippewa River
3	Mississippi
4	Island1
5	Island2

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Input Bed Gradation Data

Sediment Data - Wu Sediment Structures

File Options View Help

Boundary Conditions: **2D Bed Gradations**

Transport Function: van Rijn
 Sorting Method: Active Layer
 Fall Velocity Method: Soulsby

Define/Edit Bed Gradation ...
 Define Layers... (2D)

Bed Material Type	
1 Simplified Single Bed Gradation	Pool 2 Average Gradation
2 Structure	Non-erodible surface

Bed Gradation

View Help

Bed Gradation Template: Sand

Class	diam (mm)	MainChannel	Chippewa Channel	Coarsen Chippewa
1 Clay	0.004			
2 VFM	0.008			
3 FM	0.016			
4 MM	0.032			
5 CM	0.0625			
6 VFS	0.125	0		
7 FS	0.25	5.8		
8 MS	0.5	41.6		
9 CS	1	74.4		
10 VCS	2	83.7		
11 VFG	4	87.9		
12 FG	8	95		
13 MG	16	100		
14 CG	32			
15 VCG	64			
16 SC	128			
17 LC	256			
18 SB	512			
19 MB	1024			
20 LB	2048			

% Finer Grain Class % Convert: %finer <-> %

Set Sample Specific Cohesive Parameters

OK Close

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Define Stratigraphy

Sediment Data - Wu Sediment Structures

File Options View Help

Boundary Conditions: **2D Bed Gradations**

Transport Function: van Rijn
 Sorting Method: Active Layer
 Fall Velocity Method: Soulsby

Define/Edit Bed Gradation ...
 Define Layers... (2D)

Bed Material Type	
1 Simplified Single Bed Gradation	Pool 2 Average Gradation
2 Structure	Non-erodible surface

Define Gradation Layers

Layer Groups: Floodplain Layers

of Layers: 3 Depositional Layer thickness (ft):

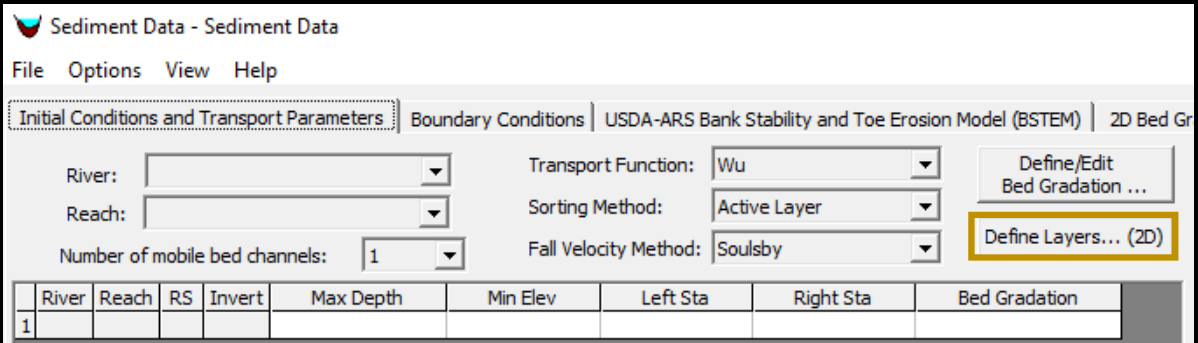
Layer Thickness (ft)	Layer Gradation Template
6	Sand
8	Chippewa Channel
1	Non-erodible surface

Sand
 MainChannel
 Chippewa Channel
 Coarsen Chippewa
 Non-erodible surface

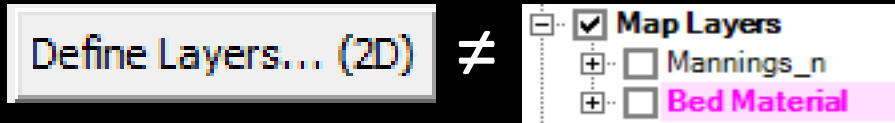
Bed Layers at time t and $t + \Delta t$ showing erosion and layer reorganization.

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Defining Stratigraphy



Note: **Layers ≠ Layers**



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Defining Bed Gradations

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Associate Bed Gradation Data with Mapper Layers

Sediment Data - Wu Sediment Structures

File Options View Help

Boundary Conditions 2D Bed Gradations

Transport Function: van Rijn

Sorting Method: Active Layer

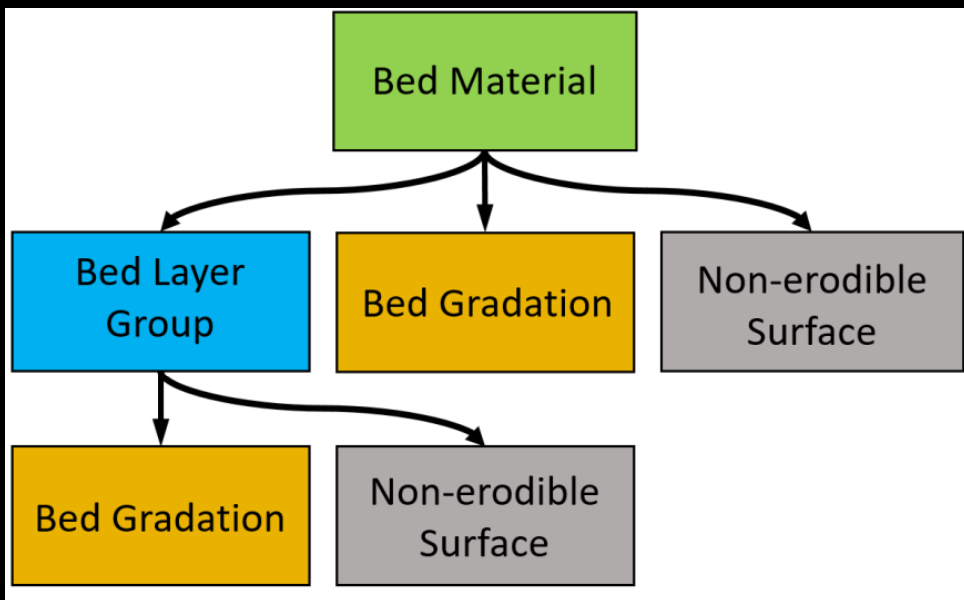
Fall Velocity Method: Soulsby

Bed Material Type	Gradation
1 sand	Sand
2 82	MainChannel
3 71	Gravel Bar
4 42	Non-erodible surface
5 52	Gravel Bar
6 43	Bank Materials
7 21	Floodplain
8 22	Floodplain
9 23	Trib Gradation
10 95	Coarse Thalweg Material
11 90	MainChannel
12 24	Floodplain
13 11	Non-erodible surface
14 31	Coarse Thalweg Material

Non-erodible surface
Sand
MainChannel
Gravel Bar
Floodplain
Coarse Thalweg Material
Trib Gradation
Bank Materials

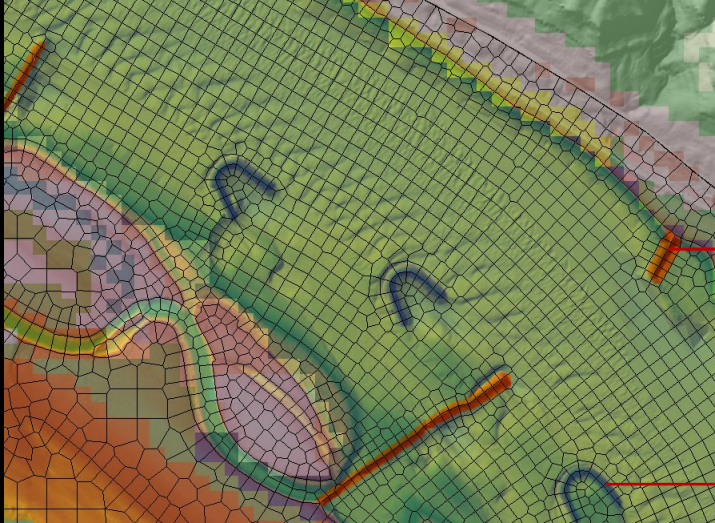
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Possible Bed Material Options



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Non-Erodible Surfaces



	Bed Material Type	
1	Bed Materials	Nonuniform
		Non-erodible surface
		Nonuniform
12	24	Floodplain
13	11	Non-erodible surface
14	31	Coarse Thalweg Material
		Non-erodible surface
		Sand
		MainChannel
		Gravel Bar
		Floodplain
		Coarse Thalweg Material
		Trib Gradation
		Bank Materials

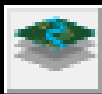
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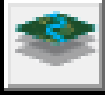


Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

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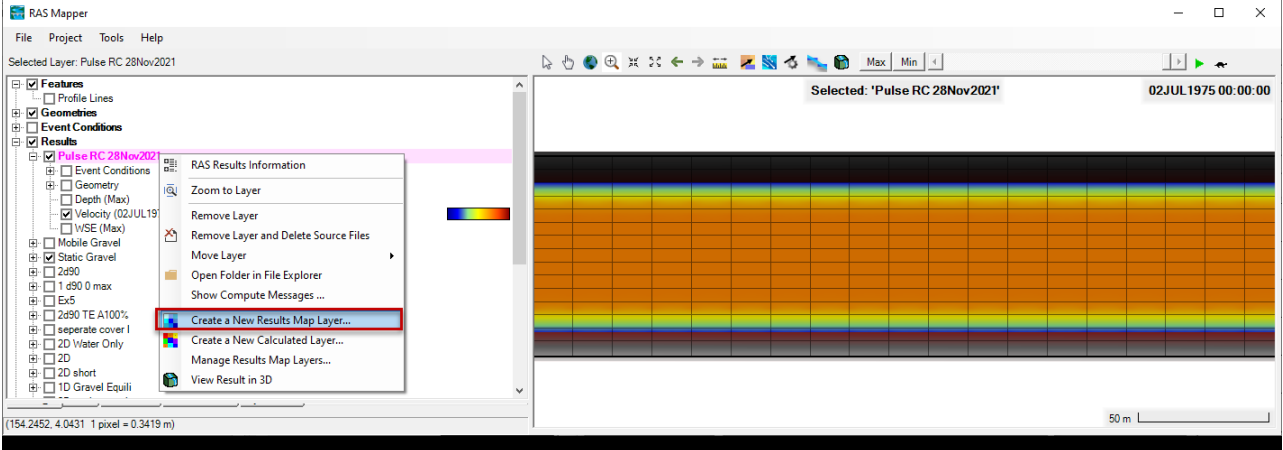
Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

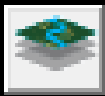
I. Add 2D Result Maps

Create a New Results Map Layer...



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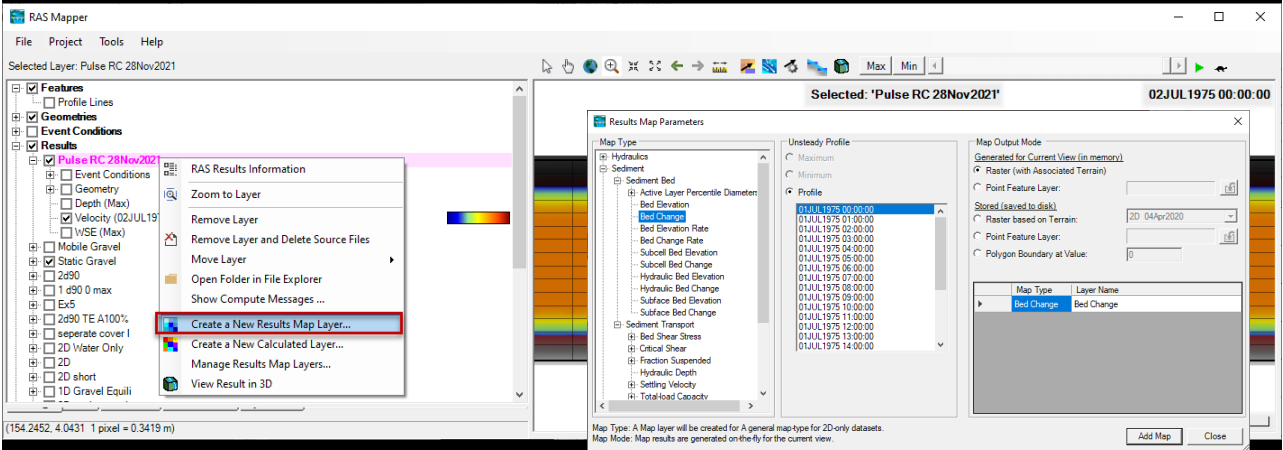
Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

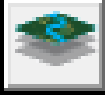
I. Add 2D Result Maps

Create a New Results Map Layer...



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Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

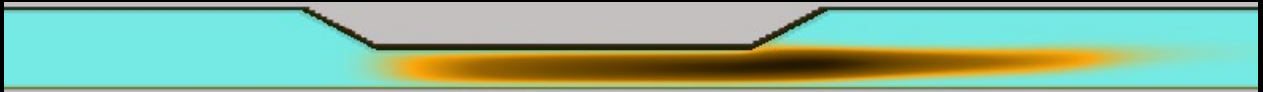
I. Add 2D Result Maps

Create a New Results Map Layer...

Bed Change

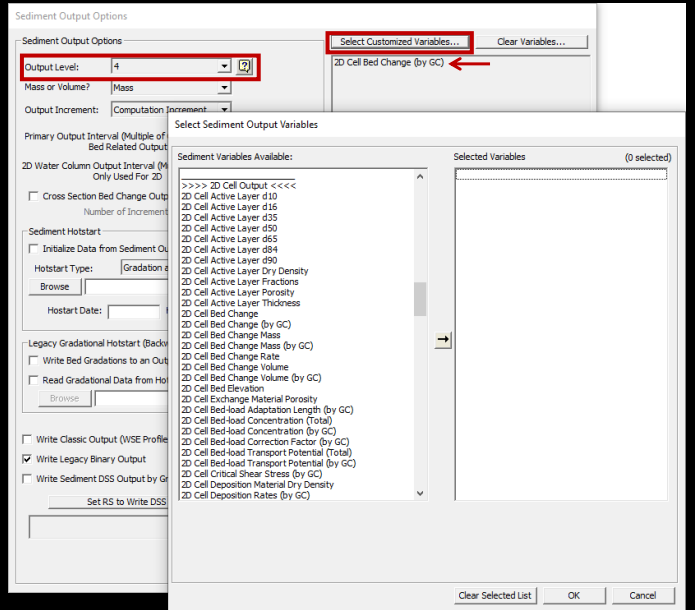
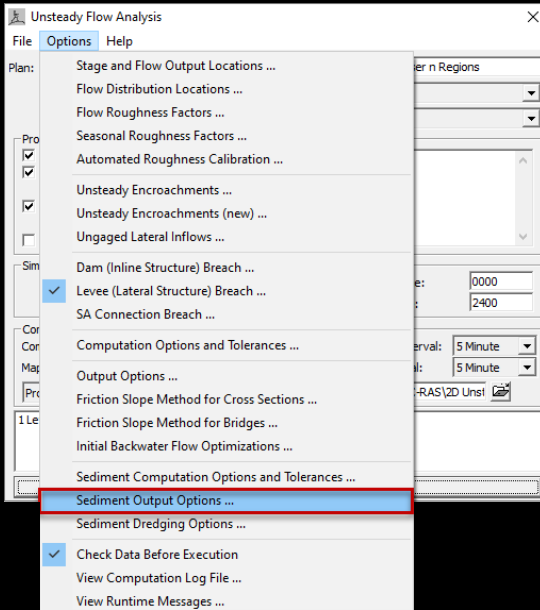


Concentration



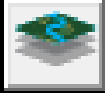
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What if you want more/different results?



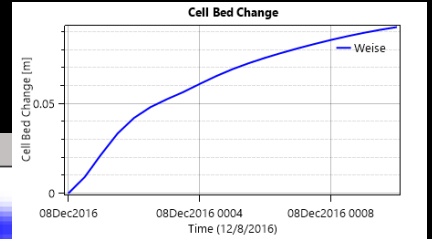
32

Adding 2D Sediment Data and Viewing Results



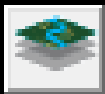
Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series



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Adding 2D Sediment Data and Viewing Results

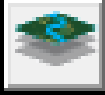


Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines

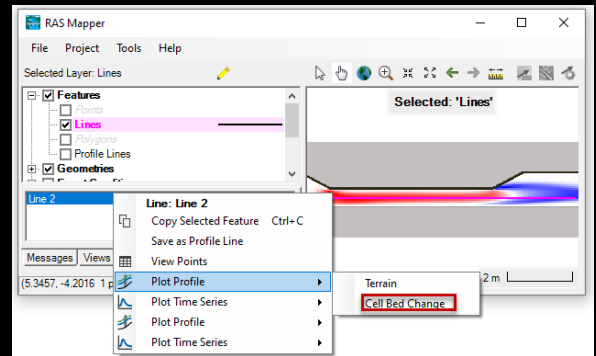
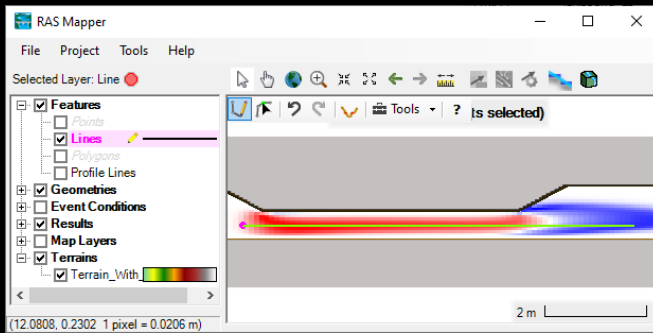
34

Adding 2D Sediment Data and Viewing Results



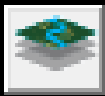
Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines



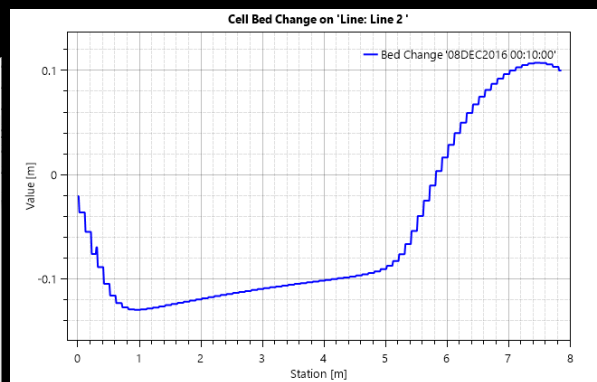
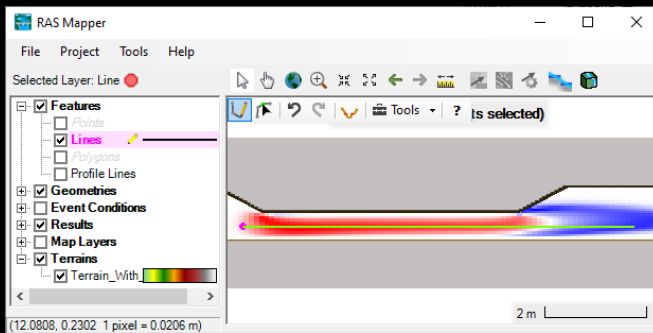
35

Adding 2D Sediment Data and Viewing Results



Viewing 2D Sediment Results

- I. Add 2D Result Maps
- II. View Time Series
- III. Profile Lines



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