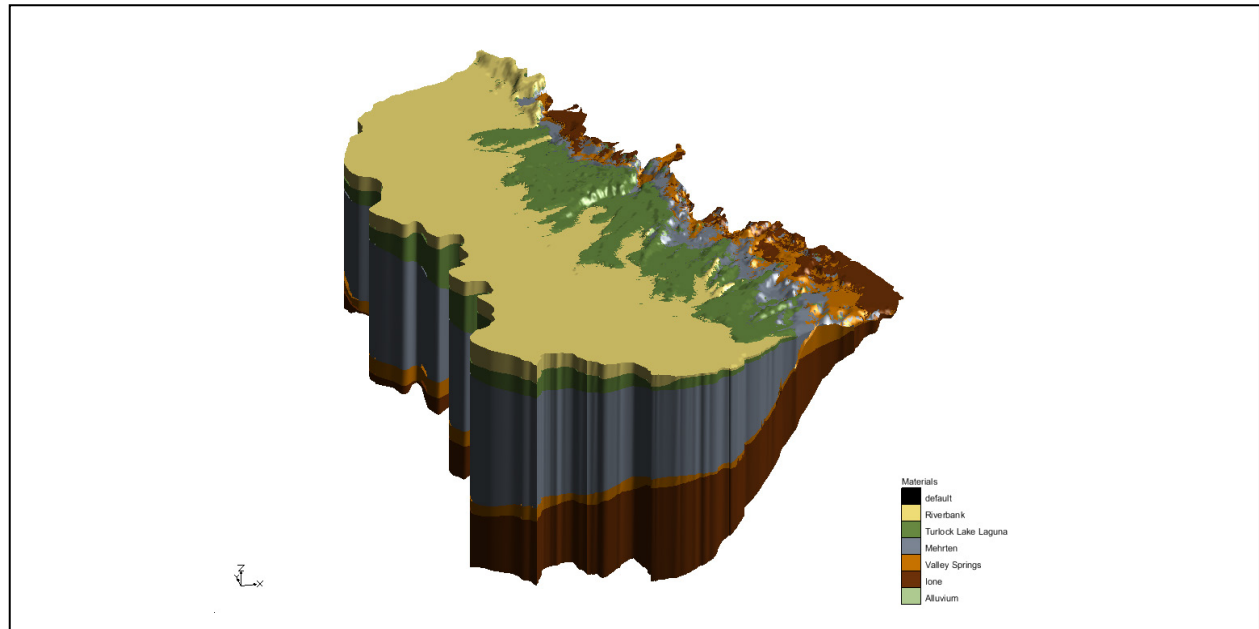*GMS 9.2 Tutorial*

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

- Horizons and Solids

Required Components

- Sub-surface Characterization
- Geostatistics
- Map
- GIS

Time

- 30-60 minutes

AQUAVEO™

1   Contents

2   Introduction

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

2.1   Outline

This is what you will do:

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.

3   Getting Started

Let's get started.

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

4 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, we will read in a previously prepared file.

To read in the file:

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.

You should now see the image below in the GMS graphics window. We have a TIN and multiple rasters loaded in this GMS project.
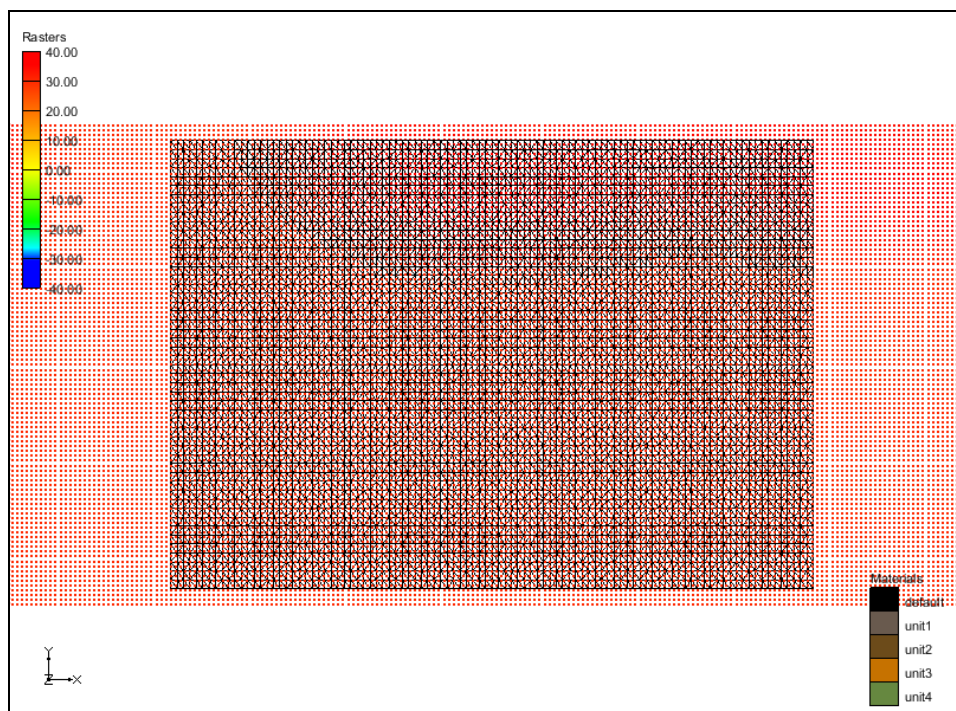

Figure 1.   *Tin and rasters displayed in the GMS Graphics Window.*

5   Viewing Raster Elevations

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

1. Select the *Oblique View* button .

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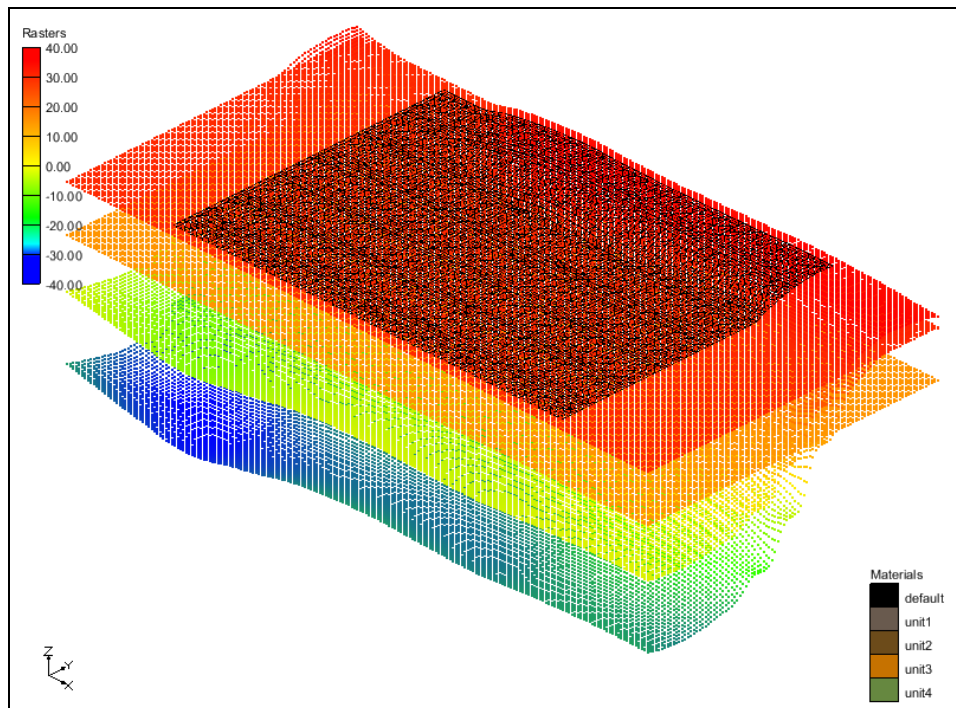

Figure 2.   Raster surfaces.

Let's change the display of the raster to be background imagery.

2. Select the *Plan View* button .

3. Right-click on the **GIS Layers** item in the *Project Explorer*.

4. Select the *Display Options* command.

5. Select the *Display as 2D image* option in the *Rasters* section of the dialog.

6. Select *OK* to exit the dialog.
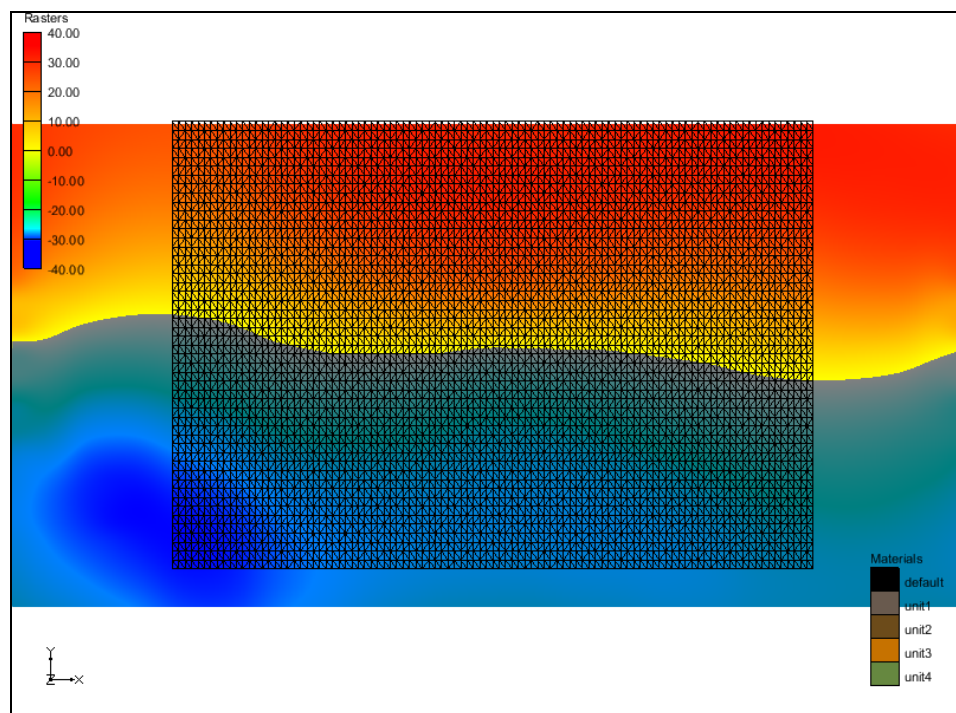
You should now the image below in the GMS graphics window.

Figure 3.   Rasters displayed as background imagery.

6   Creating the Raster Catalog

A raster catalog is a table that allows users to assign attributes to rasters. In our case we want to assign horizon ids to the rasters.

1.   Select the **unit1** raster in the *Project Explorer*.

2.   Hold down the *Shift* key and select the **unit4** raster in the *Project Explorer*.

All four of the rasters should be selected.

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

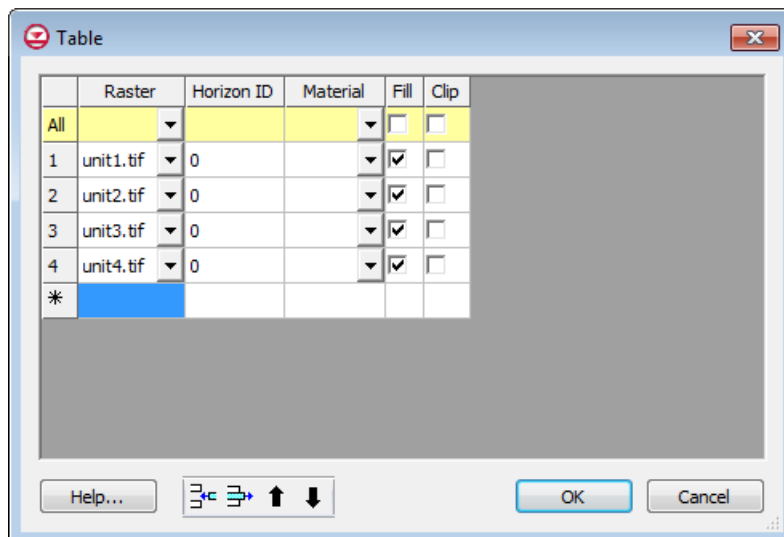A dialog should come up matching the figure below.

Figure 4.   Raster catalog.

This dialog allows us to associate properties with a raster. First we will assign horizon ids and materials to each raster.

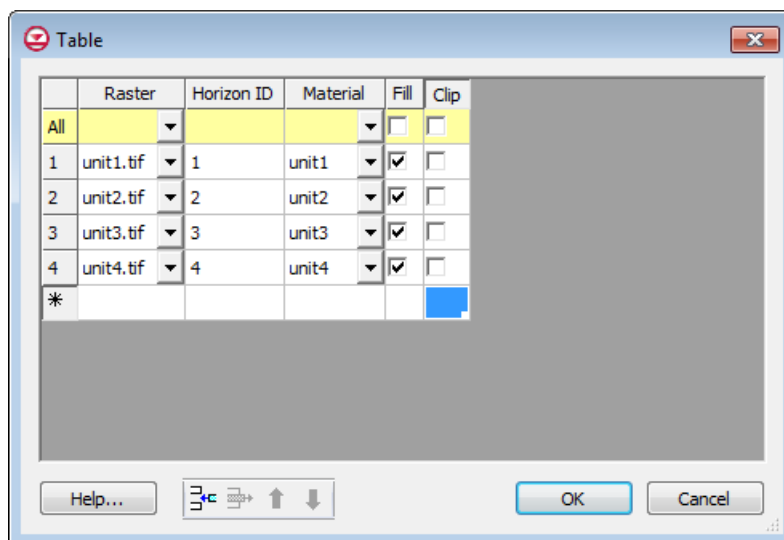4. Enter values into the spread sheet for each raster as shown in the figure below.

Figure 5.   Raster catalog with attributes assigned.

5. Select OK to exit the dialog.

7   Creating solids

We will 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 we will only use our 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. 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.

There is only one TIN in our project and it will be used as the primary TIN. Additionally we will want to use our TIN's elevations as the top of the solids and we will 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.

8   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 the next figure. Notice how the lower two layers extend upwards on the left side of the solids and cut off the upper two layers.
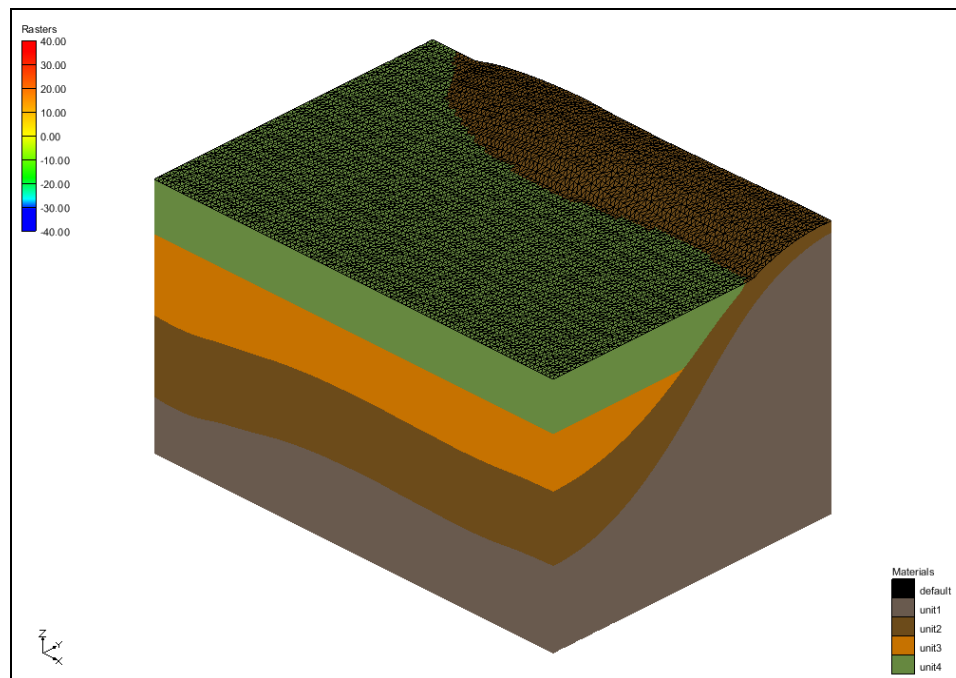
Figure 6.   Solids created from raster catalog.

9   Changing the Fill and Clip Fields

Now we will see the effect of changing the "Fill" and "Clip" fields in the raster catalog. When we first created the raster catalog and the dialog came up 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 no solid will be created 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.   Turn off 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.

9.1   Viewing the Solids

When the *Horizons* → *Solids* command is finished you will have multiple solids that have been created in the same location. We will turn off the first set of solids that were created.

1. Uncheck the **solids** folder 📁 under the *Solid Data* item 📦 in the *Project Explorer*.

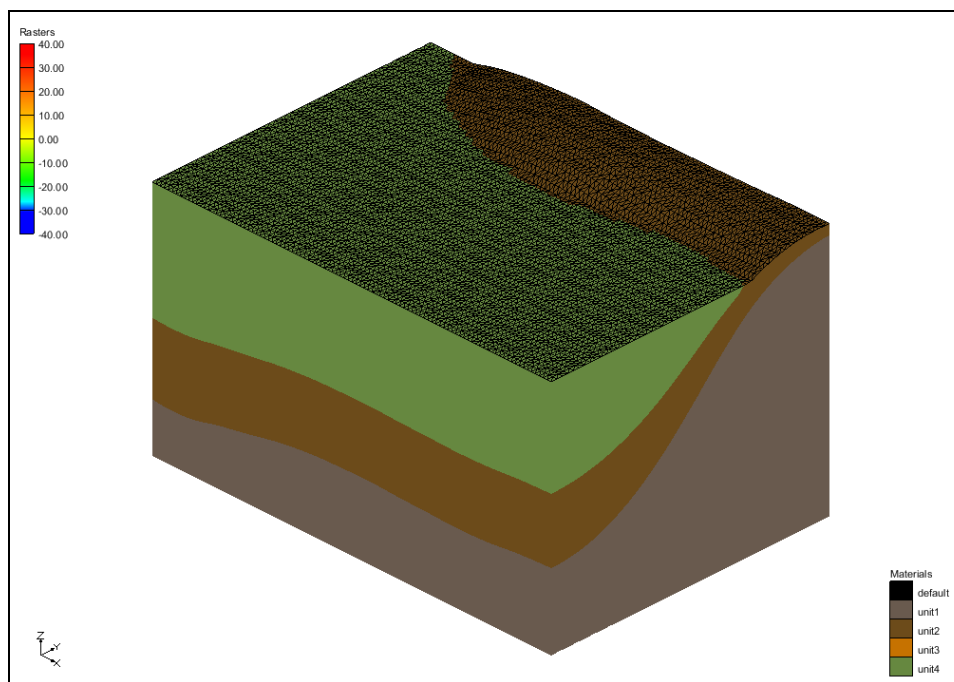Your solids should look like the image below. Notice that no solid was created for **unit3**.

Figure 7.   Solids created with the "Fill" field off for the unit3 raster.

9.2   Changing the Clip Field

Now we will 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. Turn on 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.

9.3   Viewing the Solids

1. Uncheck the **solids (2)** folder 📁 under the *Solid Data* item 🎁 in the *Project Explorer*.

Your 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 below.
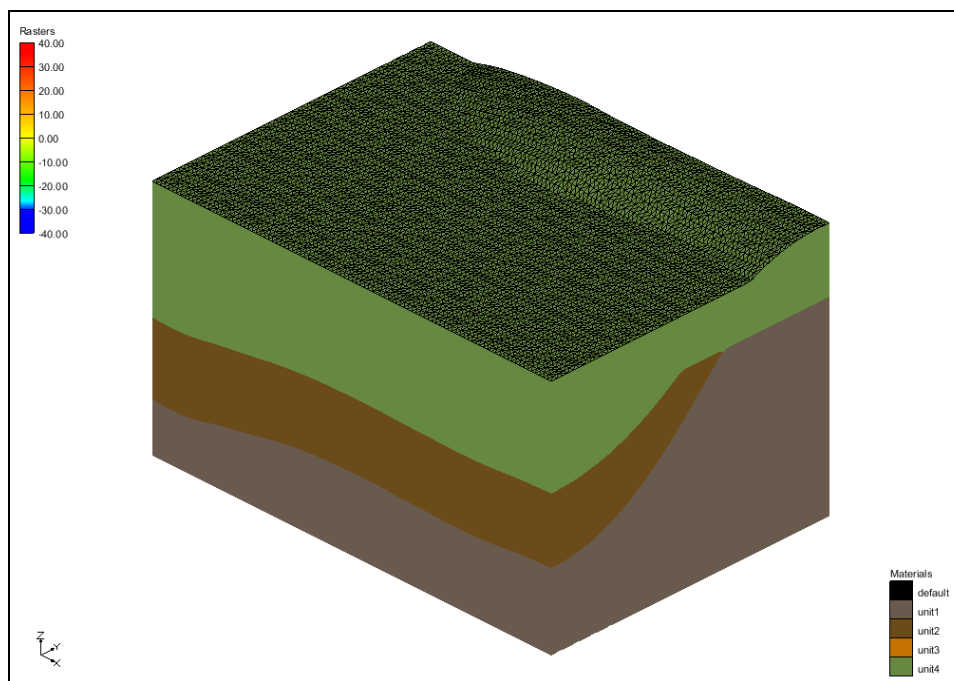

Figure 8.   Solids created with the "Clip" field on for the unit3 raster.

10   Sacramento Data

We are now ready to use what we have 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.

You should now see the image below in the GMS graphics window. This project contains two TINs to define the top and bottom of our 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.
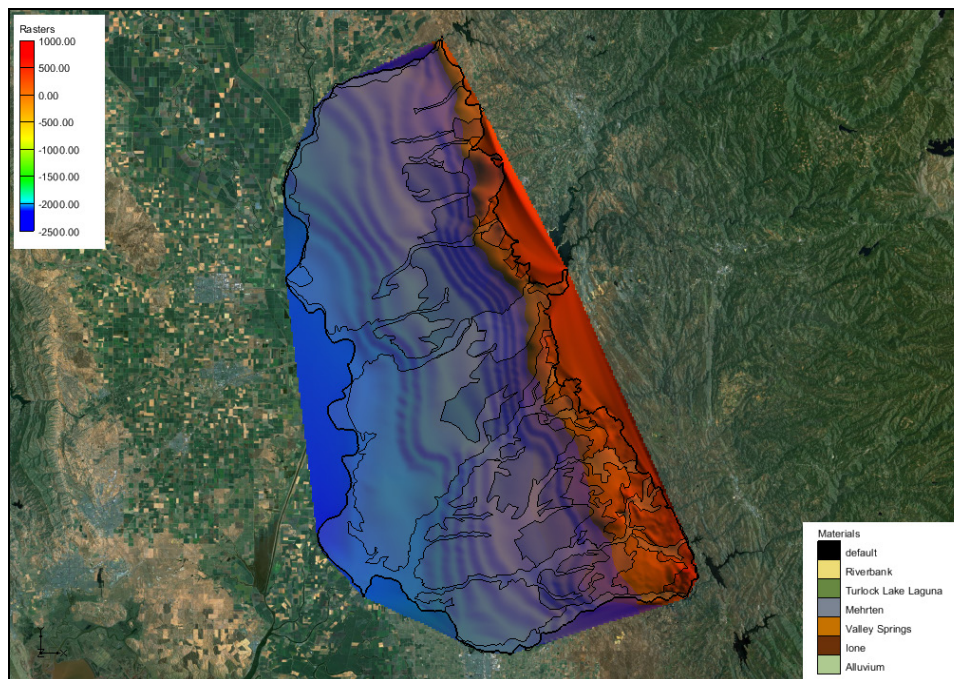

Figure 9.   Map view of Sacramento Region Data.

10.1   Creating the Raster Catalog

We will now 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*.

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

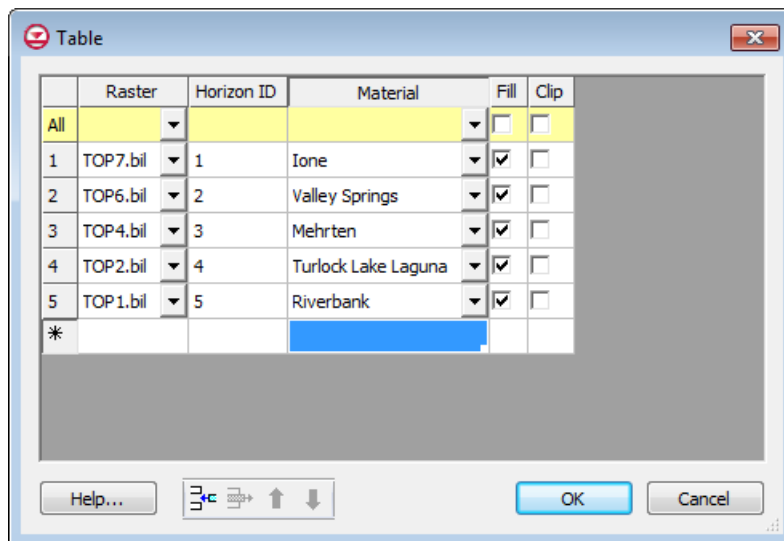5.   Fill in the dialog as shown in the image below.

Figure 10.   Raster catalog for Sacramento stratigraphic units.

6. Select the *OK* button.

10.2   Creating Solids

We will now 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. Make sure that **top** is selected as the *Primary Tin* (left section of the dialog).

6. Ensure that **Tin elevations** is the selected option for *Top elevation* (middle section of the dialog) and that **top** is the selected TIN.

7. Ensure that **Tin elevations** is the selected option for *Bottom elevation* (middle section of the dialog) and that **bottom** is the selected TIN.

8. Select the *Next >* button.

9. Make sure that the *Minimun solid thickness* option is on and that a value **1.0** has been entered.

10. Select the *Finish* button.

10.3 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 🔷.

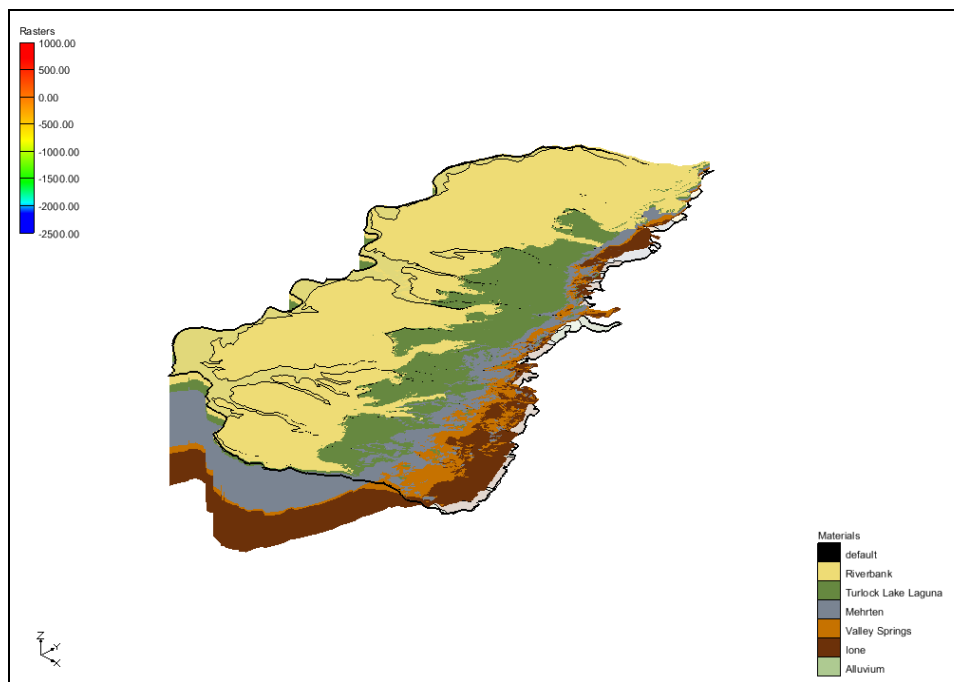The solids should appear like the figure below.

Figure 11.   Solids of the Sacramento Valley.

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

11   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, you must 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.