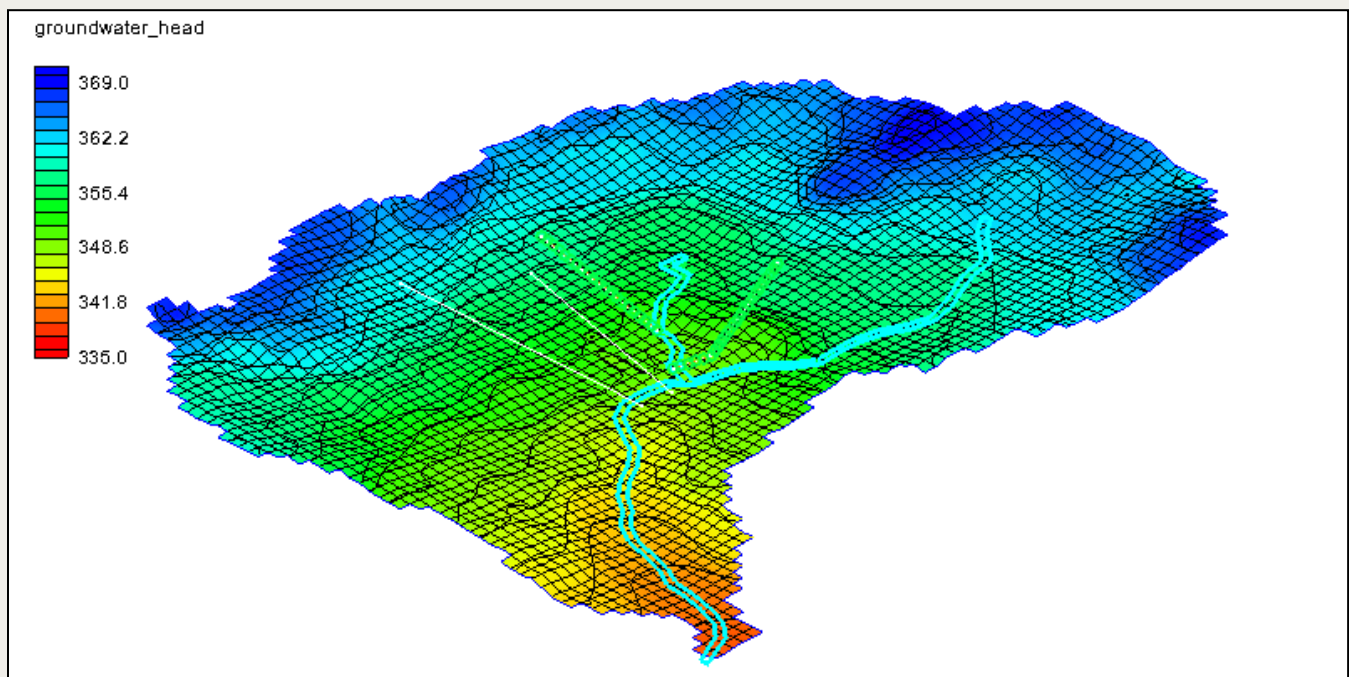


*WMS 11.2 Tutorial***GSSHA – Subsurface Storm Drains**

Add storm drains to an existing GSSHA model

**Objectives**

Learn how to add subsurface storm drain networks and associated data to an existing GSSHA model with a long term simulation and a groundwater simulation defined.

Prerequisite Tutorials

- Groundwater Modeling in GSSHA

Required Components

- WMS Core
- GSSHA Model

Time

- 15–30 minutes




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1 Introduction

This tutorial demonstrates how GSSHA can be used to simulate subsurface storm drains. An existing model that has a long-term simulation and groundwater processes defined will be used. A small storm drain network will be added and the model will be run.

2 Getting Started

Open a WMS project file for the Eau Galle watershed.

1. Make the **2D Grid Module**  active.
2. Select **GSSHA / Open Project File...** to bring up the *Open* dialog.
3. Locate the *data files* folder for this tutorial, and select the file “base.prj” file.
4. Click **Open** to import the project.
5. In the Project Explorer, turn off the display of “ Map Data” then turn on the “ GSSHA” coverage.
6. Select **GSSHA | Save Project File** to open the *Save GSSHA Project File* dialog.
7. Enter “stormdrain.prj” as the *File name* and click **Save**.

The project should appear similar to Figure 1.

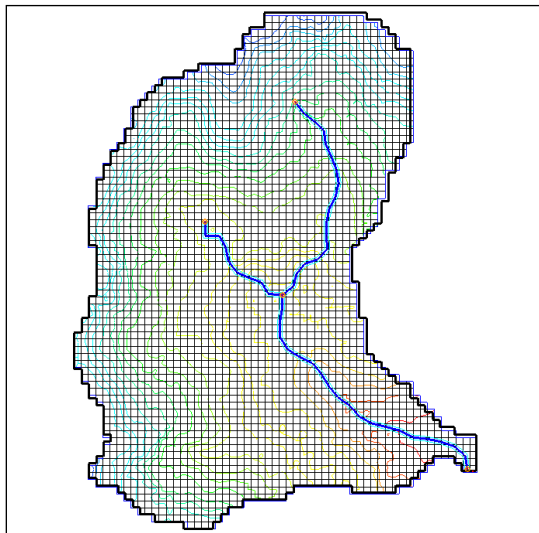


Figure 1 Initial project

3 Adding Storm Drains to the Groundwater Model

The storm drains are generally used to collect the overland flow and convey it to natural streams or to a treatment facility. In this workshop, a simple storm drain network will be created and the model will be run.

1. Select **GSSHA | Job Control** to open the *GSSHA Job Control Parameters* dialog.
2. Turn the *Storm/tile drain* toggle on to specify this as a storm/tile drain simulation.
3. Click **OK** to close the *GSSHA Job Control Parameters* dialog.

3.1 Creating Storm Drain Arcs

Next to create a pipe network as shown in Figure 2. A background image will be used to help get the pipes in the correct location.

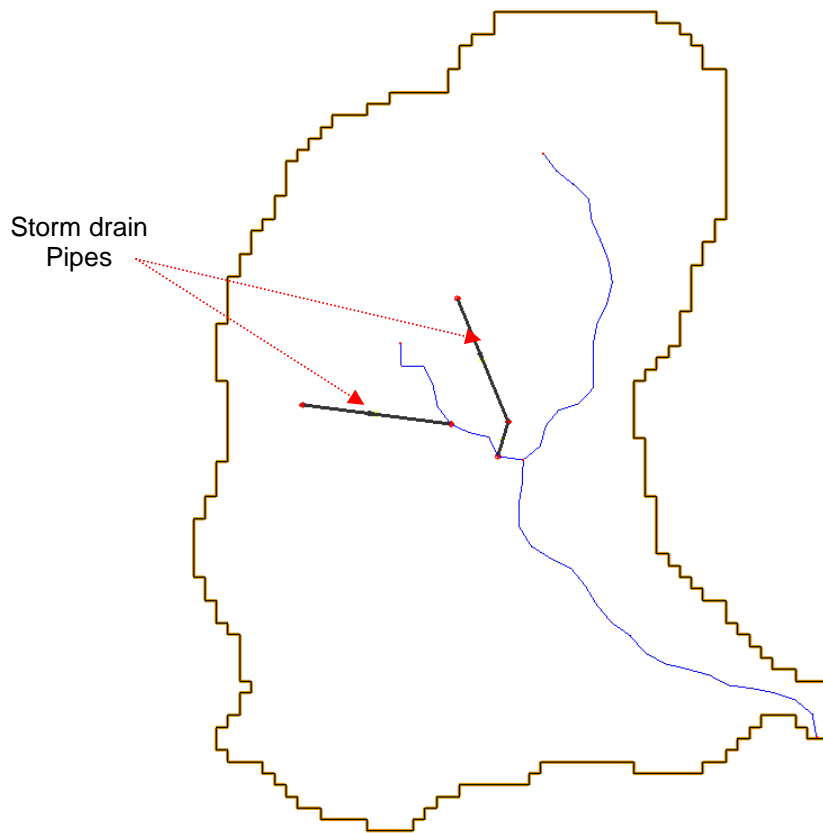









Figure 2 Storm drain pipes location

1. Turn off the display of “ 2D Grid Data” in the Project Explorer.
- This helps better visualize the storm drains in the background image.
2. Select **File / Open** to bring up an *Open* dialog.
 3. Select the file “StormDrains.jpg” and click **Open** to import the image.

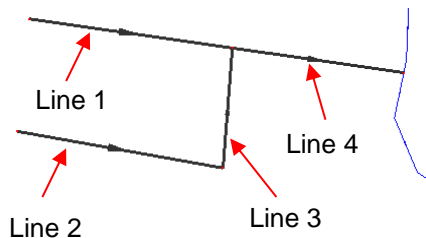
A lot of change may not be visible when the background image is loaded because the image exactly resembles the watershed. The pipe arcs and some text showing the pipe node elevations should be displayed.



4. In the Project Explorer, right-click on “ Coverages” and select **New Coverage** to open a *Properties* dialog.
5. Change the *Coverage type* to “GSSHA Storm Drain”.
6. Select **OK** to close the *Properties* dialog.
7. Under the “ stormdrain” GSSHA model folder, right-click on “ NONE” and select **Assign / GSSHA Storm Drain**.
8. **Zoom**  into the area where the pipes are shown in the background image.
9. Make sure the “ GSSHA Storm Drain” coverage is active by selecting it.
10. Using the **Create Feature Arc**  tool and trace arcs over the pipe networks, drawing the arcs from downstream to upstream.





While creating the pipe network, double-click at each bend in the pipe network to end the arc and start a new one. Make sure to start and begin at the exact locations shown in the background image (start and end at the small node locations) so the node elevations are correct.

Take the following points into consideration while drawing the pipe network:


- Draw the arcs in the downstream to upstream direction.
- If a dialog appears saying the storm drain junction is out of date, click **Yes** to renumber the junctions.
- Each arc should be a straight line—there should be no vertices in the storm drain network. If there is a bend in the storm drain network, double-click to end the arc (line) and begin a new arc. See the following figure for an example:




- The pipes drain into the natural streams in the model (the most downstream points in the storm drain network are nodes on the stream arcs).
 - The pipes cannot form a closed loop (WMS does not support closed storm drain networks in a GSSHA coverage).
11. **Zoom**  into the area where the pipes begin and end. The elevation for each node displayed in the background image should be visible.
 12. Using the **Select Feature Point/Node**  tool, select an individual node in the storm drain network.
 13. In the Properties window to the right side of WMS main window, change the *Feature Point Z* value to match the value shown in the background image for the node.
 14. Repeat steps 12–13 for each node in the new storm drain network.

15. In the Project Explorer, turn off  "StormDrain.jpg" to hide the background image.
16. Select all the storm drain pipe arcs using the **Select feature Arc**  tool.
17. Select *Feature Objects* / **Redistribute** to open the *Redistribute Vertices* dialog.
18. Select "Specified Spacing" for the *Spacing* and enter an *Average spacing* of "20" meters.
19. Click **OK** to close the *Redistribute Vertices* dialog.
20. With the pipe arcs still selected, select *Feature Objects* / **Attributes** to open the *Properties* dialog.
21. For all the arcs property, set the following:
 - *Type* to "Pipe"
 - *Manning's n* to "0.0002"
 - *Pipe type* to "Circular"
 - *Diameter* to "0.5" meters
 - *Conductance* to "0.0" cm per hour
 - *Drain Spacing* to "0.0" meters
22. Click **OK** to close the *Properties* dialog.
23. Select the **Refresh**  and **Zoom**  around the pipe network.
24. Select *Display* | **Display Options** to open the *Display Options* dialog.
25. Select Map Data from the list on the left.
26. Make certain the *Coverage Type* is set to "GSSHA Storm Drain" and then turn on the *Stream Arrows* option.
27. Click **OK** to close the *Display Options* dialog..
28. Check the flow directions for each pipe in the storm drain network, represented by an arrow head. If any arcs have an arrow pointing in the upstream direction, right-click on the arc and select **Reverse Directions**.

In WMS, storm drain and tile drain pipe arcs should be created in the downstream to upstream direction.



29. Using the **Select Feature Point/Node**  tool, select the nodes where the pipes are connected to the stream (hold the *Shift* key down to select multiple nodes).
30. Select *Feature Objects* | **Attributes** to open the *Properties* dialog.
31. Set the attributes as follows:
 - *Manhole area* to "1.0" m²
 - *Inlet type* to "Empty to channel"
 - *Weir length* to "0.1" m
 - *Orifice diameter* to "0.1" m
 - Leave all other fields the same.

- **Note:** If a hydrograph output is desired at the nodes where the pipes enter the stream, go to the GSSHA coverage, add nodes where the pipes enter the stream, and toggle on the option under the *Hydrograph output* column.
32. Click **OK** to close the *Properties* dialog.
 33. Using the **Select Feature Point/Node**  tool, select all the nodes except where the pipes are connected to the stream.
 34. Select *Feature Objects* | **Attributes** to open the *Properties* dialog.
 35. Set the attributes as follows:
 - *Manhole area* to “1.0” m²
 - *Inlet type* to “6 grate inlets”
 - *Weir length* to “0.1” m
 - *Orifice diameter* to “0.1” m
 36. Click **OK** to close the *Properties* dialog.

3.2 Assigning Pipe and Node Parameters

After defining all the arc (Super-Link) and node (Super-Junction) data for each of the pipes in the model, WMS can transfer attributes associated with the Super-Link (arc) and Super-Junctions (arc nodes) to the generated pipes and nodes. Node ground surface elevations are extracted from the 2D grid elevations at the location of each node or vertex on the selected arc. These pipes and nodes are written to the GSSHA Storm Pipe Network (.spn) file when the GSSHA project is written. It is important to define pipe and node parameters for all the pipe arcs in the storm or tile drain network. Deleting the pipes will delete the pipes and nodes from the arc. However, the pipes from the arc geometry should be reinitialized after making any changes that need to be made or WMS may not write the correct pipe and node attributes for the selected arc.

For each of the 3 storm drain pipe arcs in the model (the arcs drawn in a previous step), do the following:

1. Using the **Select Feature Arc**  tool, select one of the pipe arcs.
2. Select *Feature Objects* | **Attributes** to open the *Properties* dialog.
3. Select the  button under *Edit Pipes and Nodes* to open the *Pipe and Node Parameters* dialog.
4. Click **Initialize Pipes from Arc Geometry**.

On the selected arc (this represents a super-link) notice that a node is created for each vertex or node.

5. Select **OK** to close the *Pipe and Node Parameters* dialog.
6. Select **OK** to close the *Properties* dialog.
7. Repeat steps 1–6 for the other two pipe arcs.





4 Save and Run the Model

The storm drain network has now been defined. Save the GSSHA project and run it.

1. Select **GSSHA | Save Project File** to open the *Save GSSHA Project File* dialog.
2. Enter “stormdrain_final.prj” as the *File name* and click **Save**.
3. Select **GSSHA | Run GSSHA** to open the *GSSHA Run Options* dialog.
4. Click **OK** to start the *Model Wrapper* dialog.
5. When the model finishes running, click **Close** to exit the *Model Wrapper* and to load in the solution.

5 Results Visualization

Once done running, review the results.

1. In the Project Explorer, turn on the display of “ 2D Grid Data”.
2. Using the **Select Hydrographs**  tool, double-click on the hydrograph icon at the outlet location to bring up a hydrograph plot.
3. When done reviewing the hydrograph, close the window.
4. In the Project Explorer, right-click the “ groundwater_head” dataset and select **Contour Options** to open the *Contour Options* dialog.
5. Change the *Contour Method* to “Color Fill” and click **OK** to close the *Contour Options* dialog.
6. In the Project Explorer, select the “ groundwater_head” dataset and toggle through the time steps to see how the groundwater head varied with time.

6 Conclusion

This concludes the “GSSHA – Subsurface Storm Drains” tutorial. Feel free to experiment with other storm drains, or exit the program.