Preparing data for analysis

Dissolving features
Creating graphs
Clipping layers
Exporting data

GIS analysis projects usually begin with several data sets and the plans to process them to get a result. When you perform an operation on spatial data that creates a new data set (often a slightly modified version of the original), you are doing geoprocessing. Geoprocessing tasks are accomplished with ArcToolbox™, a collection of tools that you add to the ArcMap or ArcCatalog interface from the Standard toolbar.

Data sets are not always in exactly the condition you need for a project. For example, features may be either too detailed or too generalized for the map scale you are working at. Another problem may be not having all the attributes you want. And sometimes the problem is even one of too much data—you may have thousands of features cluttering your area of interest or extending well beyond it.

Having too much data is, of course, a better problem than not having enough. ArcToolbox contains a number of tools to help you streamline data sets. You can simplify data by dissolving a group of features with a common attribute value into one feature. You can trim a data set to your area of inrerest by using features in one layer to clip features in another. Other techniques don't require special geoprocessing tools. For example, you can work with fewer features by making a selection on a layer and creating a new layer from it.

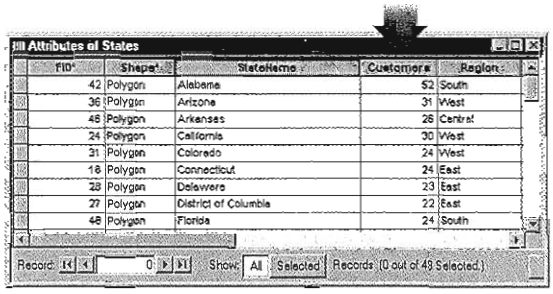
Dissolving features

A dissolve creates a new layer in which all features in an input layer that have the same value for a specified attribute become a single feature. In the following example, states are dissolved by sales region.

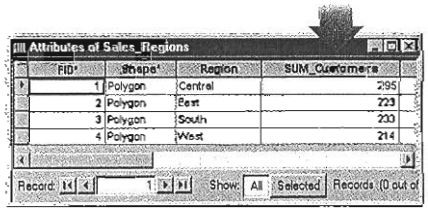
States labeled by sales region

States dissolved by sales region

The new layer's attribute table has the standard geometry (Shape) and feature identifier (FID) attributes along with the attribute used in the dissolve (Region). You can include other attributes as well. In the sales region example, the input table has an attribute storing the number of customers per state. In the output table, these values can be summed for each region.



Input sales region table

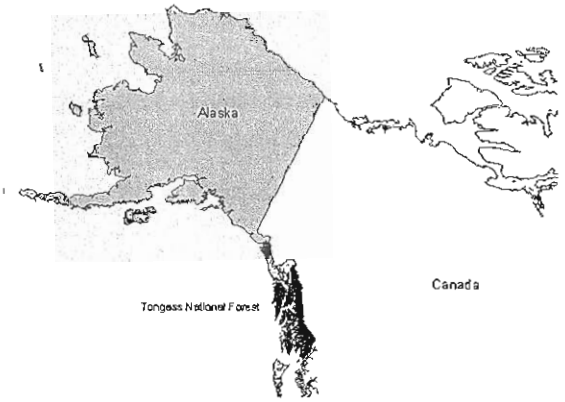


Output sales region table

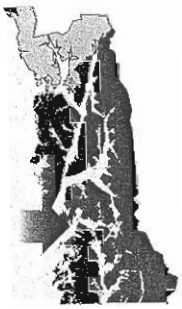
Exercise 11a

You work for a lumber company rhat plans to harvest timber in the Tongass National Forest in southeastern Alaska. Forest land can be divided into stands—groups of trees with something in common, such as type, age, or size. In a national forest, stands can be grouped into larger areas and leased ro private companies by rhe U.S. Forest Service. Restrictions are placed on logging in sensitive parts of the lease areas, such as endangered animal habitat.

The Forest Service is presently considering leasing five adjacent areas.



The Tongass National Forest, shown in dark green, covers 16,800,000 acres (about 68,000 square kilometers) of the Alaska panhandle.



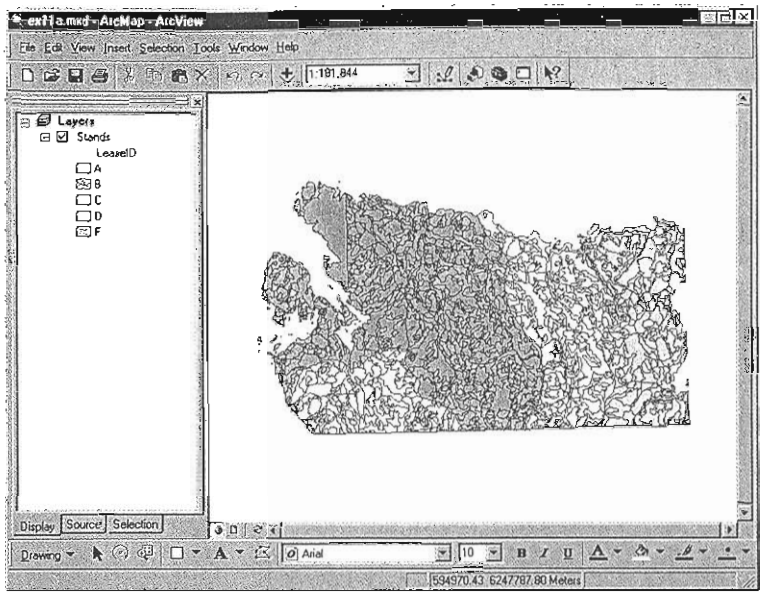
Lease areas under consideration are shown in purple.

As your company's GIS analyst, your job in this and the following chapter is to calculate the timber values of the potential lease areas. Your analysis will help your company decide how much to bid for each area.

You have a polygon layer of forest stands provided by the forest service. Its attributes include the estimated value of each stand and the lease area each stand belongs to.

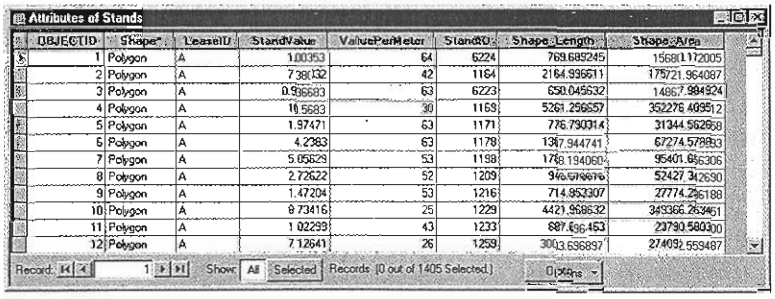
In this exercise, you'll dissolve the stands into the five lease areas. You'll total the stand values to get a preliminary estimate of how much each lease area is worth. In chapter 12, you'll refine this estimate by eliminating areas that can't be harvested.

1. Start ArcMap. In the ArcMap dialog, click the option to use an existing map. In the list of existing maps, double-click Browse for maps. (If ArcMap is already running, click the File menu and click Open.) Navigate to **C:\GTKArcGIS\Chapter11**. Click **ex11a.mxd** and click Open.



The map shows a layer of forest stands, symbolized by the lease area they belong to.

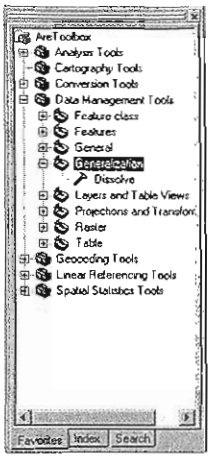
2. In the table of contents, right-click on the Stands layer and click Open Attribute Table.



The Stands layer has 1,405 stands, each represented by one record in the table.

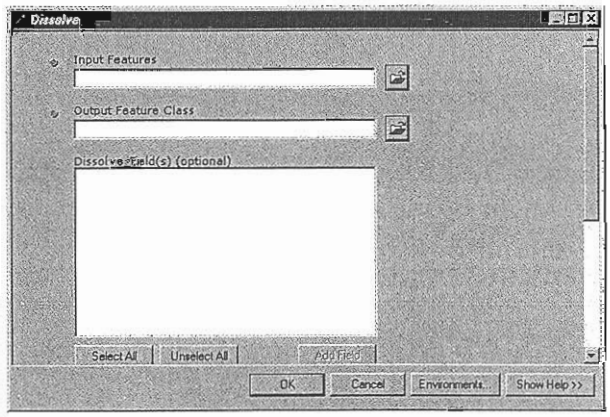
The StandValue attribute contains the dollar value of each stand in millions of dollars. It was obtained by multiplying ValuePerMeter by Shape_Area (Shape_Area stores the size of each feature in square meters) and then dividing by 1,000,000. The value of the first stand, for instance, appears as 1.00353, which is just over a million dollars.

4. In the ArcToolbox window, click the plus sign next to Data Management Tools, then click the plus sign next to Generalization.



The ArcToolbox graphics in this book assume that you are using an ArcView software license and that you have not installed optional extensions such as ArcGIS Spatial Analyst. If you have an ArcEditor or ArcInfo license, or if you have installed extensions, your window will show additional toolboxes.

5. Double-click the Dissolve tool to open the Dissolve dialog box.



Although each tool in ArcToolbox has its own functionality and settings, all use a similar dialog box with some common elements. For example, each tool has a Show Help button in the lower right corner that describes the tool and its settings.

Tools with lots of settings have a scroll bar on the right. As an alternative to scrolling, you can resize the dialog by dragging on a side or corner. Once you do this,

ArcToolbox remembers the new size and applies it to the next tool you open. (So if the dimensions of your Dissolve dialog are different from the graphic, it means you have previously resized this or some other tool. That's fine—the dialog can be whatever size you like.)

The Dissolve tool requires thar you select an input layer of features to dissolve, a location where the newly created layer will be saved to disk, and an attribute to dissolve on.

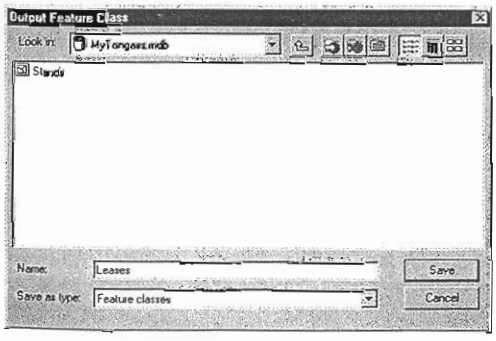
6. In the Input Features drop-down list, select Stands. (It's the only layer in the map.)

When you select the input features, a default path and file name appear for the output data. The list of attributes that can be dissolved on appears in the Dissolve_Field(s) box.

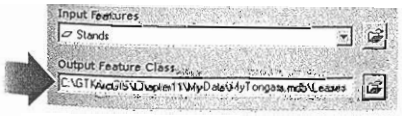
The output data can be saved as either a shapefile or as a geodatabase feature class. You'll save it as a geodatabase feature class because the rest of the Tongass data is in this format. To leave the Tongass geodatabase intact, you'll save the output to a duplicate geodatabase called MyTongass that has been created for you.

7. Click the Browse button next to the Output Feature Class box. In the Output Feature Class dialog, navigate to **C:\GTKArcGIS\Chapter11\MyData**. Double-click on **MyTongass.mdb**.

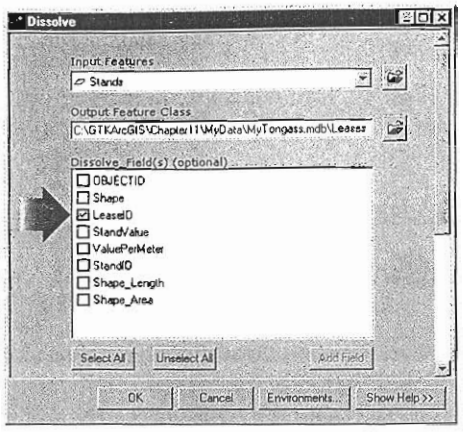
8. In the Name box, type **Leases**. Make sure your dialog matches the following graphic, then click Save.



The output feature class information is updated.



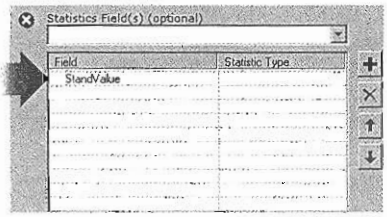
9 In the Dissolve_Field(s) box, click the LeaseID check box.



Each set of polygons with the same LeaseID will be dissolved into a single feature.

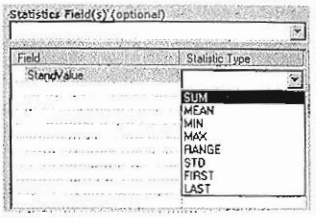
ArcMap can also summarize the attribute values of dissolved features by a variety of statistics. To find out the timber value of each lease, you will summarize the StandValue attribute by the Sum statistic type. This will total the values of all stands dissolved within a lease. (You can also get the mean, the range, the standard deviation, and other measures of numeric attributes.)

10 In the Dissolve dialog, scroll down to the Statistics Field(s) area. Click the Statistics Field(s) drop-down arrow and click StandValue to add it to the list.

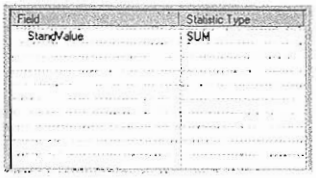


The field name displays in the Field column beneath the drop-down list. The red circle with an x indicates that you still need to specify the type of statistic you want.

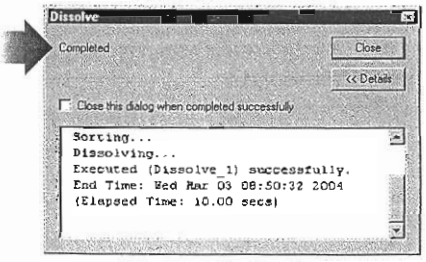
11 Click the first cell in the Statistic Type column. In the drop-down list that appears, click SUM.



12 Make sure your Statistics_Field(s) list matches the following graphic, then click OK in the Dissolve dialog.



When tools run, a dialog box opens to show the progress of the operation and the elapsed time. Your date and time will be different.



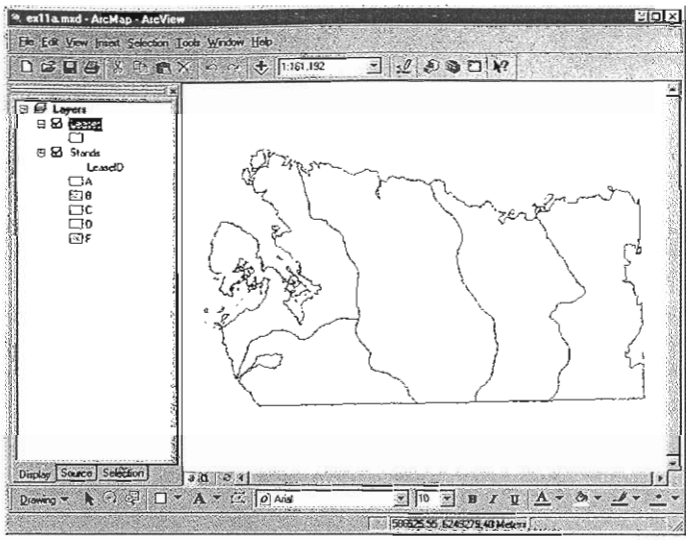
13 When the operation is completed, click Close on the dialog box.

The new Leases layer is added to the map. (If you don't see it, click the Add Data button, navigate to the MyTongass geodatabase, and add the layer. Then click the Tools menu and click Options. On the Options dialog, click the Geoprocessing tab. Near the bottom of the dialog, check the box to add results of geoprocessing operations to the display. Click OK. Any new geoprocessing layers will be added to ArcMap automatically.)

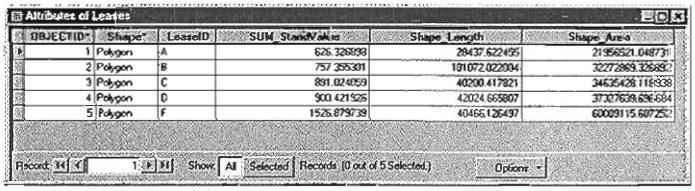
When a new geoprocessing layer is created and added to ArcMap, it displays in a random color. In many of the exercise steps in this chapter and the next, the colors on your screen may not match the graphics in the book.

The ArcToolbox window stays open until you close it. If you exit ArcMap with the window open, it will be open the next time you start ArcMap.

14 On the Standard toolbar, click the Show/Hide ArcToolbox Window button to close ArcToolbox. In the table of contents, right-click the Leases layer and click Zoom to Layer.



15 In the table of contents, right-click on the Leases layer and click Open Attribute Table. If necessary, resize the table to show all fields.



The original 1,405 stands have been aggregated into five lease polygons.

LeaseID is the attribute you dissolved on. SUM_StandValue is the statistical field you requested. It contains the sum of all stand values (in millions of dollars) in each lease area. The value of lease A, for instance, is about 626 million dollars.

Shape_Length and Shape_Area are measurement attributes automatically maintained by ArcMap for geodatabase feature classes. (Shape_Length, for a polygon feature class, measures feature perimeters.)

16 Close the table.

17 If you want to save your work, click the File menu and click Save As. Navigate to **C:\GTKArcGIS\Chapter11\MyData**. Rename the file **my_ex11a.mxd** and click Save.

18 If you are continuing with the next exercise, leave ArcMap open. Otherwise, click the File menu and click Exit. Click No if prompted to save your changes.

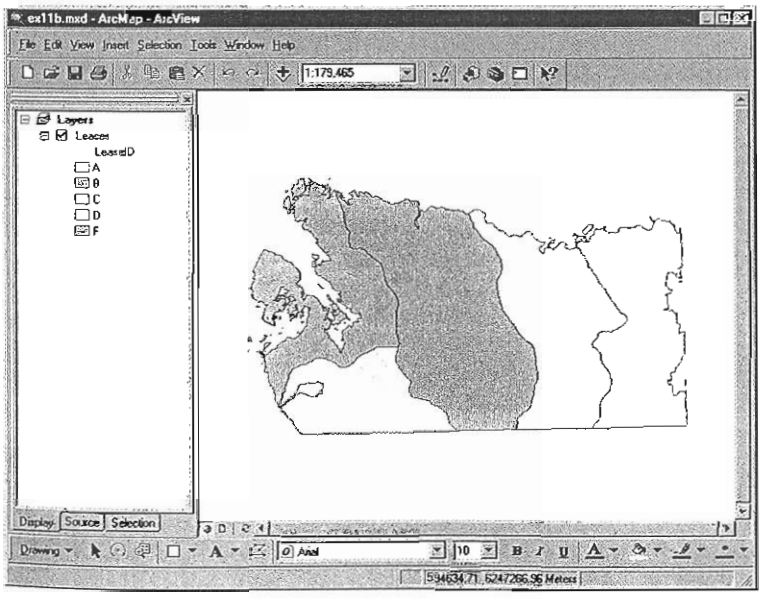
Creating graphs

The ArcGIS Graph Wizard lets you create many different kinds of graphs, including column, pie, area, and scatter graphs. You can set properties for such elements as titles, axes, and graph markers (the bars in a bar graph, for instance). Graphs can be saved with a map document or as files with a .grf extension that can be added to any map document.

Exercise 11b

You have dissolved the forest stands into lease areas and summed their harvestable values. In this exercise, you'll present the values in a graph and add the graph to a map layout.

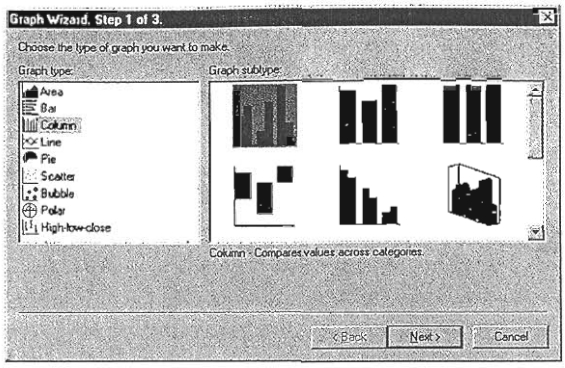
1 Start ArcMap. In the ArcMap dialog, click the option to use an existing map. In the list of existing maps, double-click Browse for maps. (If ArcMap is already running, click the File menu and click Open.) Navigate to **C:\GTKArcGIS\Chapter11**. Click **ex11b.mxd** and click Open.



The map shows the lease areas you created in the previous exercise.

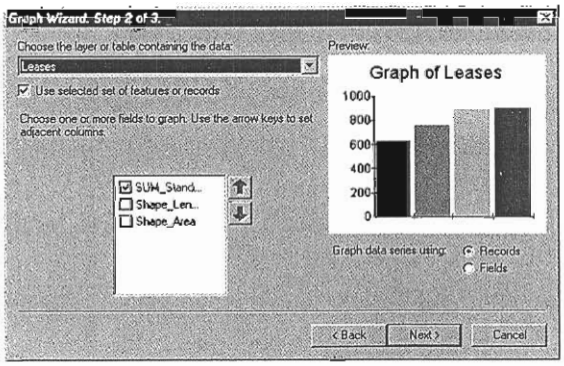
2. Click the Tools menu, point to Graphs, and click Create.

The Graph Wizard opens.



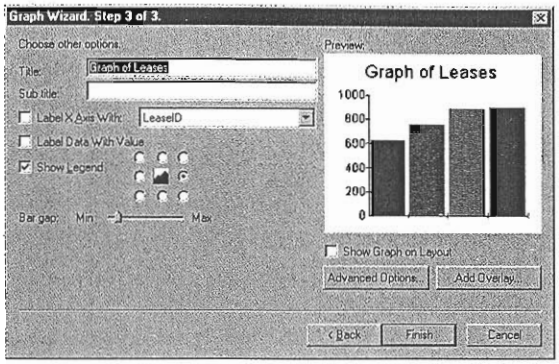
In the first panel, you'll accept the default graph type (a column graph) and subtype (one that compares values across categories).

3. Click Next.



In the second panel, you choose a layer and check the attributes you want to graph. Leases is the selected layer. In the box of attributes, Sum_StandValue is checked. (The full attribute name appears if you hold the mouse pointer over it.)

4 Click Next.



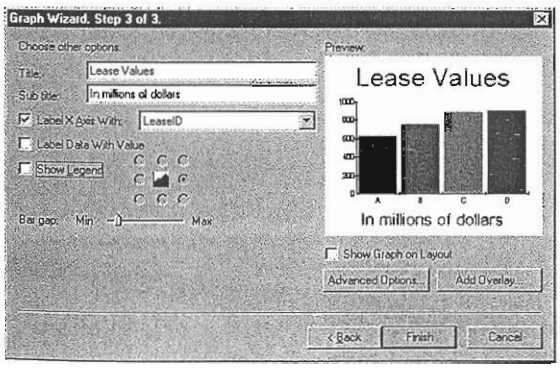
In the third panel, you'll change the default title and label the x-axis. (To change fonts, colors, and other properties, you would click Advanced Options.) As you make changes, the graph preview updates.

11

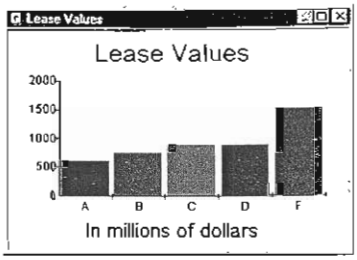
5 In the Title box, replace Graph of Leases with **Lease Values**. In the Sub title box, type **In millions of dollars**.

6 Check Label X Axis With and make sure its drop-down list is set to LeaseID.

7 Uncheck Show Legend. The LeaseID values display on the x-axis. Make sure your dialog matches the following graphic, then click Finish.



The graph displays in a window that floats on the application window. The graph makes it easy to compare the lease area values. Lease F, the most valuable, is worth about 1.5 billion dollars.

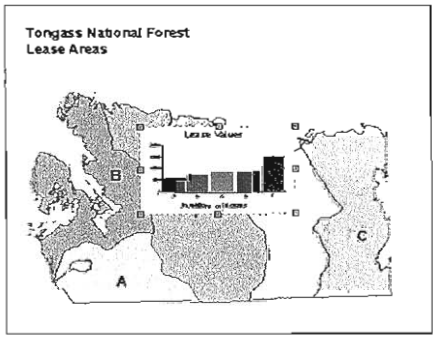


You'll add the graph to the map layout.

8. Right-click on the graph title bar. On the context menu, click Show on Layout.

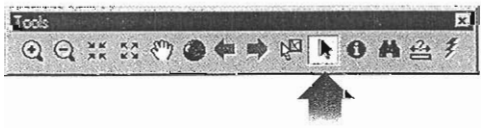
ArcMap switches to layout view.

9. Close the graph window.

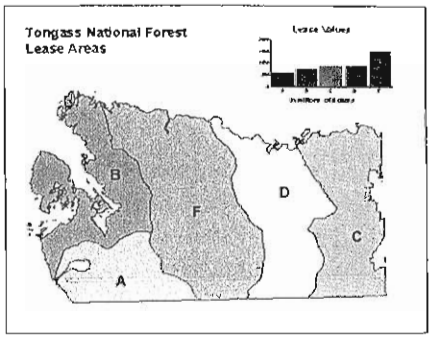


The graph displays in the middle of the layout page, marked with blue selection handles. (Other layout elements, such as the map title and lease labels, have been added for you.)

10. On the Tools toolbar, make sure the Select Elements tool is selected.



11 Drag the graph to the upper right corner of the layout, as shown in the following graphic. Click outside the layout page to unselect the graph.



12 Close the Layout toolbar.

13 If you want to save your work, click the File menu and click Save As. Navigate to **C:\GTKArcGIS\Chapter11\MyData**. Rename the file **my_ex11b.mxd** and click Save.

14 If you are continuing with the next exercise, leave ArcMap open. Otherwise, click the File menu and click Exit. Click No if prompted to save your changes.

Clipping layers

Clipping trims features in one layer using the boundaries of polygon features from another layer. It's like having a pair of scissors, or a cookie cutter, to cut away data that you don't need for your project. For example, you might have a shapefile of all the streets in your county, while your study area encompasses just one ZIP Code within that county. If you have a polygon feature representing that ZIP Code, you can use it to clip out just the streets you need. Clipping can be a matter of convenience—since smaller data sets are easier to process—but it can also be important for analysis. To find out the total length of roadway within the ZIP Code, for instance, you must exclude streets and street segments that lie outside it.

In the following example, a layer of interstate highways is clipped at the boundaries of the state of Oklahoma.

Input layer of U.S. interstate highways and clip layer of Oklahoma

Highways clipped at polygon boundary

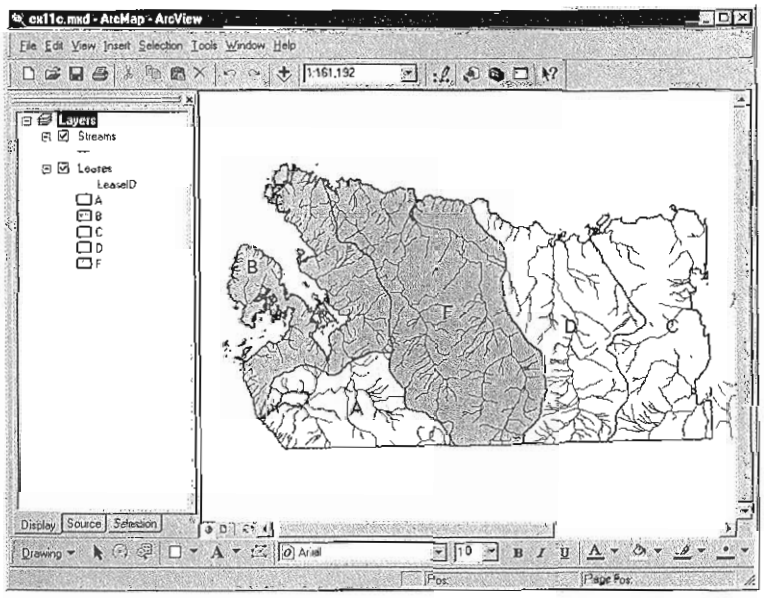
Exercise 11c

The forest service has just determined that, of the five lease areas, only lease F is mature enough for harvest. Your company will direct its attention to making a bid for this lease.

Not every square meter of the lease area is harvestable. Logging is prohibited near streams and goshawk nests. (Goshawks are a protected bird species.) You have layers of streams and goshawk nests that cover all five lease areas, but now you'd like to work with data sets that cover only the area of lease F.

In this exercise, you'll clip a layer of streams to the boundary of lease F.

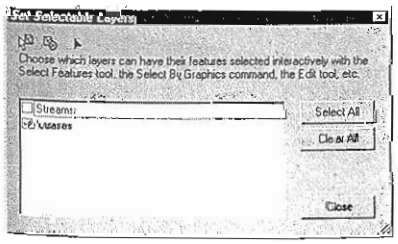
1 Start ArcMap. In the ArcMap dialog, click the option to use an existing map. In the list of existing maps, double-click Browse for maps. (If ArcMap is already running, click the File menu and click Open.) Navigate to **C:\GTKArcGIS\Chapter11**. Click **ex11c.mxd** and click Open.



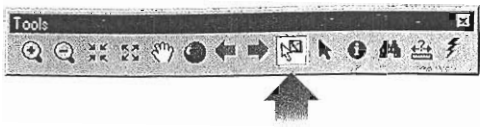
The map displays the five lease areas and a Streams layer that contains 1,566 stream segments.

To clip the streams to the lease F boundary, you must first select lease F. You'll turn the selection into a new layer so you can look ar lease F apart from the others.

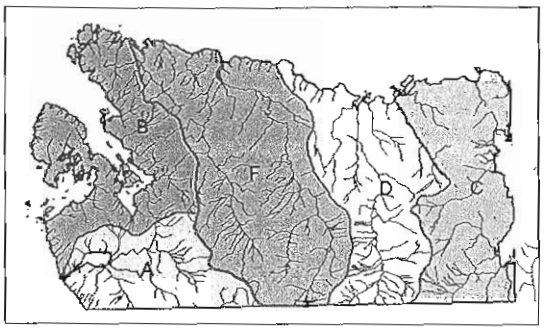
2 Click the Selection menu and click Set Selectable Layers. Uncheck Streams, as shown in the following graphic, then click Close.



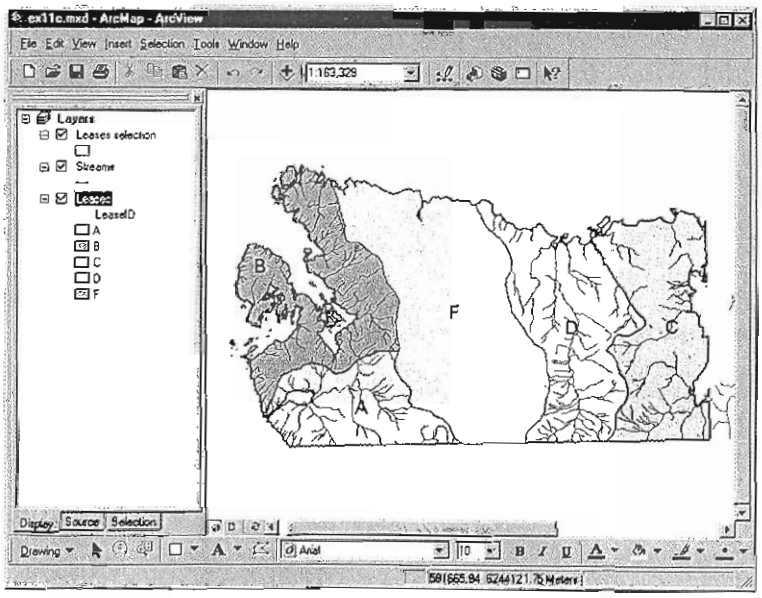
3. On the Tools toolbar, click the Select Features tool.



4. On the map, click on lease F to select it. It is outlined in cyan.



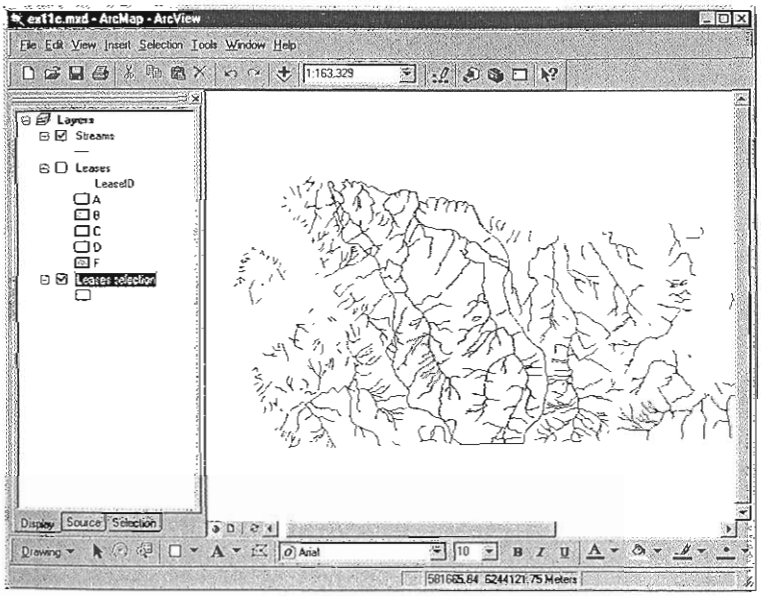
5. In the table of contents, right-click on the Leases layer, point to Selection, and click Create Layer From Selected Features.



A layer called Leases selection is added to the top of the table of contents. This layer references the same geodatabase feature class as the Leases layer. Unlike geoprocessing operations, creating a selection layer doesn't create a new data set.

(You can, however, export a selection layer, or a set of selected features, as a new data set if you want to. You will do this in the next exercise.)

6 Make sure the Display tab is selected in the table of contents. Turn off the Leases layer and drag the Leases selection layer to the bottom of the table of contents.

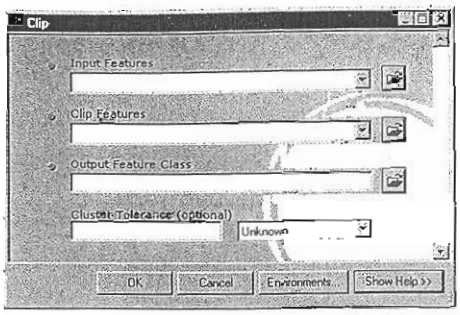


You'll use the ArcToolbox Clip tool to clip the streams to the boundary of lease F.

7 On the Standard toolbar, click Show/Hide ArcToolbox Window.

8 In the ArcToolbox window, click the plus sign next to Analysis Tools. Click the plus sign next to Extract.

9. Double-click the Clip tool.

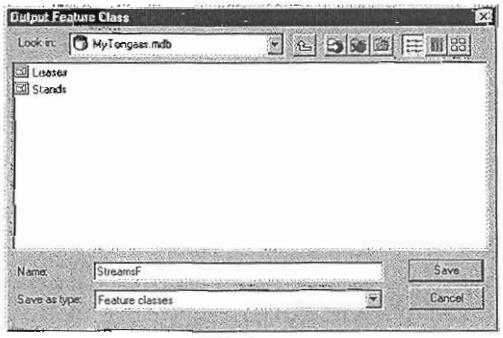


You'll select the layer with the input features to be clipped, the layer to clip with, and an output feature class. As with Dissolve, the output of a clip can be either a shapefile or a geodatabase feature class. You will add the clipped streams to the MyTongass geodatabase.

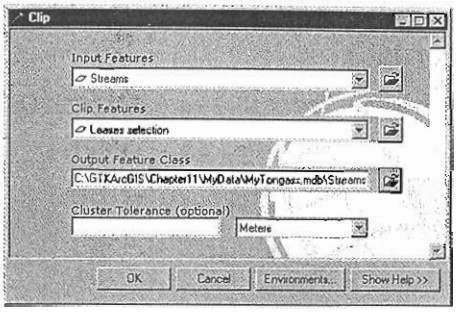
10. In the Input Features drop-down list, click Streams. In the Clip Features drop-down list, click Leases selection.

11. Click the Browse button next to the Output Feature Class drop-down list. In the Output Feature Class dialog, navigate to **C:\GTKArcGIS\Chapter11\MyData** and double-click on **MyTongass.mdb**.

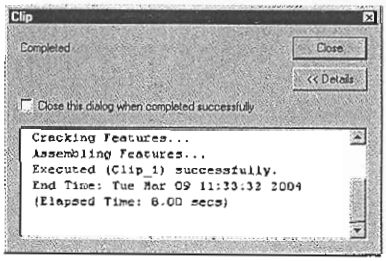
12. In the Name box, type **StreamsF**. Make sure your dialog matches the following graphic, then click Save.



The output feature class information is updated in the Clip dialog.

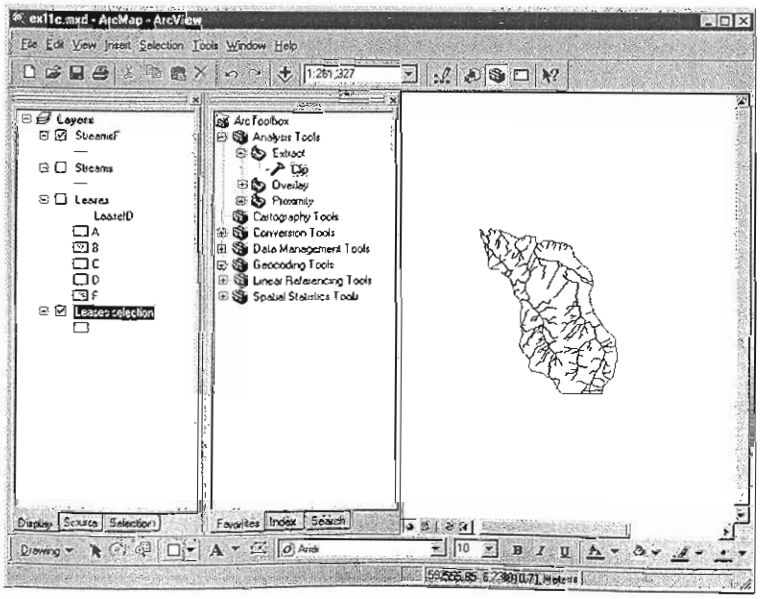


13 Click OK.



The Clip rool's progress report lists each operation and the elapsed time.

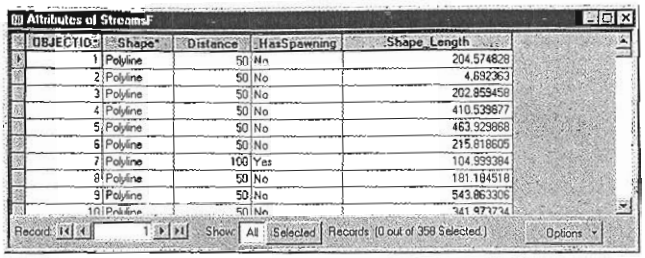
14 When the operation is completed, click Close on the dialog box. In the table of contents, turn off the Streams layer.



The StreamsF layer, consisting of stream features clipped to the boundary of lease F, is added to the map.

15 Close the ArcToolbox window.

16 In the table of contents, right-click on the StreamsF layer and click Open Attribute Table.



The Clip operation has reduced the number of stream segments from 1,566 (in the Streams layer) to 358. The table has attributes that will determine how much area around the streams is off-limits to logging. You will work with these attributes in the next chapter.

17 Close the table.

18 If you want to save your work, click the File menu and click Save As. Navigate to **C:\GTKArcGIS\Chapter11\MyData**. Rename the file **my_ex11c.mxd** and click Save.

19 If you are continuing with the next exercise, leave ArcMap open. Otherwise, click the File menu and click Exit. Click No if prompted to save your changes.

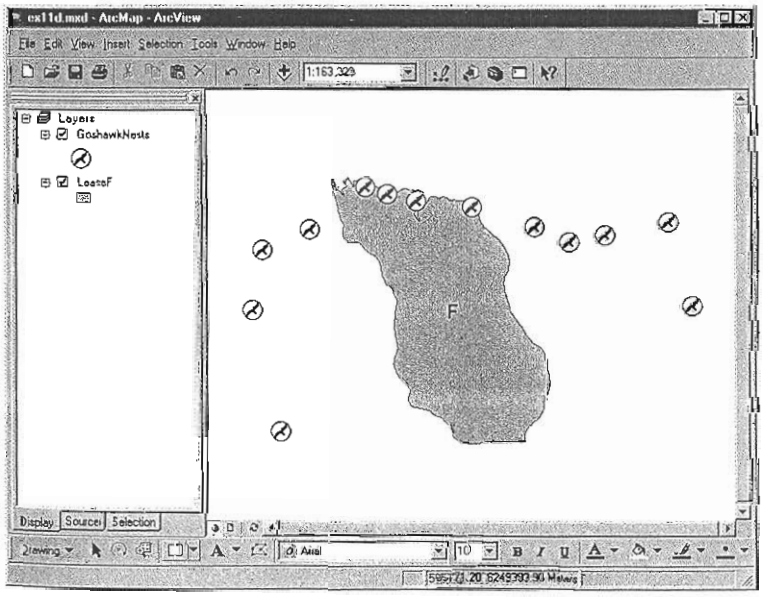
Exporting data

Operations like Dissolve and Clip create new data sets automatically. Another way to make a new data set from an existing one is to make a selection on a layer and export the selected features.

Exercise 11d

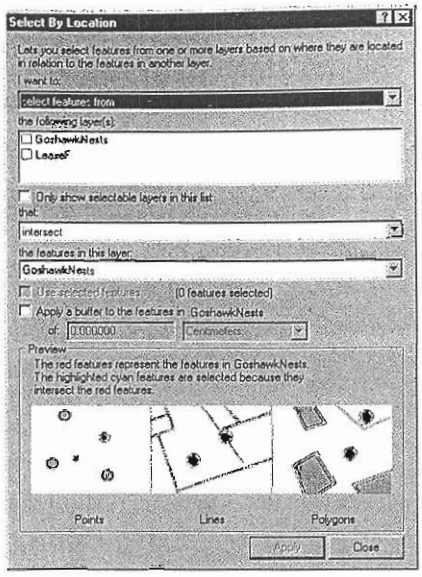
In addition to the streams layer, you have a layer of goshawk nests coveting all five lease areas. You could clip this layer just as you did the streams. Unlike the streams, however, the nests are points and therefore don't cross polygon boundaries. (In the map it will look as if they do, but that is an effect of symbology.) Because nests are contained within polygons, you can use Select By Location to select the nests in lease F and then export the selected set.

1 Start ArcMap. In the ArcMap dialog, click the option to use an existing map. In the list of existing maps, double-click Browse for maps. (If ArcMap is already running, click the File menu and click Open.) Navigate to **C:\GTKArcGIS\Chapter11**. Click **ex11d.mxd** and click Open.



The map contains a layer of goshawk nests and a layer of lease F.

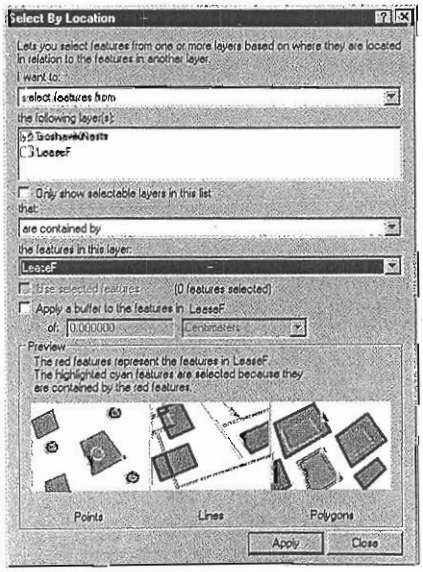
2. Click the Selection menu and click Select By Location. If necessary, click the selection method drop-down arrow and click "select features from."



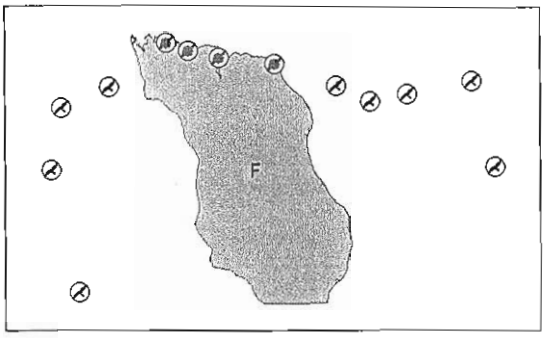
3. In the box of layers to select from, check GoshawkNests.

4. In the drop-down list of spatial relationships, click "are contained by."

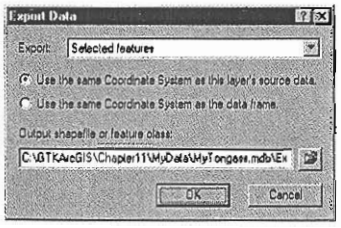
5. In the drop-down list of layers, click LeaseF. Make sure your dialog matches the following graphic, then click Apply.



On the map, the four nests in lease F are selected.



6 Click Close on the dialog. In the ArcMap table of contents, right-click the GoshawkNests layer, point to Data, and click Export Data.

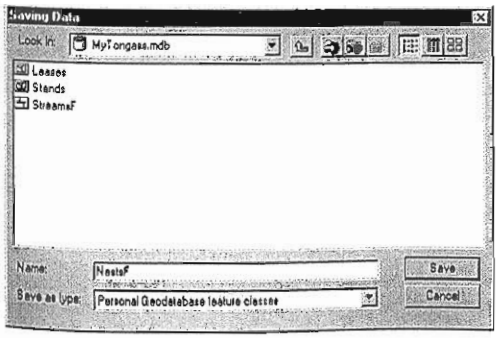


The Export drop-down list is correctly set to Selected features. The option to use the same coordinate system as the layer's source data is also correct. (You'll learn more about coordinate systems in chapter 13.)

7 Click the Browse button next to the Output shapefile or feature class box.

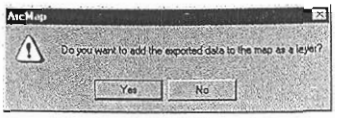
8 In the Saving Data dialog, make sure the Save as type drop-down list is set to Personal Geodatabase feature classes. If necessary, navigate to C:\GTKArcGIS\Chapter11\MyData and double-click on **MyTongass.mdb**.

9 In the Name box, replace Export_Output with **NestsF**. Make sure your dialog matches the following graphic, then click Save.

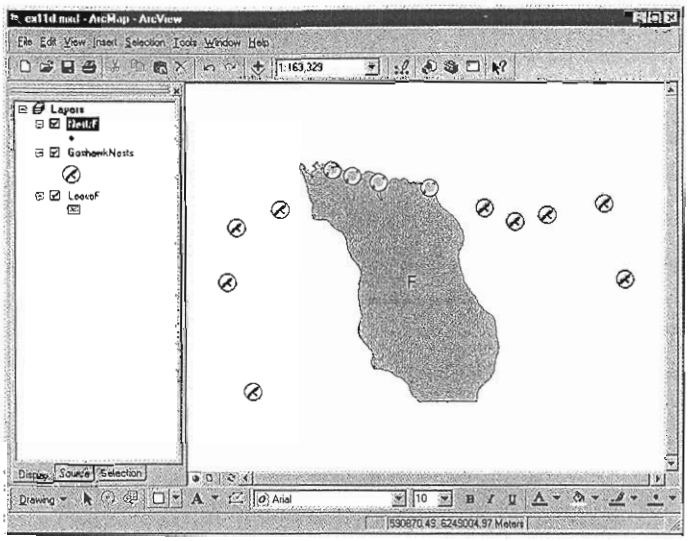


10 Click OK in the Export Data dialog.

ArcMap exports the selected nests to a new feature class and prompts you to add the data to the map.

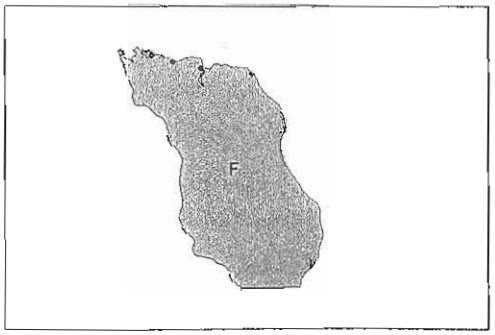


11 Click Yes.



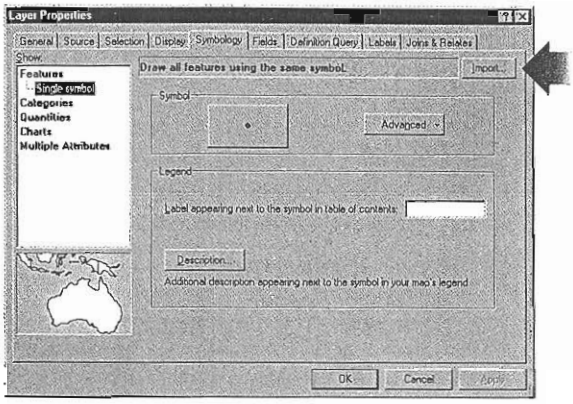
You don't see the point features of the new NestsF layer because they are covered by the selection highlights on the GoshawkNests layer.

12 In the table of contents, turn off the GoshawkNests layer.

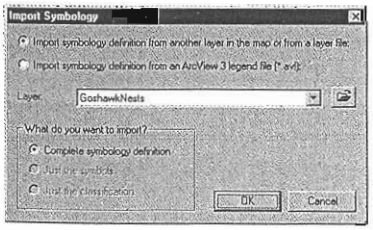


The new layer contains only goshawk nests within lease F. The default symbol is not as informative as the one in the GoshawkNests layer.

13 In the table of contents, double-click on the NestsF layer. In the Layer Properties dialog, click the Symbology tab and click Import.

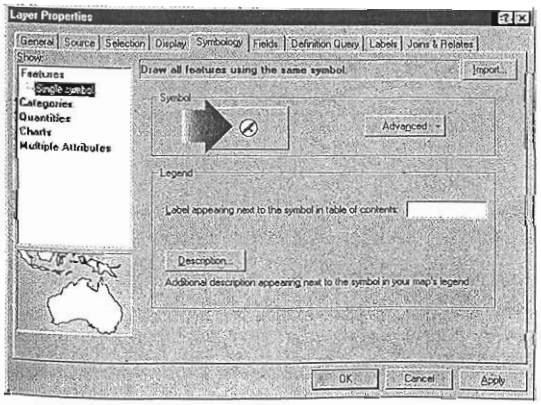


The Import Symbology dialog opens.

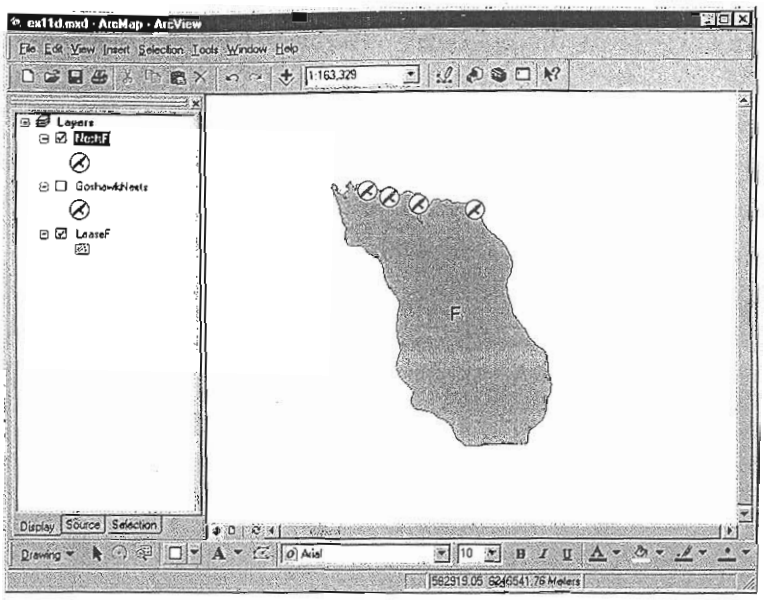


You want to import symbology from another layer in the map, so the first option is set correctly. The Layer drop-down list is also correctly set.

14 Click OK.



15 Click OK in the Layer Properties dialog.



You have prepared the data for your analysis. In the next chapter, you'll create exclusion zones around the streams and goshawk nests in lease F. You'll use these zones to figure out how much timberland in the lease area is harvestable and how much it's worth.

16 If you want to save your work, click the File menu and click Save As. Navigate to **C:\GTKArcGIS\Chapter11\MyData**. Rename the file **my_ex11d.mxd** and click Save.

17 If you are continuing to the next chapter, leave ArcMap open. Otherwise, click the File menu and click Exit. Click No when prompted to save your changes.