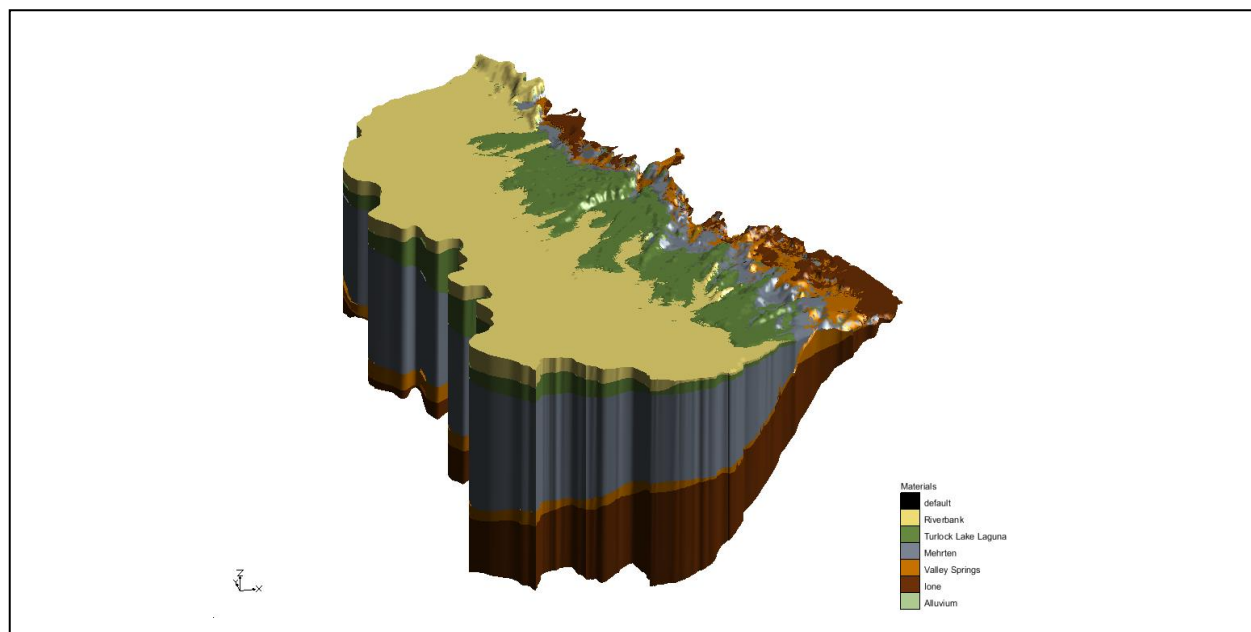


GMS 10.0 Tutorial

Stratigraphy Modeling—Horizons with Rasters

Create solids from rasters using the **Horizons** → **Solids** tool.



Objectives

Learn what a raster catalog is and how it can be used to create subsurface models.

Prerequisite Tutorials

- Stratigraphy Modeling—Horizons and Solids

Required Components

- Sub-surface Characterization
- Geostatistics
- Map Module
- GIS Module

Time

- 20-30 minutes

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1 Introduction

This tutorial builds on the concepts taught in the tutorial entitled “Stratigraphy Modeling—Horizons and Solids.” In that tutorial, the user created solids using horizons defined on boreholes and cross sections. In this tutorial, the user will learn how to assign horizons to rasters and then create solids. This tutorial will begin with a simple problem to illustrate the concepts involved in using rasters to create solids. Then this tutorial will apply the method to data from Sacramento, California, USA.

1.1 Outline

Here are the steps of the tutorial:

1. Read in a project with rasters.
2. Create a raster catalog and assign horizon IDs.
3. Create solids from the horizons.
4. Repeat these steps using data from the Sacramento, CA, region.

2 Getting Started


Do the following to get started:

1. If necessary, launch GMS.
2. If GMS is already running, select the *File / New* command to ensure that the program settings are restored to their default state.

3 Reading the Project

The first step in the construction of the solid models is to import a set of borehole logs. Borehole data can be entered into GMS manually, or the data can be read from a file. In the interest of time, the user will read in a previously prepared file.

To read in the file, do the following:

1. Select the **Open**  button.
2. Locate and open the directory entitled *Tutorials\Stratigraphy_Modeling\Horizons_with_Rasters*.
3. Select the file named “rasters.gpr.”
4. Click on the **Open** button.

The user should now see the Figure 1 image in the GMS graphics window. A TIN and multiple rasters have been loaded into this GMS project.

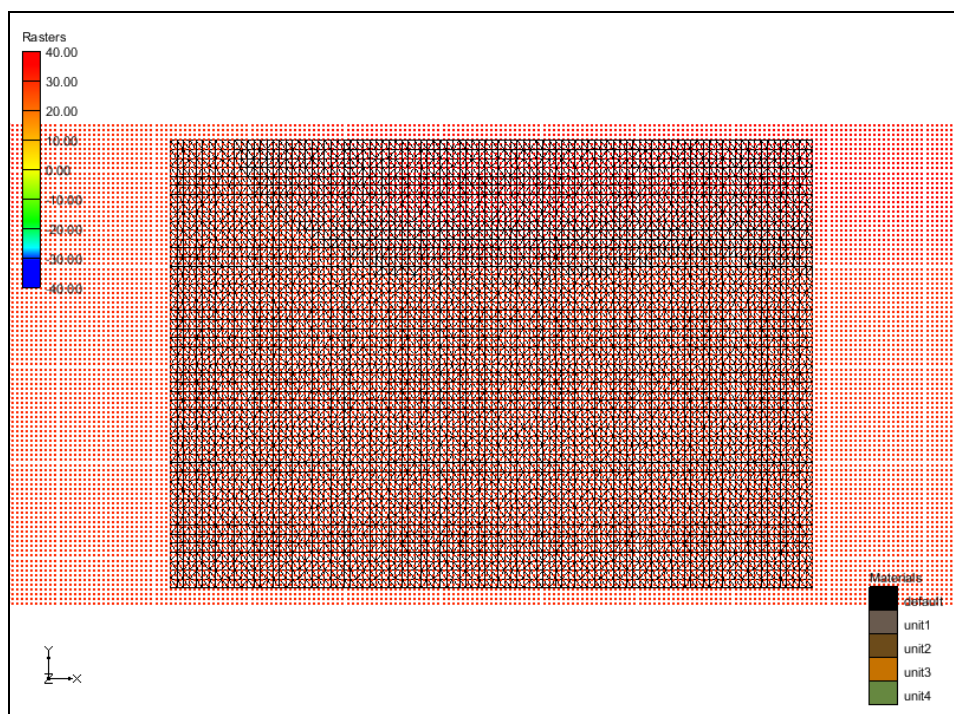


Figure 1 Tin and rasters displayed in the GMS Graphics Window

4 Viewing Raster Elevations

The display options are currently set to view the rasters as points.

1. Select the **Oblique View**  button.

2. Open up the **Display Options** button.
3. Change the *Z magnification* to “0.1.”
4. Click **OK**.

The user should now see the Figure 2 image in the GMS graphics window. The 2 lower rasters slope upward toward the right of the image. The upper 2 rasters are at constant elevations.

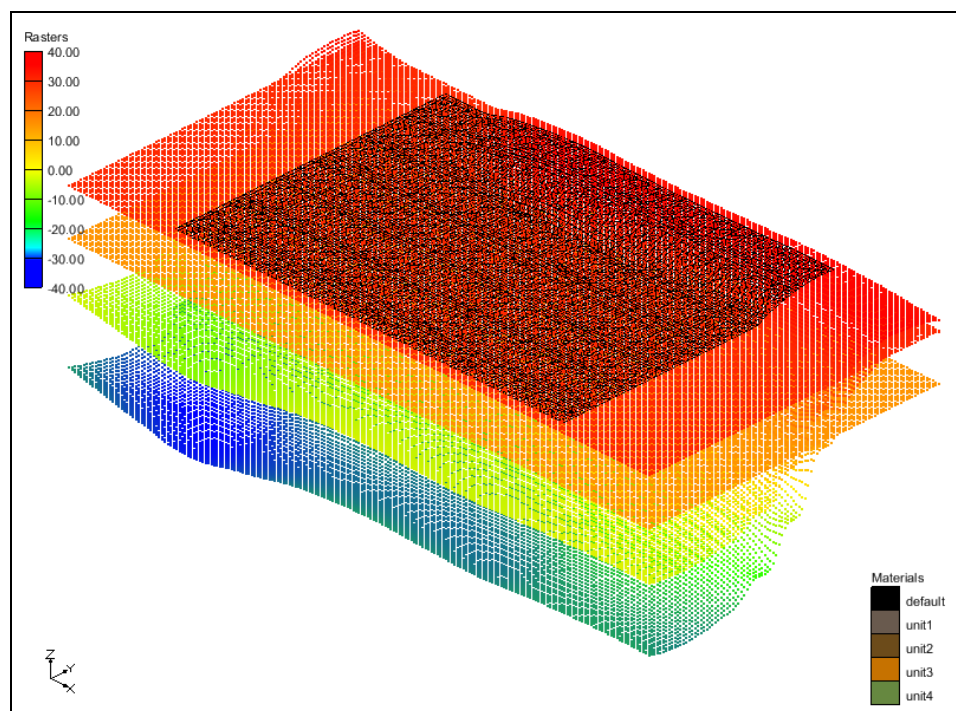




Figure 2 Raster surfaces

The next step is to change the display of the raster to background imagery.

5. Select the **Plan View**  button.
6. Right-click on the “GIS Layers”  folder in the Project Explorer.
7. Select the *Display Options* command.
8. In the *Display Options* dialog, select the *Display as 2D image* option in the *Rasters* section of the dialog.
9. Select **OK** to exit the dialog.

The user should now see the Figure 3 image in the GMS graphics window.

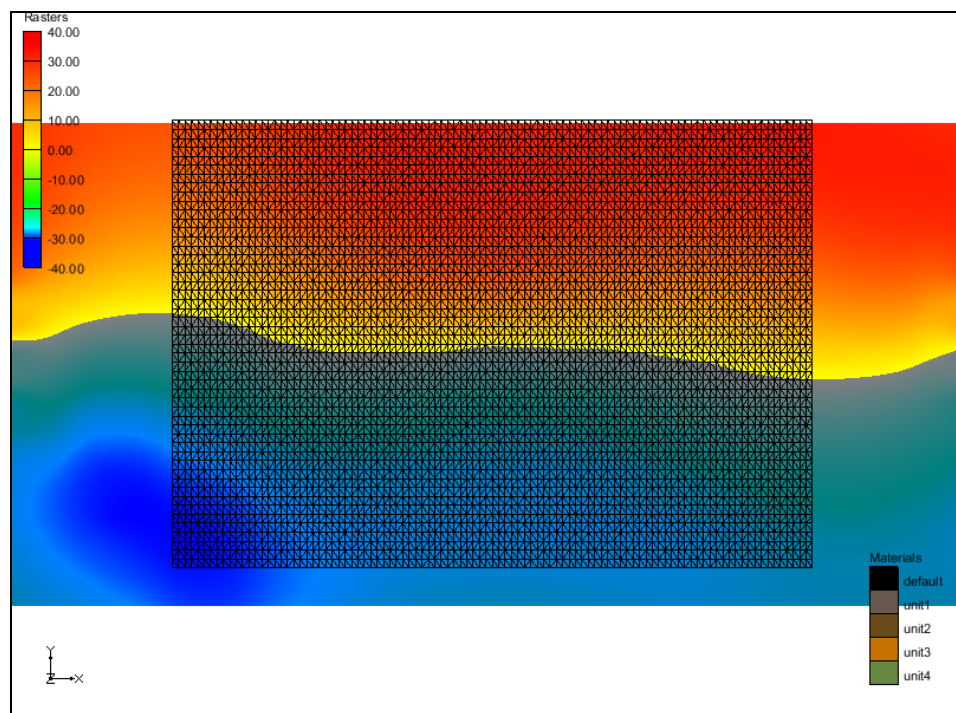



Figure 3 Rasters displayed as background imagery

5 Creating the Raster Catalog

A raster catalog is a table that allows users to assign attributes to rasters. In this case, it is necessary to assign horizon IDs to the rasters.

1. Expand the “GIS Layers”  folder.
2. Select the “unit1” raster in the Project Explorer.
3. Hold down the *Shift* key and select the “unit4” raster in the Project Explorer.

All four of the rasters should now be selected.

4. Right-click on the selected rasters and select the **New Raster Catalog** command.

A *Table* dialog should come up matching Figure 4.

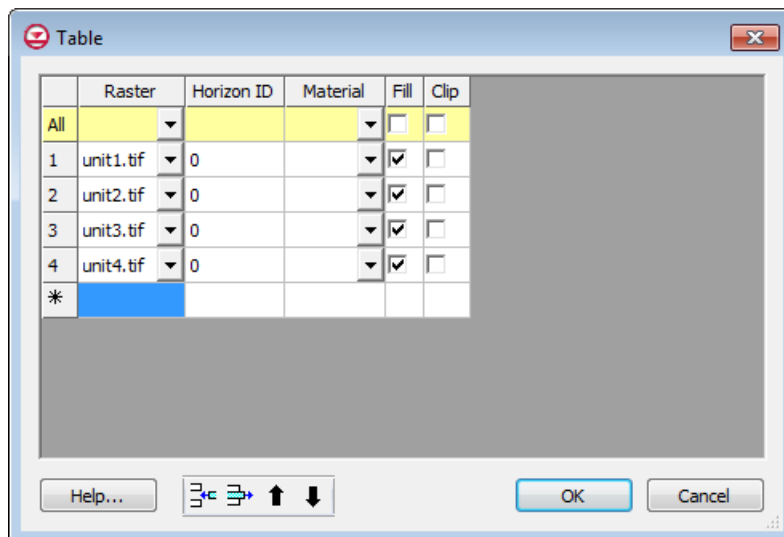


Figure 4 Raster catalog

This dialog allows users to associate properties with a raster. First, it is necessary to assign horizon IDs and materials to each raster.

5. In the *Table* dialog, enter values into the *Horizon ID* and *Material* fields for each raster as shown in Figure 5.

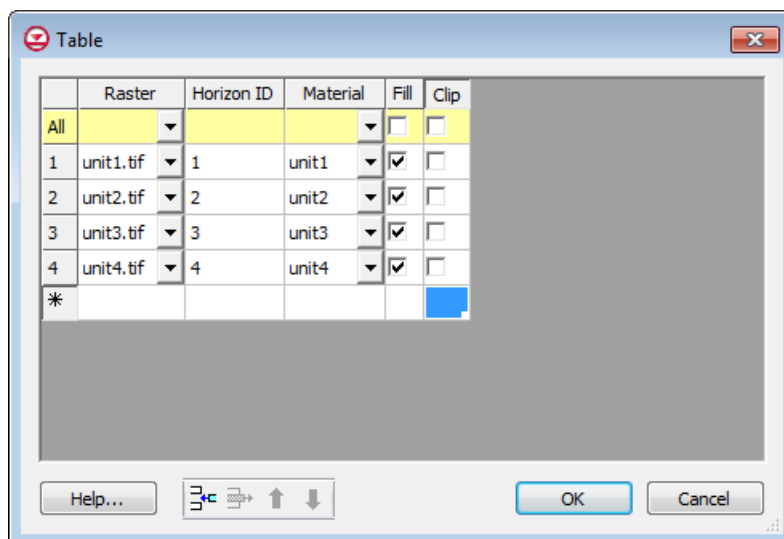



Figure 5 Raster catalog with attributes assigned

6. Select **OK** to exit the dialog.

6 Creating solids

It is now possible to create solids using the raster catalog. The **Horizons → Solids** command allows the user to use any combination of borehole, TIN, conceptual model,

and raster data to create solids. In this example, this tutorial will only use the raster catalog to define the horizon elevations.

1. Select and right-click on the “Raster Catalog”  item in the Project Explorer.
2. Select the **Horizons → Solids** command.
3. In the *Raster Catalog* section of the *Horizons → Solids* dialog, select the *Project\GIS Layers\Raster Catalog* item in the drop down list (upper right).
4. Select the **Next** button.

There is only one TIN in this project and it will be used as the primary TIN. Additionally, it is necessary to use this TIN's elevations as the top of the solids and to use a constant elevation of -45.0 as the bottom elevation of the solids.

5. Select *Tin elevations* in the *Top elevation* section (middle) of the dialog.
6. Change the value of the *Constant elevation* to “-45.0” in the *Bottom elevation* section of the dialog (far right).
7. Select the **Next** button.
8. Turn on the *Minimum solid thickness* and set the value to be “1.0.”
9. Select the **Finish** button.

7 Viewing the Solids

The **Horizons → Solids** process should complete quickly, and a new folder of solids should appear in the Project Explorer.

1. Select the **Oblique View**  button.

The solids should look similar to Figure 6. Notice how the lower two layers extend upwards on the left side of the solids and cut off the upper two layers.

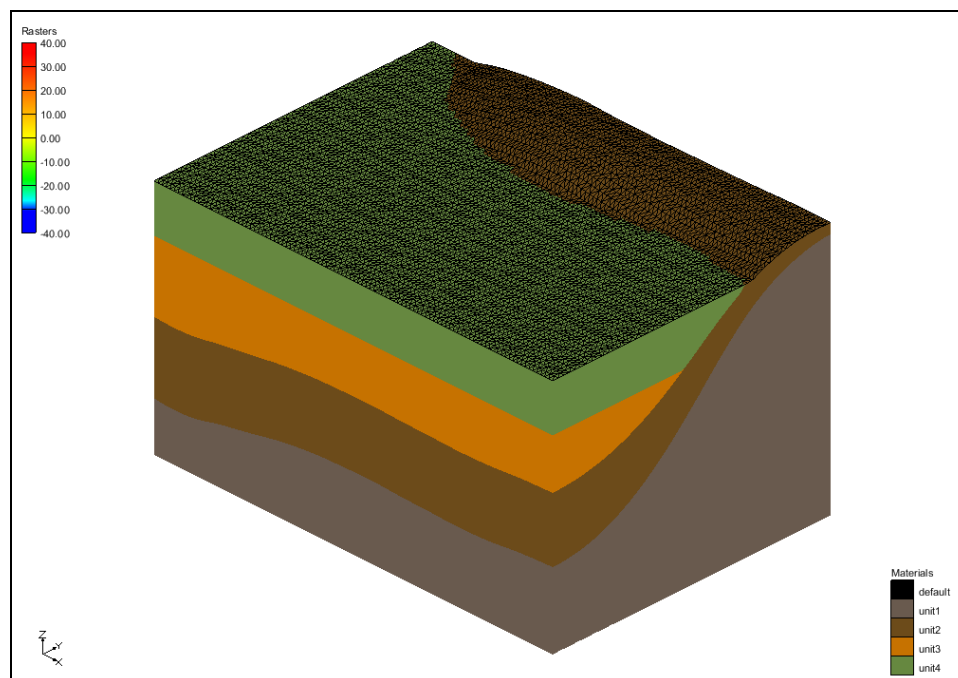




Figure 6 Solids created from raster catalog



8 Changing the Fill and Clip Fields

Now the user will see the effect of changing the *Fill* and *Clip* fields in the raster catalog. When the user first created the raster catalog and the dialog appeared, the check boxes for the *Fill* field were on by default. The *Fill* field indicates that the user wants to use the raster to create a solid. It means the **Horizons** → **Solids** operation will *Fill* between this raster and the lower surfaces. If the *Fill* field is turned off, then it will not create a solid that is associated with the particular raster. The *Clip* field is used to indicate a surface that “Clips” or truncates any lower surfaces. This process is best illustrated by the following steps:

1. Double-click on the “Raster Catalog”  item in the Project Explorer.
2. Uncheck the check box in the *Fill* field for “unit3.”
3. Select **OK** to exit the dialog.
4. Select and right-click on the “Raster Catalog”  item in the Project Explorer.
5. Select the **Horizons** → **Solids** command.
6. Select the **Finish** button.

8.1 Viewing the Solids

When the **Horizons → Solids** command is finished, multiple solids will have been created in the same location. The next step is to turn off the first set of solids that were created.

1. Uncheck the “solids” folder  under the “Solid Data”  item in the Project Explorer.

The solids should look like Figure 7 below. Notice that no solid was created for “unit3.”

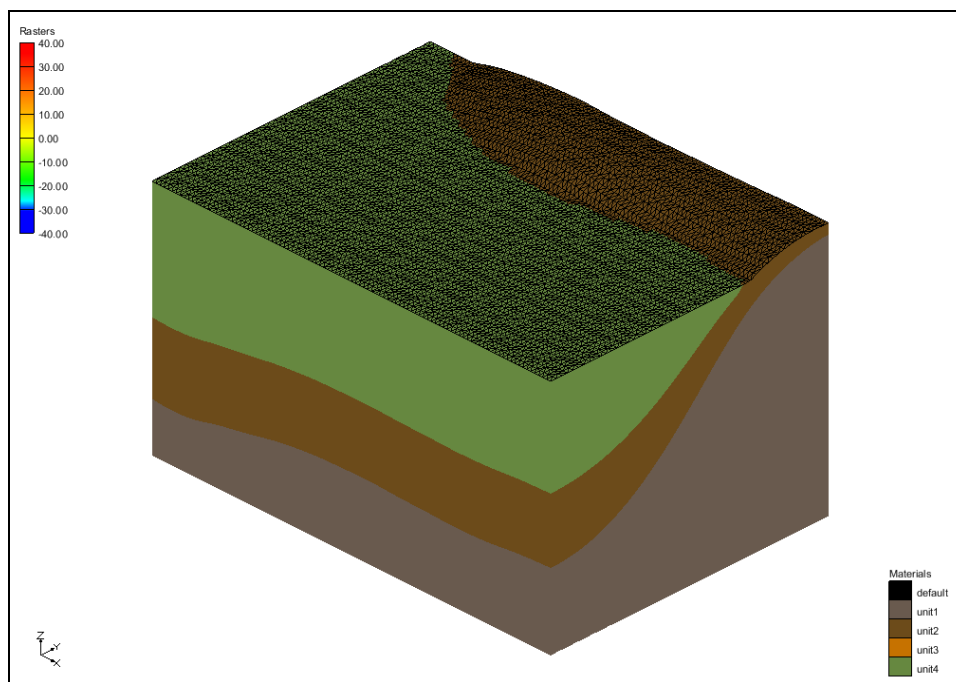




Figure 7 Solids created with the “Fill” field off for the unit3 raster

8.2 Changing the Clip Field

Now it is possible to change the Clip field for the “unit3” raster and view the effect.

1. Double-click on the “Raster Catalog”  item in the Project Explorer.
2. Check the check box in the *Clip* field for “unit3.”
3. Select **OK** to exit the dialog.
4. Select and right-click on the “Raster Catalog”  item in the Project Explorer.
5. Select the **Horizons → Solids** command.
6. Select the **Finish** button.

8.3 Viewing the Solids

1. Uncheck the “solids (2)” folder under the “Solid Data” item in the Project Explorer.

The solids should look like the image below. Notice that while no solid was created for **unit3**, the raster was used to “clip” or truncate the units as seen in Figure 8.

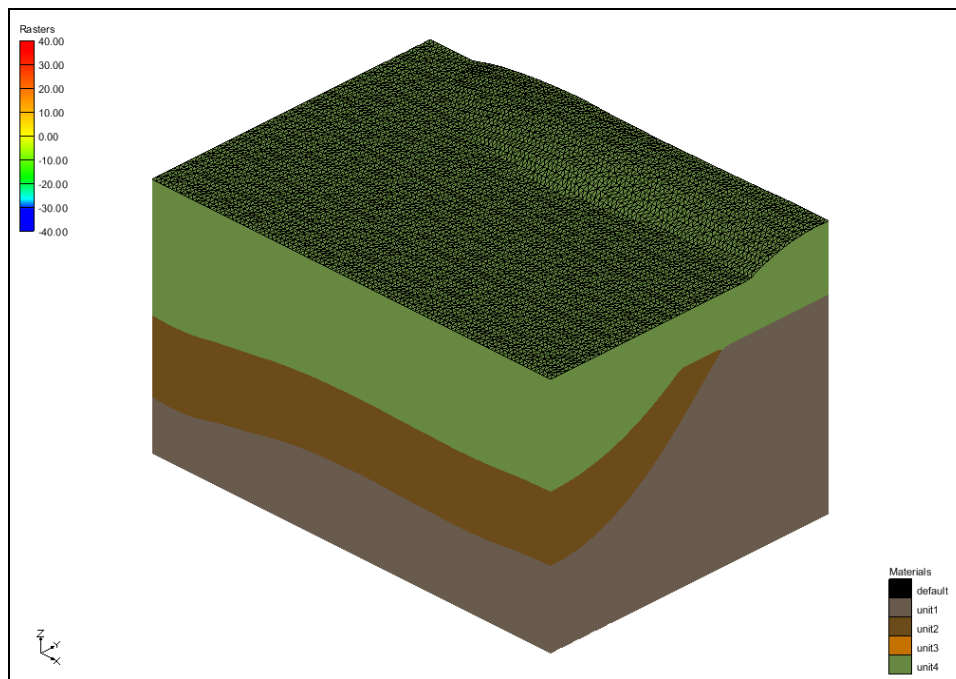


Figure 8 Solids created with the “Clip” field on for the unit3 raster

9 Sacramento Data

It is now possible to use what has been learned to create solids of data from the Sacramento Valley.

1. Select the *File* / **New** command and select *No* at the prompt.
2. Select the **Open** button.
3. Locate and open the directory entitled *Tutorials\Stratigraphy_Modeling\Horizons_with_Rasters*.
4. Select the file named “sacramento.gpr.”
5. Click on the **Open** button.

The user should now see the Figure 9 image in the GMS graphics window. This project contains two TINs to define the top and bottom of the solids, a map coverage with the

surface geology, multiple rasters to define top elevations for stratigraphic units, and an aerial photo of the Sacramento region.

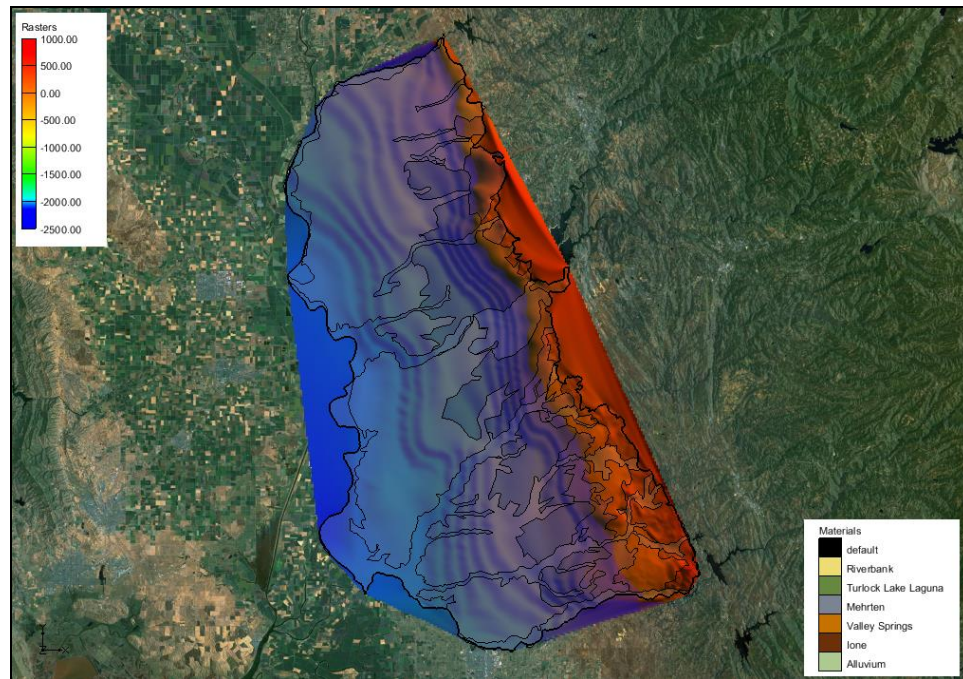



Figure 9 Map view of Sacramento Region Data

9.1 Creating the Raster Catalog

It is now possible to create a raster catalog and assign horizon IDs to the rasters.

1. Expand the “GIS Layers”  item in the Project Explorer.
2. Select the “TOP7” raster in the Project Explorer.
3. Hold down the *Shift* key and select the “TOP1” raster in the Project Explorer.

All five rasters should now be selected.

4. Right-click on the selected rasters and select the **New Raster Catalog** command.
5. In the *Table* dialog, fill in the *Horizon ID* and *Material* fields as shown in Figure 10 below.

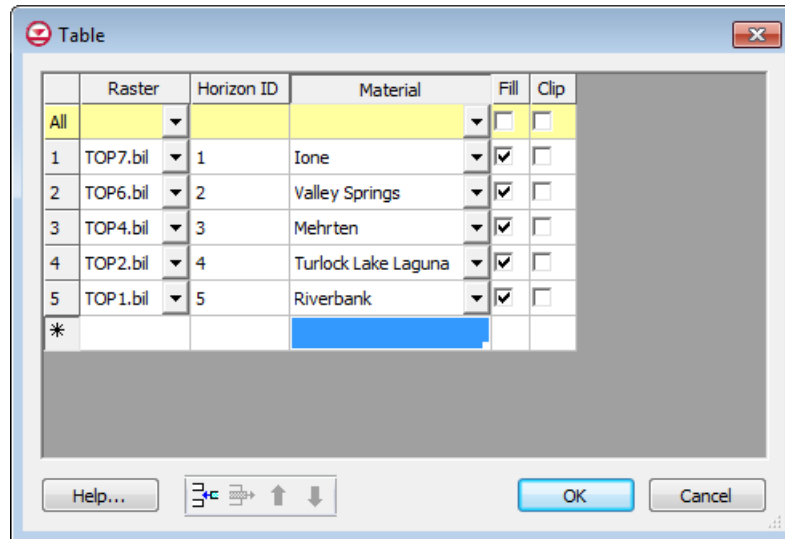



Figure 10 Raster catalog for Sacramento stratigraphic units

6. Select the **OK** button.

9.2 Creating Solids

Do the following to create solids from the rasters:

1. Select and right-click on the “Raster Catalog”  item in the Project Explorer.
2. Select the **Horizons → Solids** command.
3. Select the *Project\GIS Layers\Raster Catalog* item in the drop down list in the *Raster Catalog* section of the dialog (upper right).
4. Select the **Next** button.
5. Ensure that *Tin elevations* is the selected option for *Top elevation* (middle section of the dialog) and that “top” is the selected TIN.
6. Ensure that *Tin elevations* is the selected option for *Bottom elevation* (right section of the dialog) and that “bottom” is the selected TIN.
7. Select the **Next** button.
8. Make sure that the *Minimum solid thickness* option is on and that a value “1.0” has been entered.
9. Select the **Finish** button.

9.3 Viewing the Solids

The **Horizons** → **Solids** process should complete quickly and a new folder of solids should appear in the Project Explorer.

1. Select the **Oblique View**  button.

The solids should appear like Figure 11 below.

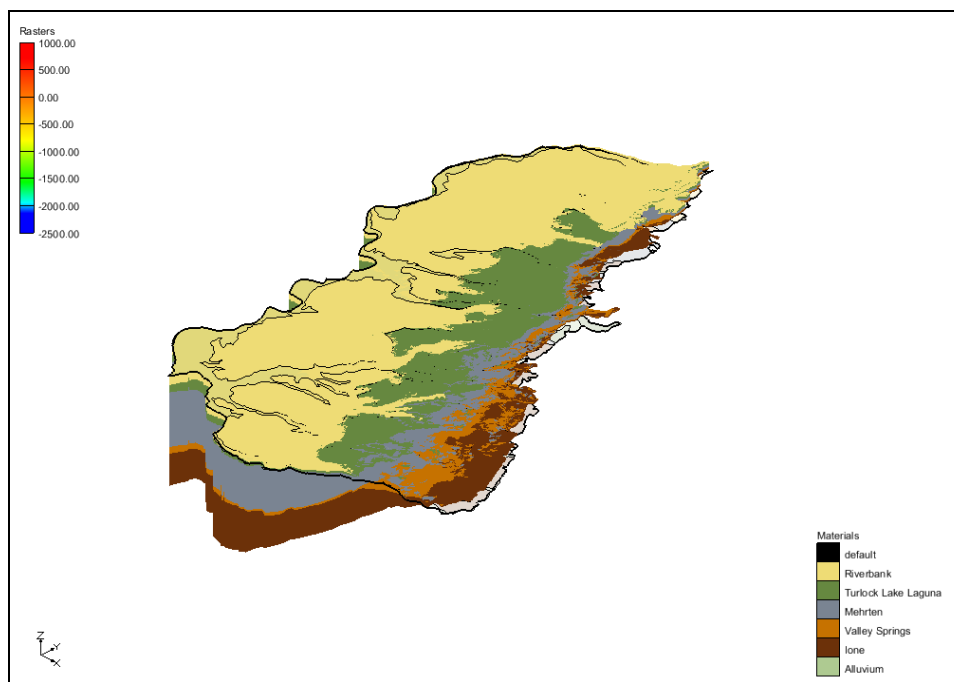


Figure 11 Solids of the Sacramento Valley

At this point, the user may wish to rotate the view, apply lighting, or cut cross sections through the solids.

10 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- Rasters can be used to create solids.
- To use rasters with the horizons method, it is necessary to create a raster catalog and assign horizon IDs to the rasters.
- Rasters can be combined with any combination of boreholes, cross sections, TINs, and conceptual model data to create solids using the horizons method.