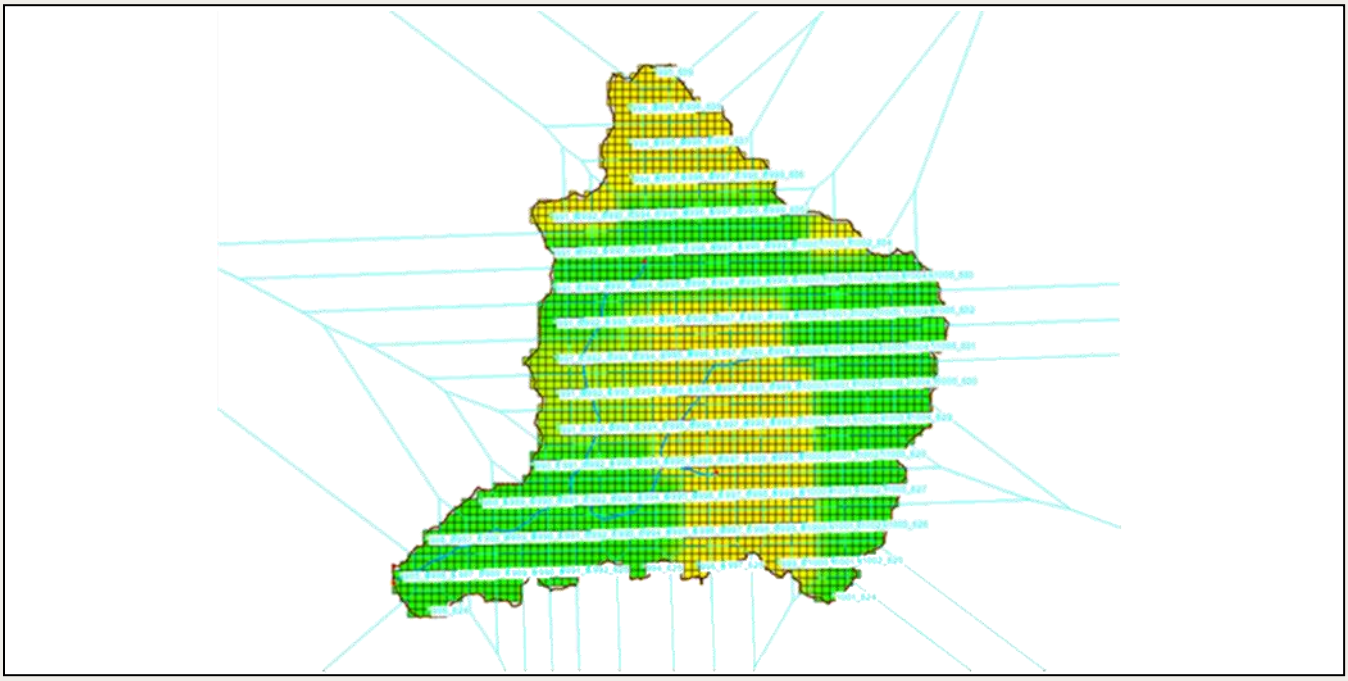
WMS 11.2 Tutorial

Precipitation Methods in GSSHA

Learn how to use different precipitation methods in GSSHA models



Objectives

Learn how to add storm and tile drain networks and associated data to an existing GSSHA model with already-defined long term and groundwater simulations.

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 the different ways that precipitation data can be defined as storms in GSSHA. It also shows how to view the difference in results while using various rainfall methods.

2 Getting Started

Starting WMS new at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. Launch WMS. If WMS is already running, press *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
2. If a dialog appears asking to save changes, click **Don't Save** to clear all data.

The Graphics Window of WMS should refresh to show an empty space.

3. Click **Open** to bring up the *Open* dialog.
4. Browse to the *data files* folder for this tutorial.
5. Change the *Files of type* to "WMS XMDF Project File (*.wms)".
6. Select "base.wms" and click **Open** to close the *Open* dialog and import the project file.
7. Click **OK** to overwrite the existing soil type table.
8. In the Project Explorer, select "new grid" to switch to the **2-D Grid Module** .

The project should appear similar to Figure 1. This model already has overland roughness, infiltration, and channel routing options defined.

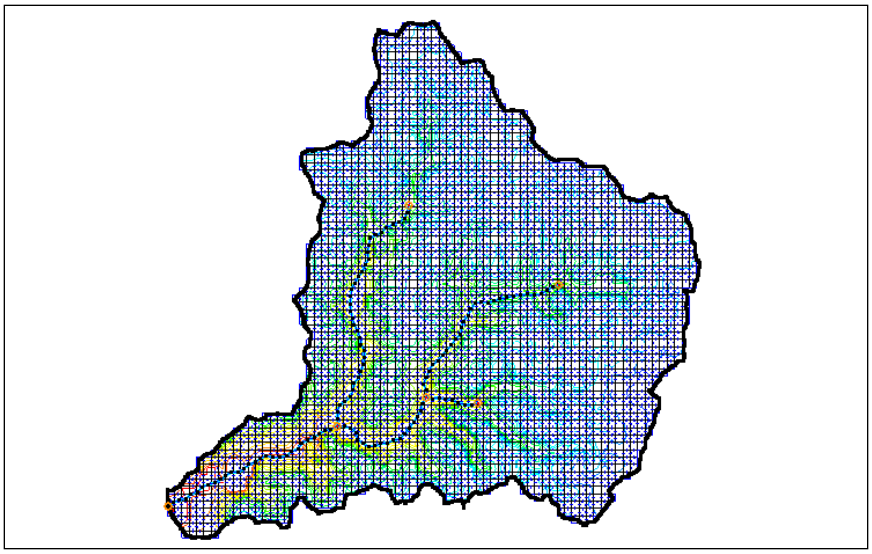


Figure 1 Initial project

3 Using Uniform Rainfall

GSSHA has four different methods of defining rainfall precipitation. The method used depends on the availability of the data and purpose of the model. The uniform precipitation method used here is generally used to evaluate the initial set up of a model.

1. Select *GSSHA* **| Precipitation…** to open the *GSSHA Precipitation* dialog.
2. Under *Rainfall event(s)*, make sure "Uniform" is selected from the drop-down.
3. For *Intensity (mm/hr)*, enter "1.809".
4. For *Duration (min)*, enter "1740".

This precipitation depth is obtained from a real storm which will be used for comparison of the different methods. It was obtained from the NOAA site.[1] The real storm total sums up to 2.065 inches over a duration of 29 hours.

5. Change the *Start date/time* to "05\07\2008 12:00:00 PM".
6. Click **OK** to close the *GSSHA Precipitation* dialog.

3.1 Changing the Job Control

Since the rainfall will last for 29 hours, the total simulation time should be adjusted so that all runoff from the watershed will be captured.

1. Select *GSSHA* **| Job Control…** to open the *GSSHA Job Control Parameters* dialog.

[1] See https://hdsc.nws.noaa.gov/hdsc/pfds/ for more details.

2. In the Computation parameters section, enter “2880” for *Total time (min)*.
3. Make sure the *Time step (sec)* is set to “10”.
4. Click **OK** to close the *GSSHA Job Control Parameters* dialog.

3.2 Save and Run the Model

The uniform precipitation is now defined. The next step is to save and run the model.

1. Select *GSSHA* **| Save Project File…** to open the *Save GSSHA Project File* dialog.
2. Enter “Uniform.prj” as the *File name*.
3. Click **Save** to save the project and exit the *Save GSSHA Project File* dialog.
4. If this file already exists, click **Yes** when asked to replace it by the *Confirm Save As* dialog.
5. Select *GSSHA* **| Run GSSHA…** to bring up the *GSSHA Run Options* dialog.
6. Click **OK** to exit the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
7. Once the model has finished running, click **Close** to read in the solution and exit the *Model Wrapper* dialog.

3.3 Visualization

The hydrograph for the project can now be viewed.

1. Using the **Select hydrographs** tool, double-click on the hydrograph icon at the outlet of the watershed to open the *Hydrograph* dialog.

The hydrograph should appear similar to Figure 2. Notice that there is no runoff. This is because the rainfall intensity was small, and all of the rain infiltrated.

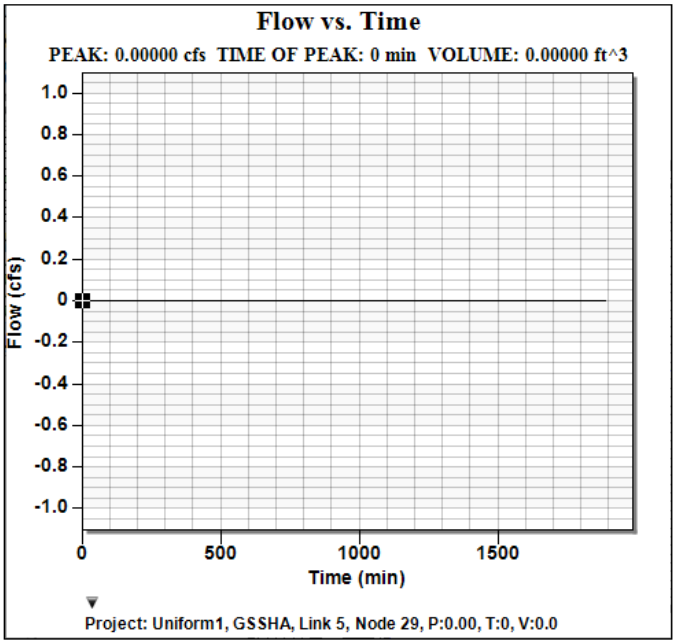


Figure 2 Hydrograph showing no runoff

2. Close the *Hydrograph* dialog by clicking the "X" in the upper right-hand corner.

4 Using a Design Storm Hyetograph

Typical rainfall distribution can be defined in GSSHA by using the SCS synthetic rainfall distribution applied to the same total depth of 52.451 mm (2.065 in). In a similar fashion, an actual temporal distribution could be defined if available. The actual temporal distribution of this storm will be used in the next section.

4.1 Define the Rainfall

First, define the rainfall event.

1. Select *GSSHA* **| Precipitation…** to open the *GSSHA Precipitation* dialog.
2. In the *Rainfall event(s)* section, select "Hyetograph" from the drop-down.
3. Click **Define Distribution…** to open the *XY Series Editor* dialog.
4. Select "typeI-24hour" from the *Selected Curve* drop-down.

The dialog should now appear similar to Figure 3.

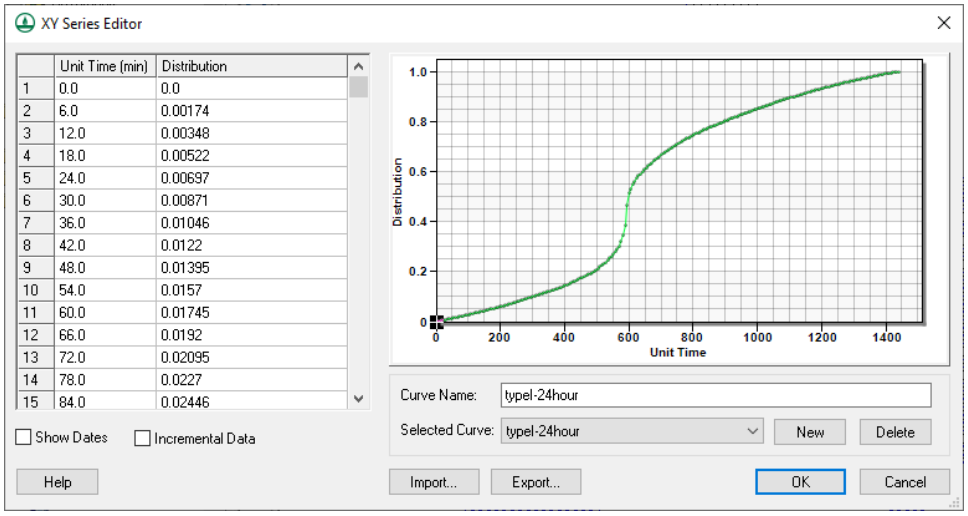


Figure 3 Curve for Type I-24 Hour storm.

5. Click **OK** to close the *XY Series Editor* dialog.
6. For *Average Depth (mm)* enter "52.451".
7. Make sure that the *Start date/time* is set to "05\07\2008 12:00:00 PM".
8. Click **OK** to close the *GSSHA Precipitation* dialog.

4.2 Save and Run the Model

It is recommended to save the project prior to running GSSHA.

1. Select *GSSHA* **| Save Project File…** to open the *Save GSSHA Project File* dialog.
2. Enter "Hyetograph.prj" as the *File name* and click **Save** to close the *Save GSSHA Project File* dialog.

3. If this file already exists, click **Yes** when asked to replace it by the *Confirm Save As* dialog.
4. Select *GSSHA* | **Run GSSHA…** to open the *GSSHA Run Options* dialog.
5. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
6. When the model is finished running, click **Close** to close the *Model Wrapper* dialog.

When viewing the hydrograph (as in Section 3.3, above), it should appear similar to Figure 4.

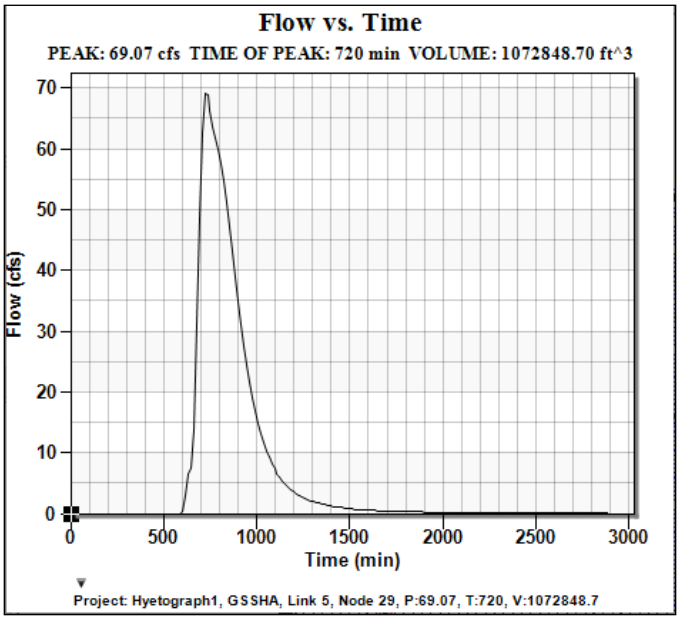


Figure 4 Hydrograph after second run

5 Using Rain Gages with the Inverse Distance Weighted Method of Interpolation

This next simulation shows how rain gages can be used to define precipitation in GSSHA. It uses four gage locations in the vicinity of the Judy's Branch watershed: namely Belleville, Carlinville, Carlyle, and the St. Louis Airport gages.

5.1 Creating Gages

First, create a new coverage.

1. Right-click on "Coverages" in the Project Explorer and select **New Coverage** to open the *Properties* dialog.
2. Select "Rain Gage" from the *Coverage type* drop-down.
3. Click **OK** to close the *Properties* dialog.

The new coverage should appear in the Project Explorer under "Coverages". Now create several new gages.

4. Using the **Create Feature Point** tool, click anywhere just outside the watershed area to create a new gage.
5. Repeat step 4 three times to create three additional gages.

Do not worry about the exact location of the gages for now. Next, edit the locations of the new gages.

6. Using the **Select Feature Point/Node** tool, double-click on any of the four gages to bring up the *Rain Gage Properties* dialog.
7. Select "GSSHA" from the *Gage type* drop-down.
8. Select "All" from the *Show* drop-down.
9. Double-click on "Gage 1" in the *Name* column and change the name to "Belleville".
10. In the X column, enter "773605.05".
11. In the Y column, enter "4272627.20".
12. Repeat steps 9–11 for gages 2–4 using the information in the table below:

ID	Name	X	Y
2	Carlinville	760702.57	4319978.10
3	Carlyle	789357.97	4295412.07
4	St. Louis Airport	739016.86	4291515.46

13. Move the *Rain Gage Properties* dialog to one side to see how WMS automatically draws Thiessen polygons (Figure 5).

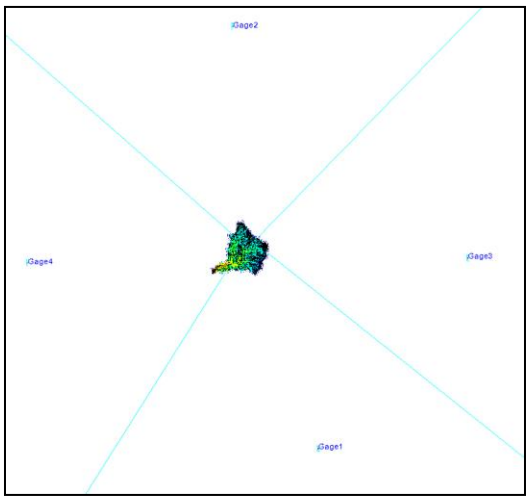


Figure 5 Thiessen polygons

14. In the *Rain Gage Properties* dialog, click **Define…** on the "Belleville" row to open the *XY Series Editor* dialog.
15. Turn on *Show Dates*.
16. In an external spreadsheet program, open "RealStorm.xls" found in the data *files* folder for this tutorial.

This spreadsheet contains the hourly precipitation records for these gages.

17. Copy the values in the *Date* column from the spreadsheet.

18. Select the topmost cell of the *Unit Time* column in the *XY Series Editor* and paste the values.
19. Copy the values in the *Belleville* column from the spreadsheet.
20. Select the topmost cell of the *Distribution* column in the *XY Series Editor* and paste the values.

The *XY Series Editor* should appear similar to Figure 6.

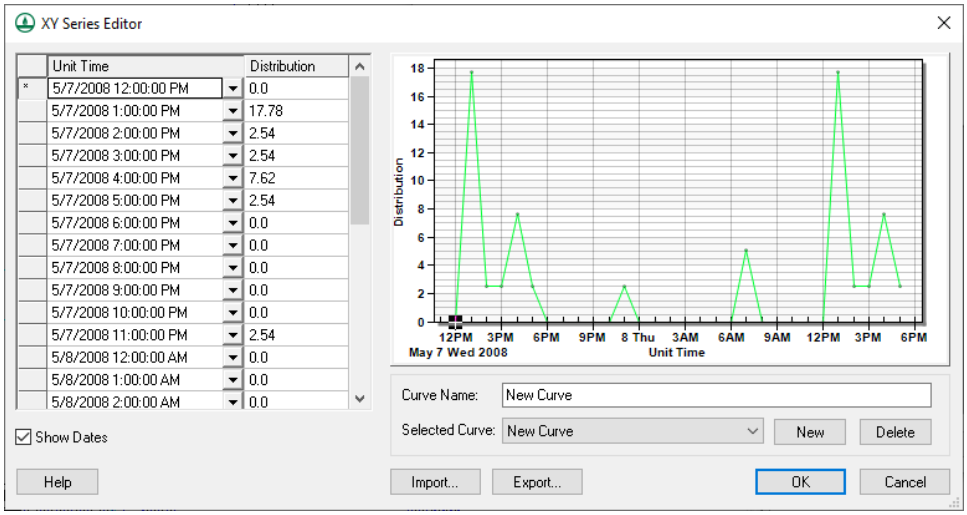


Figure 6 XY Series Editor with input values

21. Click **OK** to close the *XY Series Editor* dialog.
22. Repeat steps 14–20 for the “Carlinville”, “Carlyle”, and “St Louis Airport” gages.
23. Once done, click **OK** to close the *Rain Gage Properties* dialog.
24. Switch to the **2-D Grid Module** and select *GSSHA* **| Precipitation…** to open the *GSSHA Precipitation* dialog.
25. In the *Rainfall event(s)* section, select “Gage” from the drop-down.
26. Below the drop-down, turn on *Rain Gage*.
27. In the *Multi-gage interpolation method* section, select *Inverse distance weighted (IDW)*.
28. Click **OK** to close the *GSSHA Precipitation* dialog.

5.2 Save and Run Model

The IDW method of interpolation is being used for the gages to define the precipitation.

1. Select *GSSHA* **| Save Project file…** to open the *Save GSSHA Project File* dialog.
2. Enter “IDW.prj” as the *File name* and click **Save** to close the *Save GSSHA Project File* dialog.
3. If this file already exists, click **Yes** when asked to replace it by the *Confirm Save As* dialog.
4. Select *GSSHA* | **Run GSSHA…** to open the *GSSHA Run Options* dialog.

5. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
6. When the model is finished running, click **Close** to close the *Model Wrapper* dialog.

When viewing the hydrograph (as in Section 3.3, above), it should appear similar to Figure 7.

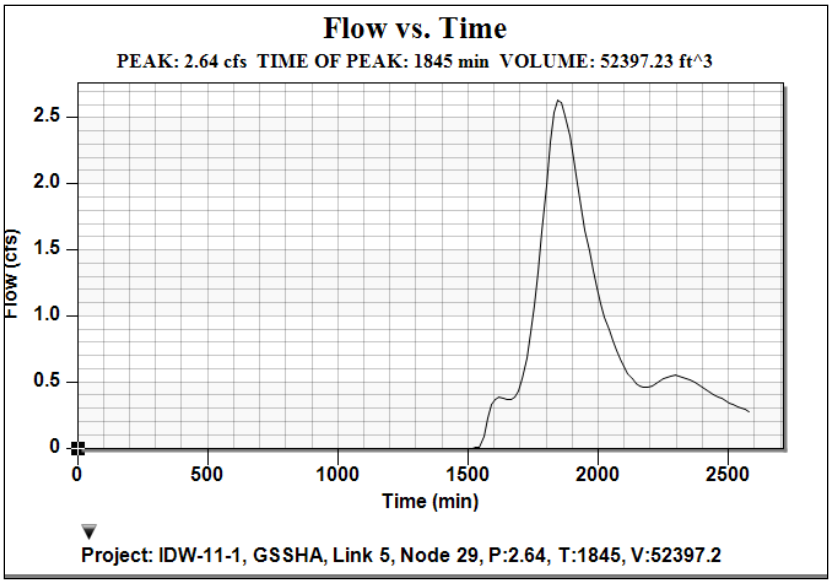


Figure 7 IDW method hydrograph

6 Using Rain Gages with the Thiessen Polygon Method of Interpolation

For this simulation, use the same gages for precipitation, but with the Thiessen polygon interpolation method.

1. Select *GSSHA* **| Precipitation…** to open the *GSSHA Precipitation* dialog.
2. In the *Multi-gage interpolation method* section, select *Thiessen polygons.*
3. Click **OK** to close the *GSSHA Precipitation* dialog.
4. Select *GSSHA* **| Save Project file…** to open the *Save GSSHA Project File* dialog.
5. Enter “Thiessen.prj” as the *File name* and click **Save** to close the *Save GSSHA Project File* dialog.
6. If this file already exists, click **Yes** when asked to replace it by the *Confirm Save As* dialog.
7. Select *GSSHA* | **Run GSSHA…** to open the *GSSHA Run Options* dialog.
8. Click **OK** to close the *GSSHA Run Options* dialog and open the *Model Wrapper* dialog.
9. When the model is finished running, click **Close** to close the *Model Wrapper* dialog.

When viewing the hydrograph (as in Section 3.3, above), it should appear similar to Figure 8. Notice that it is slightly different than the hydrograph shown in Figure 7.

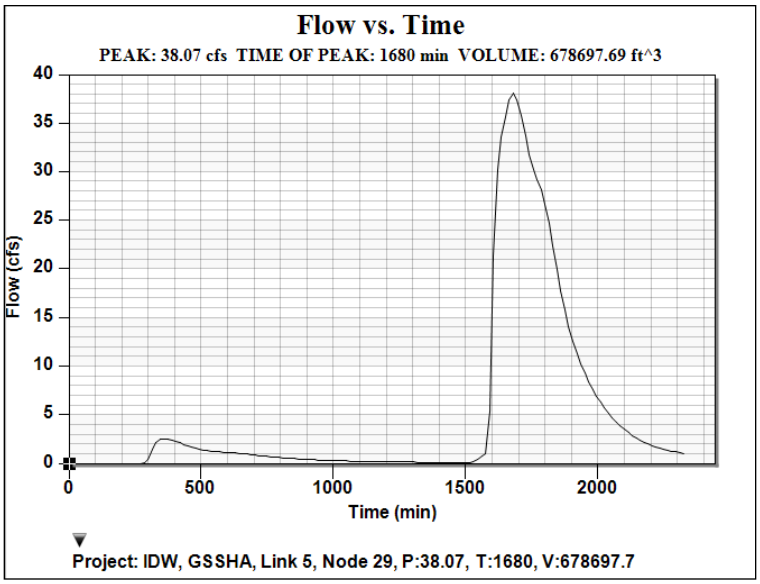


Figure 8 Thiessen method hydrograph

7 Conclusion

This concludes the “Precipitation Methods in GSSHA” tutorial. This tutorial covered how to add several different precipitation methods to a previously constructed GSSHA model including:

- Uniform
- Storm hyetograph
- Gages with IDW method
- Gages with Thiessen method

