WMS 11.4 Tutorial

GSSHA Overland Flow Hydrograph Boundary Conditions

Define overland flow boundary conditions in a GSSHA model

Objectives

Learn how to use the GSSHA interface in WMS to define hydrograph boundary conditions from a separate watershed on stream nodes.

Prerequisite Tutorials

- Developing a GSSHA Model Using the Hydrologic Modeling Wizard

Required Components

- WMS Core
- GSSHA Model

Time

- 15–20 minutes

1 Introduction

The GSSHA model allows for defining sources separate from rainfall with other boundary conditions. Two such types of boundary conditions are hydrographs defined on stream nodes and head boundary conditions defined on overland flow cells.

This tutorial discusses and demonstrates defining a hydrograph boundary condition. For information regarding variable stage boundary conditions in GSSHA, see the “GSSHA Overland Flow Variable Stage Boundary Conditions” tutorial.

This boundary condition is used if a hydrograph is input from a source upstream of the model. For example, the results from HEC-HMS or some other “regional” model can be used to drive a local model where GSSHA is employed. The hydrograph is defined in GSSHA at a node on a stream arc. The area used in the tutorial is along the Provo River leading from Deer Creek Reservoir to Provo, Utah before emptying into Utah Lake.

2 Opening an Existing Model

To begin this tutorial, do the following:

1. Open WMS, or click **New** to reset WMS to its defaults.
2. If WMS was already open, a dialog may appear asking to save changes. Click **Don’t Save** to clear all data.
3. Switch to the **2-D Grid** module.
4. Select *GSSHA* | **Open Project File**… to bring up the *Open* dialog.
5. Browse to the *data files* folder for this tutorial.
6. Select “ProvoBase.prj” and click **Open** to import the project and close the *Open* dialog.
7. Select *GSSHA* | **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
8. Select “GSSHA Project File (*.prj)” from the *Save as type* drop-down.
9. Enter “Hydrograph.prj” as the *File name*.
10. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

The project should appear similar to Figure 1. This model has variable overland flow roughness and variable infiltration processes already defined. A negligible amount of precipitation is defined because GSSHA will not run when not performing a long-term simulation if no precipitation is defined.

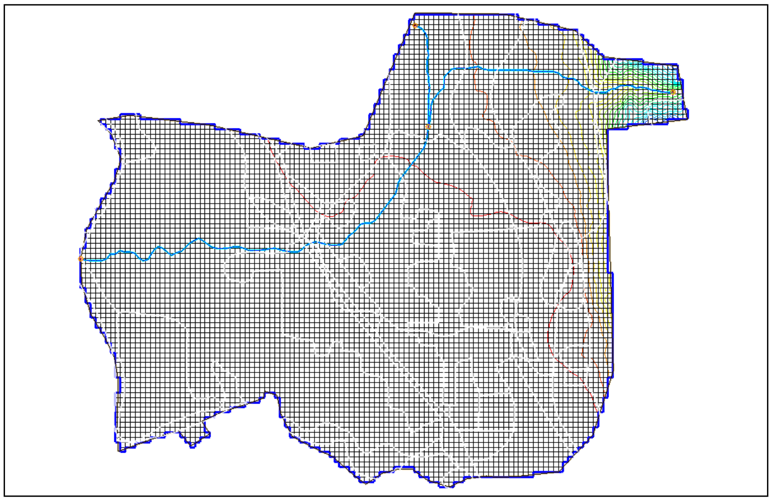

Figure 1 Initial project

3 Setting Up Channel Routing Parameters

In the model, assume a hypothetical scenario where a reservoir breach occurs upstream from the GSSHA model. This breach can be represented by a hydrograph input into the GSSHA model. Using the channel overbank option, which allows flow from the stream to spill onto the overland grid, see how the dam breach hydrograph floods the area surrounding the stream.

1. Turn off " Land Use" and " Soil Type" in the Project Explorer.
2. Select *GSSHA* | **Job Control…** to bring up the *GSSHA Job Control Parameters* dialog.
3. In the *Channel routing computation scheme* section, select *Diffusive wave* and click **Edit Parameters…** to bring up the *GSSHA Channel Routing Parameters* dialog.
4. Turn on *Allow overbank flow* and click **OK** to close the *GSSHA Channel Routing Parameters* dialog.
5. Click **OK** to close the *GSSHA Job Control Parameters* dialog.

There should be no visible change to the project.

4 Defining an Input Hydrograph

The input hydrograph should now be defined by doing the following:

1. Turn off " 2D Grid Data" in the Project Explorer.
2. Select " GSSHA" to make it active.
3. Using the **Select Feature Point/Node** tool, double-click on the top-left node in the stream (indicated in Figure 2) to open the *Properties* dialog.

This node is farthest upstream, and therefore where the influx from the dam break will occur.

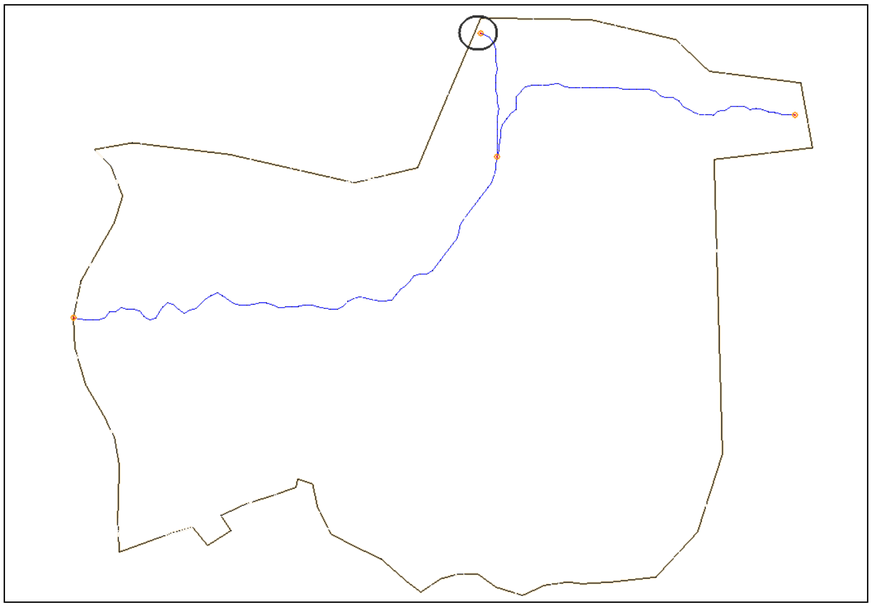

Figure 2 Upstream node (circled)

4. In the *Stream BC Type* column, on row *35057*, select "Variable flow (discharge)" from the drop-down. This column may not be visible without scrolling to the right in the spreadsheet.
5. In the *Variable Stream BC* column, click **Browse** [...] to bring up the *GSSHA Input Data* dialog.
6. On the *Hydrograph* row, click **Define** to bring up the *XY Series Editor* dialog.
7. Outside of WMS, use *File Explorer* to go to the *data files* folder for this project.
8. Open "hydroinput.txt" in a text editor, press *Ctrl-A* to select all of the contents, and press *Ctrl-C* to copy them to the clipboard.
9. Return to the *XY Series Editor* dialog and select the first cell in the spreadsheet on the left.
10. Paste (*Ctrl-V*) the clipboard contents.

The dialog should appear similar to Figure 3. This is a hydrograph that is being input at the node in the channel. This hydrograph represents a hypothetical scenario of the dam failure. However, it can come from any source, such as an upstream regional model, output from a dam break simulation, etc.

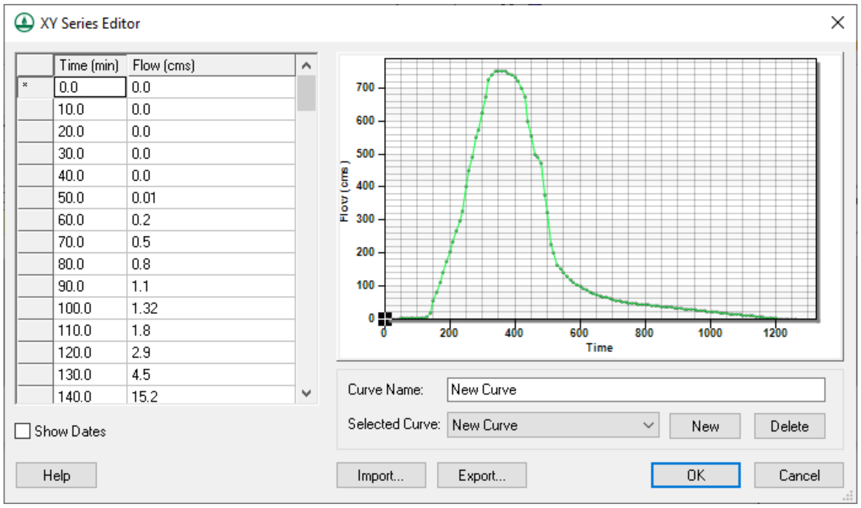

Figure 3 *XY Series Editor dialog with input hydrograph data*

11. Turn on *Show Dates* (bottom left of the dialog) to bring up the *Reference Time* dialog.
12. In the *Select the Beginning (Reference) Time* section, enter "06/07/2010" as the *Date*.
13. Enter "12:00:00 PM" as the *Time*.

This is the time when precipitation begins. The GSSHA model also begins at this time.

14. Click **Select** to close the *Reference Time* dialog.
15. Notice that the *Time* column has been modified to include specific dates and times (Figure 4) instead of showing only minutes.

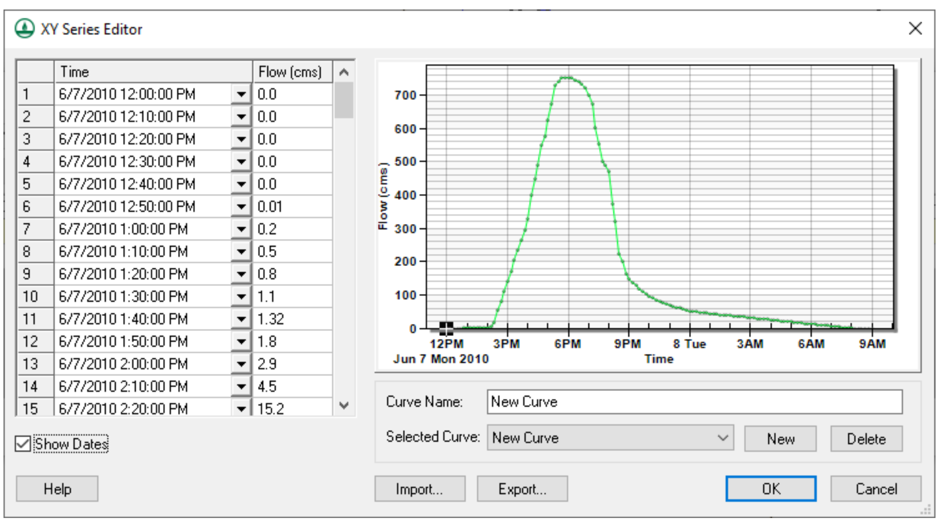

Figure 4 *XY Series Editor dialog showing specific dates and times*

16. Click **OK** to close the *XY Series Editor* dialog.
17. Click **Done** to close the *GSSHA Input Data* dialog.
18. Click **OK** to close the *Properties* dialog.

5 Changing the Overland Boundary Condition

Currently, the entire model boundary is defined as a *No Flow Boundary*. However, there is a lake on the western side of the model, and any flow that hits this boundary will get into the lake. To simulate this process, change the model boundary condition for this part of the boundary to a *Constant Stage.*

1. Select " GSSHA" to make it active.
2. Using the **Select Feature Vertex** tool, select the vertex at the northwest corner of model (indicated in Figure 5).

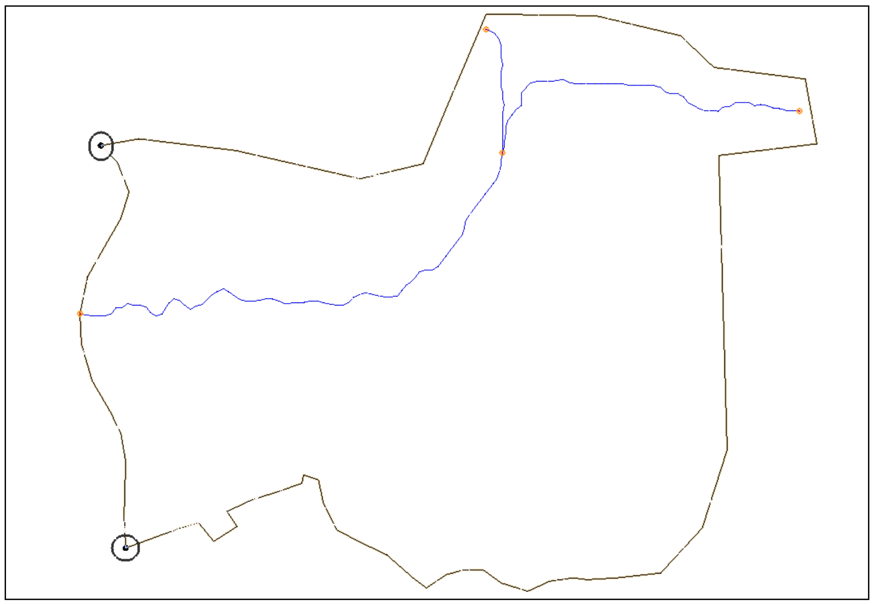

Figure 5 Northwest (top) and southwest (bottom) vertices circled

3. Select *Feature Objects* | **Vertex** ↔ **Node** to convert it to a node.
4. Repeat steps 2–3 for the southwest vertex.
5. Using the **Select Feature Arc** tool while holding down *Shift*, select the two arcs on the western boundary of the model (Figure 6).

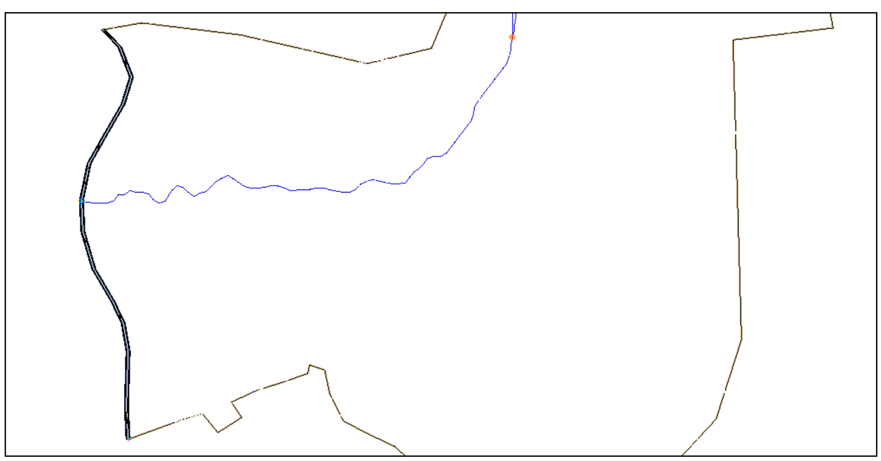

Figure 6 Select the two arcs on the western (left) boundary

6. Right-click on one of the selected arcs and select **Attributes…** to bring up the *Properties* dialog.
7. In the *Overland Flow BC Type* column, on the *All* row, select “Constant stage (water surface elevation)” from the drop-down.
8. In the *Constant BC* column, on the *All* row, enter “1367.0” and press *Tab*. This column may not be visible without scrolling to the right in the spreadsheet.

This represents the water surface elevation at the lake which is adjacent to this boundary.

9. Click **OK** to close the *Properties* dialog.

6 Saving and Running the Model

Before running GSSHA, it is recommended to save the project.

1. Switch to the **2-D Grid** module.
2. Select *GSSHA* | **Save Project File…** to bring up the *Save GSSHA Project File* dialog.
3. Select “GSSHA Project File (*.prj)” from the *Save as type* drop-down.
4. Enter “Hydrograph1.prj” as the *File name*.
5. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.
6. Select *GSSHA* | **Run GSSHA…** to bring up the *GSSHA Run Options* dialog.
7. Click **OK** to close the *GSSHA Run Options* dialog and bring up the *Model Wrapper* dialog.
8. When GSSHA finishes running, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.

A new hydrograph should appear at the western boundary (Figure 7).

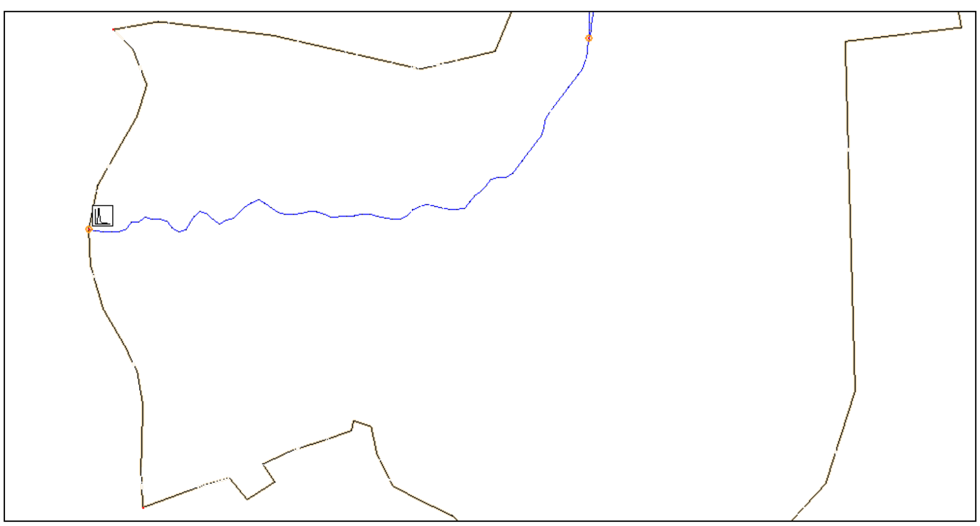

Figure 7 Hydrograph at western boundary

7 Results Visualization

There are a number of ways you can visualize the datasets created by the GSSHA run.

For example, do the following:

1. Switch to **Perspective View** (the same as oblique view).
2. Select the " Stream flow" dataset.
3. Click **Display Options** to bring up the *Display Options* dialog.
4. Select "2D Scatter Data" from the list on the left.
5. On the *Scatter Point* tab, turn on *Contours*.
6. Enter "20" as the *Radius* and "20.0" as the *Z magnification*.
7. Make sure that the *Auto z-mag* option is turned off.
8. For the *Z magnification* value under *Auto z-mag*, enter a value of "0.2".
9. Click **OK** to close the *Display Options* dialog.
10. Scroll through the time steps in the *Properties* section of the Graphics Window to the entry for "06/07/2010 06:50:00 PM".

The project should appear similar to Figure 8.

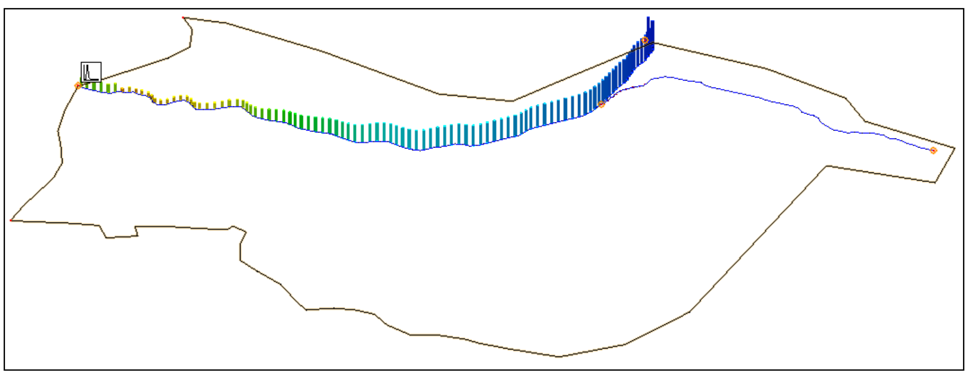

Figure 8 Oblique view showing the stream flow as bar plots along the stream

Feel free to explore other visualization options, such as opening the hydrograph plot. Datasets can also be exported for use in other projects.

8 Conclusion

This concludes the "GSSHA Overland Flow Hydrograph Boundary Conditions" tutorial. Feel free to continue experimenting or exit the program.

