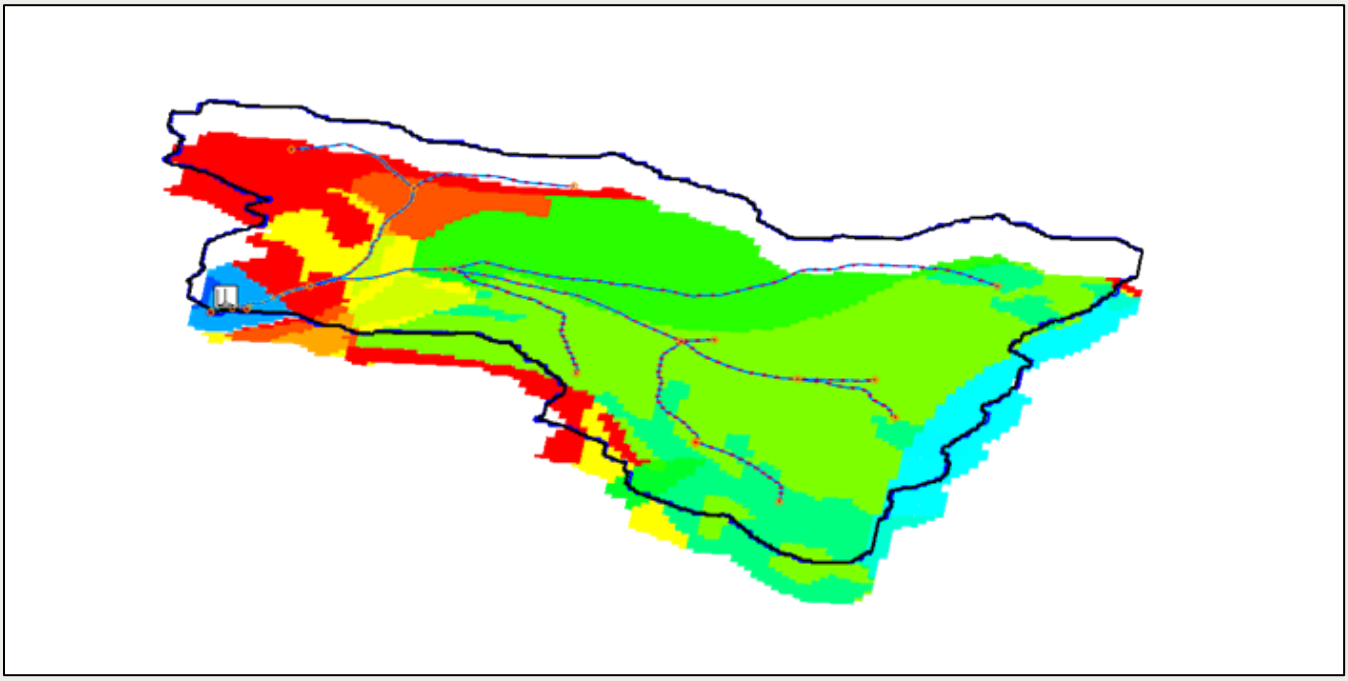
WMS 11.2 Tutorial

GSSHA Land Use Change – River Cane

Model land use changes using GSSHA



Objectives

This tutorial demonstrates how to model and compare the effects of changing land use by adding River Cane along a stream. This tutorial has been created by ERDC using the Tutorial Template from Aquaveo.

Prerequisite Tutorials

- Developing a GSSHA Model Using the Hydrologic Modeling Wizard

Required Components

- WMS Core
- GSSHA Model

Time

- 20–35 minutes

AQUAVEO™

1 Introduction

This tutorial shows how changing land use by adding planted River Cane along a river can be modeled in GSSHA. This scenario can then be used to compare pre-planting and post- planting watershed conditions.

1.1 Getting Started

Begin by opening an existing GSSHA model:

1. Open WMS, or click **New** to reset to the default settings and clear any existing data.
2. Switch to the **2-D Grid** module.
3. Select *GSSHA* | **Open Project File…** to bring up the *Open* dialog.
4. Browse to the *data files* folder for this tutorial and select “River_Cane.prj”.
5. Click **Open** to import the project and exit the *Open* dialog.
6. Click Display Options to bring up the Display Options dialog.
7. Select “2D Grid Data” from the list on the left.
8. Uncheck the Cells box under 2D grid, if needed.

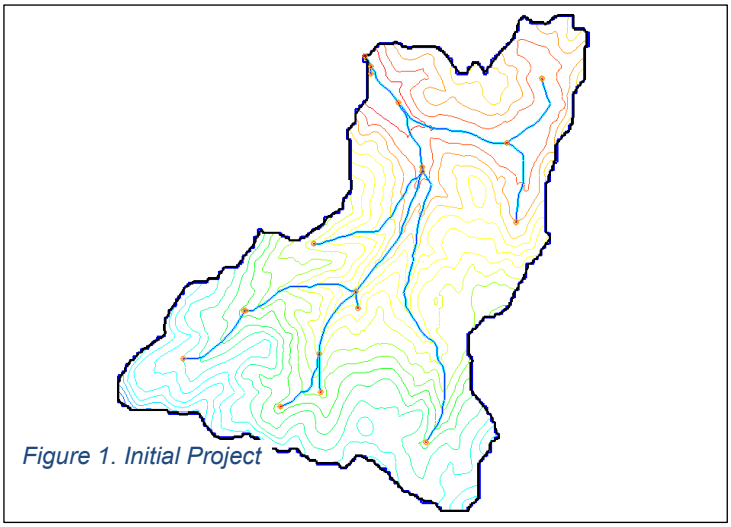


Figure 1. Initial Project

The project should appear similar to Figure 1.

2 Creating a New GSSHA Coverage

Because GSSHA is a fully distributed model, adding planted River Cane along the stream where it would occur can be simulated. In this tutorial, we will change the land use along the streams to include planting of River Cane as shown below in Figure 2. This change impacts both infiltration and the overland roughness characteristics of the watershed. We will also add retention depth to the watershed.

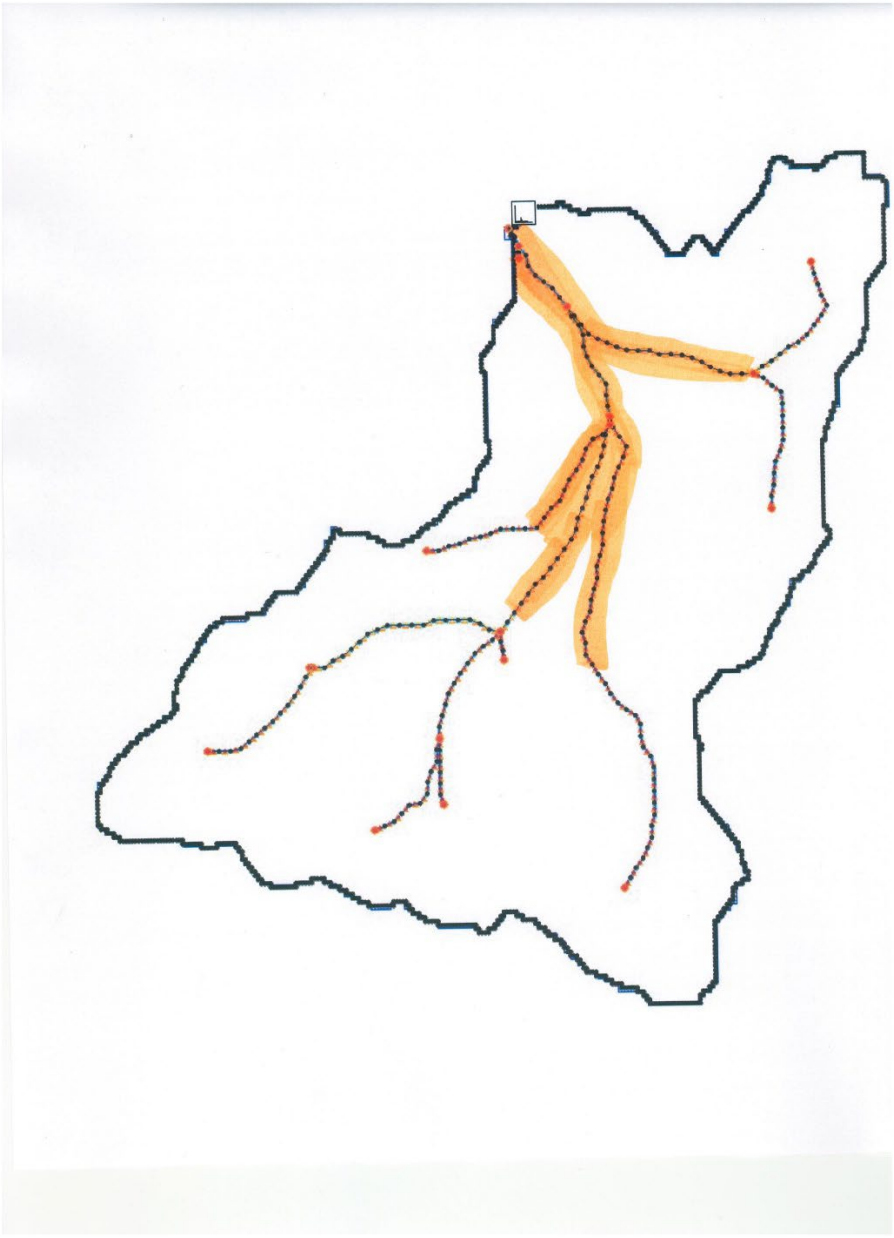


Figure 2- Location of Added River Cane

The first step is to create a new GSSHA coverage by doing the following:

1. Right-click on "LUResidential_1" and select **Duplicate** to create a new "Copy of LUResidential_1" coverage.
2. Right-click on "Copy of LUResidential_1" and select **Rename**.

3. Enter “RiverCaneAdd” and press *Enter* to set the new name.
4. Turn off all coverages except for “ RiverCaneAdd”.
5. Select “ RiverCaneAdd” to make it active.
6. Right-click on “ River_Cane” and select **Duplicate** to create a new “ River_Cane(2)” project. This creates a new version of the GSSHA model.
7. Right-click on “ River_Cane(2)” and select **Rename**.
8. Enter “Adding_River_Cane” and press *Enter* to set the new name.

There should now be “ River_Cane” and “ Adding_River_Cane” projects in the Project Explorer.

9. Under “ Adding_River_Cane”, right-click on “ GSSHARes_1” and select *Assign coverage* | **GSSHARes_1**. This assigns a GSSHA coverage for the streams and setup of the new model.

3 Saving the Working Project

Before continuing, save the new GSSHA project by doing the following:

1. Right-click on “ Adding_River_Cane” and select **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
2. Select “GSSHA Project File (*.prj)” from the *Save as type* drop-down.
3. Enter “GSSHA_River_Cane.prj” as the *File name*.
4. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

4 Modifying the Index Maps

We want to revise the land use maps to include new areas of planted River Cane along the streams in this model. This means that the index maps, “ LUResidential_1 ” needs to be modified to match the area planned for planting of River Cane. The area of River Cane planting is greater than would normally be done in an actual mitigation, but for this tutorial example is exaggerated.

We will add a new land use for River Cane, as this is not in the current model.

4.1 Modifying the Land Use Index Map to Include River Cane

For convenience, a template background image has been created to allow easy creation of the new land use that includes the planned added River Cane.

1. Turn off all coverages except “ LUResidential_1” and “ RiverCaneAdd”.
2. Click on “ RiverCaneAdd” to make it active.
3. Turn off “ 2D Grid Data”.
4. Click **Open** to bring up the *Open* dialog.
5. Browse to the *data files* folder for this tutorial and select “River_Cane_location_to_add.jpg”.
6. Click **Open** to close the *Open* dialog and import “River_Cane_location_to_add.jpg”.
7. Once it finishes loading, right-click on “ River_Cane_location_to_add.jpg” and select **Zoom To Extents**.

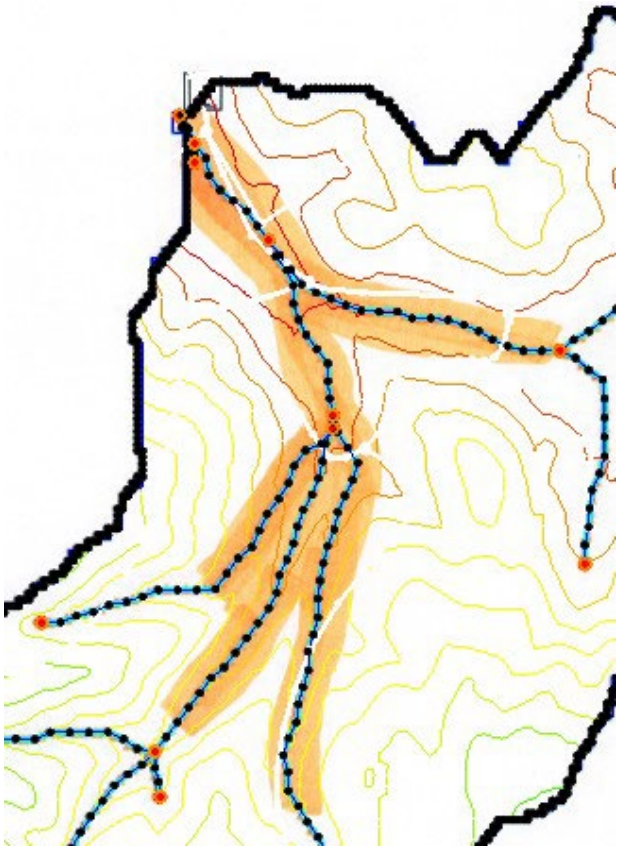


Figure 3. Orange Area for Planted River Cane

8. **Zoom** into the area around the orange colored area, this represents the area that will have the land use changed to River Cane". The project should appear similar to Figure 3 above.

9. Switch to the **Map** module.

Much of this area is residential area (LUCode 11). After planting of River Cane, the area along the river would be rougher, as River Cane is in the bamboo family and would slow flow, and in this example also alter the soil properties.

10. Select "RiverCaneAdd" coverage to make it active.

11. Using the **Create Feature Arc** tool, to create an arc that begins and ends surrounding the area shown in orange. It is o.k. to have the new arc connect with the existing arcs in the coverage. Create arcs are placed around the orange area for the planned River Cane as shown in Figure 4 below. You can either skip over the existing arcs in this land use coverage of connect to them.

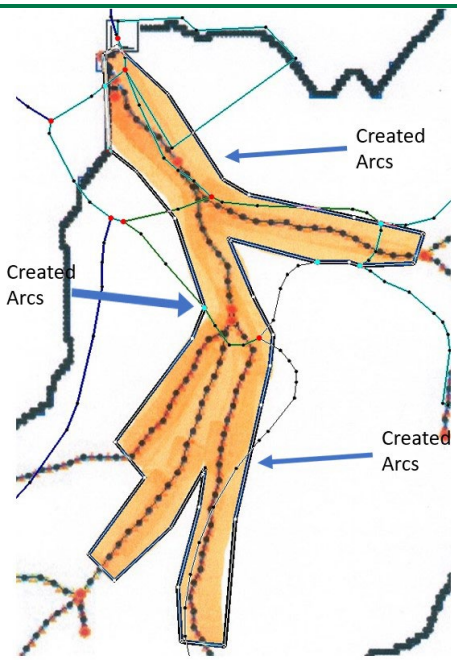


Figure 4. Enclosed arc with beginning/end circling the orange area

12. Using the Select Feature Arc tool, and pressing the Shift key, select all of the arcs that surround the orange area. It is o.k. if some of these arcs were already in the coverage, all of the arcs should be highlighted all the way around the orange area as shown below in Figure 5.

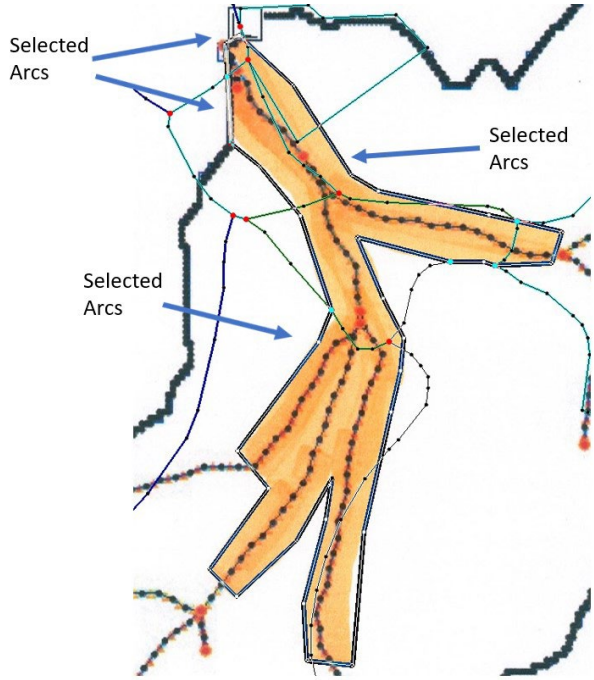


Figure 5. Hit Shift Key and Select all the Arcs

13. Select *Feature Objects* | **Build Polygon**.
14. Using the **Select Feature Polygon** tool, double-click inside the new polygon to bring up the *Land use mapping* dialog.
15. In the *WMS landuse ID* section, select “Add landuse ID to list”.
16. Under the *WMS land use properties* section “Land ID 0”, put “1” in for land use

ID, and click the **Apply** key. A land used ID of 1 is now created for " RiverCaneAdd coverage".

17. Select "GSSHARes_1" to make it active. This makes the main GSSHA coverage active again. Also check it.
18. Turn off "LUResidential_2" and "RiverCaneAdd".
19. **Frame** the project.
20. Then use the Zoom tool on the main area of the watershed.

4.2 Creating the Modified Index Maps

With the land use coverage changed to add the River Cane along the streams, the index maps that use the revised above "RiverCaneAdd" need to be updated with the new land use ID of 1. First, create a new land use index map that includes the River Cane by doing the following:

1. Right-click "Adding_River_Cane" and select **Maps…** to bring up the *GSSHA Maps dialog.* This is second duplicate GSSHA model that was created.
2. On the *Index - Grid* tab, in the *Compute index using WMS coverages* section, select "RiverCaneAdd" from the *Input coverage (1)* drop-down.
3. Select "Id" from the *Coverage attribute* drop-down.
4. Enter "RiverCaneAdded" as the *Index map name*.
5. Click **Coverages→Index Map** to map the coverage to a new " RiverCaneAdded" index map.

Next, create a new index map which is a combination of soil type data and the modified land use data by doing the following:

6. Select "RiverCaneAdd" from the *Input coverage (1)* drop-down.
7. Select "Id" from the *Coverage attribute* drop-down.
8. Turn on *Input coverage (2)* and select "Soil Type" from the drop-down.
9. Select "Texture" from the *Coverage attribute* drop-down below that.
10. Enter "ComboSoilRiverCane" as the *Index map name*.
11. Click **Coverages→Index Map** to map the coverages to a new " ComboResidential_2" index map.
12. Click **Done** to close the *GSSHA Maps* dialog.
13. Turn on "2D Grid Data" and select "ComboSoilRiverCane" to make it active. The project should appear similar to Figure 6.

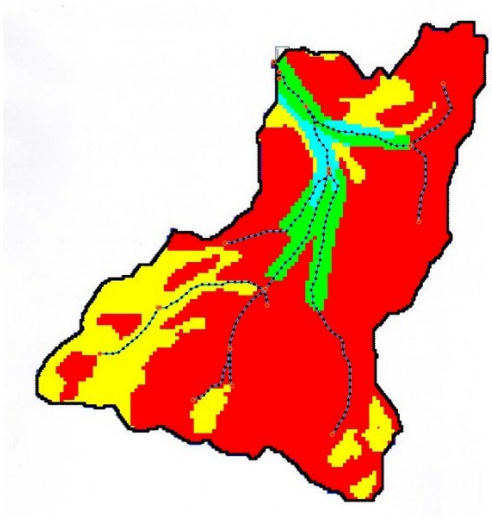


Figure 6. River Cane Soil Combined Land Use

5 Assigning New Index Maps and Updating Parameters

Now assign the new index maps and update the parameters prior to running GSSHA.

1. Under the "Index Maps" folder, under "Adding_River_Cane", right-click on " LUResidential_1" and select **Remove**.
2. Repeat step 1 for "ComboResidential_1".

The "Index Maps" folder should now contain only "ST", "River_CaneAdded", and "ComboSoilRiverCane" index maps.

Now update the mapping tables:

3. Right-click on "Adding_River_Cane" and select **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.
4. On the *Roughness* tab, select "ComboSoilRiverCane" from the *Using index map* drop- down.
5. Click **Generate IDs**, clicking **Yes** when asked to delete existing IDs. This created an index map with 4 integers for cell in the model, #1 and #2 for the soil outside the areas of River Cane, and #3 and 4 for the soil within the areas of River Cane. There are many different methods that the index maps can be combined, this is just one example, and for simplicity only 4 different land uses/soil combinations are kept. What we have here is loam and clay loam with and without River Cane.
6. Fill in the GSSHA Map Table Editor as shown below. We estimate that overland flow roughness for River Cane is being higher (0.45), and the remaining areas 0.192 for forest and 0.13 for grassland. This is shown in Figure 7 below.

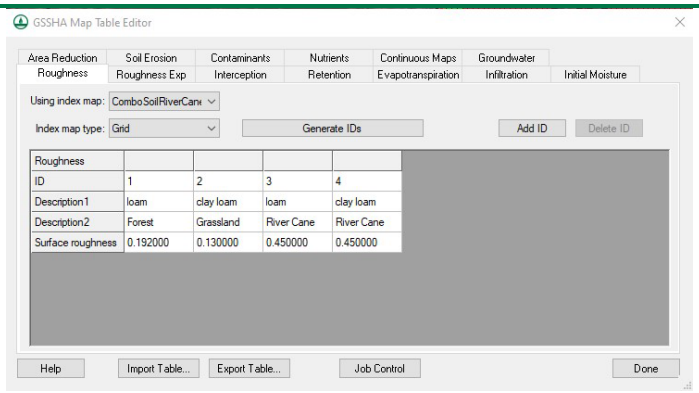


Figure 7. Mapping Table

7. On the “Infiltration tab,” select “ComboSoilRiverCane” from the Using index map drop- down.
8. Click Generate IDs, clicking Yes when asked to delete existing IDs. This created an index map with 4 integers for each cell, #1 and #2 for the soil outside the areas of River Cane, and #3 and 4 for the soil within the areas of River Cane. We will assume that planting River Cane raises the hydraulic conductivity values, with more roots providing pathways for water to infiltrate.
9. Fill in the GSSHA Map Table Editor as shown below in Figure 8. To fill in the table, you can copy and paste from one column to the next.

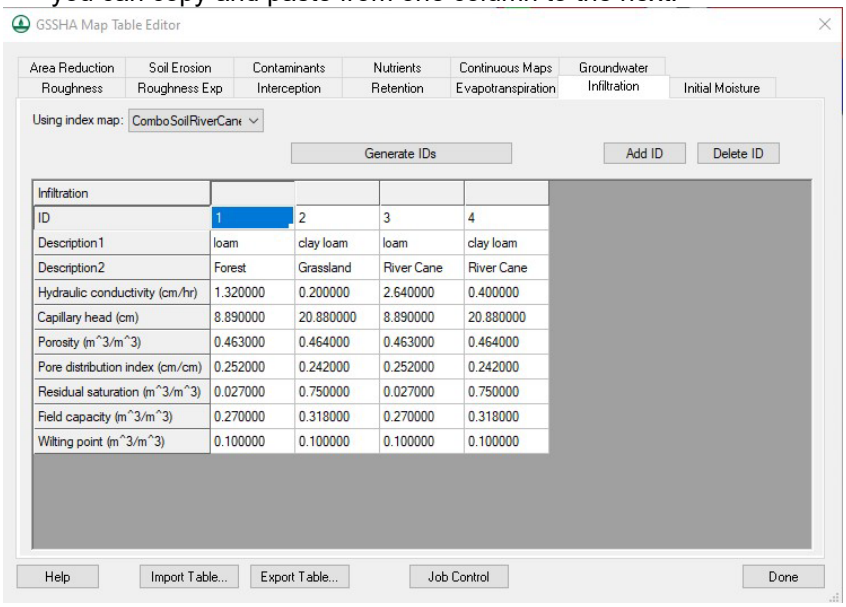


Figure 8. Infiltration Parameters

10. The GSSHA model run parameters are now modified to include one scenario of adding River Cane.

6 Adding Retention Depth

The last step prior to running GSSHA in this tutorial is to add Retention Depth to the model. Retention depth is an amount of initial rainfall from a storm that is retained on the surface, for River Cane there is a dense organic layer that forms on the surface the can retain the first amount of rainfall from a storm. To add retention depth:

1. Right-click “ Adding_River_Cane” and select **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.
2. On the *Retention* tab, select “ComboSoilRiverCane” from the *Using index*

map drop- down. WMS will ask you if you want to turn on retention in the job control, respond **YES** to this. Additional processes can be added to the GSSHA model this way.

3. On the "Retention tab," select "ComboSoilRiverCane" from the Using index map drop- down.
4. Click Generate IDs. It then has the same 4 combined soil/land use different types as before. We will assume 5 mm for retention depth for the River Cane, and 0.0 for other soils, as shown in Figure 9.

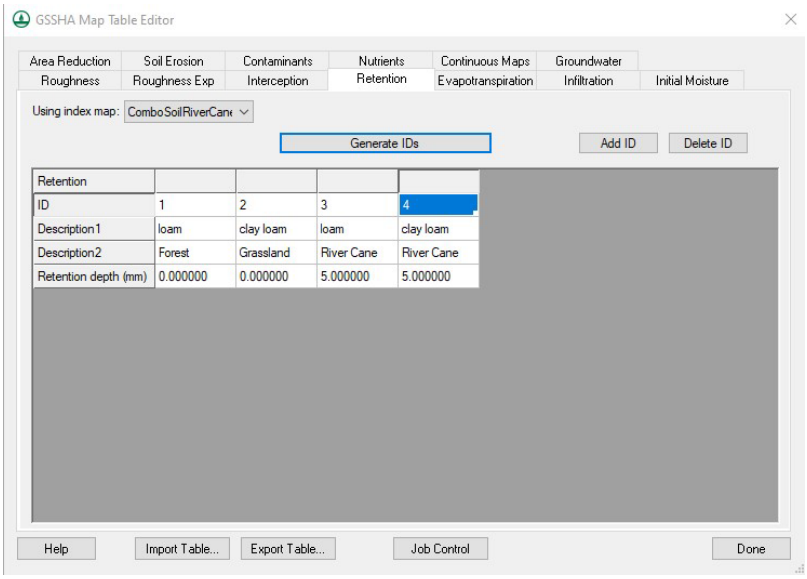


Figure 9. Retention Depth Added to Model

7 Running GSSHA

Before running GSSHA, the project file should be saved.

1. Right-click on "Adding_River_Cane" and select **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
2. Select "GSSHA Project File (*.prj)" from the *Save as type* drop-down.
3. Enter "Adding_River_Cane.prj" as the *File name*, or any name you would like.
4. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog. You can overwrite what you have previously done.
5. Right-click on "Adding_River_Cane" and select **Run GSSHA** to bring up the *GSSHA Run Options* dialog.
6. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
7. When GSSHA finishes, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.
8. Click **Yes** if prompted to replace the existing file.

8 Visualizing the Results

Because the values are very small overall, the display options need to be adjusted in order to make the results visible.

1. Select "Stream flow" in the Project Explorer.
2. Click **Display Options** to bring up the *Display Options* dialog.
3. Select "2D Scatter Data" from the list on the left.
4. On the *Scatter Point* tab, turn on *Contours*.
5. Enter "15" as the *Radius* and "1000" as the *Z magnification*.
6. Click **Options…** to bring up the *Stream flow Contour Options* dialog.
7. In the *Contour Method* section, select "Color Fill" from the first drop-down.
8. Click **OK** to close the *Stream flow Contour Options* dialog.
9. Click **OK** to close the *Display Options* dialog.
10. Select "07/01/2010 10:10:00 AM" from the list of time steps in the *Properties* section of the Graphics Window.
11. Using the **Rotate** tool, rotate the project to appear as in Figure 10.

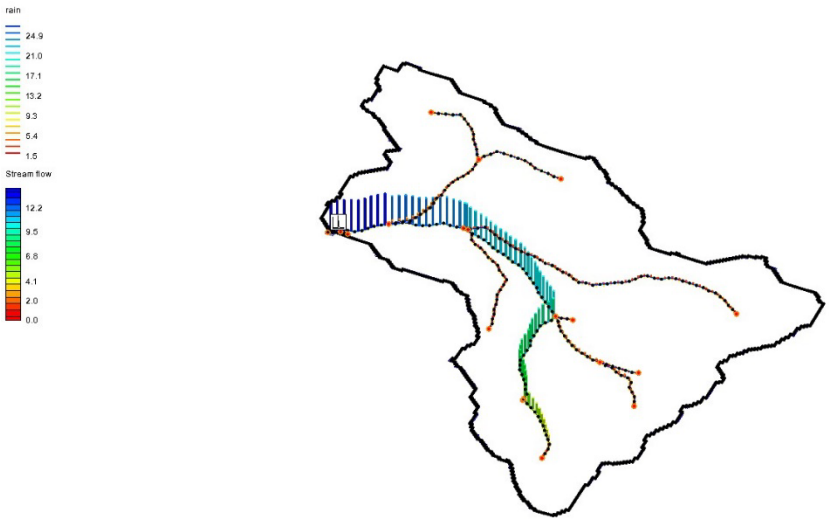


Figure 10 Rotated view showing stream flow

12. There are many additional ways to visualize the results. Feel free to experiment with reviewing the results.