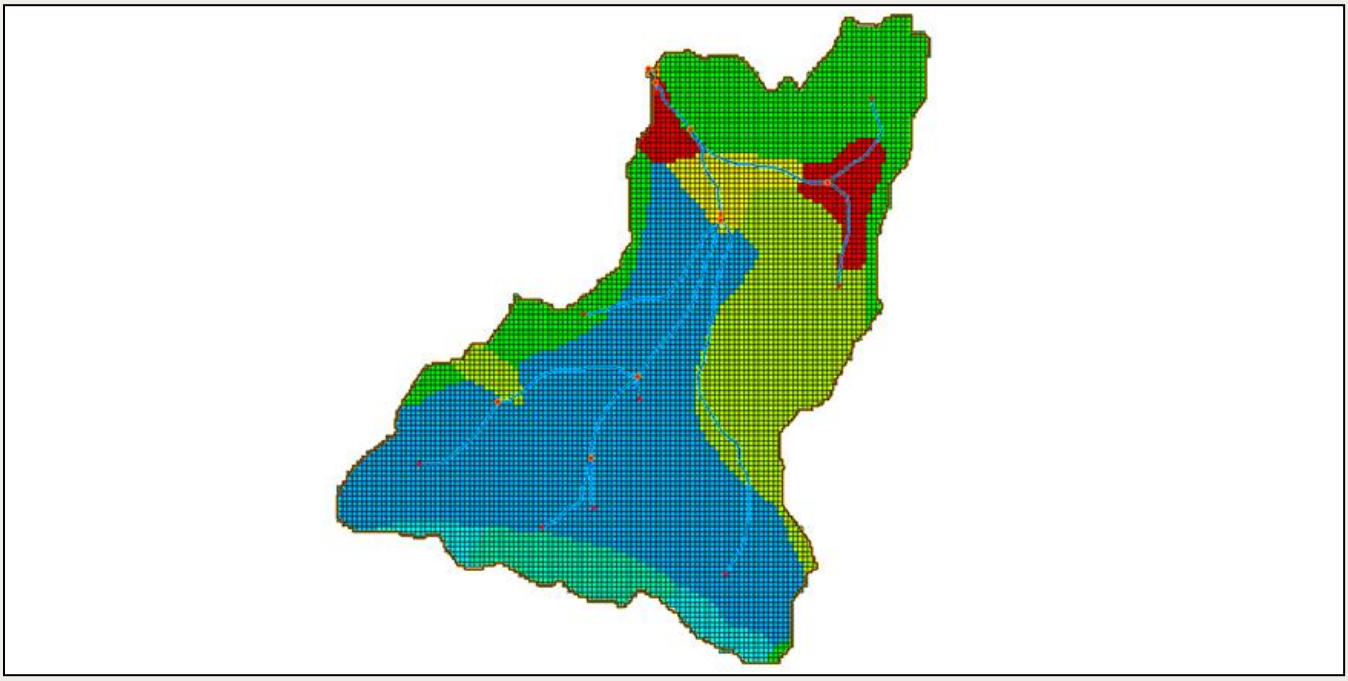
WMS 11.2 Tutorial

GSSHA Land Use Change – Residential

Model land use changes using GSSHA



Objectives

This tutorial demonstrates how to model and compare the effects of residential land use changes using the GSSHA model.

Prerequisite Tutorials

- Developing a GSSHA Model Using the Hydrologic Modeling Wizard

Required Components

- WMS Core
- GSSHA Model

Time

- 30–45 minutes

1 Introduction

This tutorial shows how changing land use to residential can be modeled in GSSHA. This scenario can then be used to compare pre-development and post-development 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 “Base.prj”.
5. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1.

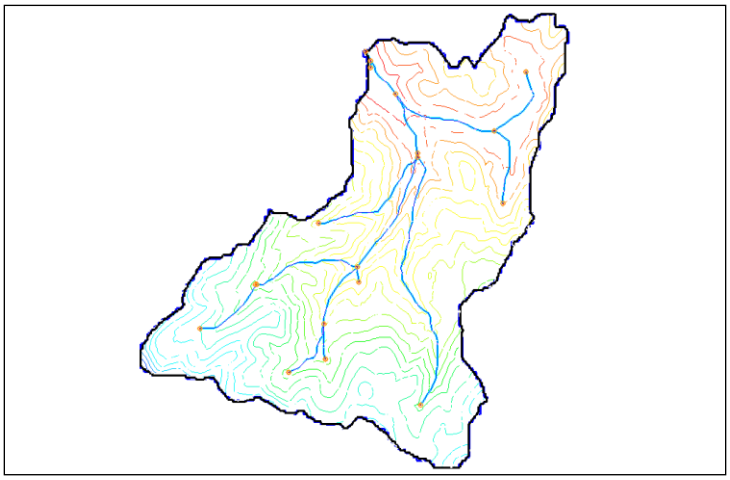


Figure 1 Initial project

2 Creating a New GSSHA Coverage

The land under consideration for development is in the Park City, Utah watershed. To simulate the development, the existing land use will be converted to a residential area. This change impacts both infiltration and the overland roughness characteristics of the watershed.

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

1. Right-click on "GSSHA" and select **Duplicate** to create a new "Copy of GSSHA" coverage.
2. Right-click on "Copy of GSSHA" and select **Rename**.
3. Enter "GSSHARes_1" and press *Enter* to set the new name.
4. Right-click on "Base" and select **Duplicate** to create a new "Base(2)" project.

There should now be two projects listed: "Base" and "Base(2)".

5. Under "Base(2)", right-click on "GSSHA" and select *Assign coverage* | **GSSHARes_1**.

The coverage should change from "GSSHA" to "GSSHARes_1".

3 Saving the Working Project

Now save the project into a different directory so the original files are not overwritten.

1. Right-click on "Base(2)" 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. Navigate to a directory that is not the same directory as the starting files.
4. Enter "Residential_1.prj" as the *File name*.
5. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

Notice that the project name changed to "Residential_1" in the Project Explorer.

4 Duplicating the Coverage

Before modifying the land use coverage, create a duplicate to work with by doing the following:

1. Right-click on "Land Use" and select **Duplicate** to create a new "Copy of Land Use" coverage.
2. Right-click on "Copy of Land Use" and select **Rename**.
3. Enter "LUResidential_1" and press *Enter* to set the new name.

The coverage should now be named "LUResidential_1" in the Project Explorer.

5 Adding a Background Image

A background image will help to identify the proper location of the residential development under consideration. Background images can be added by downloading dynamic maps from the internet as well as by using a previously downloaded and registered raster image. For convenience, this tutorial uses the latter.

To import the image, do the following:

1. Select *File* | **Open…** to bring up the *Open* dialog.
2. Browse to the *data files* folder for this tutorial and select "Aerial.jpg".
3. Click **Open** to exit the *Open* dialog and import the image.
4. In the Project Explorer, right-click on "Aerial.jpg" and select **Zoom To Extents**.
5. Turn off "GSSHA", "Land Use", and "Soil Type" in the Project Explorer.

The project should appear similar to Figure 2.

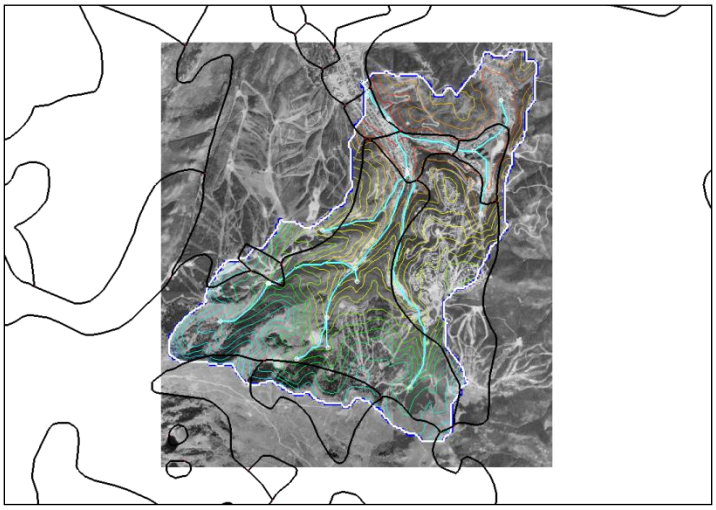


Figure 2 Background image with land use polygons

6 Updating the Land Use Parameters

The land use parameters need to be updated

1. Turn off "new grid".
2. Select "LUResidential_1" to make it active.
3. **Zoom** in to the area indicated by the box in Figure 3.

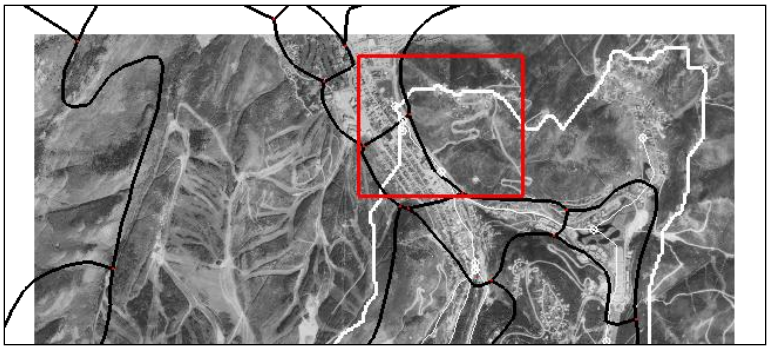


Figure 3 Zoom area

Notice that most of the area could be classified as shrub and brush rangeland (land use ID 32). After development, the area will be converted to a relatively impervious land use type that could be classified as a residential area (land use ID 11). The area of interest within the zoomed area is shown in Figure 4.

Figure 4 Area of interest

4. Switch to the **Map** module.
5. Using the **Select Feature Polygon** tool, double-click in the center of the area shown in Figure 5 to bring up the *Land use mapping* dialog.
6. In the *WMS landuse ID* section, notice that "Land ID 32" is selected.

The USGS land use classification uses land use ID 32 to represent areas of primarily shrub and brush rangeland. Now change a portion of this land use to be residential. A background image has been created that shows the location of new development.

7. Click **Close** to exit the *Land use mapping* dialog.
8. Turn off "Aerial.jpg" in the Project Explorer.
9. Click **Open** to bring up the *Open* dialog.
10. Select "Residential1.jpg" and click **Open** to import the new background image and exit the *Open* dialog.
11. Right-click "Residential1.jpg" and select **Zoom To Extents**.

The project should appear similar to Figure 5. Notice how the arc (labeled “Trace this arc”) begins and ends at the border of existing land use polygons.

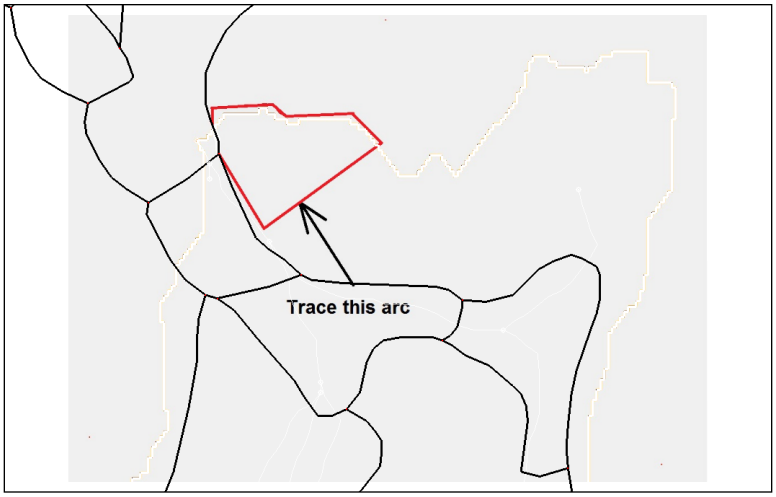


Figure 5 Future residential area

12. Select “LUResidential_1” and make it active to switch to the Map module.
13. **Zoom** in to the arc template (Figure 6).

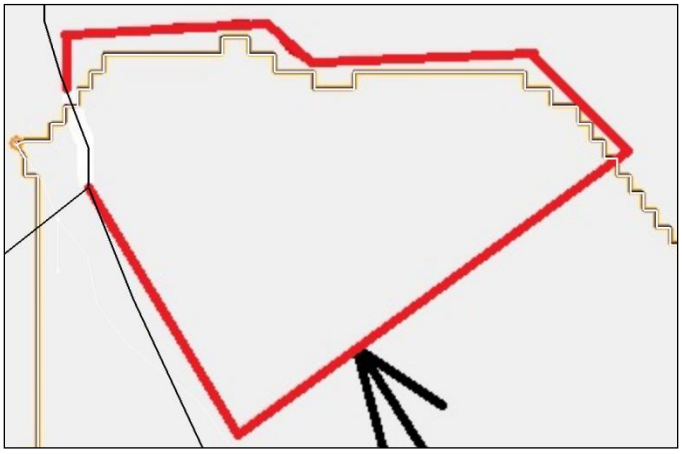


Figure 6 Zoomed in to the arc template

14. Using the **Create Feature Arc** tool, create an arc starting at the top left end point (Figure 6) and proceeding clockwise to the end of the arc, making sure the beginning and end points are on the land use polygon arcs. The direction of the arc is not important, however, it is important that the new arc starts and ends on the existing land use arc.
15. Select *Feature Objects* | **Build Polygon**, clicking **OK** when asked if all polygons should be used.
16. Using the **Select Feature Polygon** tool, double-click inside the newly-created polygon (the area just enclosed with the arc) to bring up the *Land use mapping* dialog.
17. Select “Land ID 11” from the list in the *WMS landuse ID* section.

Changing to this ID tells WMS that this area has been changed to residential land use.

18. Click **Apply** to exit the *Land use mapping* dialog.

7 Creating the Modified Index Maps

With the change made to the land use coverage, the index maps that use the land use coverage need to be updated as well. To do this, create new land use and combined index maps.

1. Right-click "Residential_1" in the Project Explorer and select **Maps…** to bring up the *GSSHA Maps* dialog.
2. On the *Index – Grid* tab, in the *Compute index using WMS coverages* section, select "LUResidential_1" from the *Input coverage (1)* drop-down.
3. Select "Id" from the *Coverage attribute* drop-down.
4. Enter "LUResidential_1" as the *Index map name*.
5. Click **Coverages→Index Map** to map the coverage information to the index map for the project.

This creates a new "LUResidential_1" entry under "Index Maps" in the Project Explorer. Now create another new index map that combines soil type data and modified land use data.

6. Select "LUResidential_1" 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 under *Input coverage (2)*.
10. Enter "ComboResidential_1" as the *Index map name*.
11. Click **Coverages→Index Map** to map the coverage information to the index map for the project.

A new "ComboResidential_1" entry appears under "Index Maps" under "new grid" in the Project Explorer.

12. Click **Done** to close the *GSSHA Maps* dialog.
13. Turn off "Residential1.jpg" and "LUResidential_1".
14. Turn on "new grid".
15. **Frame** the project.
16. Select "LUResidential_1" to make it active.

The project should appear similar to Figure 7.

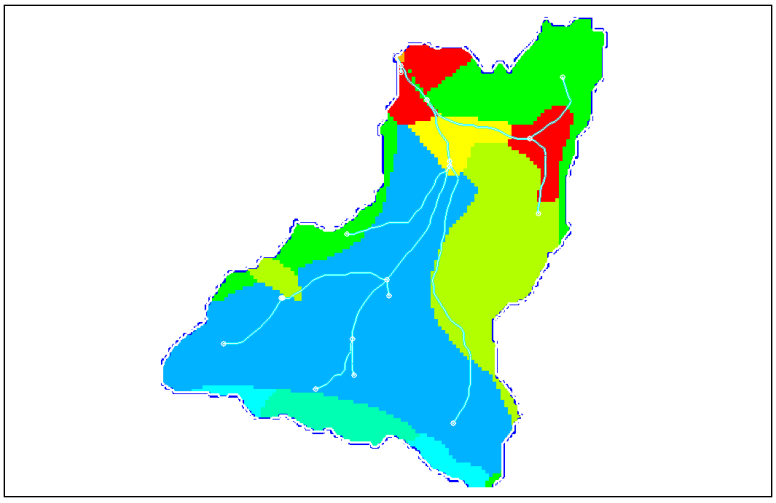


Figure 7 LUResidential_1 index map

17. Select "ComboResidential_1" to make it active.

The project should appear similar to Figure 8.

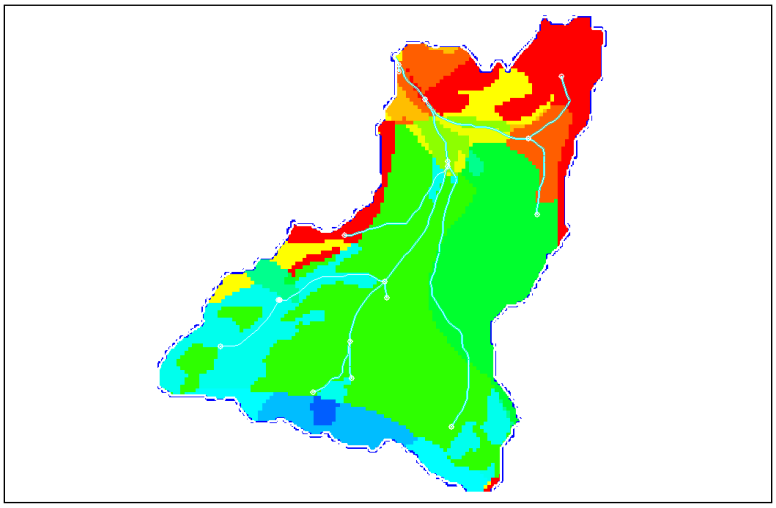


Figure 8 ComboResidential_1 index map

8 Assigning New Index Maps and Updating the Parameters

There are three index map folders:

- "Index Maps" directly under "new grid".
- "Index Maps" under "Base" under "2D Grid Data".
- "Index Maps" under "Residential_1" under "2D Grid Data".

The first (with the gold folder) is a set of index maps shared by all GSSHA models in the project. The second two (with the blue folders) are index map sets specific to those individual GSSHA models. Only make changes to the index maps within the folder for the specific GSSHA model on which you are working.

1. Notice that "ST", "LUResidential_1" and "ComboResidential_1" are listed under "Index Maps" under the "Residential_1" GSSHA model.
2. Right-click on "LU" in the same location and select **Remove**.
3. Repeat step 2 for "Combined" to remove it as well.

This GSSHA project uses the *ST*, *LUResidential_1* and *ComboResidential_1* as the index maps.

4. Right-click on "Residential_1" and select **Map Tables…** to bring up the *GSSHA Map Table Editor* dialog.
5. On the *Roughness* tab, select "LUResidential_1" from the *Using index map* drop-down.
6. Click **Generate IDs** and click **No** when asked if existing IDs should be deleted.

In this case, no new IDs will be added because Land use ID 11 already existed in the original index map. By changing some of the land use to residential, the number of cells with ID 11 increased and the number of cells with ID 32 decreased.

7. On the *Infiltration* tab, select "ComboResidential_1" from the *Using index map* drop-down.
8. Click **Generate IDs** and click **No** when asked if existing IDs should be deleted.

Again, there will be no fields added to this table.

9. Click **Done** to close the *GSSHA Map Table Editor* dialog.

9 Saving the Project and Running GSSHA

Before running GSSHA, save the "Residential_1" project by doing the following:

1. Right-click on "Residential_1" 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 "Residential_1_end.prj" as the *File name*.
4. Click **Save** to save the project under the new name and exit the *Save GSSHA Project File* dialog.

The project name should change to "Residential_1_end" in the Project Explorer. This saves only the "Residential_1_end" model, leaving the "Base" model unsaved.

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. When GSSHA finishes, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.

10 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 "20" as the *Radius* and "400.0" as the *Z magnification*.
6. Click **Options…** to bring up the *Stream flow Contour Options* dialog.
7. In the *Contour Method* section, select "Normal Linear" 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 10:05:00 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 9.

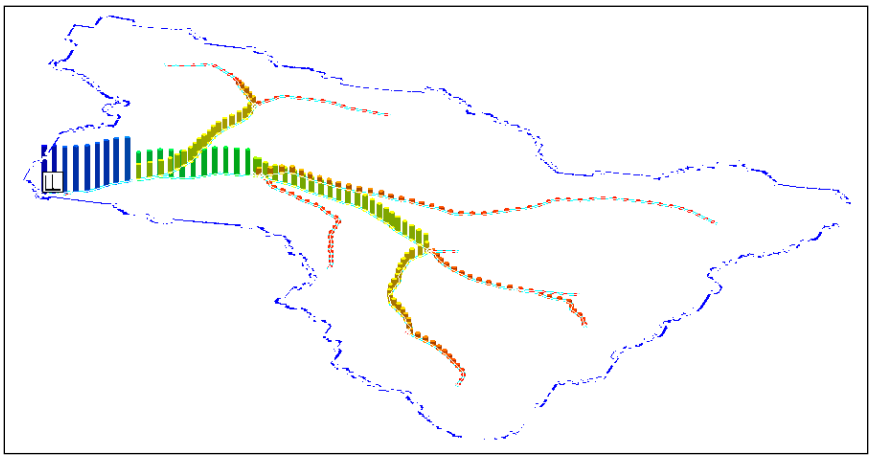


Figure 9 Rotated view showing stream flow

There are many additional ways to visualize the results. Feel free to experiment with other visualization options.

11 Conclusion

This concludes the "GSSHA Land Use – Residential" tutorial. Feel free to continue experimenting, or exit the program.