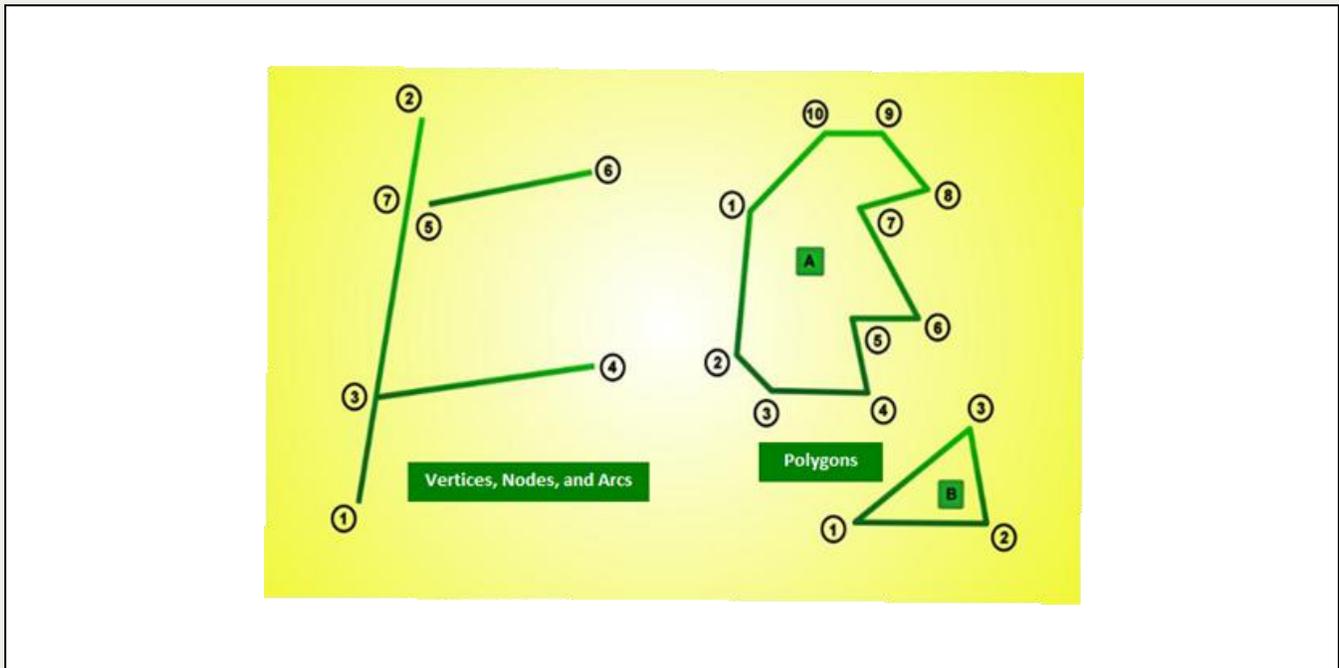*WMS 11.4 Tutorial*

Basic Feature Objects

Learn about, create, edit, and manage feature objects in WMS, and import and use GIS data

Objectives

Define the term "Feature Objects". Create, edit, and manage feature objects and coverages in WMS. Import GIS data and convert the data to feature objects in the map module. Use images to create feature objects from scratch.

Prerequisite Tutorials	Required Components	Time
• None	• Map	• 30–60 minutes

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1   Introduction

Feature objects are points, lines, and polygons organized in coverages by different attribute sets such as drainage features, land use, soils, travel time paths, cross sections, and so on. The primary coverage in WMS is the drainage coverage, which holds drainage boundary polygons, stream lines, and outlet nodes. Most of the other coverages are secondary to the drainage coverage and are used to "map" other hydrologic parameters such as travel time or curve numbers.

Feature objects are equivalent to GIS vector data. Importing from GIS databases is one way to create coverages in WMS. Feature object coverages can also be digitized directly from the screen, using a georeferenced image in the background as a guide. This tutorial demonstrates both methods, focusing on using various tools and assigning attributes.

This tutorial teaches the basics of creating and importing feature objects and managing different coverages. It discusses and demonstrates:

- Creating and editing feature objects.

- Defining feature object attributes.

- Creating coverages.

- Specifying attribute sets.

- Using shapefiles.

- Using images to create feature objects.

- Managing multiple coverages.

2   Getting Started

Launching WMS at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.

2. If WMS is already running, from the *Menu* bar, select the *File | New* menu item to ensure that the program settings are restored to their default state.

3. A dialog may appear asking to save changes. To clear all data, click the **Don't Save** button.

The graphics window of WMS should refresh to show an empty space.

4. From the *Macro* bar, switch to the **Map** module.

5. To bring up the *Open* dialog, from the *Macro* bar, click the **Open** macro.

6. Browse to the *feature\feature* folder.

7. Select the "FeatureObjects.jpg" file.

8. To import the image and exit the *Open* dialog, click the **Open** button.

An image similar to Figure 1 will appear in the *Main Graphics Window*. This image depicts different examples of feature objects. This tutorial will use them to trace and create feature objects.
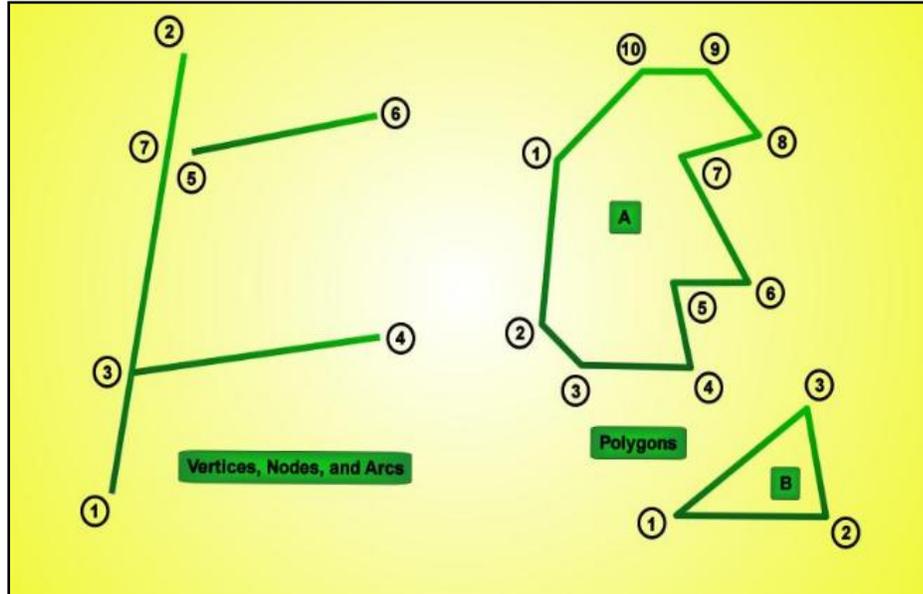

Figure 1:   Example feature objects depicted in the imported image

3   Creating and Editing Feature Objects

The **Terrain Data**, **Drainage**, and **Map** modules are where the feature objects are created and manipulated. All feature objects are made from a set of points and the lines (arcs) connecting the points. There are three main types of feature objects: points, arcs, and polygons. The following sections show how to create and edit the different types of feature objects.

3.1   Creating Feature Arcs

Use the "Vertices, Nodes, and Arcs" section of Figure 1 for sections 3.1 through 3.5.

When WMS creates an arc, each end is a node and all points in the middle are vertices.

While creating a feature arc:

- *Enter* key or *single-click* to make a vertex.

- *Backspace* key to back up one vertex.

- *Double-click* to end the arc.

- *Esc* key to cancel.

Create a feature arc:

1. In the Project Explorer, select "🗺 Drainage" to make the coverage active.

2. From the *Dynamic* tool bar, select the **Create Feature Arc** 𝄌 tool.

3. In the Graphics Window, click on the image near point "1".

4. Double-click on the image near point "2" to end the arc.

5. Click at point "3", directly on top of the newly created arc.

6. Double-click at point "4" to end the arc.

Notice how WMS automatically links the new arc to the existing arc and creates a node at the point of intersection, splitting the existing arc into two arcs.

7. Click at point "5".

8. Double-click at point "6".

This creates a separate arc leaving the rest unaltered.

3.2   Inserting Vertices and Snapping Arcs

If two arcs very close to each other should share a common node, WMS has a tool to snap these nodes together.

1. From the *Macro* bar, click the **Display Options** 🖥 macro to bring up the *Display Options* dialog.

2. From the list on the left, select, "⭐ Map Data".

3. On the *Map* tab on the right, turn on the *Vertices* checkbox.

4. To bring up the *Point Properties* dialog, click on the button to the right of the *Vertices* check box.

5. For the *Radius,* enter "5".

6. To close the *Point Properties* dialog, click the **OK** button.

7. To close the *Display Options* dialog, click the **OK** button.

8. From the *Dynamic* tool bar, select the **Create Feature Vertex** 🖋 tool.

9. In the *Graphics Window,* click on the first arc next to where it is labeled "7".

A vertex is inserted here, making it possible for the "5–6" arc to be "snapped" to this location.

10. From the *Dynamic* tool bar, select the **Select Feature Point/Node** 🖱 tool.

11. In the *Graphics Window,* on node "5", right-click and select the **Clean…** context menu item to bring up the *Clean Options* dialog.

12. Turn on the *Snap selected nodes* checkbox.

13. Click the **OK** button to close the *Clean Options* dialog.

In the *Status* bar, at the bottom left of the WMS screen, notice the prompting to "Select a snapping point…" (Figure 2).

14. In the *Graphics Window,* select the newly created vertex "7".
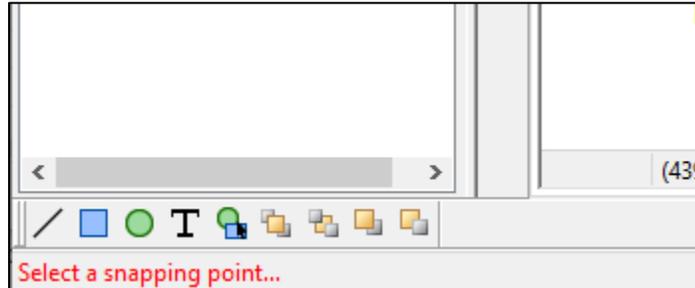

Figure 2:   Select a snapping point

WMS snaps the two arcs together and changes vertex "7" to a node (Figure 3).
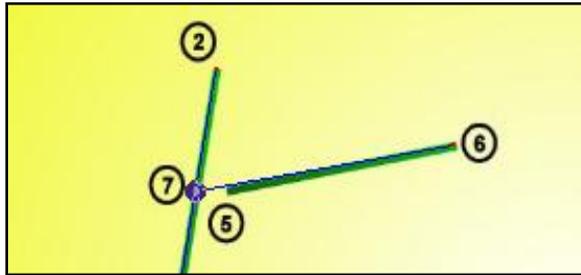

Figure 3:   Vertex 7 becomes Node 7 after snapping Node 5 to it

3.3   Deleting an Arc

Now that the main arc has two nodes along its length, delete the center arc only.

1. From the *Dynamic* tool bar, select the **Select Feature Arc** 🏃 tool

2. In the Graphics Window*,* select the arc between nodes "3" and "7".

Notice that WMS highlights the selected arc.

3. Press the **Delete** key—or right-click and select the **Delete** context menu item—to delete the arc.

4. If asked to confirm deleting the arc, click the **OK** button.

Arcs can be created between two existing nodes by doing the following:

5. From the *Dynamic* tool bar, select the **Create Feature Arc** 🌿 tool.

6. In the Graphics Window, click on node "3".

7. Click on node "7" to re-form the arc.

3.4   Converting Vertices to Nodes

WMS uses vertices and nodes for different purposes. For example, nodes can have attributes while vertices simply define the shape or position of the arc. Changing a vertex to a node—or a node to a vertex—is sometimes necessary.

1. From the *Dynamic* tool bar, select the **Create Feature Vertex** ✧ tool.

2. In the Graphics Window, click on the 3–7 arc anywhere between nodes "3" and "7".

A dot should appear, indicating the location of the new vertex.

3. From the *Dynamic* tool bar, select the **Select Feature Vertex** ✧ tool.

4. In the Graphics Window, right-click on the new vertex and select the **Vertex →
   Node** context menu item.

A red node should appear at this location (Figure 4). The 3–7 arc is now broken in half. It is now possible to define attributes (for example, a drainage outlet) at this location.

Figure 4:   The new node appears as a red dot below Node 7

3.5   Converting Nodes to Vertices

Just as vertices can be changed to nodes, nodes can be changed to vertices. Doing so can leave the project with a cleaner representation of its feature arcs. For example, instead of managing and assigning attributes to two arcs, converting a node to a vertex merges the two arcs together.

1. From the *Dynamic* tool bar, select the **Select Feature Point/Node** ✧ tool.

2. In the Graphics Window, right-click on the new node and select the **Node →
   Vertex** context menu item.

The node has been changed back to a vertex.

3.6   Assigning Arc Attributes

Each of the nodes, arcs, and polygons were created with default properties or attributes. WMS allows changing the attributes of feature objects.

1. From the *Dynamic* tool bar, select the **Select Feature Arc** ✧ tool.

2. In the Graphics Window*,* hold down the *Shift* key and select all five arcs in the "Vertices, Nodes, and Arcs" section of the image.

3. From the *Menu* bar, select the *Feature Objects |* **Attributes…** menu item to bring up the *Feature Arc Type* dialog.

This dialog allows you to choose the type of arc for the selected arc(s).

4. Select the *Stream* radio button.

5. To close the *Feature Arc Type* dialog, click the **OK** button.

6. In the Project Explorer, turn off the "⊞ FeatureObjects.jpg" checkbox.

7. In the Graphics Window, click anywhere outside of the feature objects to deselect all of them.

8. From the *Macro* tool bar, click the **Display Options** 🖥 macro to bring up the *Display Options* dialog.

9. Select "✦ᴺ Map Data" from the list on the left.

10. In the *Map* tab on the right, in the list below the *Coverage type* drop-down, scroll to the bottom of the list and turn on the **Stream Arrows** checkbox.

11. Click the **OK** button to close the *Display Options* dialog.

Notice that the arcs are now colored blue. Each arc portion should have a blue arrow indicating flow direction for the stream. The original direction in which the arc was created determines the way the stream flows (though the flow direction can be reversed).

💡 It is best practice to create stream arcs from downstream to upstream.

Notice that the lower node on the arc looks different now. WMS has automatically changed it to a drainage outlet instead of a generic node.

12. From the *Dynamic* tool bar, select the **Select Feature Point/Node** 🖈 tool.

13. In the Graphics Window, double-click on the lower outlet node 🔴 (In the *Properties* window: Feature Point ID "2C") to bring up the *Drainage Feature Point Type* dialog.

Notice that in the *Type* section, *Drainage outlet* is selected. This dialog can be accessed by selecting any feature object (point, line, or arc) and then selecting *Feature Objects | Attributes…* or by double-clicking on the object.

14. Click the **OK** button to close the *Drainage Feature Point Type* dialog.

3.7   Building Polygons

For this section, use the "Polygons" section on the imported image.

1. In the Project Explorer, select "🫧 Drainage" to make the coverage active.

2. From the *Dynamic* tool bar, select the **Create Feature Arc** 〰 tool.

3. In the Graphics Window, click on point "1" of polygon "A".

4. Click on points "2" through "10" and then click again on point "1" to close the arc.

5. If a warning appears asking to convert the arc to a generic feature arc, click the **Yes** button.

6. Do the same for points "1" through "3" on polygon "B".

Now there are two closed arcs. To change them into polygons, do the following:

7. In the Project Explorer, right-click on the "🫧 Drainage" coverage and select the **Build Polygon** context menu item.

8. When asked to use all arcs, click the **OK** button.

The two polygons should now be drawn with a thicker line instead of the thinner arc lines (Figure 5). Additionally, the polygons are now filled with color.

Polygons are built from their constituent arcs. The appropriate topology is established when the polygon is built.
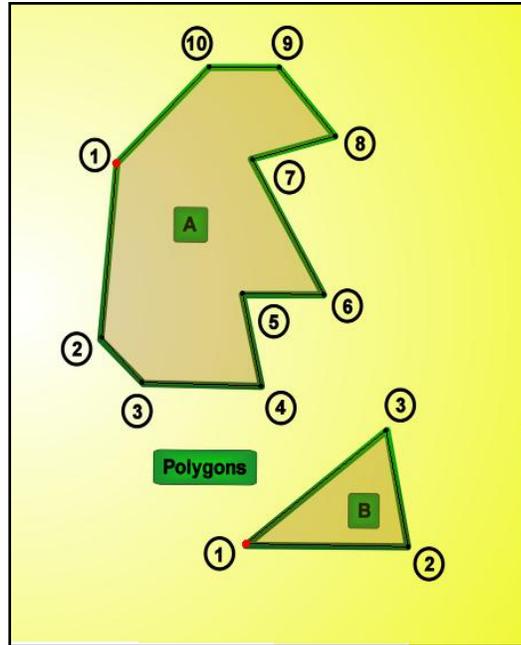

Figure 5:   The polygons have thicker lines and are filled with color. The transparency for these polygons has been adjusted.

3.8   Assigning Polygon Attributes

Just as the attributes of arcs and nodes can be changed, the attributes of polygons can be changed.

1. From the *Macro* tool bar, click the **Display Options** 🖥 macro to bring up the *Display Options* dialog.

2. Select "✦ Map Data" from the list on the left.

3. In the *Map* tab on the right, in the list below the *Coverage type* drop-down, turn on the **Color Fill Polygons** checkbox.

4. Click the **OK** button to close the *Display Options* dialog.

5. From the *Dynamic* tool bar, select the **Select Feature Polygon** 🔲 tool

6. In the Graphics Window, double-click anywhere inside polygon "A" to bring up the *Drainage Feature Polygon Type* dialog.

7. In the *Type* section, select the "Drainage boundary" radio button and click the **OK** button to close the *Drainage Feature Polygon Type* dialog.

The boundary and color fill of polygon "A" should remain the same (Figure 6).

8. Double-click anywhere inside polygon "B" (the triangle) to bring up the *Drainage Feature Polygon Type* dialog.

9. In the *Type* section, select the *Lake/Reservoir* radio button and click the **OK** button to close the *Drainage Feature Polygon Type* dialog.

10. Click outside the polygons to deselect all polygons.

Polygon "B" should have a light blue border and a light blue color fill (Figure 6).
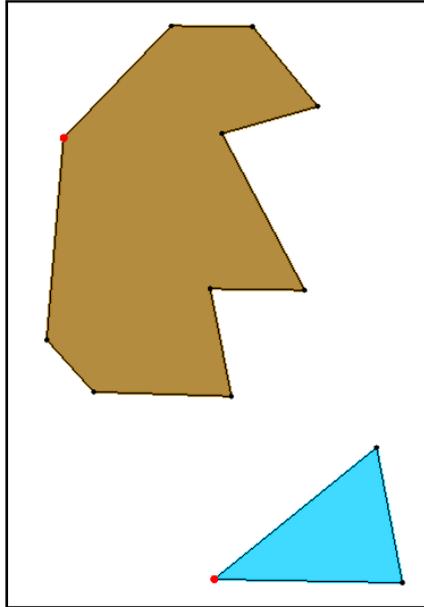

Figure 6:   Polygons after the Type attribute is set

4   Using Shapefiles to Create Feature Objects

One of the most important features of WMS is the ability to automatically create feature objects using shapefiles. Importing shapefile data can be done in different ways. Additional options may be available, depending on which external software (e.g., ArcGIS) is installed.

Before proceeding, reset to a blank project.

1. From the *Macro* bar, click the **New** macro.

2. When asked to save changes, click the **Don't Save** button.

4.1   Importing a Shapefile and Mapping to Feature Objects

Import the shape file from the project data folder.

1. From the *Module* bar, switch to the **GIS** module.

2. In the Project Explorer, right-click on the " GIS Data" folder and select the **Add Shapefile Data...** context menu item to bring up the *Select shapefile* dialog.

3. Select the "streams.shp" shape file and click the **Open** button to import the shapefile and close the *Select shapefile* dialog.

The shapefile should appear similar to   Figure 7.

Note that the DBF and SHX files (in this case, "streams.dbf" and "streams.shx") must always be in the same directory as the SHP file or the shapefile will not work properly.
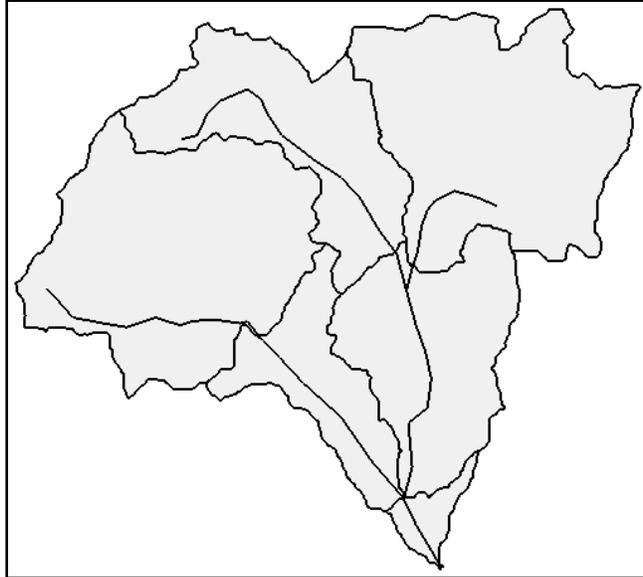
Figure 7:   *The imported shapefile showing the drainage basin*

4. Using the **Select Shapes** ➤ tool from the *Macro* bar, click and drag a box around all the shapes to select them all.

5. Select the *Mapping | **Shapes → Feature Objects*** from the *Menu* bar to bring up the *Step 1 of 3* page of the *GIS to Feature Objects Wizard* dialog.

This dialog is used to map shapefile data to feature objects in WMS.

6. Click the **Next** button to go to the *Step 2 of 3* page of the *GIS to Feature Objects Wizard* dialog.

The spreadsheet shows each shapefile attribute in capitalized letters (e.g., *DRAINTYPE*, *LENGTH*, *SLOPE*, and so on). Underneath each attribute is a drop-down containing the WMS attributes available to map to the shapefile attributes.

7. In the *Mapping Preview* section on the *Mapping* row of the spreadsheet in the *DRAINTYPE* column, select "Drainage Arc type" from the drop-down.

8. Select "Stream Length" from the *LENGTH* drop-down.

9. Select "Stream slope" from the *SLOPE* drop-down.

10. Select "Not mapped" from the *DMANNINGS* drop-down.

This attribute cannot be mapped because there is not a corresponding WMS attribute available to map it onto, because it is not an attribute of a feature object in WMS.

11. Select "Stream basin id" from the *BASINID* drop-down.

Review the values assigned to each attribute for each shape in the spreadsheet.

12. Click the **Next** button to go to the *Step 3 of 3 (Finished)* page of the *GIS to Feature Objects Wizard* dialog.

13. Click the **Finish** button to close the *GIS to Feature Objects Wizard* dialog.

14. In the Project Explorer, turn off the "⬚ streams.shp" checkbox.

The shapefile containing streams and basins has been imported, with all the shapes converted to WMS feature objects. The data from the original shapefile has been mapped to WMS attributes (Figure 8) which shows up in the *Map Data* folder.
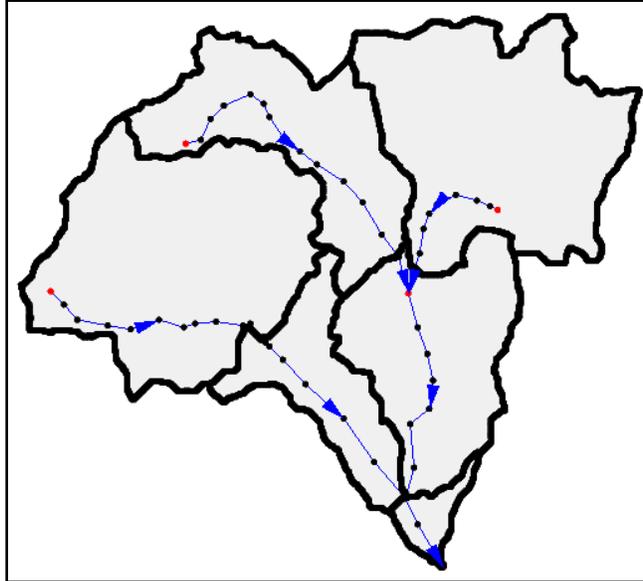
Figure 8:   Shapefile mapped to feature objects

5   Using Background Images to Create Feature Objects

WMS enables the creation of feature objects using background images as guides—for instance, importing a soil use map into WMS.

Before proceeding, reset to a blank project.

1. From the *Macro* bar, click the **New** ☐ macro.

2. When asked to save changes, click the **Don't Save** button.

5.1   Creating a New Coverage

Notice the default coverage, "🌐 Drainage", listed under the "📁 Map Data" folder in the Project Explorer. This is the default coverage automatically created in any new project in WMS. The Project Explorer enables management of the default coverage, the ability to make new coverages, delete coverages, edit coverage properties, and change the active coverage.

1. In the Project Explorer*,* right-click on "🌐 Drainage" and select the **Rename** context menu item.

2. Enter "PracticeDrainage" and press the **Enter** key to set the new name.

3. Right-click on the "📁 Coverages" folder and select the **New Coverage** context menu item to bring up the *Properties* dialog.

4. From the drop-down on the *Coverage type* row in the *Value* column, select "Soil Type".

Notice that the *Coverage name* in the field below automatically changes to "Soil Type".

5. Click the **OK** button to close the *Properties* dialog and create the new coverage.

6. In the Project Explorer*,* select the "🌐 Soil Type" coverage to make it active.

5.2   Importing Images

Now that a soil type coverage has been added, import the soils image.

1. From the *Macro* bar, click the **Open** 📂 macro to bring up the *Open* dialog.

2. From the *Files of type* drop-down, select "Image Files (*.img)".

3. Select the "soils.img" file and click the **Open** button to import the image and exit the *Open* dialog.

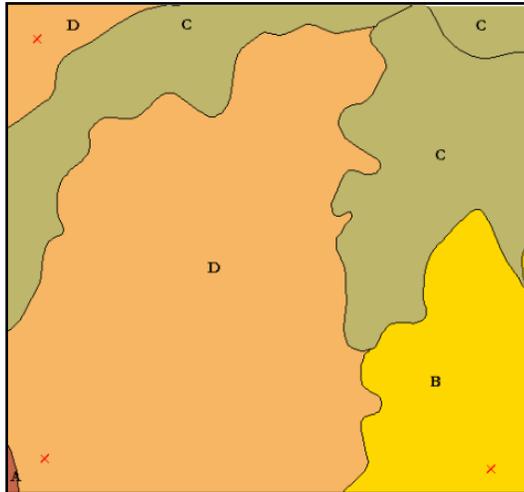A soils image similar to Figure 9 should appear.

Figure 9:   Soils image showing different soil types

5.3   Manually Digitizing Feature Objects

1. In the Project Explorer, select the "🖼 Soil Type" coverage to make it active.

2. Using the **Create Feature Arc** 🖊 tool, from the *Macro* bar, build the following arcs:

3. Starting anywhere on the border of the large orange area (labeled "D"), outline with an arc the entire region.

4. Create arcs for all the other soil type areas, being careful not to create arcs on top of previously defined borders.

Zoom 🔍 in to get a closer view of the image if needed. End an arc by double-clicking in order to be able to select any other tools, such as **Zoom** 🔍, **Pan** ✛, or show all. When outlining each soil region, simply start on a previously created arc and proceed around each border, ending when another previously created border is reached. When clicking near an existing vertex or arc, WMS automatically snaps the new arc to the existing one.

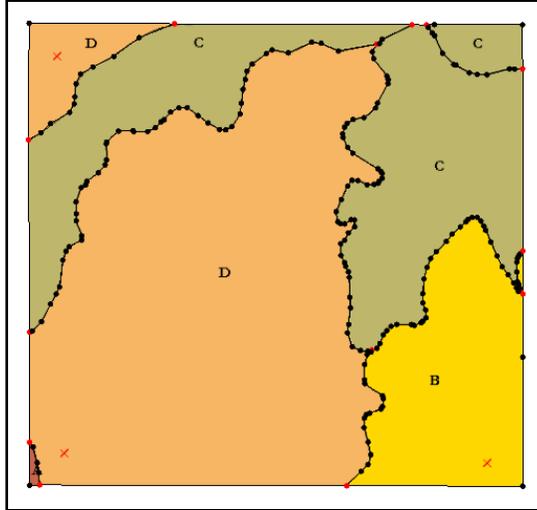The resulting arcs should appear similar to Figure 10.

Figure 10:   All of the soil areas defined with closed arcs

5. Right-click on the "⬤ Soil Type" coverage and select the **Build Polygon** context menu item. An alert dialog may appear.

6. In the alert dialog, click **OK** to use all the arcs.

Check to make sure that each soil use polygon is completely outlined. If one or more polygons do not build correctly, check to be sure that the arcs surrounding the polygons are completely closed. The resulting polygons should appear similar to Figure 11. Notice how the polygon borders are thicker than the closed arcs.
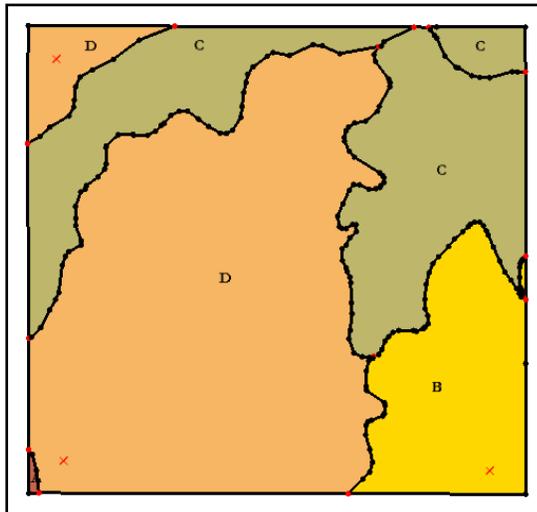

Figure 11:   After the polygons are built

5.4   Assigning Feature Polygon Attributes

Now that the soil use polygons have been created, assign the soil use attributes to the correct polygons.

1. Using the **Select Feature Polygon** 🔲 tool, double-click on the largest yellow polygon labeled "B" to bring up the *Soil type mapping* dialog.

Double-clicking on a feature object brings up a dialog allowing the selection or editing of its attributes. Because a "Soil Type" coverage is being used, the automatic attribute for a polygon is "Soil Type".

2. In the *WMS soil ID* section, click **Add soil ID to list** to create a new entry in the list above the button.

3. Repeat step 2 until there are four entries in the list above the button.

Now assign soil types to the WMS Soil IDs.

4. In the *Soil type properties* section, from the drop-down in the *Soil ID 1* column, select "Type A".

5. From the drop-down in the *Soil ID 2* column, select "Type B".

6. From the drop-down in the *Soil ID 3* column, select "Type C".

7. From the drop-down in the *Soil ID 4* column, select "Type D".

8. Since the polygon selected was Type B (and was therefore labeled "B" on the imported image), select "Soil ID 2" from the *WMS soil ID* list and click the **Apply** button.

9. Repeat steps 1 and 8 for the smaller yellow polygon on the right edge of the image.

10. Repeat steps 1 and 8 for the polygon labeled "A", instead assigning "Soil ID 1".

11. Repeat steps 1 and 8 for the three polygons labeled "C", assigning "Soil ID 3".

12. Repeat steps 1 and 8 for the two polygons labeled "D", assigning "Soil ID 4".

It is recommended to recheck the soil types to make sure they have been entered correctly, especially on larger projects with many different types.

6   Display Options

WMS has many display options to help tailor the look of a project. It is possible to change options such as polygon colors, presence of nodes and vertices, and legends using the Display Options command.

1. In the Project Explorer, right-click on the "🌐 Soil Type" coverage and select **Display Options…** to bring up the *Display Options* dialog.

2. Select "Map Data" from the list on the left.

3. On the *Map* tab, turn on the *Color Fill Polygons* and *Soil Type Legend* checkboxes.

4. Turn off the *Points/Nodes* and *Vertices* checkboxes.

5. Click the **Soil Type Display Options** button to bring up the *Soil Type Display Options* dialog.

6. Select "Soil ID 1" from the list on the left and click the **Pattern** ⬚ button.

7. Select "Red" from the list of colors.

8. Repeat steps 6–7 for "Soil ID 2", "Soil ID 3", and "Soil ID 4", setting them to "Blue", "Green", and "Yellow", respectively.

9. Click the **OK** button to close the *Soil Type Display Options* dialog.

10. Click the **OK** button to exit the *Display Options* dialog.

11. In the *Project Explorer,* turn off the " soils.tif" checkbox.

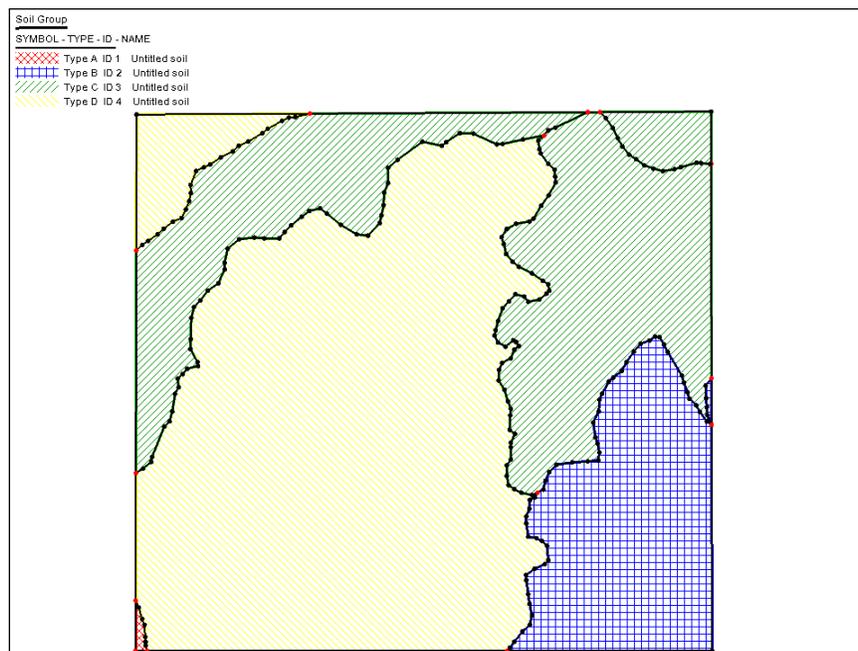The Graphics Window should appear similar to Figure 12.

Figure 12:   Soil types with new display colors

Feel free to continue to exploring the display options. To assign new colors to the land uses, select the " Land Use" coverage before opening the *Display Options* dialog, or select "Land Use" from the *Coverage type* drop-down on the *Map* tab of the *Display Options* dialog.

7   Conclusion

This concludes the "Basic Feature Objects" tutorial. The basics for creating and importing feature objects and managing different coverages were covered. Both these concepts are central to an understanding of WMS.

The following key concepts were also discussed and demonstrated:

- Create and edit feature objects.

- Set feature object attributes.

- Create coverages and specify coverage attribute sets.

- Import shapefiles.

- Use images to create feature objects.

- Manage multiple coverages.