

Lab 1: Introduction to ArcGIS

What You'll Learn: how to:

- Start ArcMap
- Add data layers
- Change data symbology
- Add legends, titles, North arrows, and other elements
- Print a map to a PDF
- Create a new map
- Pan and zoom

Data for this exercise are located in the Lab1 subdirectory.

Videos for this exercise are located in the \Instructional_Videos subdirectory.

What You'll Produce: Two maps, one of lakes and roads, and one of wetlands.

Background: This is the first in a series of introductory exercises for ArcGIS/ArcMap. These are practical skills that complement the theory and practice of GIS described in the textbook "GIS Fundamentals: A First Text on Geographic Information Systems", by Paul Bolstad. These exercises use datasets available at www.paulbolstad.net/gisbook.html, under the "ArcGIS Exercises and Videos" link.

These Lab instructions and data used are available for download, and are described in the word document "GettingStarted.doc" found at the website.

Note that quicktime (.mov) videos are included in most Labs, and shown in bold text at appropriate points, as in **Video: L1_1_Start_ArcMap.mov**.

We assume you have a functioning copy of ArcMap running on your computer. The exercises were developed with ArcGIS, Arcview version 9.2, student edition.

Starting ArcGIS, adding data and creating your first map

First, find the ArcMap icon, shown to the right. The icon is often located

1) as a desktop or taskbar shortcut,



or

2) in an ArcGIS folder

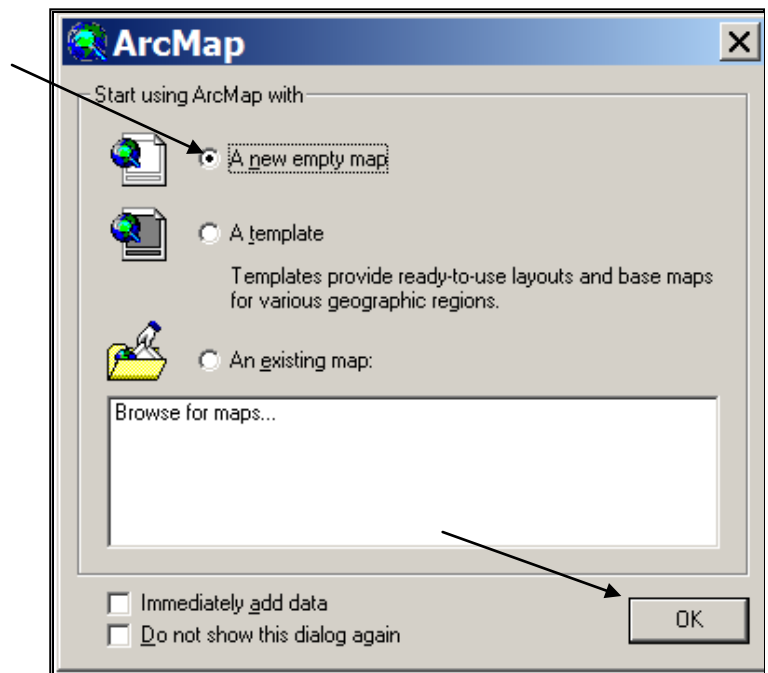
In Windows XP it may often be found by left clicking on the Start button in the lower left of the screen and selecting Programs → ArcGIS → ArcMap.

Double left click on the ArcMap icon, and be patient while a start banner displays.

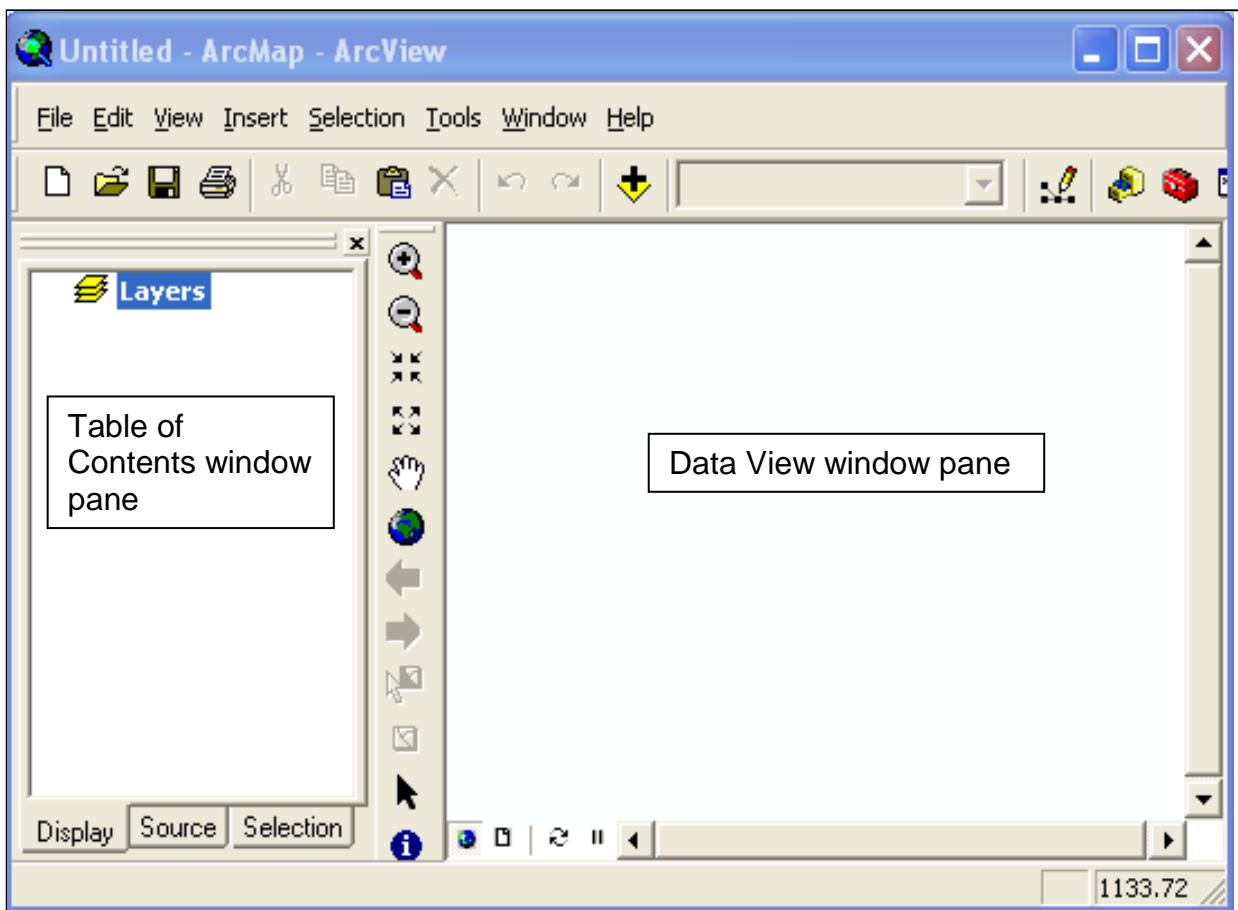
Next, a window should open that is similar to that below. You can elect to create a new, empty map (more precisely, a map project), or open a template or an old map.


You indicate your choice by left clicking on the open radio button, filling it, as shown.

Now single left click on the OK button in the lower right corner of the popup window.



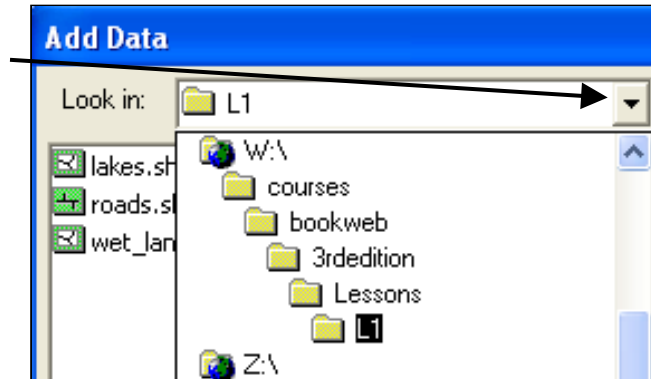
This will open the main ArcMap window, similar to that displayed below. Note there is a **Table of Contents** window pane, a mostly blank area forming the left part of the are various icons and menu bars, each of which allows you to perform some action.



Left click on the **Add Data** button  in the top center of the window frame to add data layers (also called themes).

You will see a dialog box to select a layer or layers for the map.

Click on the display triangle to the right of the “Look in:” sub window, and navigate the directory tree, clicking up and down, until you see your data located in the sub-directory named Lab\L1.



Double left click on the file named *lakes.shp*.

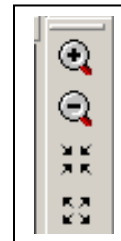
This will add this data layer to your map.

Note that the *Lakes.shp* layer data are displayed in the data view pane, and data names are listed in the table of contents pane on the left.

Repeat the process to add the *roads.shp* data layer.

Panning and Zooming

ArcMap allows you to change the magnification and area that you view in your data pane. There is a cluster of zoom buttons, most easily identified by plus (+) and minus (-) magnifying glasses (see at right). Because the toolbars are “dockable”, or movable about the main ArcMap window, they may be in one of several places. They are typically near the table of contents pane, or along the top of the window.



Left clicking on the zoom and pan icons change the cursor function. For example, left clicking on the plus (+) magnifying glass changes it to a “zoom in” cursor. When you have activated this cursor, clicking on the data pane will zoom in on a point.

You can also hold down on a left click and drag to define a zoom to area.

The minus cursor zooms out based on a point click, and the “arrows in” and “arrows out” cursors zoom the entire pane by a fixed amount.

To exit the pan in or out cursors, click on the arrow zoom button in cluster of the pan and zoom tools.



There is also a globe zoom button (at right), that zooms to the area covered by, or Extent, of your data. Below this is a button that zooms to your previous display.



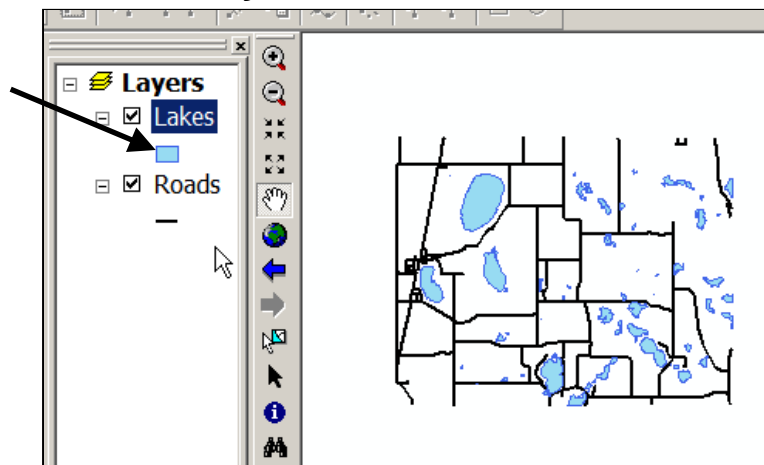
Finally, there is a “pan” button, a hand, that does not change the magnification, but allows you to position the data up, down, left, or right.



Experiment with these cursors.

Changing the appearance of the Data Layers

We can customize a layer's appearance. Left double-click on a symbol icon, the colored patch below the name of the lakes data layer in the table of contents.

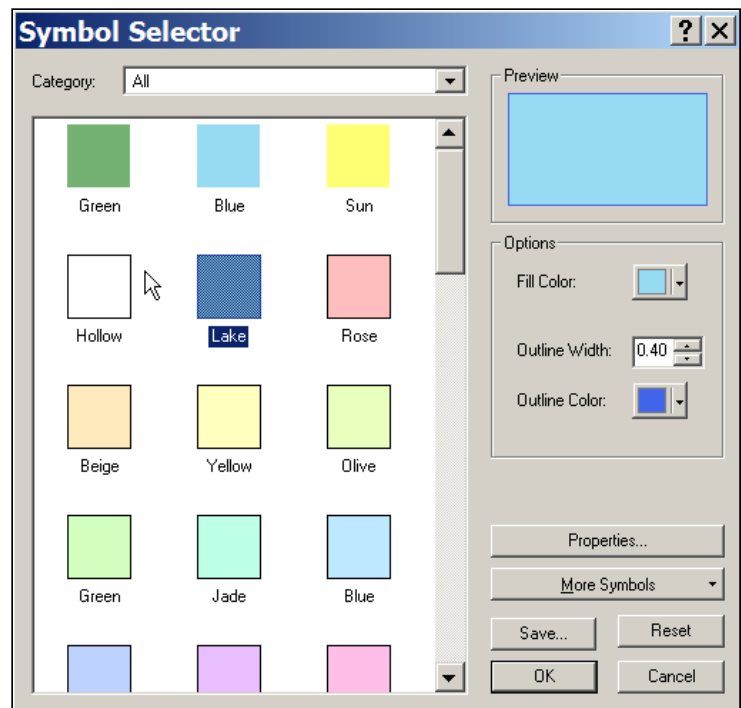


The **Symbol Selector** window will appear.

You can select a symbol type from the examples on the left of the window, and change the properties with the controls on the right of this window.

Left click on the blue patch (shown highlighted in the figure), or another that suits your fancy, and left click on the **OK** near the lower right.

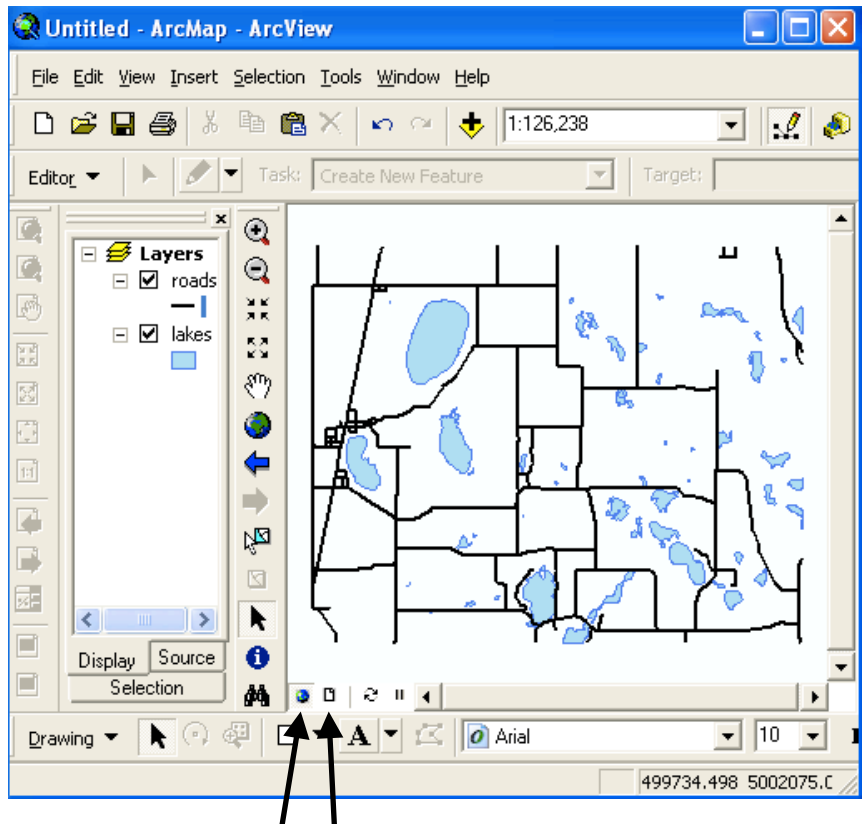
Repeat this process for the Roads layer.



Your map should look something like the picture to the right.

Within the data pane, there can be two “views” on the data. We have been working with the **Data View**. This is an uncluttered view, used primarily when we’re working with our data. There is also a **Layout View**, used to prepare maps for output. A layout view allows you to add a north arrow, scalebar, and other elements we usually expect to find on a printed or other published map.

You switch between the Data View and the Layout View by two icons near the lower left of the Data window pane



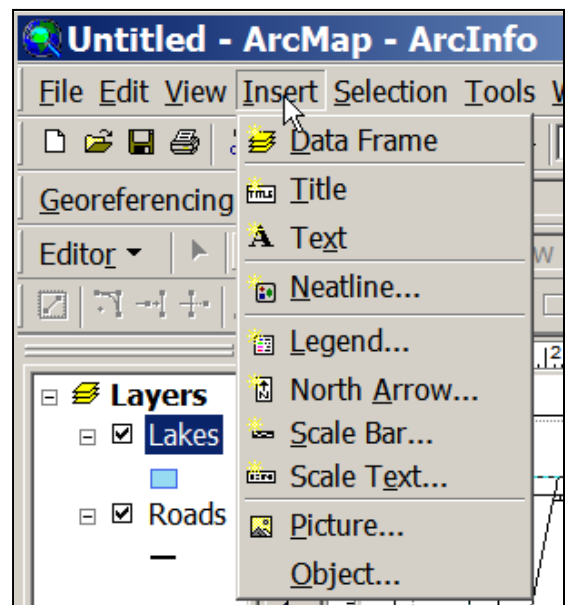
Using the Layout View, Adding a Legend and North Arrow

Left click on the Layout View button (the sheet of paper icon, on the right side) to prepare your map for printing. The globe button moves you back to the data view.

Make sure you have selected the Layout View, and select **Insert** from the list at the top of the main ArcMap menu (see figure at the right).

Left click to select **Title** from the drop down menu. A text box for typing a title appears on the layout view page. Type in something logical, for example “Lakes and Roads in Hugo, Minnesota”.

After you have typed in your title, left click and hold over the title, and drag the mouse to reposition it.

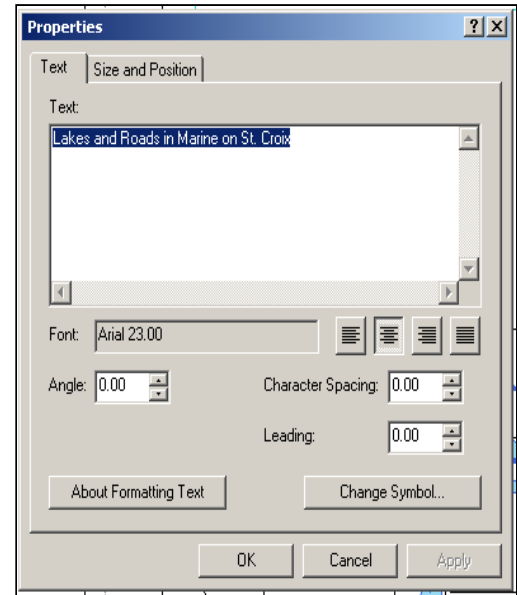


Double left click on the title to display a properties dialog box similar to the one on the right. Here you can make other changes; for example “Change Symbol” is the button for increasing the text size or changing fonts. Experiment with the settings.

Return to the Insert Menu (as you did with the title, above) to add a **North Arrow**.

Select a north arrow design from the popup menu and then left click **OK**.

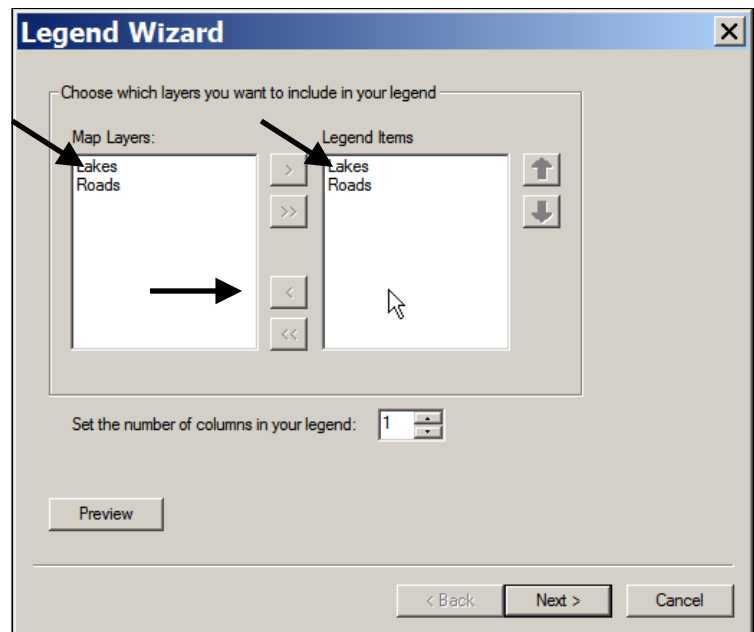
The north arrow is put on the page with a box around it. You may reposition it as with the title, and you may increase the size by dragging a corner.



Use the Insert Menu to add a **Scale Bar**. Detailed instructions aren't provided, but the sequence is similar to adding a north arrow.

Add a **Legend** from the Insert Menu. This will open a Legend Wizard (figure at right).

Possible map layers are shown in a pane on the left, and those to be displayed are shown in a pane on the right. You move layers between the possible and displayed with the arrow boxes in between the two panes

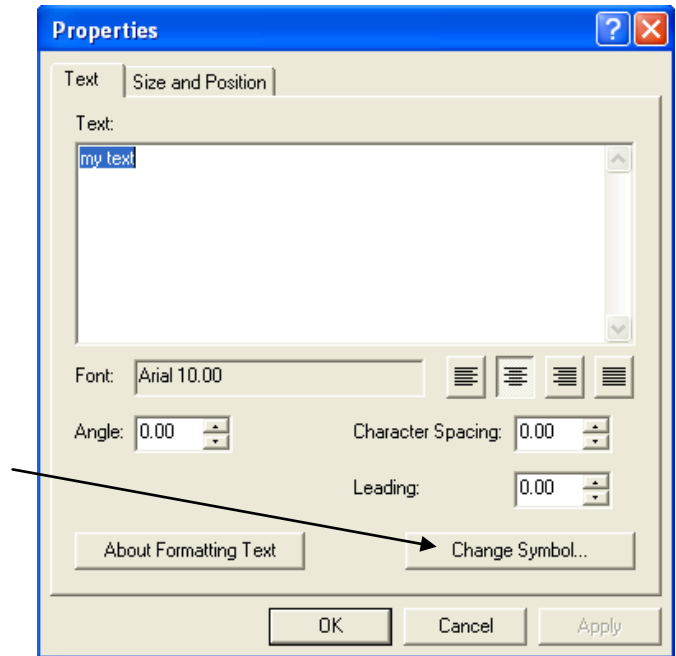


Left click the **Next** button (lower right of the **Legend Wizard**) to accept the default values. As you add the legend you will be asked several questions about the number of columns, boxes, style, and other options.

Click **Next** several times to accept the defaults through the successive windows, and then Finish. The Legend appears on the page.

Finally use the **Text** selection from the Insert Menu to add a text box to the Layout with a descriptive title, and your name and the date.

Once you have typed in your text, select the text box by left clicking on the box on the map. A right click will bring up a menu; select **Properties**. Use **Change Symbol** to increase the font, perhaps to 18. Select **OK** and **Apply** and **OK**. Move the text to a logical place on the page.



Notice that the names above the legend boxes are the file names. You can modify these names in the table of contents.

Switch to the data view (click the globe in the lower left of the data pane)

Left click on the layer name "Lakes" in the table of contents (a dark blue box appears).

Right click on the blue box

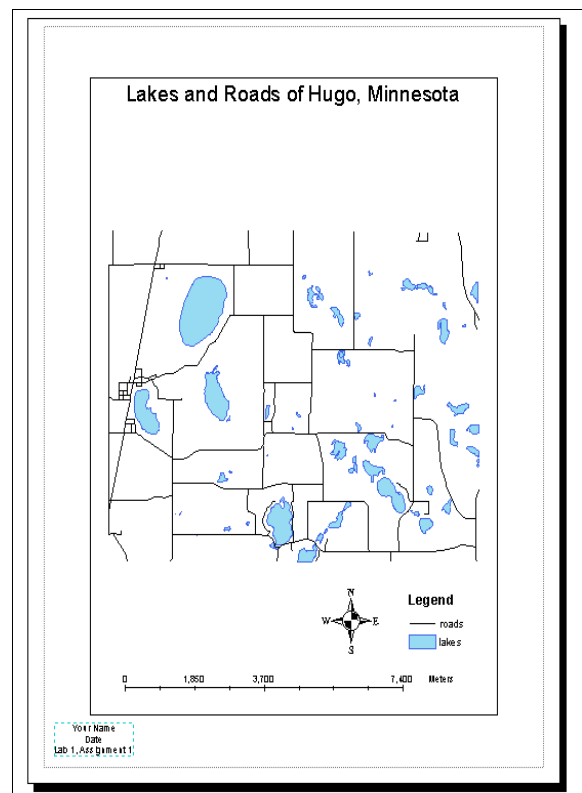
Select **Properties** from the drop-down box with a left click.

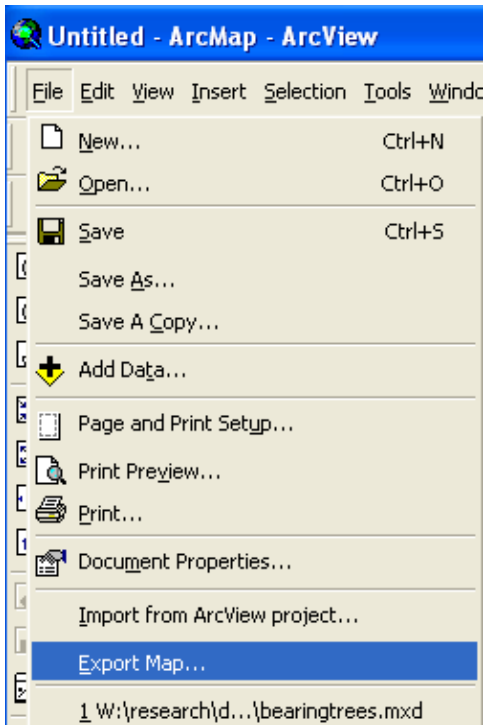
Select the tab labeled "General" and change the layer name from "Lakes" to "Hugo Lakes" and click **OK**.

Similarly, change the roads layer to "Hugo Roads"

Notice the layer names in the legend change "on the fly", as you change them in the table of contents, they are changed on your layout.

Your map should look something like the image to the right.

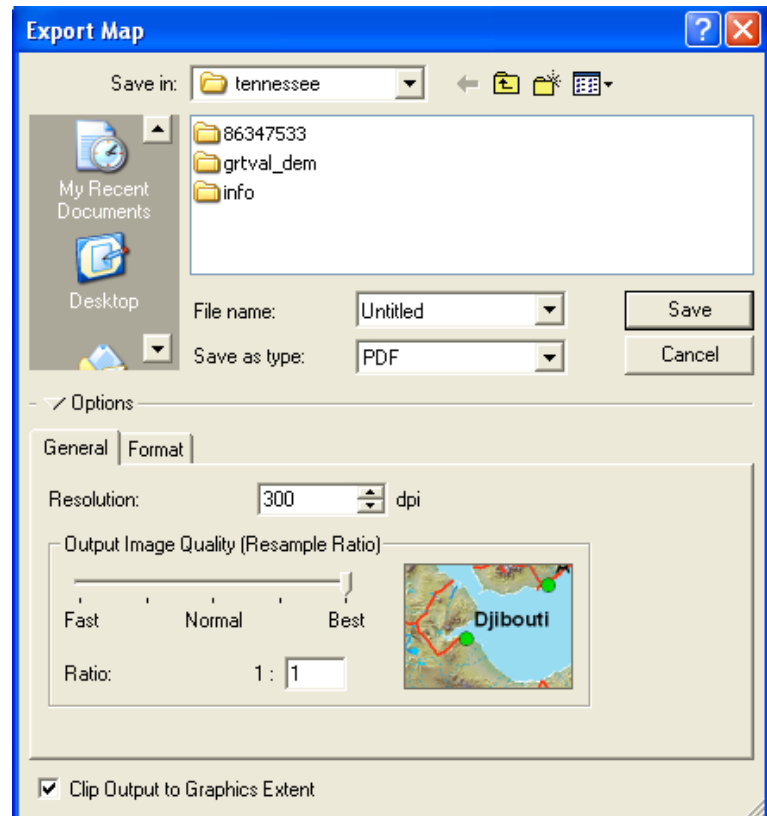




If your computer is connected to a printer, you may create a hardcopy of this map by returning to the main ArcMap menu, and selecting **File** → **Print**.

If your computer is not connected to a printer, you may select **File** → **Export Map** (see figure at left).

This will open an export window (see the graphic below).



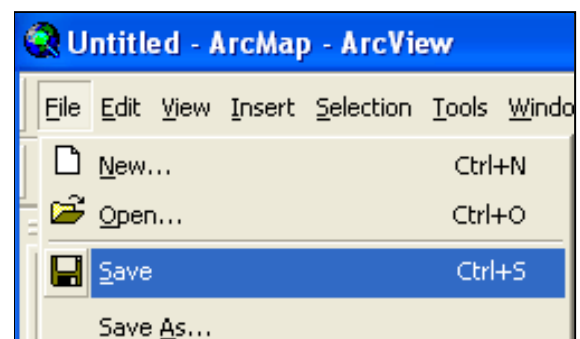
Typically, you restrict the output to the graphic extent (check box in the extreme lower left of the export window).

PDF files are often chosen when the map page is to be distributed. One of the graphic formats (e.g., .TIF, .JPG) are selected when the graphic is to be incorporated into another document.

Saving Your Project

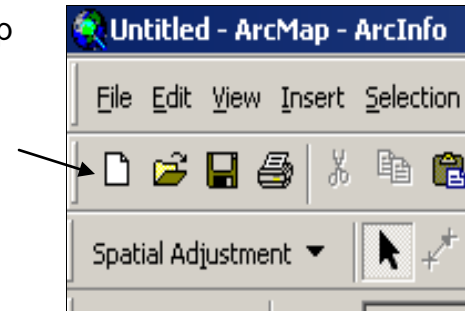
Save the project, so that you may open it later, by using the main ArcMap menu window, **File** → **Save**.

You're usually best served when saving the map in the Lab directory that contains the associated data files, in this case, our L1 directory. The map is saved with the file extension .mxd.



MAP 2

Create a second map; use **File→New**, or the New Map Icon, the sheet of paper in the top left of the main ArcMap window (see figure at right).



Add the layer “wet_land.shp” to you new Map (remember, all data are from the L1 subdirectory). This layer shows polygons that depict the wetlands of the Hugo USGS quadrangle, in Minnesota.

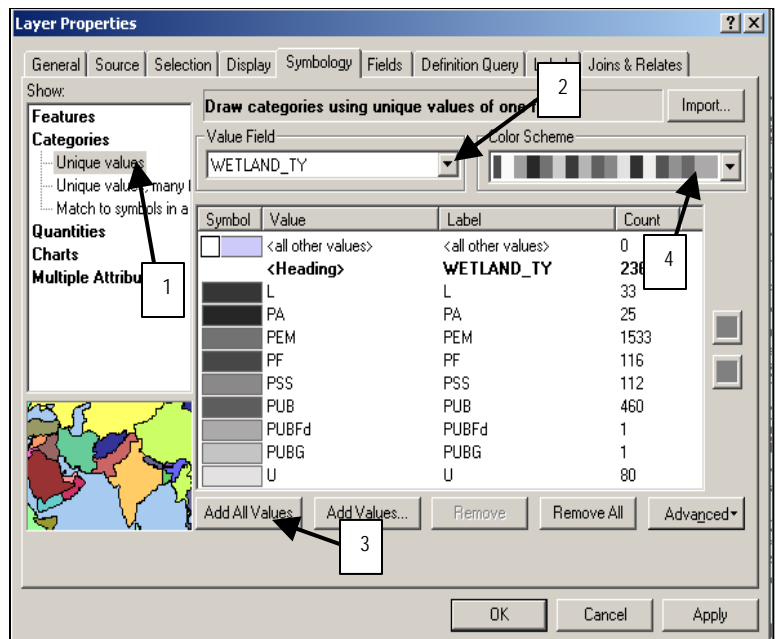
After adding the data, left click on the name of the layer (wet_land or wetland.shp) and right click to select Properties.

This opens a Layer Properties window, with several actions you can begin by activating tabs along the top of the window (see the graphic at right).

(Setting Layer properties, and more, is described in **Video: L1_2_Set_Class_Symbols.mov**)

Use the General tab (furthest to the left) to change the Name of the layer to Hugo Wetlands.

Left click on the Symbology tab (located near the top center of the tabs). This will open a window, shown at right.



- 1) In the upper left select Categories, then Unique Values.
- 2) Select Wetland_ty using the down arrow next to the Value Field.
- 3) Click on the Add All Values. All the wetland types will now be shown. Uncheck the box to the left of the “all other values”.
- 4) Change the color scheme for the map to colors you prefer.

Since the U value (which means Uplands) is such a large part of the map let’s make it blank to make the map more readable.

Left click twice quickly on the colored box to the left of the U value.

Select Hollow from the symbol selector window and then OK.

Finally, Select Apply and then OK.

As before, switch to the Print Layout View and add a Title, Legend, Scale Bar, North Arrow and your name/date. Practice selecting the map, title, legend and resizing each item. Move these objects around into a pleasing arrangement. Your map should look similar to the image at the right. Print this map to a PDF.

Finally, save this map as a map project file; **File → Save As**. Note the directory you are saving to, as before, that with simple projects it is usually a good idea to save the project with or near the data it contains.

Video:L1_3_Save_Project.mov

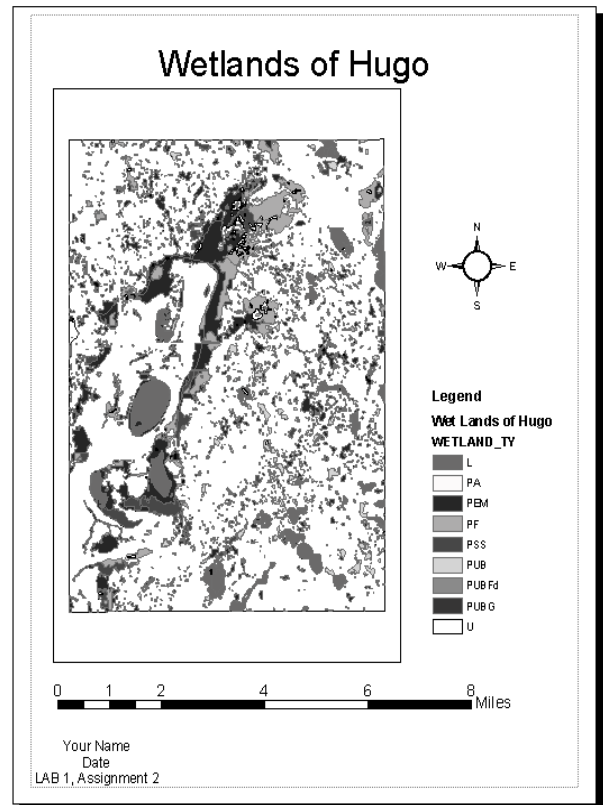
You will specify a map project name, and ArcMap will add an .mxd extension when it saves the file. An important note on saving map project files and data:

There are a couple of confusing aspects of saving maps. ArcGIS documentation sometimes refers to these as map files, sometimes as project files, and sometimes as map project files. Generally, these refer to a file with a name you specify, and a **.mxd extension**. Just remember that when you see these three different names, they are often talking about the same thing, but sometimes not. Map project file is perhaps the clearest way to describe an .mxd file.

A second, more confusing aspect of map project files is that they do not contain any spatial data. This can cause problems if you are not careful.

For example, if I save the “map” I created above into the file “HugoWetlands.mxd” on a portable disk drive and move it to a different computer, opening HugoWetlands.mxd will show my my data sets in a table of contents, but my data view and layout view will be empty.

This is because the file HugoWetlands.mxd doesn't hold the data. It only holds the instructions on where to find the data, and what symbols to use when displaying the data, among other information. If I haven't also moved my data to the new computer, then there will be nothing for the map project file to display



Think of the .mxd file as the recipe, and the data as the ingredients. You need both to make a map. If you save the .mxd in the same directory as the data, then you can easily move both the .mxd map project and the data the same time.

Data Frames

When you first started ArcGIS, it automatically created a working area, called a “Data Frame.” It named this first working area “Layers,” as shown by the yellow stack in the table of contents



It is perhaps easiest to think of this data frame as analogous to a desktop, onto which you place data layers. Just as you may have several desks in a room, you may have several data frames in an ArcMap project.

To carry this analogy further, you may place different data on each “desktop” represented by each data frame. You may also display a different area, use different symbology, and different coordinate systems for each “desktop”, or data frame.

A map may have several DATA FRAMES. When you add data layers to a map the data will be placed in the “active” frame; by default this active frame is called “Layers”. This exercise will only use the default DATA FRAME called “Layers”.

Setting Data Frame Properties

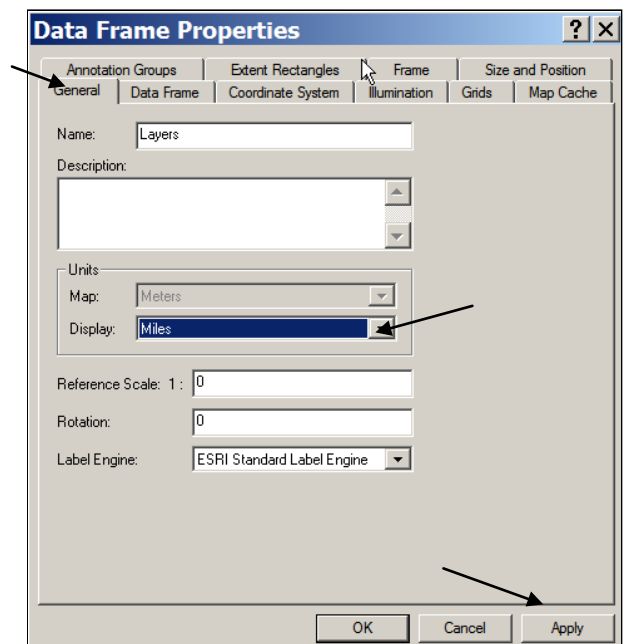
To control DATA FRAME options, use the table of contents pane (remember, the narrow, vertical sub window on the left side of the main ArcMap window):

Left click twice on “Layers” with the yellow stack icon near the top of the table of contents display:

This will display a **Data Frame Properties** window (see at right). Various tabs control various properties for a data frame, such as the name, the size of the frame, and distance units reported when measuring or making other calculations.

Before leaving the data frame properties screen, select some of the other tabs (see what operations they control).

From the Coordinate System tab notice the “Current Coordinate System. To leave the data frame properties window, left click on the **OK**.



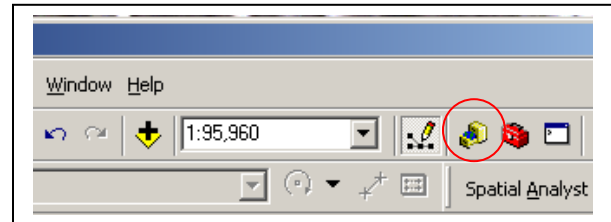
Geodatabases

You may wonder about the data layers you have just used for your two maps, *Lakes*, *Roads*, and *wet_land*. These layers are shapefiles, a special file type defined by ESRI for storing spatial data. Shapefiles are a group of files that share a file name but have different extensions, such as .shp or .dbf or .prj.

ESRI subsequently created a more complex data structure, called a **Geodatabase**.

You typically create the geodatabases (or the simpler/older shapefiles) in ArcCatalog, a program that supports the creation, filing and documenting of data layers.

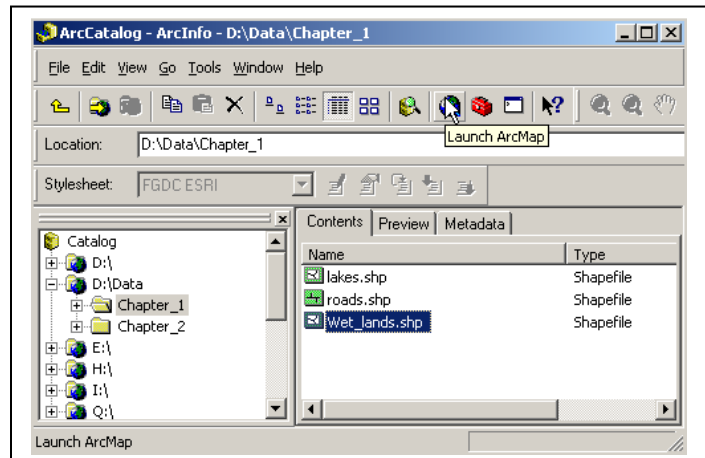
You start ArcCatalog one of two ways: in ArcMap, click the file cabinet icon (see right). Or, start from the ArcGIS program groups on the Window Start Menu and select **Programs → ArcGIS → ArcCatalog**.



Video: L1_4_Geodatabases.mov

ArcCatalog should start with a screen something like this:

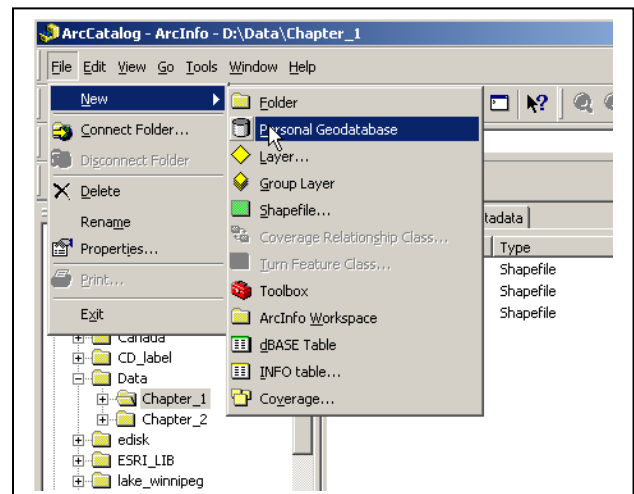
Notice that to the left there is a directory tree and on the right a detail pane. As you change directories by clicking on files in the left pane, the contained subdirectories or files are displayed in the window pane on the right.



Our exercises will primarily use shapefiles because they are adequate for demonstrating most basic concepts. However, we'll at least introduce how to create a geodatabase, and describe some of the things you may do with them.

Select **File > New > Personal Geodatabase** from the ArcCatalog main menu:

Note that you are asked to name the geodatabase, and that it has an .mdb extension. Also note that the type is listed as personal geodatabase. Type something in for the name, e.g., your name, or "testbase".



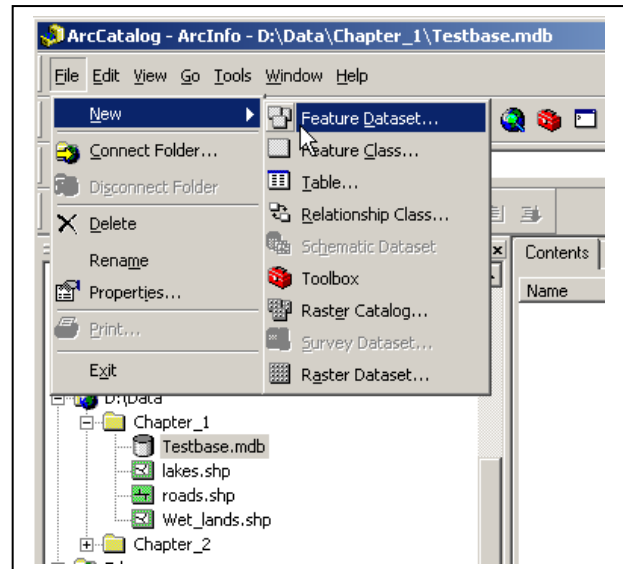
Double left click on the geodatabase in the right window pane. Notice it goes blank, and the left window pane shows the personal geodatabase you just created.

You will now create files to hold data layers, data tables, or other information.

Select **File > New** from the main ArcCatalog menu to open a window (see right).

This lists the types of new data sets, or other constructs, you may create and store within a geodatabase.

Creation of feature datasets, feature classes, and tables are the most common actions.



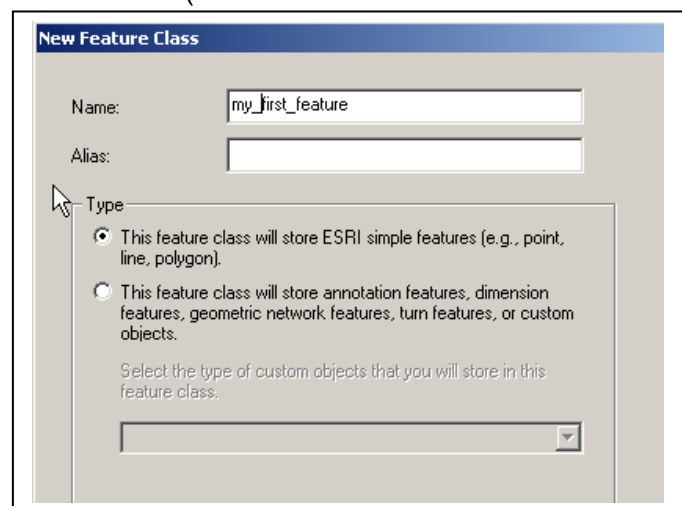
In ESRI's parlance, a **Feature Dataset** is a collection of related spatial data, usually data layers and other geometric constructs. You may want to hold clusters of data together, for example, data layers on river locations, lakes along those rivers, and dams associated with each lake. The river, lake, and dam data are **Feature Classes**, and additional tables and network connections may also be stored in the feature dataset.

You may create a new feature dataset, feature class, or table by selecting File > New, then the geodatabase item you'd like to create. You'll be prompted by a series of menus asking you to specify the characteristics of the item.

For example, to create a stand-alone feature class (one not contained in a feature dataset), you could select **File > New > Feature Class**, and would get a window (see right) to:

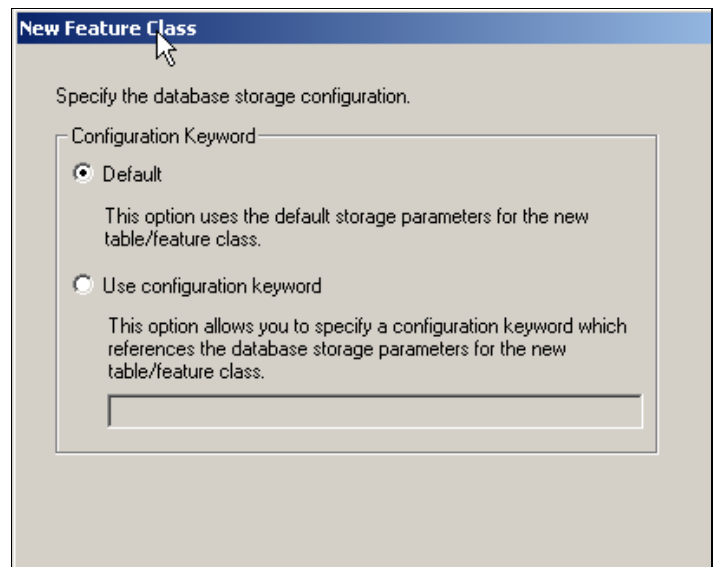
Name the feature class.

Enter a name, and click **Next**.



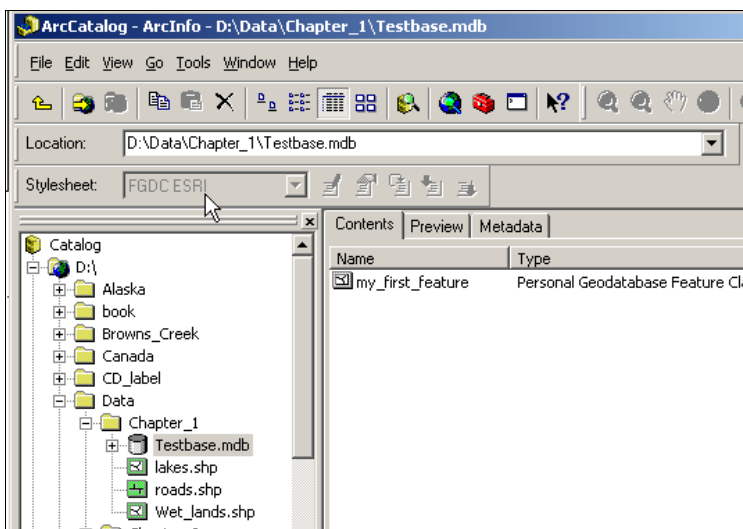
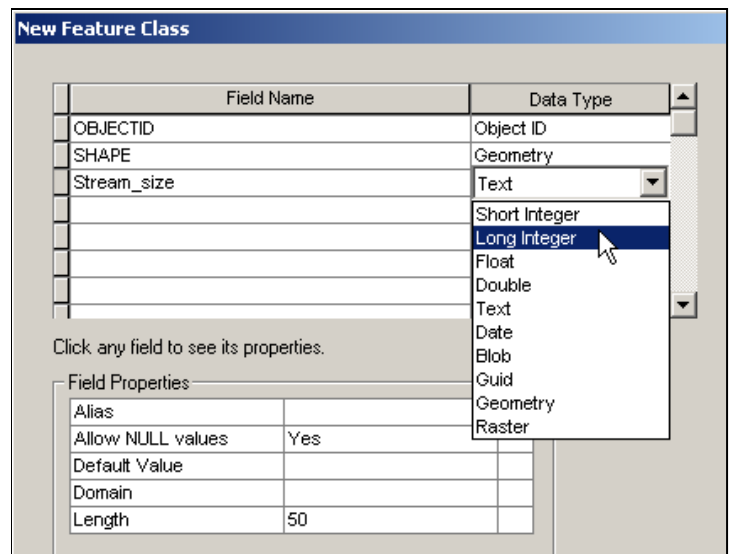
Specify the default storage configuration.

Click **Next**



Specify the data fields for the feature class. ObjectID and SHAPE are typically defined by default for basic feature classes. You may add new fields (variables) that hold information about each feature. For example, for a stream feature class, I could define the stream_size, order, type, name, etc. I would specify an appropriate data type for each, e.g., stream_size as a long integer, order as a short integer, type and name as text, etc.

Click **Finished**.



When you click finished, you should now get a view that shows your new feature class in a geodatabase, as on the right. The feature class doesn't have anything in it (we will cover data entry in another Lab), and this is only the simplest sort of feature class as it is not inside a feature dataset, but it is a new, empty layer into which you may add features.

To Turn In

(via WebVista as .pdf's)

Remember, you have two maps to turn in:

- 1) the lakes and roads map, and
- 2) the wetlands map.

Each map must have:

- a. The lab specified results
- b. Title
- c. North Arrow
- d. Legend
- e. Scale bar or Scale text