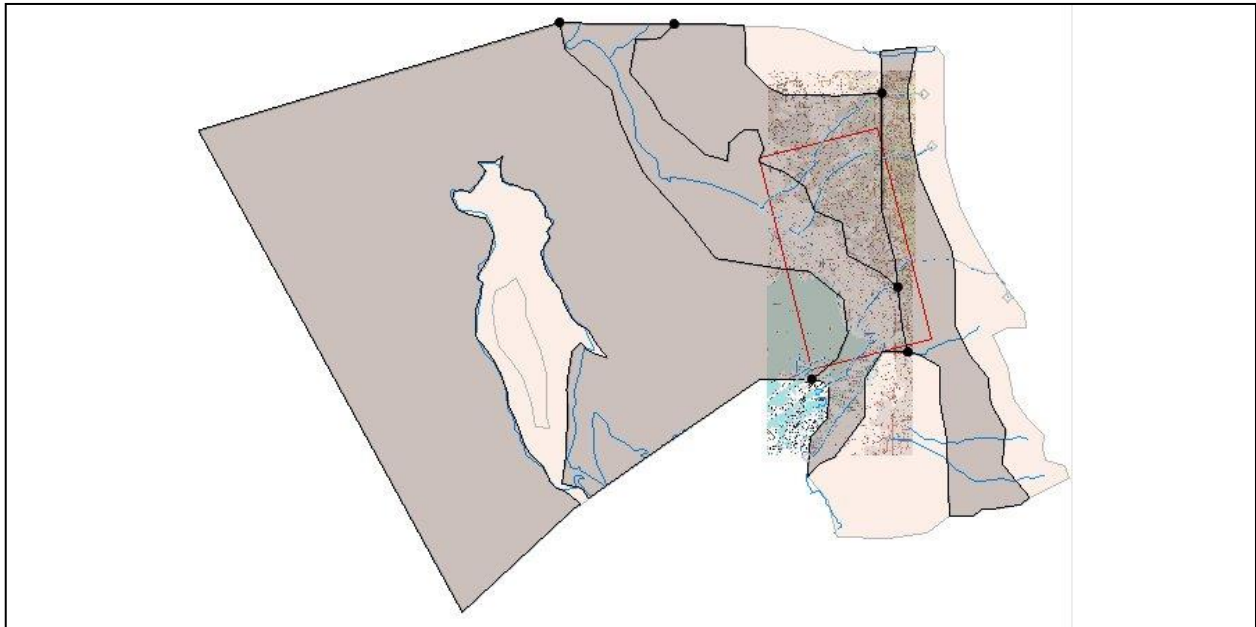*GMS 10.0 Tutorial*

GIS Module

Importing, displaying, and converting shapefiles

Objectives

Learn how to import and display shapefiles with and without ArcObjects. Learn how to convert the shapefiles to GMS feature objects.

Prerequisite Tutorials
- None

Required Components
- GIS Module
- Map Module

Time
- 20-30 minutes

1   Introduction

The GIS module can be used to display data from a GIS database directly in GMS without having to convert that data to GMS data types. Native GMS data such as grids and boreholes can be displayed along with the GIS data. The GIS module can also be used to select a portion of the GIS data and convert it to GMS data types to be used in constructing a groundwater model. Currently, the GIS module can only be used for steady-state data.

If users have a license of ArcObjects® installed on their computers, many features available in ESRI® software (such as ArcMap®) become available in GMS. If the user does not have a license of ArcObjects® installed, he or she can still use the GIS module, but many features will not be available. Users can still import and display shapefiles and convert them to GMS feature objects. For a full list of the features available in the different modes, refer to GMS Help.

This tutorial will introduce the GIS module. This tutorial has two parts. The first part shows the features available if the user doesn't have a license of ArcObjects® installed on his or her computer. The second part shows the features available if the user does. Hence, users will not be able to complete the second part if they do not have a license of ArcObjects® installed on their computers.

1.1   Outline

Here are the steps of this tutorial:

1.   Open a shapefile.

2.   View the attribute table.

3. Convert the shapefile to scatter points.

4. Enable ArcObjects and read in some layers and shapefiles.

5. Convert the shapefile to feature objects.

2   Part 1 – Without ESRI® ArcObjects®

First, it is necessary to import a point shapefile containing well data. Then it will be possible to create scatter points from the shapefile points. Next, it will be possible to create a GMS MODFLOW conceptual model in the Map module and create a coverage with well attributes. Then the user will convert the shapefile to GMS wells that could be used to help build a model. This will illustrate how GIS data can be imported and converted to GMS data.

3   Getting Started

1. Launch GMS if necessary.

2. If GMS is already open, select the *File* | **New** command to ensure that the program settings are restored to the default state.

4   Reading the Shapefile

The first step is to read the shapefile.

1. Select the **Open** button.

2. Locate and open the directory entitled *Tutorials\GIS\gis*.

3. In the *Open* dialog, change the *Files of type* to "Shapefiles (*.shp)."

4. Select the file entitled "arcmap.shp."

5. Select the **Open** button.

5   Viewing the Shapefile

The user should now see a number of points displayed on the screen. These are the wells in the shapefile.

1. Select the "GIS Layers" folder in the Project Explorer.

2. In the Project Explorer, expand the "GIS Layers" folder if necessary.

Notice the "arcmap.shp" object in the Project Explorer. This is the shapefile that was just opened.

Without ESRI® ArcObjects®, users have only a limited set of options for displaying the shapefile.

3. Select the **Display Options** button.

4. In the *Display Options* dialog, click on the button displaying the point symbol style (not on the arrow).

5. In the *Point Properties* dialog, change the point radius to "10" and the color to red.

6. Click **OK** to exit the *Point Properties* dialog.

7. Click **OK** to exit the *Display Options* dialog.

Notice that the point scale and color have changed.

6   Viewing the Attribute Table

The shapefile that was opened has a number of attributes associated with each point.

1. In the Project Explorer, right-click on the "arcmap.shp" object.

2. Select the **Attribute Table** command from the pop-up menu.

3. Resize the *Attributes* dialog by dragging the bottom right corner out so that more of the data is visible.

A number of attributes (columns) are associated with each point. Notice the data is not editable.

4. Click **OK** to exit the dialog.

7   Converting the Shapefile to 2D Scatter Points

Now it will be possible to convert the GIS data to 2D scatter points that can be used to perform interpolations.

1. In the Project Explorer, right-click on the "arcmap.shp" object.

2. Select the *Convert to |* **2D Scatter Points** command from the pop-up menu.

Some new symbols should appear on the screen. These are the new 2D scatter points.

3. If necessary, expand the "2D Scatter Data" folder.

Notice the "arcmap.shp" 2D scatter point set that was just created.

4. Expand the "arcmap.shp" dataset.

Notice that GMS automatically created a dataset from each numeric attribute in the attribute table. This procedure can be used to create scatter points and then interpolate from the scatter points to a grid. If the user had water level information for each point, for example, he or she could create a starting head dataset for the model.

This tutorial won't do anything more with the scatter points, so it's time to delete them.

5. In the Project Explorer, right-click on the "2D Scatter Data" folder and select **Delete** from the pop-up menu.

Now it is possible to convert the GIS data to GMS feature objects that could be used to build a conceptual model. The first step is to create a default conceptual model and coverage with the appropriate attributes.

7.1   Creating the Conceptual Model

1. In the Project Explorer, right-click on the empty space.

2. Then, from the pop-up menu, select the *New* / **Conceptual Model** command.

3. In the *Conceptual Model Properties* dialog, change the *Name* to "Model1."

4. Make sure the *Type* is set to *MODFLOW,* and click **OK**.

5. In the Project Explorer, right-click on the "Model1" conceptual model.

6. Select the **New Coverage** command from the pop-up menu.

7. In the *Coverage Setup* dialog, rename the new coverage "coverage1."

8. Select the *Wells* option in the list of *Sources/Sinks/BCs*.

9. Click **OK**.

7.2   Mapping the GIS Data

1. Select the "GIS Layers" folder in the Project Explorer.

2. Select the *GIS* / **Shapes → Feature Objects** command.

3. Click *Yes* to confirm the use of all visible shapes.

At this point, the *GIS to Feature Objects Wizard* appears.

4. Click **Next**.

5. In the WELLNAME column, change the mapping drop-down selection to "Name."

6. In the PUMPRATE column, change the mapping drop-down selection to "Flow rate."

7. Click **Next**.

8. Click **Finish**.

Once GMS processes this command, feature points will now exist in the same location as the GIS points. But since they're in the same locations, the user probably won't notice any difference in the display.

9. Uncheck the "arcmap.shp" object in the Project Explorer.

10. In the Project Explorer, right-click on "coverage1" .

11. Select the **Attribute Table** command from the pop-up menu.

This *Attributes* dialog shows the properties of all the feature points in the coverage. Notice that the names and flow rates were transferred from the GIS attributes, just as specified. However, the type for all points is labelled as "NONE." It is necessary to make them into wells.

12. In the *Attributes* dialog, find the spreadsheet cell corresponding to the *All* row and the *Type* column. Change the type to "Well." Since this is the *All* row, all of the points are changed to wells.

13. Click **OK**.

7.3   Part 1 Conclusion

At this point, the user has well points that could be used to further construct a MODFLOW conceptual model. This topic is discussed more thoroughly in the tutorial entitled "MODFLOW – Conceptual Model Approach" and will not be discussed further here.

8   Part 2 – With ESRI® ArcObjects®

If users have a license of ArcObjects® installed on their computers or on your network, they can proceed through part 2 of this tutorial. If users have ESRI® software like ArcGIS® installed, then users should have a license of ArcObjects® available. In case the user doesn't know if he or she has a license of ArcObjects®, the tutorial will show the user how to tell.

Many more features in the GIS module are available if the user has a license of ArcObjects^{®.} This part of the tutorial introduces those features.

9   Enabling ArcObjects

First, it is necessary to delete everything that has been done so far and enable ArcObjects.

1. Select the **New** ⬜ button.

2. Select *No* at the prompt to save changes.

3. Switch to the GIS module 🌐.

4. Select the *GIS* / **Enable ArcObjects** menu command.

If a check mark appears next to the menu command, then the user has a license for ArcObjects installed, so he or she can continue with the tutorial.

10   Reading the Data

The first step is to read in the required data

1. Select the *GIS* / **Add Data** command.

2. Locate and open the directory entitled *Tutorials\GIS\gis*.

3. Select the files entitled "streams.shp," "Ndavis.tif," "Sdavis.tif," "recharge.shp," and "area_interest.shp."

4. Select the **Add** button.

11   Viewing the Shapefile

The display order of the different layers is controlled by the order of the items in the Project Explorer. Now it is possible to arrange the data so that it can be viewed easily.

1. In the Project Explorer, expand the "GIS Layers" 🌐 folder if necessary.

2. In the Project Explorer, right-click on the "area_interest" 🔳 shapefile and select the **Zoom To Layer** command.

3. In the Project Explorer, arrange the items in the order shown in the figure below (Figure 1) to adjust the display order in the Graphics Window.
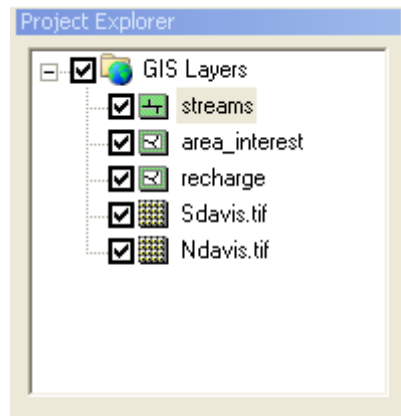
Figure 1   GIS display order

With ESRI® ArcObjects®, an expanded set of options is available for display. First, it is necessary to change the display of the stream layer.

4. In the Project Explorer, right-click on the "streams" ⊞ shapefile and select the **Properties** command.

5. Select the *Symbology* tab.

6. In the *ArcView® Display Symbology* dialog, select the button in the *Symbol* section.

7. Select the "River" type from the *Symbol* selector.

8. Select **OK** to exit the *ArcView® Display Symbology* dialog.

9. Select **OK** to exit the *Properties* dialog.

To better see the background images, the user will now increase the transparency of the recharge layer and turn off the fill color for the interest layer area.

10. In the Project Explorer, right-click on the "recharge" ▧ shapefile and select the **Set Layer Transparency** command.

11. Change the transparency to "50 %."

12. Click **OK**.

13. In the Project Explorer, right-click on the "area_interset" ▧ shapefile.

14. Select the **Properties** command.

15. Select the *Symbology* tab.

16. In In the *ArcView® Display Symbology* dialog, select the button in the *Symbol* section.

17. Select the "Hollow" type and change the *Outline Color* to red.

18. Select **OK** twice to exit the *ArcView® Display Symbology* dialog.

19. Select **OK** to exit the *Properties* dialog.

12   Converting the Shapefile to Feature Objects

Now it is possible to convert the GIS data to GMS feature objects that could be used to build a conceptual model. First, it is necessary to create a default conceptual model and coverages with the appropriate attributes.

12.1   Creating the Conceptual Model

1. In the Project Explorer, right-click on the empty space.

2. Then, from the pop-up menu, select the *New* / **Conceptual Model** command.

3. Change the *Name* to "Model1."

4. Make sure the *Type* is set to "MODFLOW."

5. Click **OK**.

6. In the Project Explorer, right-click on the "Model1" 🗂 conceptual model.

7. Select the **New Coverage** command from the pop-up menu.

8. In the *Coverage Setup* dialog, rename the new coverage to "Rivers."

9. Select the *River* option in the list of *Sources/Sinks/BCs*.

10. Click **OK**.

11. In the Project Explorer, right-click on the "Model1" 🗂 conceptual model.

12. Select the **New Coverage** command from the pop-up menu again.

13. In the *Coverage Setup* dialog, rename the new coverage to "Recharge."

14. Select the *Recharge rate* option in the list of *Areal Properties*.

15. Click **OK**.

12.2   Mapping the GIS Data

Now it is necessary to map the "streams" shapefile to the "Rivers" coverage. The user will only map objects that are within the area of interest by selecting items to map by their location.

1. In the Project Explorer, select the "Rivers" coverage to make it the active coverage.

2. Select the "GIS Layers" folder in the Project Explorer

3. Select the *GIS | Selection* / **Select by Location** menu command.

4. In the *Select by Location* dialog, make sure the dialog matches the following figure (Figure 2) and select **Apply**.
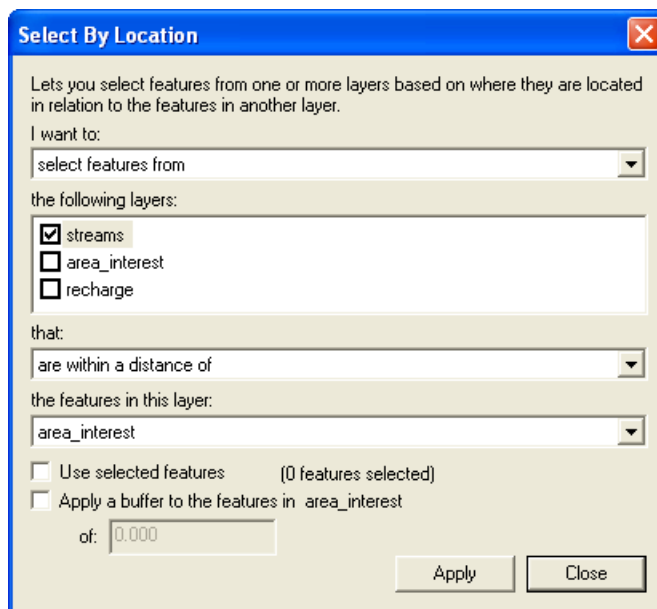

Figure 2   Selecting stream features by location

5. Click **Close**.

6. Select the *GIS* / **ArcObjects → Feature Objects** command.

At this point, the *GIS to Feature Objects Wizard* appears.

7. Click **Next**.

8. In the TYPE column, change the mapping in the drop-down menu to "Type."

9. In the NAME column, change the mapping in the drop-down menu to "Name."

10. Click **Next**.

11. Click **Finish**.

Feature arcs now exist that represent the rivers in the same location as the GIS arcs. Now it is necessary to map the "recharge" shapefile to the "Recharge" coverage.

12. In the Project Explorer, select the "Recharge" 🔲 coverage to make it the active coverage.

13. Select the "GIS Layers" 🌐 folder in the Project Explorer

14. Select the *GIS | Selection |* **Select by Location** command.

15. In the *Select by Location* dialog, make sure the dialog matches the following figure (Figure 3) and select **Apply**.
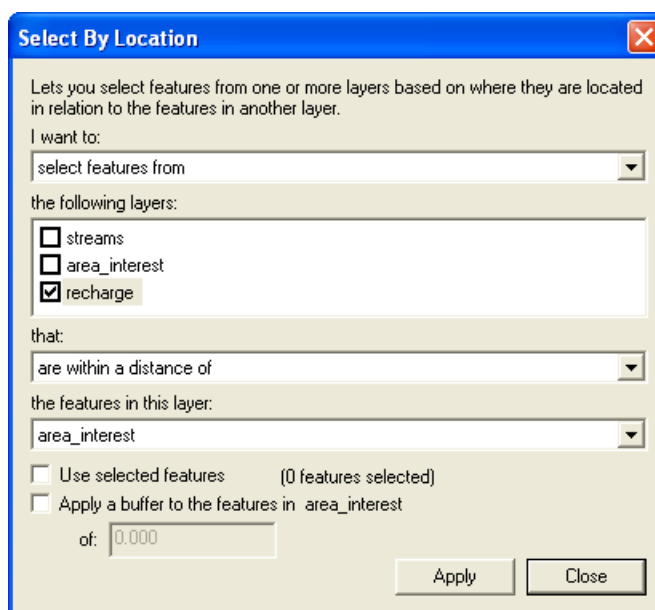

Figure 3   Selecting recharge features by location

16. Click **Close**.

17. Select the *GIS |* **ArcObjects → Feature Objects** command.

At this point, the *GIS to Feature Objects Wizard* appears.

18. Click **Next**.

19. In the RECH_RATE column, change the mapping in the drop-down menu to "Recharge rate."

20. Click **Next**.

21. Click **Finish**.

Feature polygons now exist in the same location as the GIS polygons.

22. Uncheck the "GIS Layers" folder in the Project Explorer.

23. In the Project Explorer, right-click on "Recharge" .

24. Select the **Attribute Table** command from the pop-up menu.

25. In the *Attributes* dialog, change the *Feature type* to "Polygons."

This dialog shows the properties of all the feature polygons in the coverage. Notice that the recharge rates were transferred from the GIS attributes, just as specified.

26. Click **OK**.

At this point, the user has river arcs and recharge polygons that could be used in further constructing a MODFLOW conceptual model. This topic is discussed in depth in the tutorial entitled "MODFLOW – Conceptual Model Approach" and will not be discussed further here.

13   Conclusion

This concludes the tutorial. Here are the things that were covered in this tutorial:

- ArcView Shapefiles can be imported into GMS without having a license of ArcView on your computer.

- Shapefile data can be converted to GMS scatter points or feature objects.

- If users have a license of ArcObjects installed, they can use a lot of powerful GIS tools in GMS that ESRI has provided.