Introduction to ArcGIS

Using ESRI ArcView 10.2 and VT GIS Data

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NOTE: These workshop materials are not intended as an endorsement of any product or organization.

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CHAPTER 1

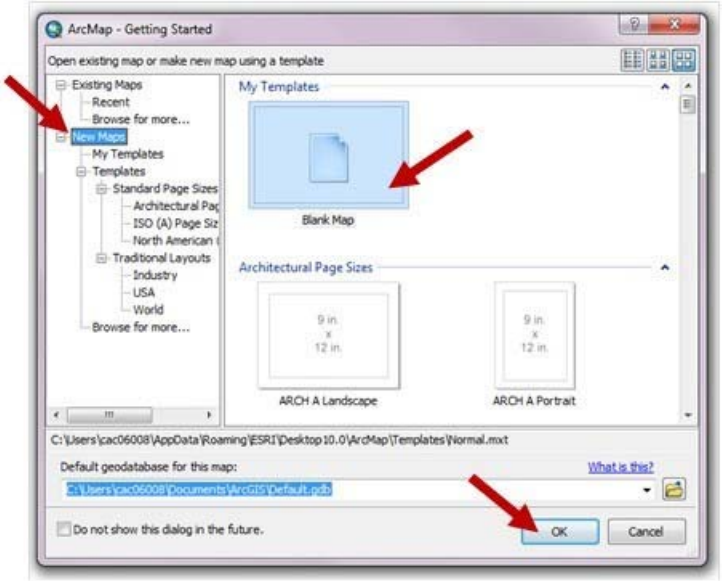
Tour of ArcMap

1. Open ArcMap

a) Start ArcMap by double-clicking on the ArcMap icon on your desktop. If an icon is not present, you can use the Start Menu instead. Usually, you will find ArcMap if you click on: START BUTTON> PROGRAMS> ARCGIS> ARCMAP 10

b) When the Getting Started window pops up, click on New Maps under the "Open existing map or make new map using a template" heading on the left.

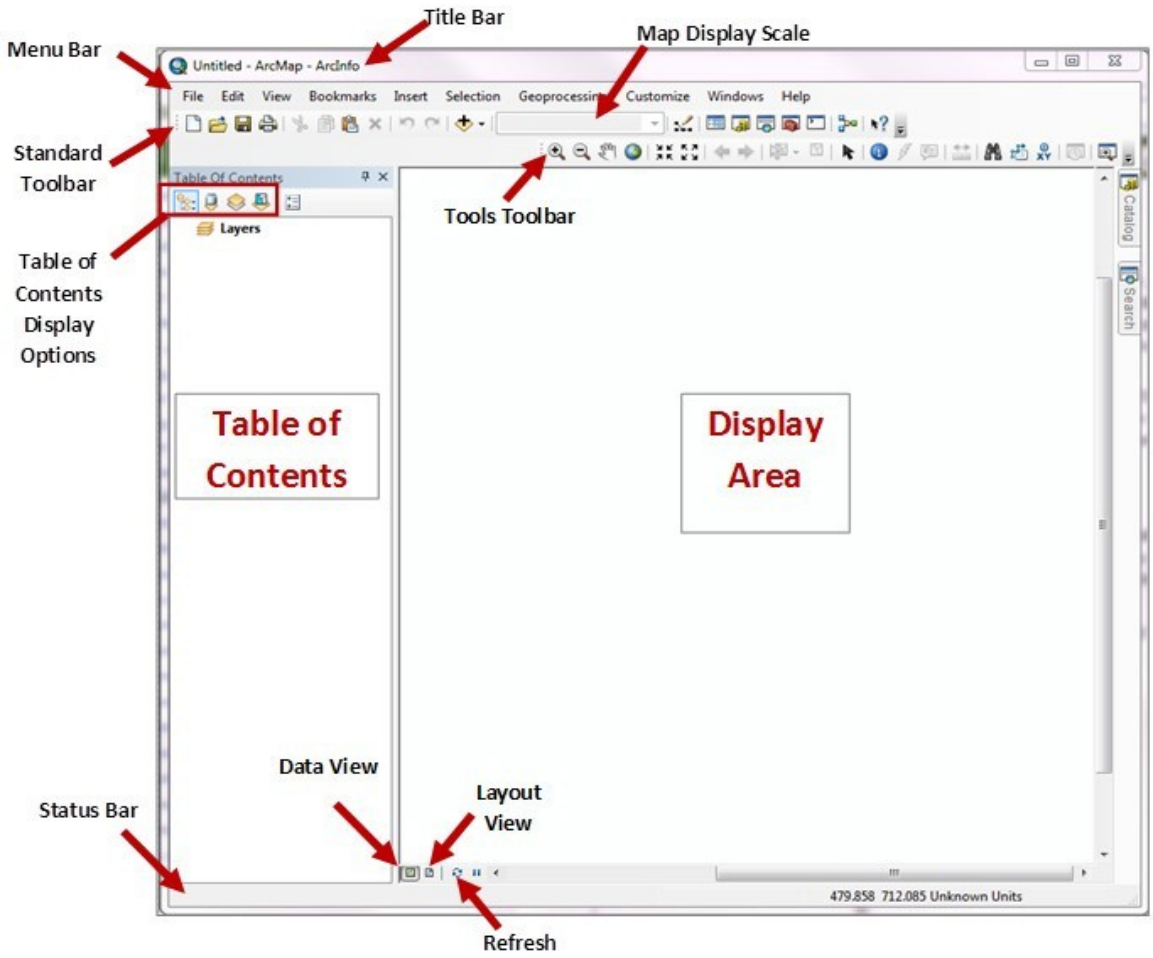
c) Under My Templates, select Blank Map. Click OK at the bottom of the window to open a blank map in ArcMap.



The ArcMap Graphical User Interface (GUI) will look something like what you see below. If it looks slightly different, it's because additional functionality (toolbars, etc.) may have been turned on or enabled by a previous user. When ArcMap is closed, it "remembers" these settings and restores them when it is reopened.

Explore the ArcMap Interface. As you hold the mouse pointer over a button, a description of its function will appear in a small box below it. Take a few minutes to try out this technique. As you mouse over some of the icons and buttons, try to familiarize yourself with what each one does.

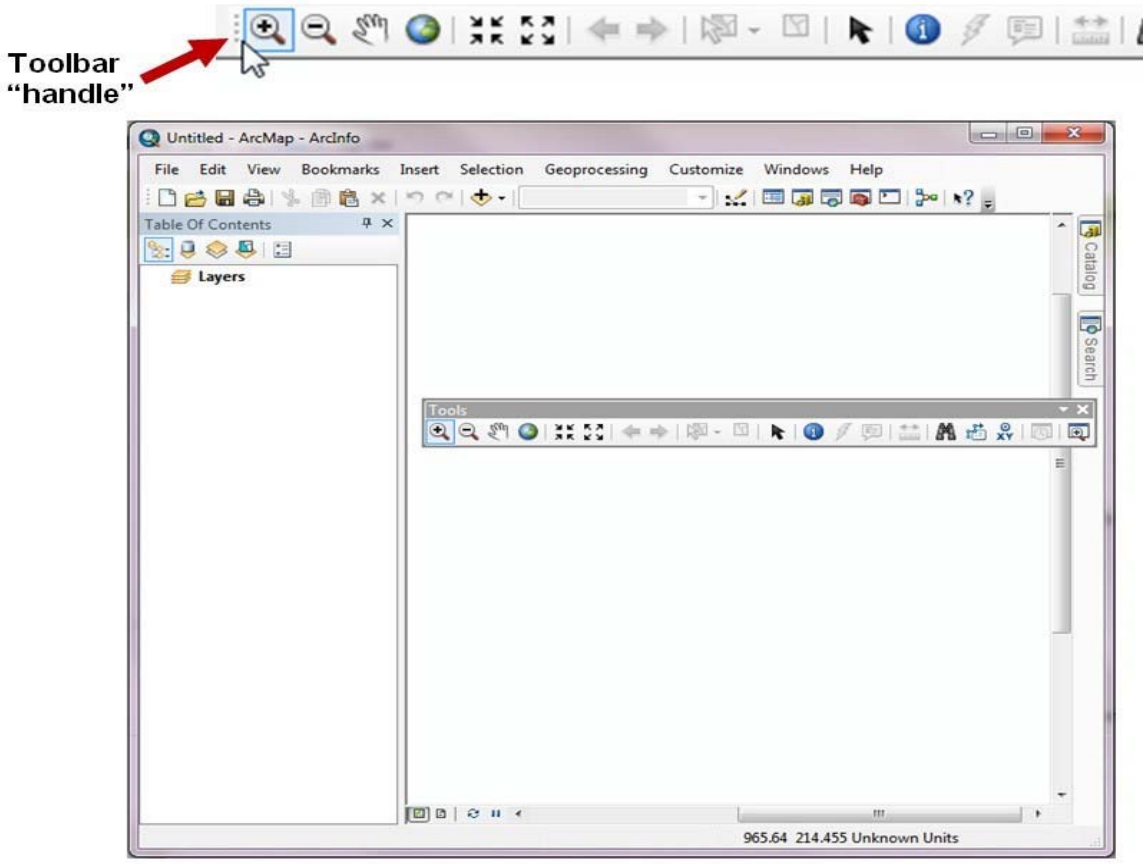
Some of the major “areas” of the ArcMap interface are labeled below.



2. Docking toolbars

Toolbars in ArcMap are sets of tools that perform similar types of functions. The Tools toolbar includes tools for navigating around the map display and tools for performing basic query functions. All toolbars can be moved around the ArcMap interface and can be “floating” windows or docked to the left, right, top or bottom of the GUI. The position of toolbars can be manipulated by clicking on the “handle” on its far left side and dragging it to a new location.

a) Try moving the Tools toolbar around the ArcMap window. You can even drag it to a location on your desktop that’s completely off the ArcMap GUI, just try not to lose it!



b) After you have finished experimenting with new toolbar locations, move the Tools toolbar back to its original position.

3. Add Data

Now that you are familiar with the ArcMap GUI, let's explore some GIS data. In this step, you will add data to your ArcMap document. An ArcMap document does not contain the data itself, but rather includes layers that point to data sources. In this training course, you will be using the VCGI training dataset, which can be acquired at http://vcgi.vermont.gov, by clicking "Data and Imagery" on the left side of the screen, then "products", then the download icon to the right of "VCGI Training Data"

a) In ArcMap, click on the ADD DATA button.

b) Navigate to C:\INTROGIS\DATA\TransRoad_RDSMAJ1_LINE. Click ADD.

c) Click the ADD DATA button again, and then navigate to C:\INTROGIS\DATA\BOUNDARY_TWNBNDS_POLY. Click ADD.

d) Click the SAVE button and navigate to C:\INTROGIS\PROJECTS\

e) Save your map as Exercise1.mxd.

4. Explore the Table of Contents

The TABLE OF CONTENTS is the pane at the far left of your screen that lists the data layers that you have added to your map document – in this case BOUNDARY_TWNBNDS_POLY and TransRoad_RDSMAJ1_LINE. You will work within the TABLE OF CONTENTS anytime you are in ArcMap – it is the place to go to access layer properties, attribute tables, and more. Right now you will just get used to the way ArcMap draws data layers.

a) Note that TransRoad_RDSMAJ1_LINE is at the top of the TABLE OF CONTENTS, and BOUNDARY_TWNBNDS_POLY is below it. ArcMap always draws layers from the bottom of the TABLE OF CONTENTS up, so in this case towns are drawn first, and roads are drawn on top of them. Click on the layer name BOUNDARY_TWNBNDS_POLY and drag it to the top of the Table of Contents. What happens?

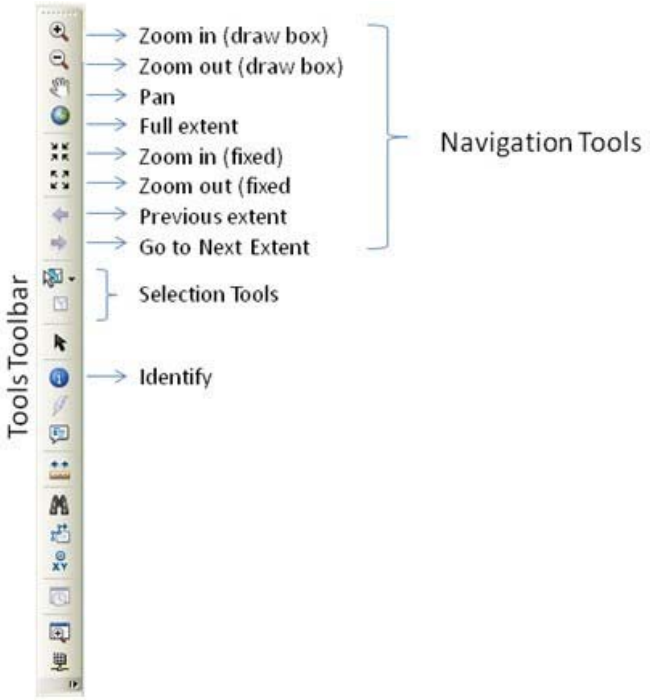
   (You should see that the towns now cover up the roads, because they are drawn on top of the roads layer.)

b) Return BOUNDARY_TWNBNDS_POLY to its original position below TransRoad_RDSMAJ1_LINE.

c) Click the check box next to BOUNDARY_TWNBNDS_POLY on and off. Notice the effect this has. If you like, turn off TransRoad_RDSMAJ1_LINE and leave it off for a while – this layer can take a while to redraw

5. Use the Tools Toolbar to Navigate Within Data View

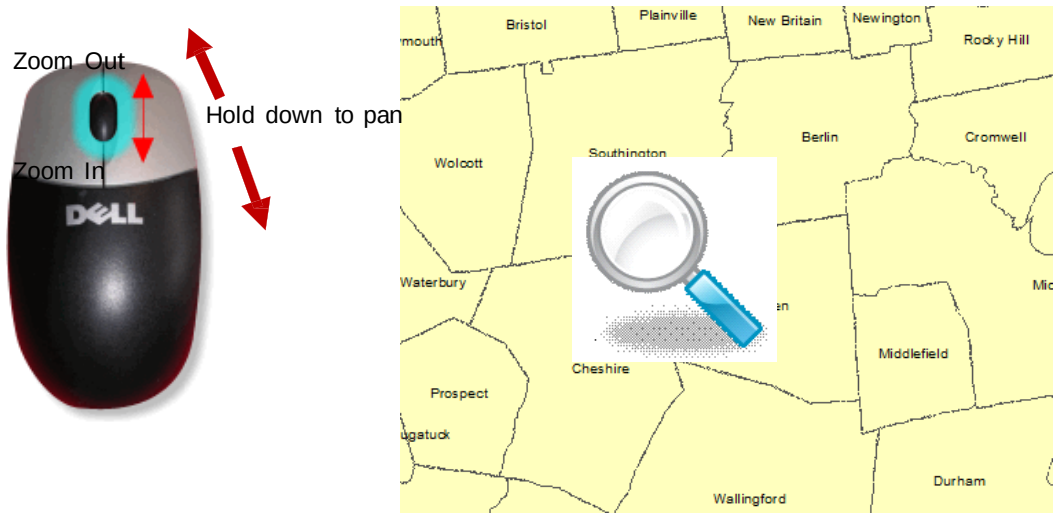
Let's start exploring some GIS data. The Tools Toolbar, usually located either horizontally at the top of the screen or vertically at the far left of the screen, has eight tools to help navigate. It also has several other tools to help you with basic functions like selecting and identifying features, measuring distance and area, and finding XY coordinates on your map. The most common tools are briefly described below.



Take several minutes and try using each of the first 8 navigation tools on the TOOLS TOOLBAR to see how each one works. If you get stuck or lose your place, you can always click on the Earth icon on the toolbar. This is the FULL EXTENT tool. It will restore the map display to its full extent. We will get to some of the other tools later.

a) You can explicitly set the display scale of your map by typing a value into the scale window on the STANDARD TOOLBAR. Try typing in something like "1 inch = 1000ft." You can also select from a set of predefined scales. This set of scales can be customized to include a user defined scale. Give it a try.

b) Use your mouse to Pan and Zoom. If your mouse has a scroll wheel, you can use it to zoom in and out and to pan around the display area. Rotate the wheel forward to zoom out and backwards to zoom in. Hold the wheel down and then move the mouse to pan around the display area. This can be a real time saver!

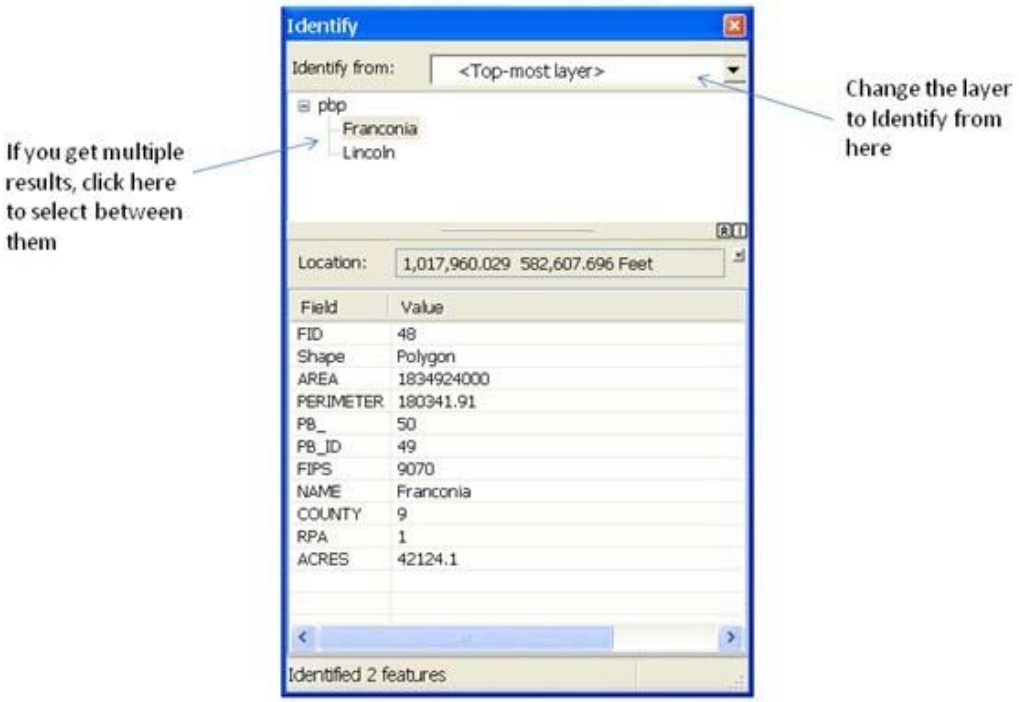


6. Use the Identify Button

The Identify button is very handy – it will report to you all of the attributes for any feature that you click on in your map. By default it works on the top-most visible layer in your TABLE OF CONTENTS, but you can set it to identify features from a specific layer, from all visible layers, or from all layers.

a) Click on the IDENTIFY button in the TOOLS TOOLBAR, and then click somewhere in your map. If TransRoad_RDSMAJ1_LINE is turned off, then you will get information for whatever town you clicked on. If roads are visible, then you will get information for whatever feature you clicked on – a road or a town.

b) Experiment with drawing a box with the IDENTIFY button (this will give you multiple results) and with changing the layers that the tool works on.


Identify
Identify from:
<Top-most layer>
pbp
Franconia
Lincoln
Location:
1,017,960.029 582,607.696 Feet
Field
Value
FID 48
Shape Polygon
AREA 1834924000
PERIMETER 180341.91
PB_ 50
PB_ID 49
FIPS 9070
NAME Franconia
COUNTY 9
RPA 1
ACRES 42124.1
Identified 2 features
If you get multiple results, click here to select between them
Change the layer to Identify from here

CHAPTER 2 Asking GIS questions and planning a Mapping Project

Spatial Concerns

When we think about how GIS can be used to help solve problems, we are simply incorporating the idea of a spatial perspective. An example might be to consider where a new landfill should be placed. You would want to get a map of rivers to make sure you are not too close to running water, a map of geologic cover types to make sure you place it on top of relatively impervious clay and bedrock, a slope map to minimize the damage that potential spills might cause by choosing flat ground, a map of residential locations to keep it away from people, etc.. These are spatial concerns, and these pieces of spatial information can all be quickly utilized in a GIS environment such as ArcMap, assuming the data has already been collected, which it often has. This thought experiment is referred to as a ***Suitability Analysis***. In a suitability analysis, you are considering where something should/can exist, and you utilize the relevant spatial data to help you come to that decision. This is a common form of GIS analysis. If everyone in interested and if time permits, you will perform a suitability analysis at the end of this training course.

It is always a good idea to plan a project, and planning a mapping project will save you time and inconvenience! There are a few basic tasks to perform in order to plan your project:

1. Determine the scope of your project
    a. Geographic Area: _____

    b. Topic/focus/goal:

2. Audience: _____

    a. How you will share completed project with audience (online, paper, etc.):_____

3. Data needed to complete project: _____

    a. Source(s) of data needed:

    b. How you will acquire or create the data:

4. Project partners or participants:_____

5. Funding:_____

6. Legal/privacy issues?_____

CHAPTER 3

Acquiring Data

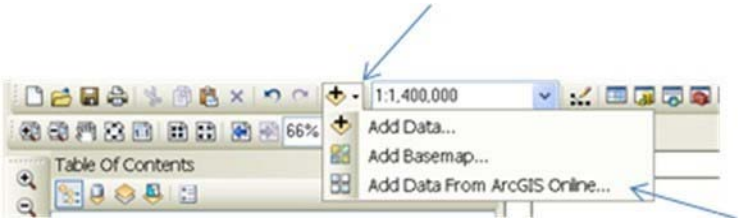
Data is now available from many sources online. Many states, including Vermont, stream data over the internet, and you can add these data services to your map. ESRI also has a service called ArcGIS Online to which users can post data, and from which you can stream or download data. In this exercise, you will see how to access these online data sources. Note that when you stream data, you are not actually downloading it onto your local computer – you will need an active internet connection to view the data.

1. Add Data from ArcGIS Online (if you have access to an account)

a) First, start a new, empty map.

b) Then click the Add Data button, and browse to C:\INTROGIS\DATA\BOUNDARY_TWNBNDS_POLY.shp, and click add

c) It is very easy to add data from ArcGIS Online – you can do so directly from that same ADD DATA button on the STANDARD TOOLBAR



This time, instead of clicking in the middle of the ADD DATA button, click on the tiny triangle just to the right of it. This will provide a sub-menu of options.

Choose ADD DATA FROM ARCGIS ONLINE.

When the ArcGIS Online window opens, you can type in a search term, such as “Imagery”, “Elevation”, or “Soils”.

Choose one of the results that you find appealing, and click DETAILS. If you want to add that layer to your map, click ADD.

It may take a little while for the data to load. When it does, zoom in and explore the data set. Is it what you expected?

2. Explore VCGI’s Vermont GIS Data

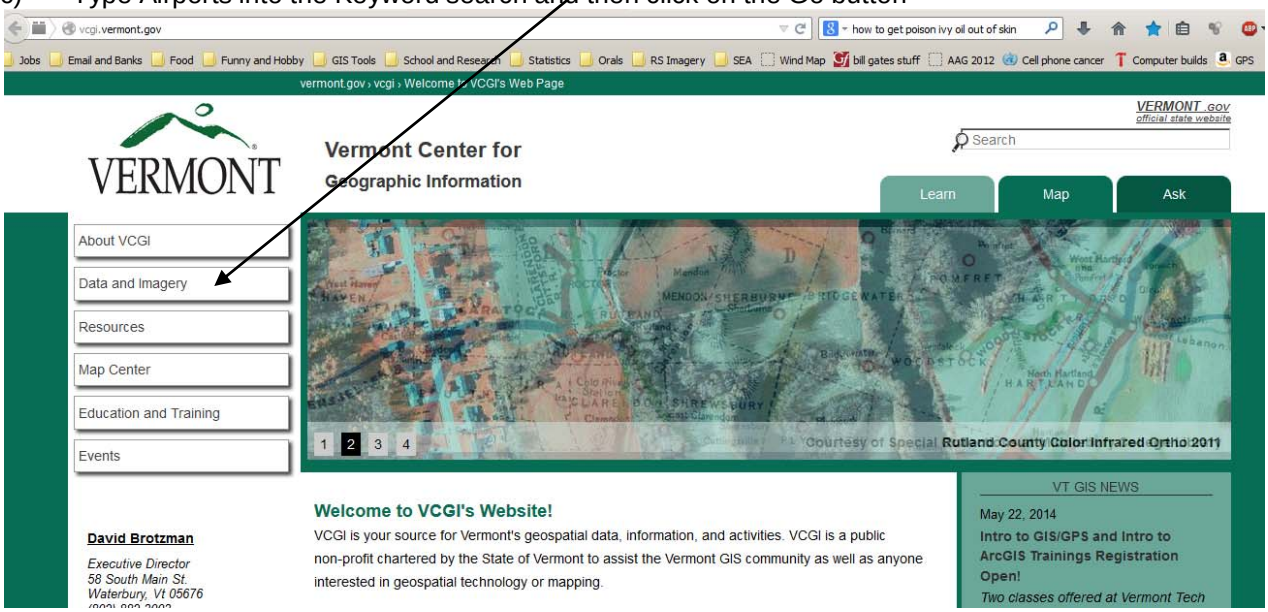
VCGI is a public non-profit supported in part by the State of Vermont (through the property transfer tax) and in part through grants and fees paid for the products and services it provides to clients (e.g. the VT Agency of Transportation and the VT Enhanced 9-1-1 Board).

The storage and provision of free digital geographic data created by members of the VT GIS community are two of the most important tasks that VCGI performs. Anyone can visit the VCGI Data and Imagery section of the website to download this GIS data. Newer aerial photographs and some data layers, are available as Web Map Services (WMS).

a) Open a web browser and go to http://vcgi.vermont.gov

b) Click on the Data and Imagery button to the left on the front page

c) Type Airports into the Keyword search and then click on the Go button



d) See what information is provided in the search results table

e) We will not download any data to the workshop computers, but this is something you can do from your home or office computer (wherever you have ArcGIS available).

3. Stream Data via VCGI's Web Map Service (WMS)

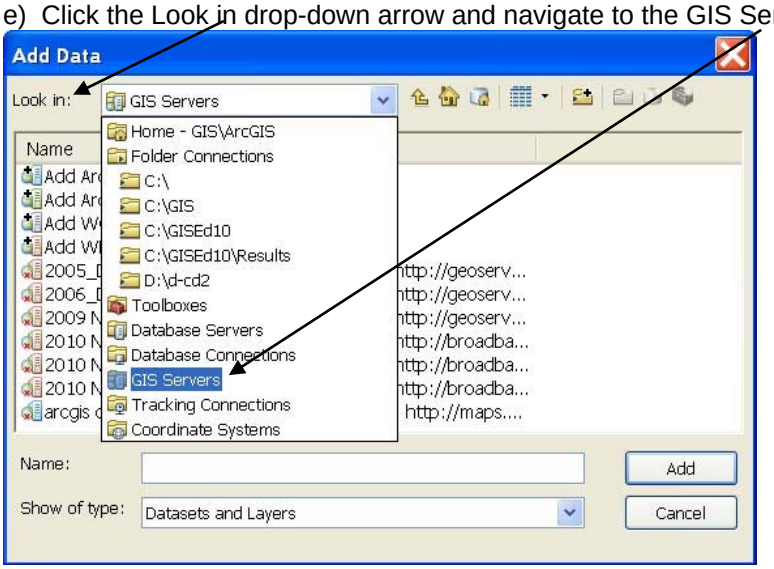
Rather than requiring users to download full datasets (shapefiles, geodatabases, imagery, etc.) from their websites, many data providers, including VCGI, are making some of their datasets available as **live map services**. This is very helpful for many users, as they have access to the newest datasets automatically, without having to download anything to their computers. The downside is that to display the data, you need a live (and fast) internet connection.

Currently, VCGI is providing Web Map Services (WMS) of much of their imagery as well as a basemap (many layers), contours, hillshade, and USGS topographic maps.

In this exercise you will connect to VCGI's Web Map Services

a) Click on Data and Imagery on the VCGI website's main page
b) Click on "Web Services", then "How to Use Web Services" (this will appear just below "Data and Imagery")
c) Highlight and copy the URL provided in step 5 of the "Connecting to GIS Servers in ArcGIS" section

d) In ArcMap, click the Add Data button.
e) Click the Look in drop-down arrow and navigate to the GIS Servers folder.



f) Double-click Add ArcGIS Server.
g) Make sure "use GIS services" is chosen, then click Next
h) In the General window, enter the URL you just copied: it should be: "http://maps.vcgi.org/arcgis/rest/services/" (remove the quotation marks) – don't enter anything for a User Name or Password. Click Finish.
i) Double-click the new ArcGIS server (it will now be listed in this GIS Servers Add Data window)
j) Double-Click on the folder containing the service you wish to connect with (basemap is in VCGI Services, everything else is in EGC services)
k) Click on the service you want to add, then click Add.
i) Explore the data you have added using the Tools toolbar

Now you will add a WMS of aerial photos using a 'Layer File'

a) Click on Data and Imagery on the VCGI website's main page
b) Click on Web Services
c) Click on Imagery Services
d) Click on the first bullet under "Best of Black and White Imagery, Cached, VT State Plane Meters" It should say "Link to layer file (opens in ArcGIS 10+)"
e) A window will pop up asking you how to handle the file, it should say "open file with…ArcGIS file handler", click OK.
f) Return to ArcMap, you should see that the Best of Black and White Imagery layer has been added to your project.
g) Explore this data along with the other data you have added

Additional Data Sources:

- The National Atlas (http://nationalatlas.gov/atlasftp.html)
- The Census Bureau (http://www.census.gov/geo/maps-data/data/tiger.html)

CHAPTER 4

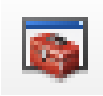
GPS and Tabular Data

Collecting GPS data is a common way to get locational information into your GIS. GPS units generally save their data in a .GPX format. ArcGIS v.10.2 can import .GPX data, which can then be transformed into shapefile format.

1. Import .GPX Data

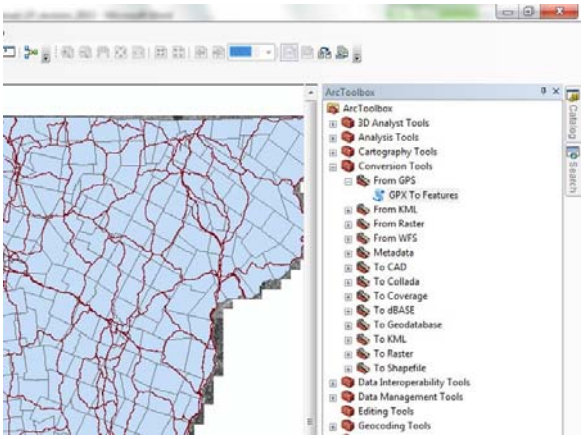
GPX is a common GPS data file interchange format. In this exercise you will convert a GPX file to a shapefile.

a) Start a new, empty map and add BOUNDARY_TWNBNDS_POLY.shp to it. Note that by adding a data layer with a known spatial reference (like BOUNDARY_TWNBNDS_POLY.shp, which uses VT's standard coordinate system: VT State Plane, units = meters, and datum = NAD 1983), the data frame is assigned that spatial reference. Add TransRoad_RDSMAJ1_LINE.shp as well.

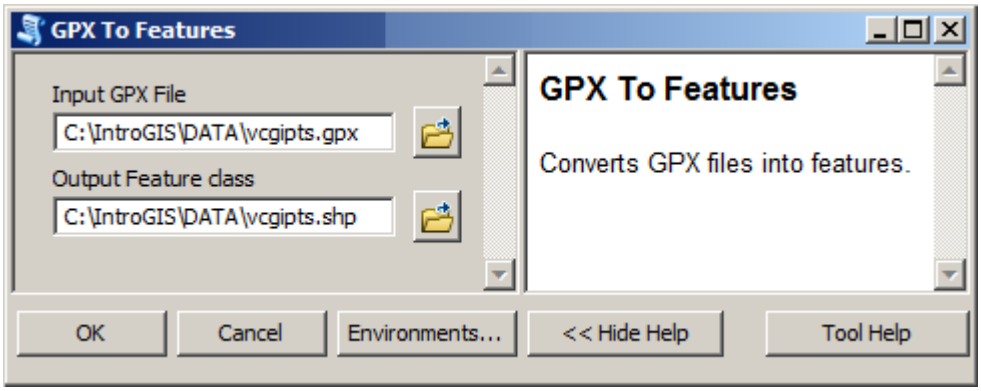
b) Click on the ArcToolbox icon 

c) Click the plus sign next to Conversion Tools, then the plus sign next to From GPS

d) Double-Click on GPX TO FEATURES.



d) Navigate to the GPX file “C:\INTROGIS\DATA\vcgipts.gpx”, then adjust the Output Feature class as the instructor indicates and click OK. It takes a minute for the new layer to appear



e) Right click on the new layer and click ZOOM TO LAYER.

2. Re-Project Data

Note that the GPX to Features dialogue does not give you very many options -- it does not give any ability to define coordinate systems (input or output), attributes, data types, etc. You will have to manually attend to each of these.

a) Double click on your new layer to open its properties.

b) Click on the SOURCE tab, and check out the spatial reference for the GPS data

Its coordinate system is GCS_WGS_1984 -- a geographic (not projected) coordinate system, and a common one used for GPS data. This is not the coordinate system used by your data frame or the other layers in your map, but that does not prevent ArcGIS from being able to draw the data in the proper place, because it performs Coordinate Reference System Transformation on-the-fly.

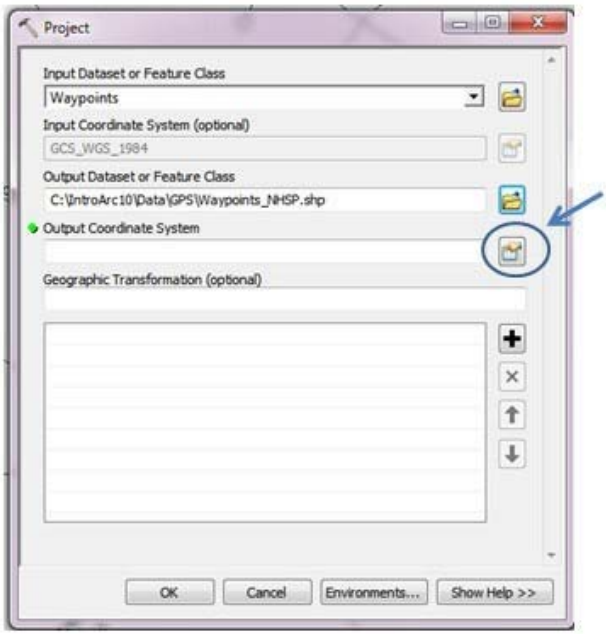
You could simply leave the dataset in its current coordinate system, but that could be confusing for other users of the data, who have come to expect VT’s standard spatial reference (VT State plane, meters, NAD 1983). Also, if this dataset were ever the first added to a new dataframe, the dataframe would take on its spatial reference, which again can be confusing and make other data sets behave strangely. Finally, accuracy may be improved when all the layers in a data frame share the same spatial reference -- especially if they will be used for any geoprocessing tasks. Therefore, we will take a minute to project the data into VT’s standard spatial reference.

In ArcToolbox, browse to DATA MANAGEMENT TOOLS> PROJECTIONS AND TRANSFORMATIONS > FEATURE > PROJECT (double-click).

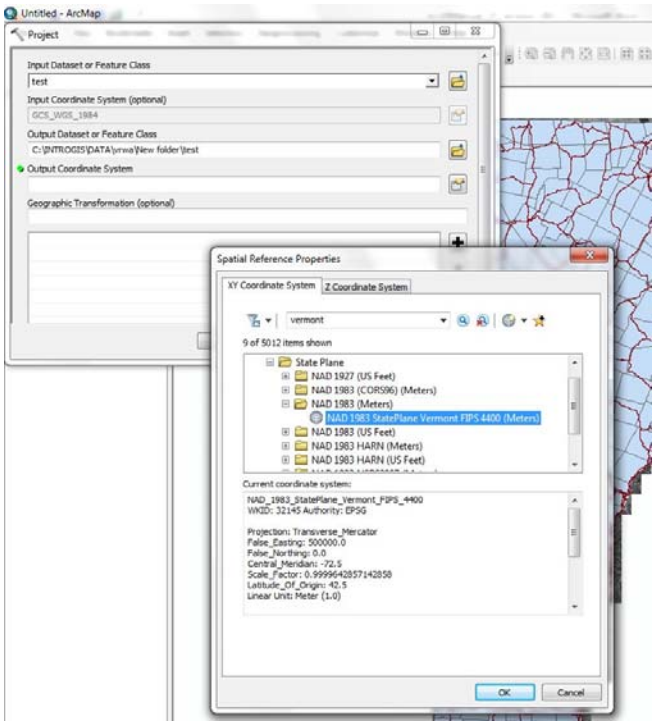
NOTE: Do NOT open the tool called “Define Projection” -- all this does is write a text file stating what the projection is (or actually, just what YOU have said the projection is -- you could in fact define the projection incorrectly! For example, if you accidentally ran that tool now, you would write a projection file saying that the Waypoints shapefile uses NH Stateplane coordinates, but in fact it would still be in its old WGS 1984 geographic coordinates.)

c) Set your input layer and define the output location and name.

d) Click the icon on the Output Coordinate System line to choose a pre-defined coordinate system.



e) In the window that appears, type Vermont in the search area, open Projected, State Plane, and NAD 1983 (Meters). Click on NAD 1983 State Plane Vermont FIPS 4400(Meters).



f) Click OK. NAD_1983_StatePlane_Vermont_FIPS_4400 should now be listed as the output coordinate system. Click OK. – Now open the properties of this new layer and look at the spatial reference information under the Source tab

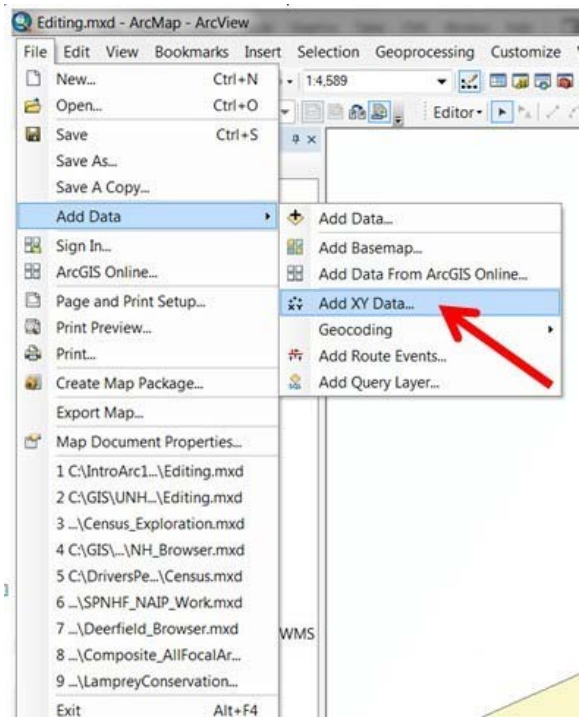
Note that using the Project tool creates a new dataset -- it does not simply project the existing dataset.

3. Add X,Y Coordinate Data to ArcMap

In addition to data sources such as shapefiles and TIF images, you can also add tabular data that contains geographic locations in the form of x,y coordinates to your map.

In this exercise, you will add a text file containing points defined with latitude and longitude.

a) From the FILE menu, select ADD DATA, then ADD XY DATA

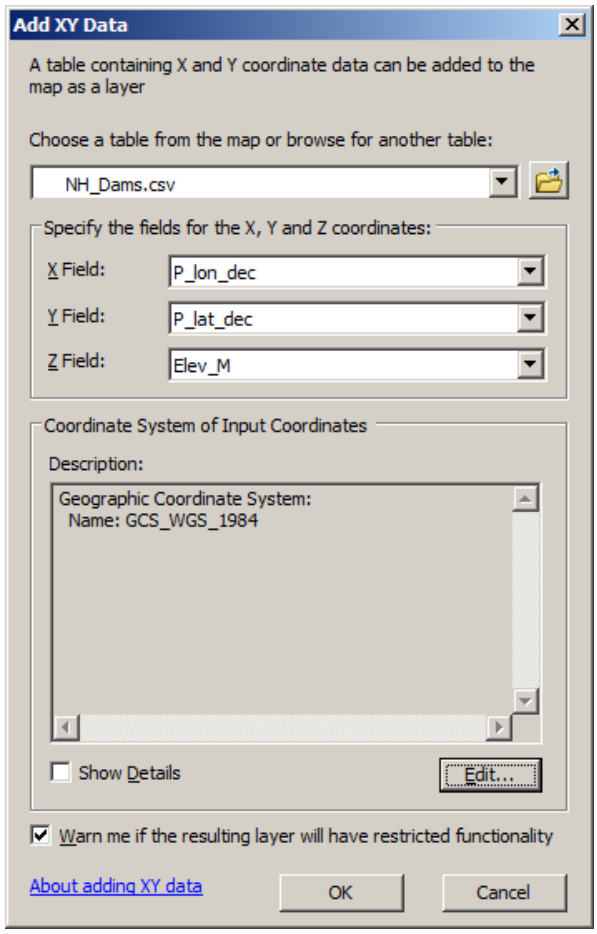


b) Click the BROWSE button, and browse to the file C:\INTROGIS\NH_Dams.csv.

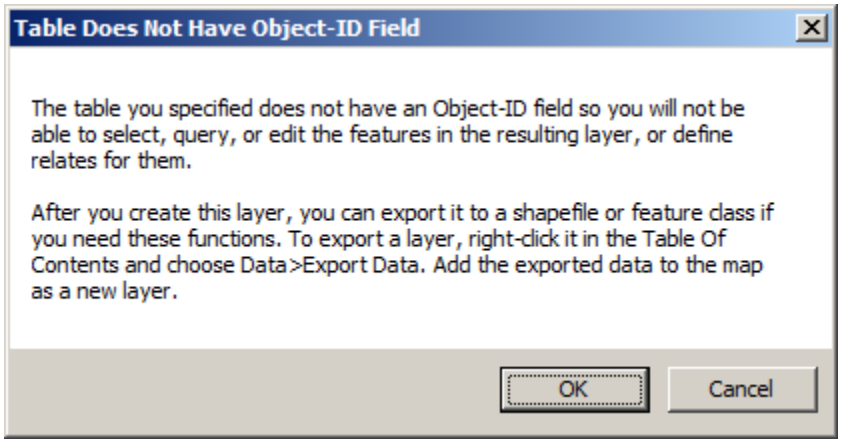
c) Specify "Long" as the X FIELD, and "Lat" as the Y FIELD. Don't click OK yet!

d) Click EDIT to change the coordinate system for the input coordinates. You need to tell ArcMap that the coordinates in this new file do not reference VT's standard spatial reference. Rather, they are unprojected ("geographic") coordinates -- latitude and longitude. We will assume that they are registered to the WGS 84 spheroid, the most common way that GPS data are registered.

e) Open the folder for Geographic Coordinate Systems. Within that, browse to World, and select the last one in that list: WGS 1984. Click OK, then OK again



f) You may get a warning about the lack of an Object-ID field -- read through it, and then click OK.



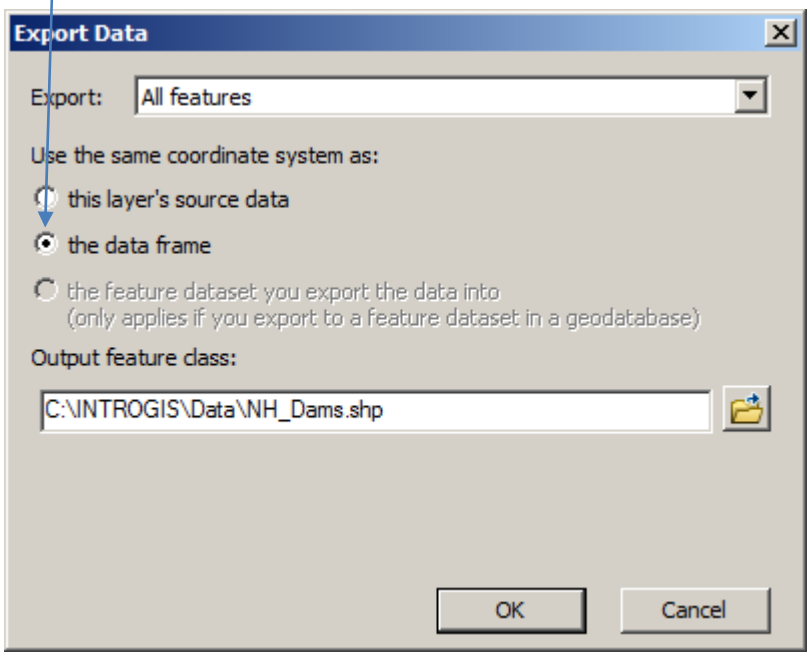
g) Right click on the new layer in the TABLE OF CONTENTS and select ZOOM TO LAYER.
This new layer is a type of temporary file – to make it a permanent layer it must be exported

4. Save X,Y Coordinate Data as a Point Shapefile

a) Right click on the new layer in the TABLE OF CONTENTS and select DATA - EXPORT DATA.

b) Choose to export all features, using the same coordinate system as the data frame.

NOTE: Depending on your version of ArcGIS, the dialog box may appear slightly different... just make sure that you are causing the exported data to inherit the coordinate system of the current dataframe. This is especially important if you started with Latitude/ Longitude (or other) data and want it to end up as VT Stateplane data.



CHAPTER 5

ArcCatalog

1. Open ArcCatalog as a Stand-Alone Program

Now that you have some familiarity with the ArcMap interface, we will open the stand-alone version of ArcCatalog. (There is also a way to open ArcCatalog (with limited functionality) within ArcMap – we will do that later.

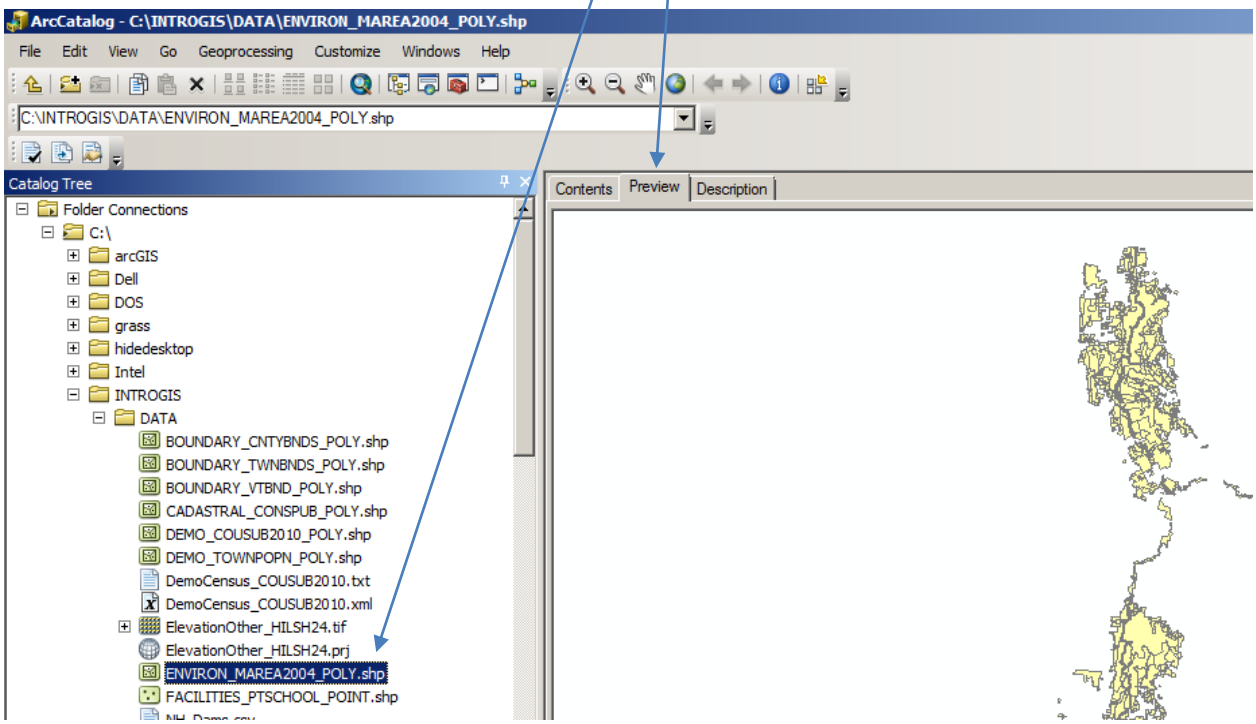
ArcCatalog is the place to go to manage your data – to move or rename files, to browse through and preview your data sets, to create new empty shapefiles or geodatabases, etc.

a) Click the ArcCatalog icon on the desktop or, from the Start menu choose ALL PROGRAMS > ARCGIS > ARCCATALOG 10.

b) ArcCatalog is structured somewhat like Windows Explorer – there is a catalog tree on the left, and on the right you can see the contents of whatever folder you have selected in the catalog tree. If you have navigated to a folder and selected a dataset on the left, you can preview it on the right.

c) In the left-hand pane, navigate to:
C:\INTROGIS\DATA\ENVIRON_MAREA2004_POLY.SHP.

d) At the top of the right-hand pane, click on the Preview tab.



e) Notice that the same navigation tools (ZOOM, PAN, etc.) and the IDENTIFY tool that we used in ArcMap are available here as well. Feel free to zoom, pan, and identify features in the preview pan

f) Right now you are previewing the geography of this dataset. You can also preview its attribute table. Choose TABLE from the drop- down list at the bottom of the preview pane.

g) Scroll through the table to get a feel for the type of information it contains. You will learn more about attribute tables in the next exercise (and throughout this workshop).

2. Open ArcCatalog within ArcMap

a) When you are finished exploring the ArcCatalog (stand-alone) interface, click the X in the upper right hand corner of the window to close it.

Note: it is generally worthwhile to close ArcCatalog if you are not actively using it, as it can sometimes lock up your data files and make it so you cannot edit them or make any permanent changes (like adding attribute fields) to them.

b) Return to your ArcMap document.

c) You will now open an ArcCatalog window within ArcMap.

d) Click the ArcCatalog icon in the STANDARD TOOLBAR.

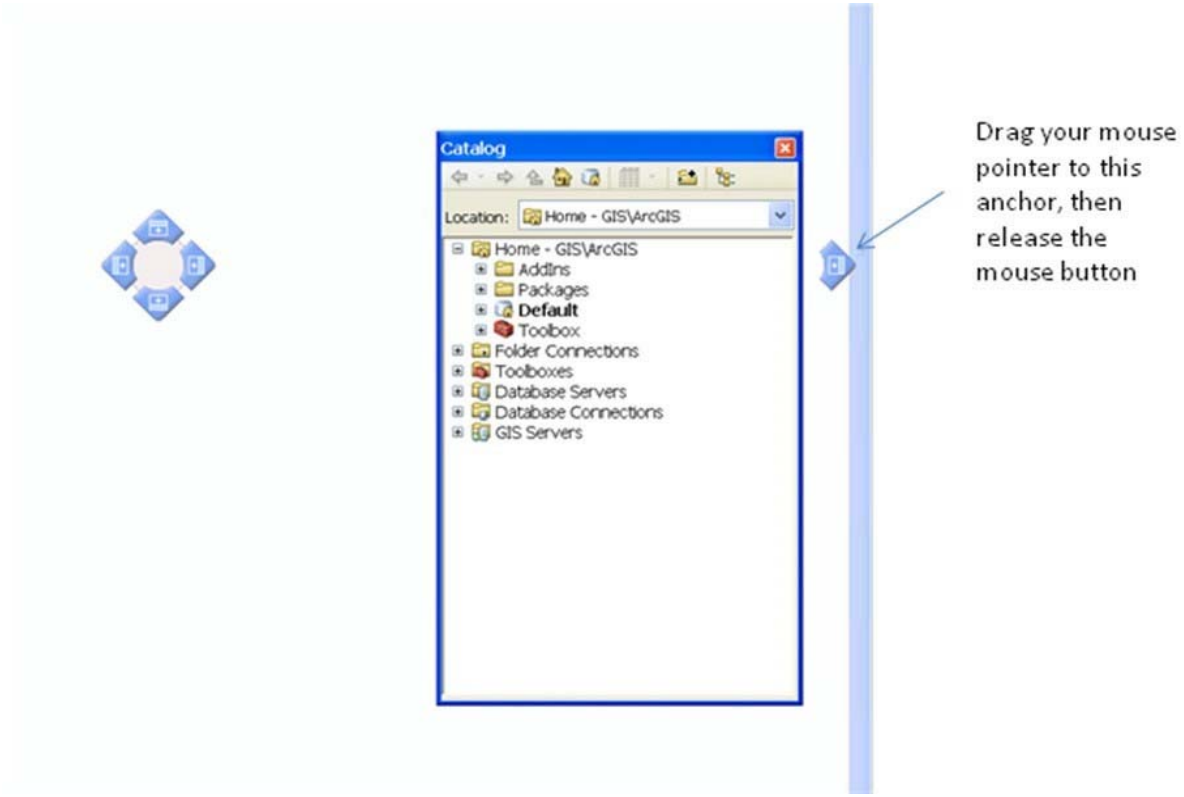
e) An ArcCatalog catalog tree should appear. Depending on how the last user on your computer left it, the catalog tree may be floating in the middle of your screen, or it may be docked at the far right side of your screen. (It could actually be docked at the top, left, or bottom of your screen also, but most people seem to dock it to the right.)

3. Dock the ArcCatalog Window

One useful feature of ArcGIS 10 is the ability to dock all sorts of windows (such as ArcCatalog, attribute tables, the Identify results window, etc.) along the edges of the interface.

a) If your ArcCatalog window is already docked, grab its blue title bar and drag it to the center of your screen to un-dock it.

b) To dock a window in ArcMap, click on its blue title bar and—with the mouse button still depressed—drag it a little bit. As you drag it, you will see sets of blue triangles (anchors) appear. Drag the window until your mouse pointer is on top of the right-most blue anchor triangle, and then release the mouse button.



c) This technique works for many of the windows that you will use in ArcMap, though using the anchors at the sides of the interface has a slightly different effect than using the anchors at the center of the screen. As you work in Arc-Map, feel free to experiment with these different anchor locations.

d) Once ArcCatalog is docked, a small pushpin icon appears in its title bar, next to the X. If the pushpin is vertical, the docked window will always be visible. If the pushpin is horizontal, the docked window will autohide—that is, it will dis-appear until your cursor hovers over it.

e) Click the pushpin to change whether your window autohides or not. Leave it in whichever position you prefer. Note that you cannot drag the window about if Autohide is ON.

4. Add Data from ArcCatalog

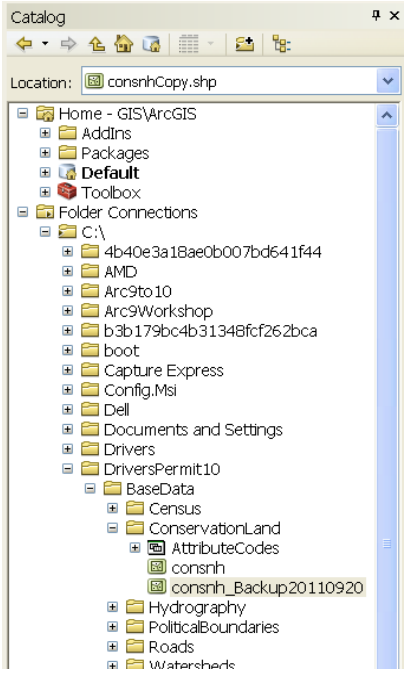
a) In the ArcCatalog pane, expand the Folder Connections folder, and then browse to C:\INTROGIS\DATA\ENVIRON_MAREA2004_POLY.

b) Click on CADASTRAL_CONSPUB_POLY.shp and drag it to the left, into your map document. This is an easy way to add data to a map document (though unlike using the Add Data button, you can only add one layer at a time) – Explore this data

c) Save your map. (Do this regularly!!)

5. Manage Data in ArcCatalog

You can copy, paste, move, and rename data layers in ArcCatalog, as well as create new folders, shapefiles, or geodatabases. In this example, you will make a backup version of a shapefile and rename it with today's date.



a) Right click on ENVIRON_MAREA2004_POLY In ArcCatalog and choose Copy.

b) Right click on the folder name **DATA** and Choose Paste.

c) A new shapefile called ENVIRON_MAREA2004_POLYcopy is created.

e) Rename the shapefile: Click once to select the new shapefile, and then click again to make its name editable. (If you have trouble doing this, just right click on its name and choose Rename.) Give it the name Marea2004_BackupYYYYmmdd

7. Optional: View Datasets Using Windows Explorer

You just created a new shapefile using ArcCatalog. It was very easy to do: just copy, paste, and rename one file. However, what really happened was a little more complicated: seven files were copied, pasted and renamed. You can see that this is what has occurred if you open Windows Explorer to view the files within your shapefile.

The purpose of this step is simply to better understand the files that contribute to a shapefile, and why we use ArcCatalog rather than Windows Explorer to manage data. You will not be making any changes within Windows Explorer.

a) Right click on the Start button and choose Explore.

b) Browse to C:\INTROGIS\DATA\ENVIRON_MAREA2004_POLY

c) Notice how many files are present. A shapefile is not a single file – it is a collection of three or more files with the same first name (such as ENVIRON_MAREA2004_POLY) and different suffixes (*.shp, *.dbf, *.shx, *.sbx, *.prj, etc.)

d) Using ArcCatalog to manage your data means fewer steps for you – instead of copying, pasting, renaming, or moving three or more files, you only have to work on one. It also—vitally—means far fewer chances for error. It is far too easy to accidentally leave out one of the sub-files contributing to a shapefile, or make a typo and mis-name just one of them. Either of these mistakes can be hard to trace back and will make the shapefile unusable.

CHAPTER 6

Attribute Tables

In this exercise you will explore the attribute tables for the layers in your map and learn how to select features based on their attributes or their location.

It may seem strange to focus on the task of selecting features based on their attributes or location, but in fact, making selections is a very useful way to examine your data, and is a frequent first step in analyses. For example, if you were working on a project based in a specific town, your first step might be to zoom to that town in your view. You could do that by first selecting the town, and then choosing to zoom to your selected feature. Your next task might be to sub-set a number of statewide datasets (such as roads or streams) to just the area of your town. To accomplish this, you would also need to first have your town selected.

1. Use Select Features Tool

a) If it's not already open, open ArcMap and the map you were working on earlier: Exercise1.mxd.

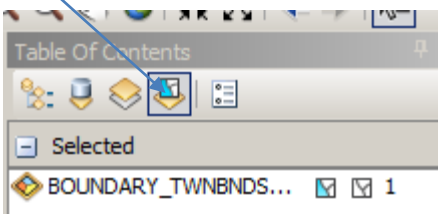
b) Click on the SELECT FEATURES tool on the TOOLS toolbar , and then click on a feature in your map.

c) Any feature or features that you selected should now be outlined in bright turquoise.

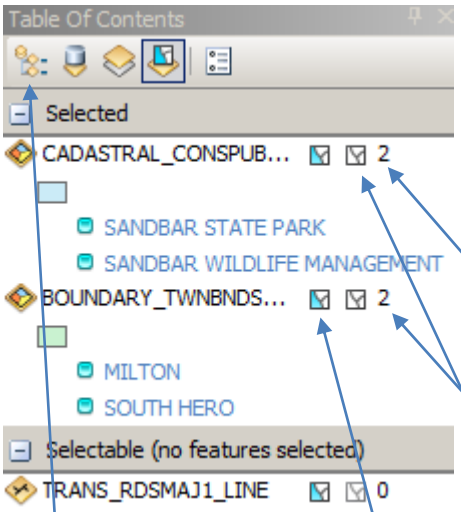
2. Set Selectable Layer(s)

Particularly when using the Select Features tool, it can be very difficult to figure out what you've selected once you have clicked somewhere. In the step above, you may have selected some roads and a town or two with just one click of the tool. There is, however, a handy way to control what can get selected: the List By Selection tab.

a) Click the 4th icon from the left at the top of the TABLE OF CONTENTS – the List By Selection tab.



b) The "regular" TABLE OF CONTENTS view shows you which layers are visible and in what drawing order; the List By Selection view instead shows you which layers are able to be selected and how many features in each are currently selected



c) In the example above, all layers are selectable, but only the town boundaries and cadastral features have features selected. BOUNDARY_TWNBNDS_POLY_POLY has 2 features selected, and they are listed by name – the same goes for CADASTRAL_CONSPUB_POLY. Experiment with this tool a bit.

d) If you had only wanted to select towns, you could click the Clear Selected Features button next to the selection results for CADASTRAL_CONSPUB_POLY, and only the 2 towns would remain selected.

e) On your screen, Clear selected features on one of your layers, and then make it NOT selectable by clicking the "Click to toggle selectable" button next to it.

f) Return to the "regular" Table of Contents view by clicking on the first icon from the left at the top of the Table of Contents: List By Drawing Order. It is probably a good habit to return to this Table of Contents view, because you will frequently want to do things like turn layers on and off and rearrange the drawing order.

3. Open and Dock an Attribute Table

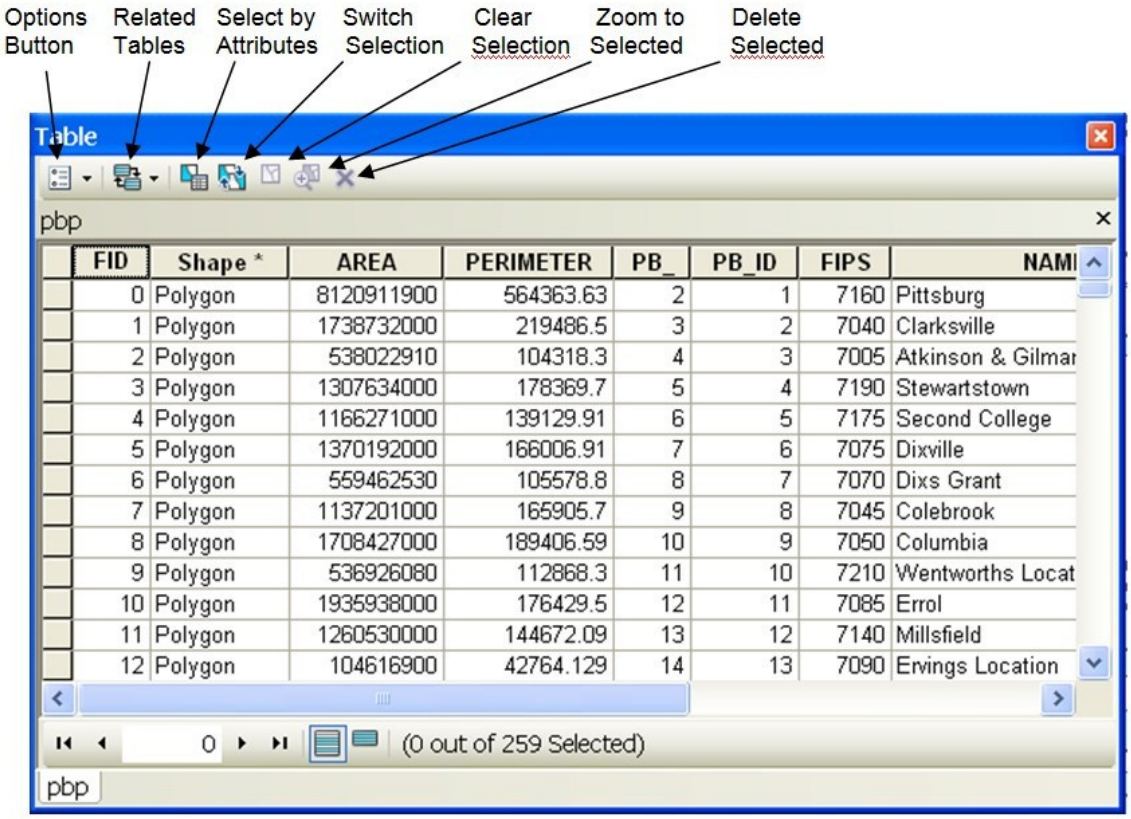
a) Right click on the name BOUNDARY_TWNBNDS_POLY in the TABLE OF CONTENTS, and choose OPEN ATTRIBUTE TABLE.

b) Drag the attribute table down and dock it at the bottom of the screen.

ex: If you drag the table by its blue title bar down to the bottom of the screen until the four- way arrow appears. Hover your mouse pointer over the down arrow, and the table should dock.

If you like, turn on AUTO HIDE by clicking the thumbtack in the upper right hand corner of the table.

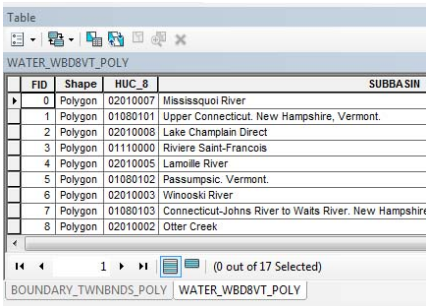
A menu is available from an OPTIONS icon at the top of the table. Other common tasks (Select by Attributes, Switch Selection, Relates) are represented by icons at the top as well.



FID	Shape *	AREA	PERIMETER	PB_	PB_ID	FIPS	NAMI
0	Polygon	8120911900	564363.63	2	1	7160	Pittsburg
1	Polygon	1738732000	219486.5	3	2	7040	Clarksville
2	Polygon	538022910	104318.3	4	3	7005	Atkinson & Gilmar
3	Polygon	1307634000	178369.7	5	4	7190	Stewartstown
4	Polygon	1166271000	139129.91	6	5	7175	Second College
5	Polygon	1370192000	166006.91	7	6	7075	Dixville
6	Polygon	559462530	105578.8	8	7	7070	Dixs Grant
7	Polygon	1137201000	165905.7	9	8	7045	Colebrook
8	Polygon	1708427000	189406.59	10	9	7050	Columbia
9	Polygon	536926080	112868.3	11	10	7210	Wentworths Locat
10	Polygon	1935938000	176429.5	12	11	7085	Errol
11	Polygon	1260530000	144672.09	13	12	7140	Millsfield
12	Polygon	104616900	42764.129	14	13	7090	Ervings Location

c) Click the ADD DATA button and add C:\INTROGIS\DATA\WATER_WBD8VT_POLY.shp

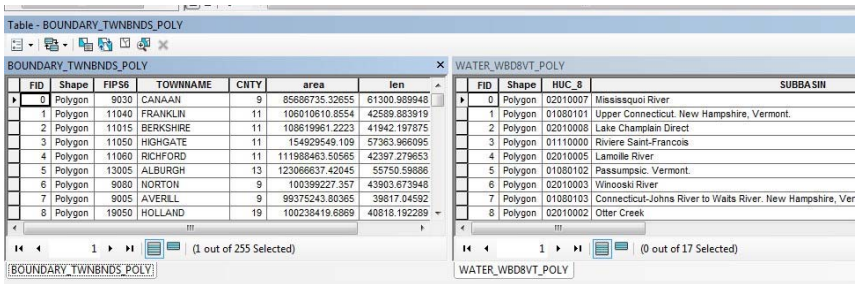
d) Right click on WATER_WBD8VT_POLY.shp and select Open Attribute Table. Notice that the WATER_WBD8VT_POLY.shp attribute table is docked as well, right where the BOUNDARY_TWNBNDS_POLY table had been. The BOUNDARY_TWNBNDS_POLY table is still open, and is accessible from a tab at the bottom left.



FID	Shape	HUC_8	SUBBASIN
0	Polygon	02010007	Mississquoi River
1	Polygon	01080101	Upper Connecticut. New Hampshire, Vermont.
2	Polygon	02010008	Lake Champlain Direct
3	Polygon	01110000	Riviere Saint-Francois
4	Polygon	02010005	Lamoille River
5	Polygon	01080102	Passumpsic. Vermont.
6	Polygon	02010003	Winooski River
7	Polygon	01080103	Connecticut-Johns River to Waits River. New Hampshire
8	Polygon	02010002	Otter Creek

e) You can also arrange the tables so they display side by side. To do so, grab one of the tabs (BOUNDARY_TWNBNDS_POLY or WATER_WBD8VT_POLY.shp) and pull it up toward the center of the table until the blue docking handles appear. Click on the handle to the right, and the table will dock to the right, just next to the other table.

Notice that the two tables share one set of tools at the top of the attribute table window (options, select by attributes, etc.). These tools work on whichever table is selected – that is, whichever table's title bar is blue.

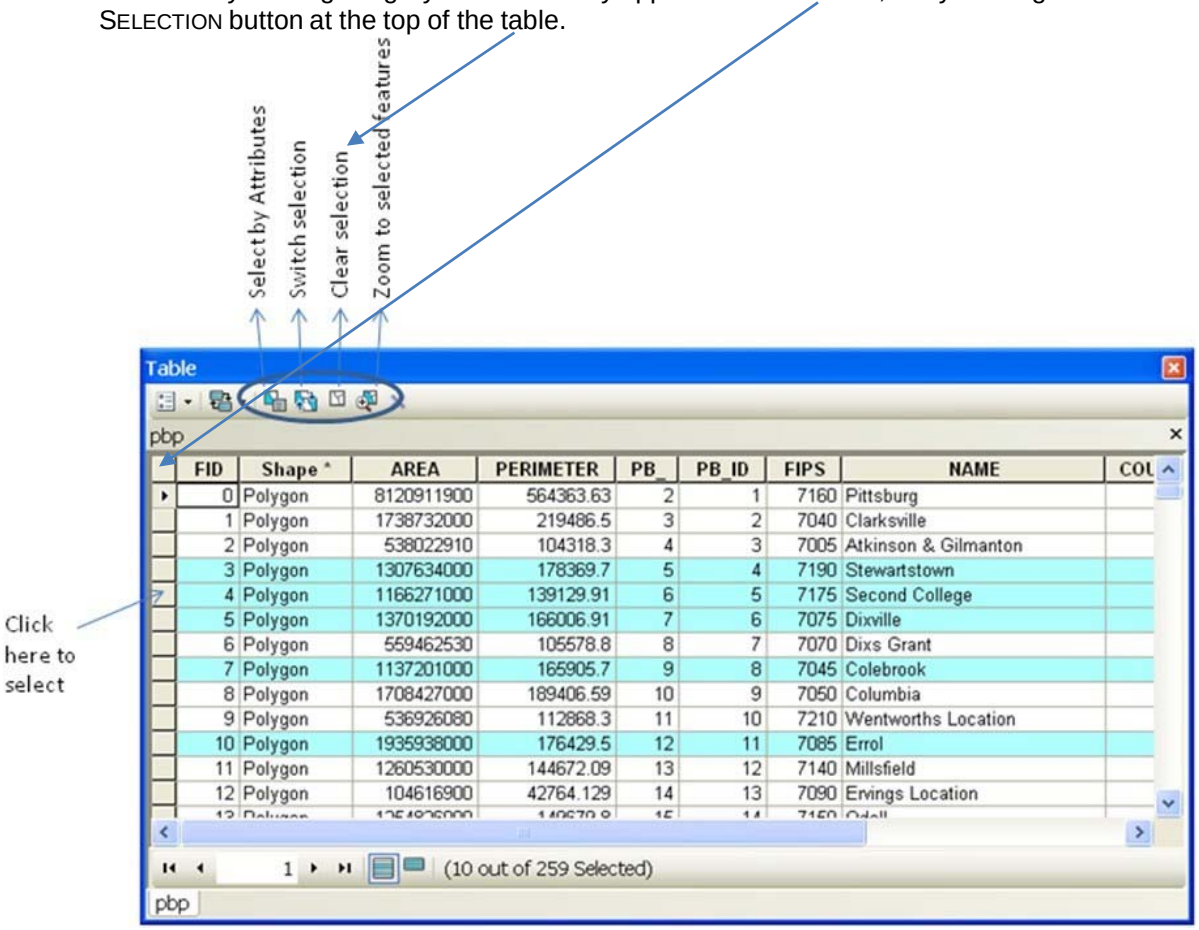


f) Close the WATER_WBD8VT_POLY.shp attribute table by clicking the X in its upper left hand corner.

4. Select Features in an Attribute Table

In an attribute table, you can select features by clicking on the small gray box at the far left of a row. You can click on just one row, drag down for several rows, or hold down the Ctrl key to select multiple rows.

a) Experiment with selecting towns by clicking on the gray box at the left. You can clear your selection by clicking the gray box in the very upper left hand corner, or by clicking the CLEAR SELECTION button at the top of the table.



b) Notice what happens to your map display as you select rows in the table.

c) After you have selected some features, try some of the other buttons and tools – use the ZOOM TO SELECTED FEATURES, CLEAR SELECTION, and SWITCH SELECTION buttons – what happens?

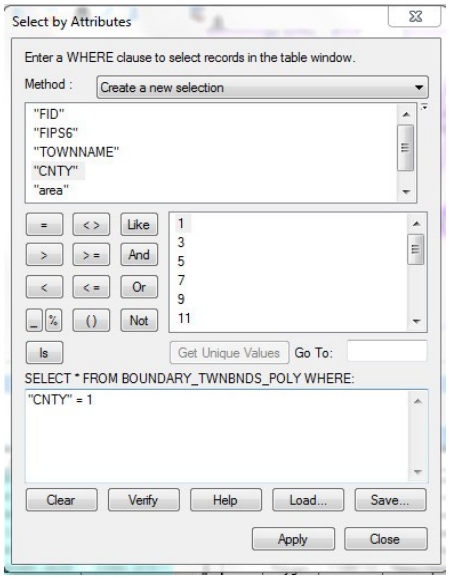
5. Select By Attributes

The Select By Attributes dialogue lets you write a query to select features based on the values in the attribute table.

a) Click the SELECT BY ATTRIBUTES button at the top of the table window.

b) Select all of Addison County by the following steps:
   i. Double click on the field "CNTY"
   ii. Single click on the = operator
   iii. Click the GET UNIQUE VALUES button
   iv. Double click on the number 1 (for Addison County)

c) Your statement should read: SELECT * FROM BOUNDARY_TWNBNDS_POLY WHERE: "CNTY" = 1 (Note that by clicking on the options as instructed above, you avoid having to know whether/where to use single quotes/double quotes, etc. You are much better off doing it this way than trying to type the statement in the dialog window!)



d) Click APPLY, then CLOSE. All of the towns in Addison County should now be selected.

e) For more guidance on writing selection queries, click the HELP button in the SELECT BY ATTRIBUTES dialog. ArcGIS's Help is actually remarkably helpful, and frequently gives very useful examples. Queries can be more complex than the ones we use here – combining multiple expressions, incorporating wild- cards, involving calculations, and so on. The help text gives many examples that may be quite useful to you.

6. Select By Location

In this next step, you will select from one feature based on its geographic location relative to another feature. Specifically, you will select all towns that Interstate 89 runs through (intersects). First you will need to select I-89, then you will select towns based on their location relative to I-89.

a) Clear any selected features you may already have by clicking the CLEAR SELECTED FEATURES button on the TOOLS toolbar.

b) Right click on TransRoad_RDSMAJ1_LINE and choose OPEN ATTRIBUTE TABLE.

c) Click the Select By Attributes button at the top of the roads attribute table.

d) Double click on the field RTNAME then click the = operator, then click the GET UNIQUE VALUES button.

e) Double-Click on I-89. Your statement should read: "RTNAME" = 'I 89'

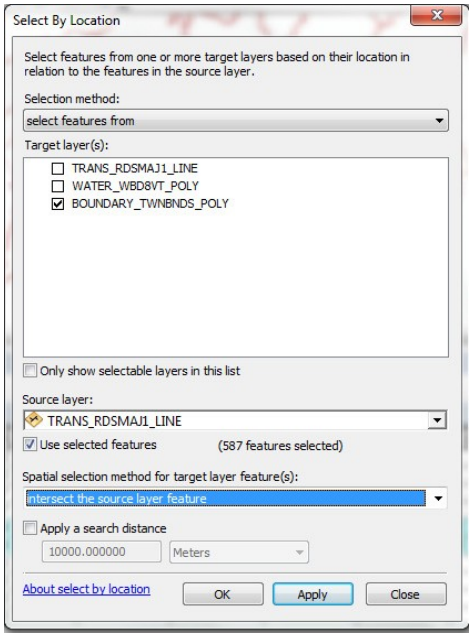
f) Click APPLY and then CLOSE.

g) From the SELECTION menu, choose SELECT BY LOCATION.

h) Select BOUNDARY_TWNBNDS_POLY as the target layer, TransRoad_RDSMAJ1_LINE as the source layer.

Make sure the box "Use Selected Features" is checked – otherwise it will search for any town intersected by any road. You want it to only find towns intersected by the selected road: Route 89.

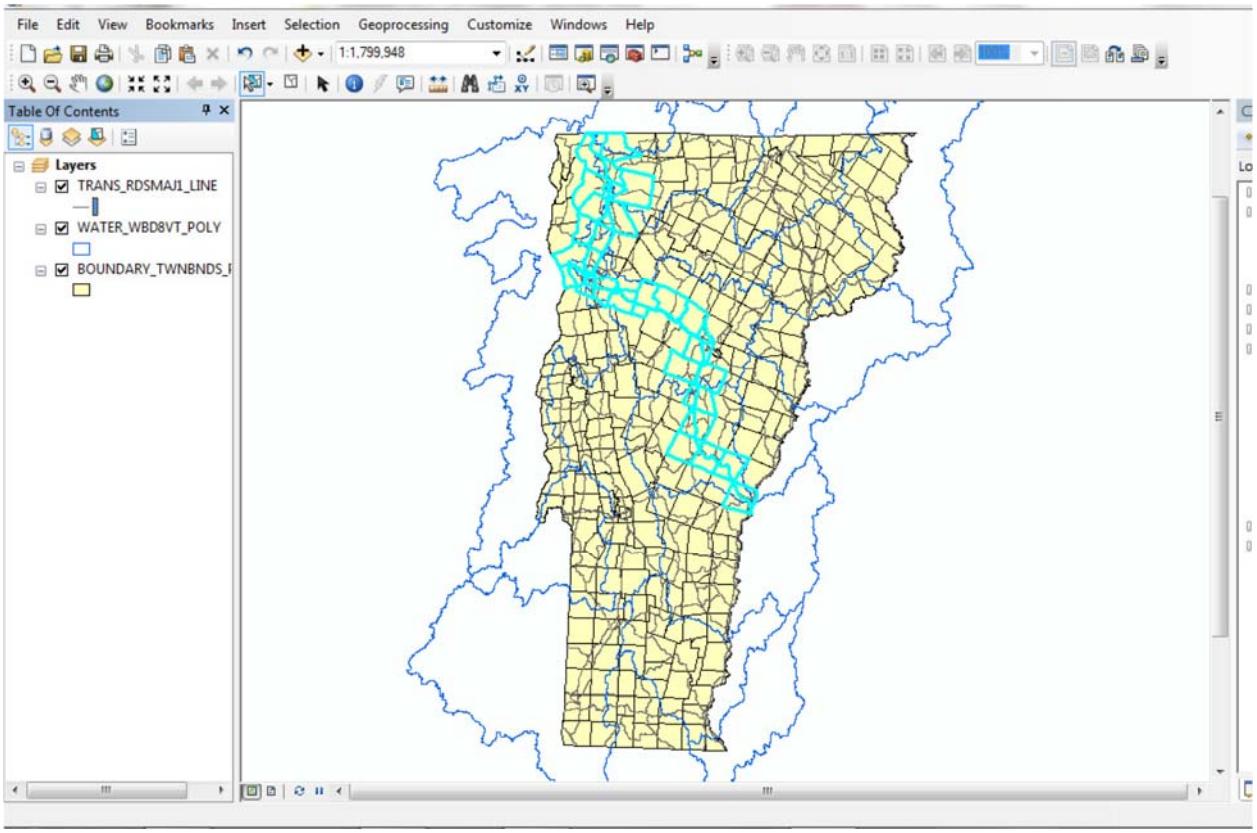
Note that if you wanted, you could apply a search distance – say, 10 miles – and find any towns that were within 10 miles of Route 89.



i) Click OK.

j) Turn off the roads layer and, if necessary, zoom to the full extent of NH so you can see the results of your selection.

k) Save your map.


File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:1,799,948
Table Of Contents
Layers
TRANS_RDSMAJ1_LINE
WATER_WBD8VT_POLY
BOUNDARY_TWNBNDS_

CHAPTER 7

Joining Tables

As with any other database, you can bring in data tables and join them to the tables in your GIS. In order to join tables, you need a field that is common to the two tables. For example, if you want to join population data to your political boundary attribute table, you would need to have a field in the population data that is the same as a field in the political boundary data. The political boundary data we are using in these exercises would require that you have population data by town and have a field that would identify the town by name or FIPS code. In this example, you couldn't join tables that have the population information by another geographic designation such as zip code because the shapes in the political boundary data do not represent zip code boundaries, they represent town boundaries.

The fields in both tables do not have to be named identically in order to join the tables, but they do need to contain the same information. For example, your population data may have a field entitled "Town" while the political boundary data's field is "Name". You would simply indicate to ArcView that "Town" and "Name" are fields to use for the join.

Although it is not necessary for the field names to be identical, it is necessary for the corresponding field values to be identical in order for a join to be successful. In this example, it is important that the town name be identical in each table. ArcView would not join the Income data to a record if, for example, the town is identified as "North Hampton" in one data table and "N. Hampton" in the other data table.

The income data used in this exercise can be downloaded from: http://www.state.vt.us/tax/pdf.word.excel/statistics/2012/

1. Open ArcMap

a) Start ArcMap with a new empty map.

b) If you are not already in DATA VIEW, switch to it by clicking the DATA VIEW icon at the bottom of the view window.

c) Click the SAVE button.

d) Navigate to C:\INTROGIS\PROJECTS and save your map as income.mxd.

2. Join a Layer with a Table

a) Click the ADD DATA button, and browse to

b) C:\INTROGIS\DATA\DEMO_COUSUB2010_POLY.shp and click Add

c) Next add Median_income_2012.csv

d) Right-click on DEMO_COUSUB2010_POLY.shp.

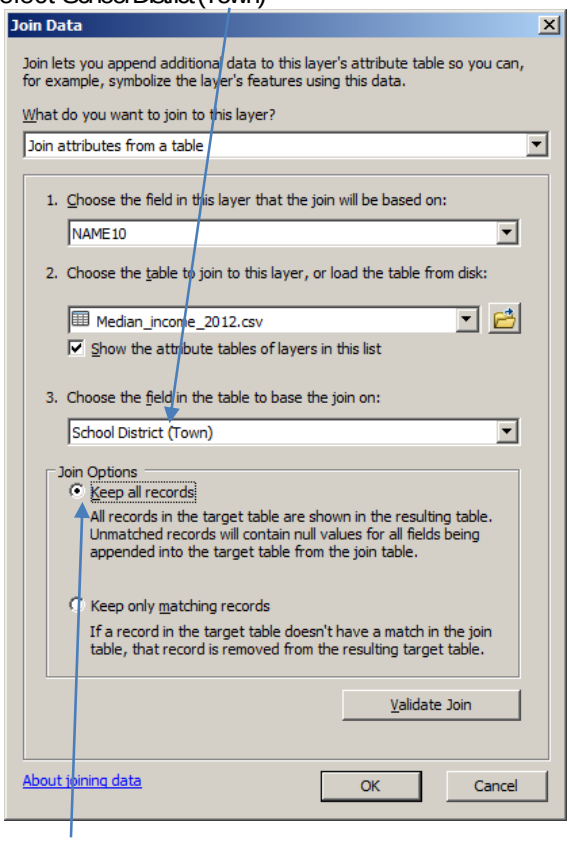
e) Select JOINS & RELATES, and then JOIN…

f) Select JOIN ATTRIBUTES FROM A TABLE.

g) Select the field NAME10 in Box 1.

h) In Box 2, The CSV You loaded should appear

i) In Box 3, select School District (Town)



j) Check the first box (which is the default) to keep all records.

k) Click OK to join the tables.

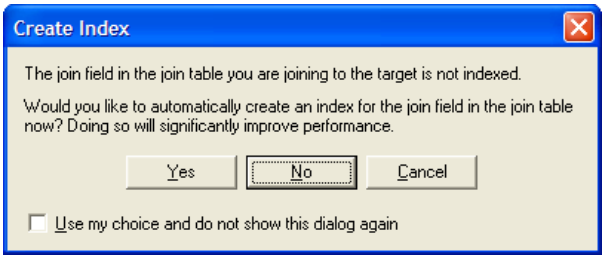
l) If a Create Index window pops up, click YES to create an index. If you like you can read more about indexing fields in HELP.

m) Right click on DEMO_COUSUB2010_POLY.shp, and select OPEN ATTRIBUTE TABLE.

n) Scroll across the table, and see that it now contains some fields about income.

o) Also notice that if you scroll down the table, a number of fields contain null values -- this can occur for a couple reasons – either the names used for the same town are slightly different, or, the data just don't exist in one of the datasets. This is more likely the case here. The income data are split into school districts, which are not the same thing as towns, but the resolution of these datasets are similar enough to almost be one-to-one

p) Close the attribute table.



3. Save Joined Tables as a New Shapefile

Remember that the tables you have joined -- the attribute table from DEMO_COUSUB2010_POLY and the income table, Median_income_2012.csv -- are still actually separate tables. This join is just a virtual join, and when you add DEMO_COUSUB2010_POLY.shp to a new document, none of the income data will come with it.

If you want to preserve this join, and make it easily available in other documents, you have two options. You could save DEMO_COUSUB2010_POLY.shp as a layer file, which will keep all of its current formatting including the join. Or you could save it as a new shapefile, which would not keep the formatting, but would permanently join the tables.

The layer method has the benefit of not duplicating your data, but also means that if you were to share the data, you would have to remember to pass on several files: If you save it as a new shapefile, you would duplicate your data, which makes it harder when you update either the DEMO_COUSUB2010_POLY.shp shapefile or income table, but your data would all be contained in one shapefile.

In this exercise you will save the joined data to a new shapefile.

a) If the attribute table is not already open, then right click on DEMO_COUSUB2010_POLY.shp and select OPEN ATTRIBUTE TABLE.

b) Leave the ATTRIBUTES TABLE open, right click on DEMO_COUSUB2010_POLY.shp in the Table of Contents, and choose PROPERTIES.

c) Click on the FIELDS tab.

d) Uncheck any fields that you don't think you will need in your exported shapefile.

e) Click OK to close the PROPERTIES window, and then close the attribute table.

f) Right click on DEMO_COUSUB2010_POLY.shp, and choose DATA - EXPORT DATA.

g) Navigate to C:\INTROGIS\DATA\, and name the new file MEDIAN_INCOME.shp.

h) Click OK in the Export Data dialog.

i) Click YES to add the new data to your map.

j) Right click on MEDIAN_INCOME, and open the attribute table.

k) Scroll across the table. Notice that all of the population fields are present, and that the field names no longer show the source table prefix.

l) Close the attribute table.

m) Save your map.

CHAPTER 8

Edit Data in ArcMap

In ArcMap, accidentally editing the actual geography of your data (or easily changing its attributes) is prevented by an extra step: opening an editing session.

In this chapter, you will start an editing session and create new features, define their attributes, and alter existing features.

1. Edit Features

In this exercise, you will edit an existing polygon shapefile. Using aerial photographs for reference, you will digitize new polygons and split, reshape, and attribute existing ones.

a) Start ArcMap and open an empty map document. Add some VCGI statewide aerial imagery via Web Map Service, then add ENVIRON_MAREA2004_POLY.shp

b) From the CUSTOMIZE menu, select TOOLBARS, and then click the EDITOR TOOL-BAR.

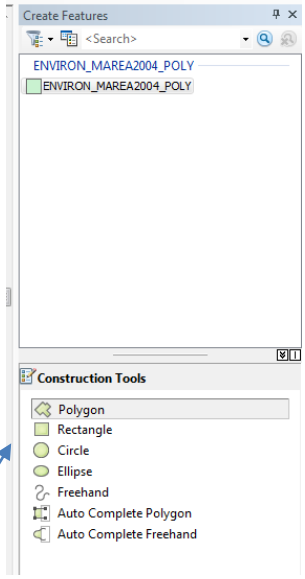
c) Dock the EDITOR TOOLBAR at the top of your screen.

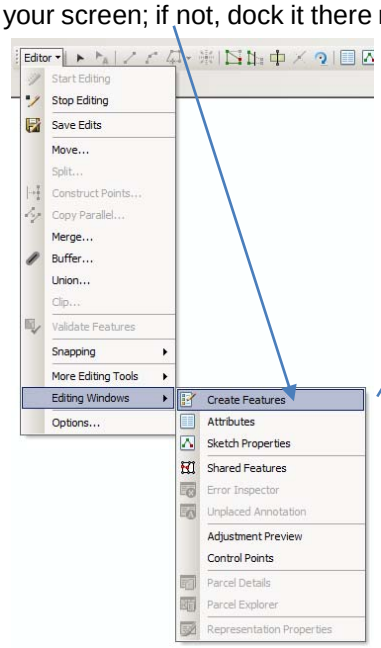
d) From the EDITOR menu on the new toolbar, choose START EDITING.

e) You need to select the folder or workspace in which you will edit. You can just select the layer (or one of the layers) you wish to edit, and its workspace will become editable.

f) Double-click on ENVIRON_MAREA2004_POLY to start editing.

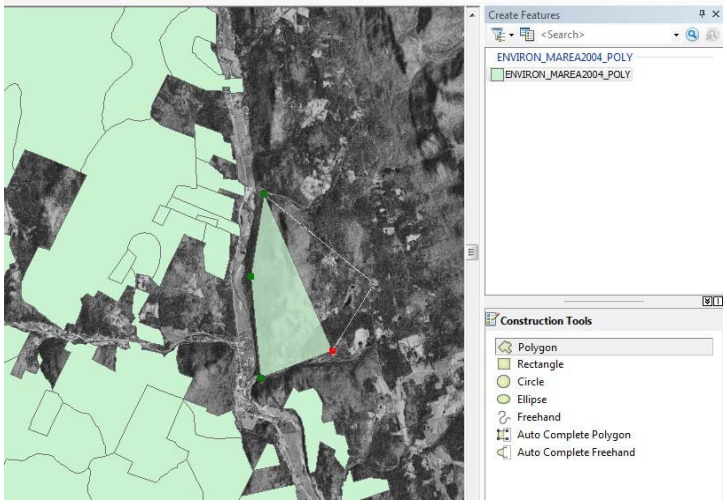
g) The Create Features window may appear. It is probably docked at the right hand side of your screen; if not, dock it there now.





h) The top of the Create Features window displays the layers that are available for editing. In our example, only ENVIRON_MAREA2004_POLY is available. When you single-click on it, Construction Tools appear in the lower window.

i) Start by clicking on Polygon in the CREATE FEATURES pane



f) Now you will start to digitize an additional managed area to add to the Green Mountain National Forest. Pick an area to the east of the existing polygons, and not touching them; click all the way around its border. When you are done, you can double-click or press F2.

The field you just digitized does not touch any of the already digitized areas. If you want, you can practice drawing a few more isolated polygons.

As you started editing, you probably noticed the semi-transparent FEATURE CONSTRUCTION TOOLBAR that followed your cursor around. It contains tools that could conceivably be helpful (and that you will use later in this chapter) but the toolbar sometimes really gets in the way! If you want the toolbar to stay visible, but get out of your way, just click the TAB button. After you have practiced with editing a bit, you may decide that you want to close the toolbar and not use it at all; if that is the case, go to EDITOR > OPTIONS > GENERAL tab and remove the check mark next to “Use mini toolbar.”

2. Save Your Edits

While you are editing, you need to remember to save your edits regularly -- possibly after adding each new feature.

a) To save your edits, pull down the EDITOR menu and select SAVE EDITS.

b) To save your map, click the SAVE button on the STANDARD TOOLBAR.

Saving your edits and saving your map are two different things. You must remember to save your edits! Simply saving your map will not do so!!

3. Reshape an Existing Polygon

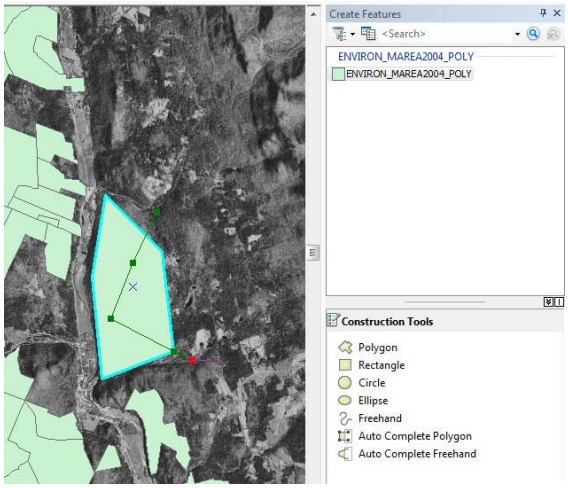
Pretend for a minute that you are not happy with the job you did tracing that field, and want to change (reshape) a bit of it.

a) Click on the SELECT tool on the EDITOR TOOLBAR.

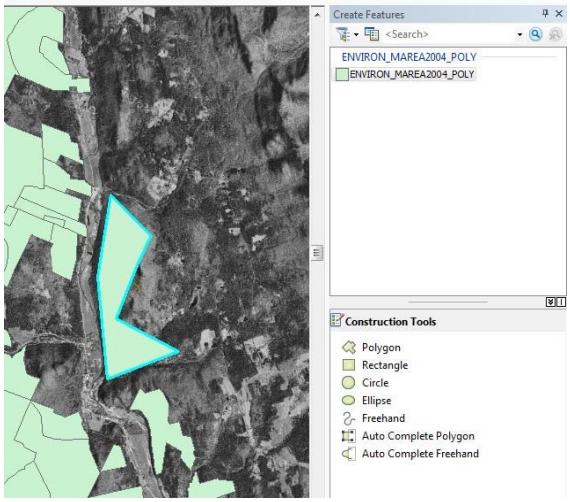
b) Select the polygon you just drew by clicking on it.

c) Click on the RESHAPE tool on the EDITOR TOOLBAR.

d) Starting outside your polygon, digitize a half circle that dips into your polygon and finishes outside of it again. Double-click or press F2 when you are done.



d) The field should have been reshaped as if you had cut along that line and discarded the remainder.



f) See what happens if you do it the opposite way: start inside the existing polygon, digitize a line that dips out of the polygon and finished inside of it again. Another way to change the shape of your polygon is to move individual vertices.

g) Click on the EDIT VERTICES tool on the EDITOR TOOLBAR.

h) A new small toolbar is added to your view.

i) You can select and drag any of the vertices of your polygon. You can use the + and - tools on the Edit Vertices tool bar to add and delete vertices. When you are done, click F2

j) Save your edits.

4. Digitize Abutting Polygons

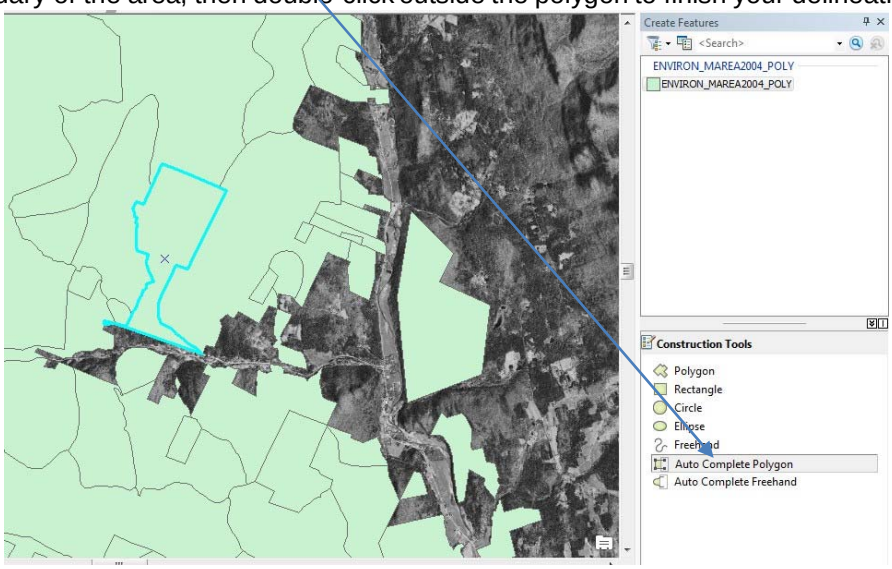
When digitizing polygons, one would frequently want to create polygons that perfectly abut one another -- that is, they completely share a boundary, and do not slightly overlap or have small gaps between them. This would be very difficult to do if you simply tried to trace along an existing boundary as you digitized a new polygon. Luckily there is a special construction tool just to accomplish it: the Auto Complete Polygon tool.

Now you will create a polygon for the managed area to fill in an area not currently in the GMNF. Using Auto Complete Polygon to make it abut an existing polygon.

a) Hold down the Shift key and select polygons surrounding an area that is mostly within GMNF.

b) Choose the Auto Complete Polygon tool

c) Click outside the new polygon to start delineating the area, click along the approximate boundary of the area, then double-click outside the polygon to finish your delineation.



The actual shape of the area you digitize does not matter right now -- just be sure that you understand where to start and finish when using this tool. To digitize polygons that perfectly abut other polygons, first you must select the existing polygons, then start and finish editing within them.

d) After you have completed your polygon, double-click or press F2.

e) Save your edits.

5. Create a New Shapefile

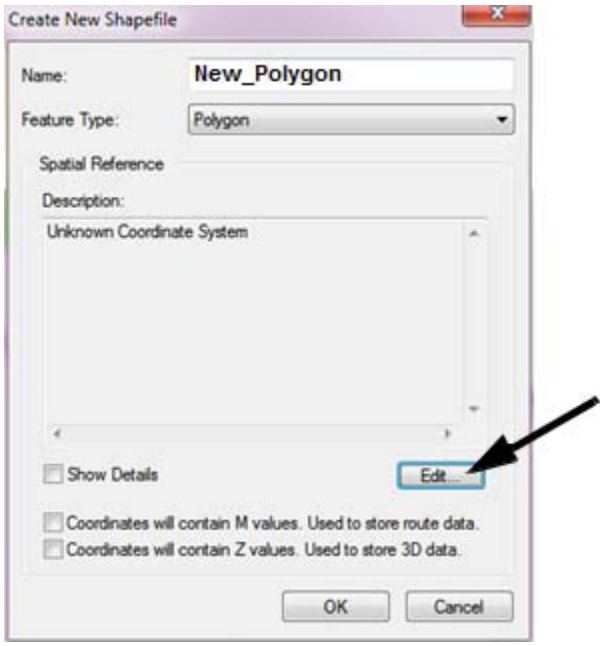
In this exercise, you will create a new shapefile representing either an additional managed area or something more meaningful to you!

Before you can start drawing the property boundary, you will need to create an empty shapefile to work in. You will do this in Catalog.

a) Open the catalog window, and browse to the folder C:\INTROGIS\DATA.

b) Right-click on the folder name and choose New > Shapefile.

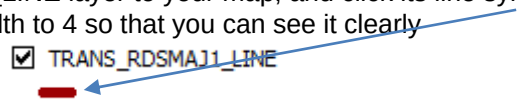
c) Name your shapefile New_Polygon, and make it a polygon shapefile.



d) Click the Edit button at the bottom of the window to define the new shapefile's spatial reference. Choose: Projected Coordinate Systems> State Plane> NAD 83 Meters> then scroll down until you find the VT coordinate system. Click on it then click on OK. Then click on OK again.

e) Add this new layer to ArcMap, and left click on New_Polygon in the Table of Contents to change its fill color to none and its outline color to something bright, like orange or fuchsia.

f) Add the TRANS_RDSMAJ1_LINE layer to your map, and click its line symbol in the Table of Contents and change the width to 4 so that you can see it clearly



f) Right click on New_Polygon in the Table of Contents and select Edit Features > Start Editing.

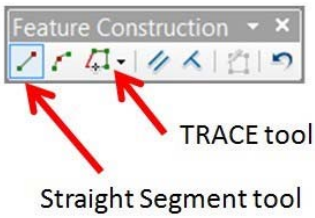
g) In the Create Features window, click on New_Polygon to display the available construction tools.

h) With the Polygon tool, begin delineating the property boundary. Start in the southwest corner. Notice that the FEATURE CONSTRUCTION toolbar follows your cursor around for easy access. Sometimes, however, it just gets in the way. You can grab its title bar and move it out of the way.

Try the various buttons and tools in the editing toolbar and the create features window.

It may be a little hard to tell at first which buttons are "on" and which are "off." It may also not be obvious what the function of each button is – remember that Tool Tips will define the buttons for you if you hover your cursor over them for a moment.

Next you will make a polygon follow the path of a road using the Trace tool.



a) From the Feature Construction toolbar, choose the third option – the Trace tool. Click on the nearest road, and follow it as it forms the boundary of your property.

b) When you get to the end of the bounding road segment, click once to finish tracing, and then switch tools again. From the Feature Construction toolbar, choose the first option - the Straight Segment tool.

c) Continue until you have delineated the entire boundary. When you are done, you can double click to finish your sketch, press F2, or choose the Finish Sketch button on the Feature Construction toolbar.

d) From the Editor menu, choose Save Edits.

CHAPTER 9

Symbolizing Data

In this exercise, you will work through several different methods of symbolizing data, using town and county data and 2010 census data. ArcGIS uses the information in a layer's attribute table (such as county name or population) to symbolize the data.

After working through some of the Symbology options, you will probably begin to get an idea of how much work can go into making a data set look the way you want it to. It would be very time-intensive to go through that effort each time you wanted to use a common data set. Fortunately, you do not have to--you can save the Symbology (and more) as a layer file.

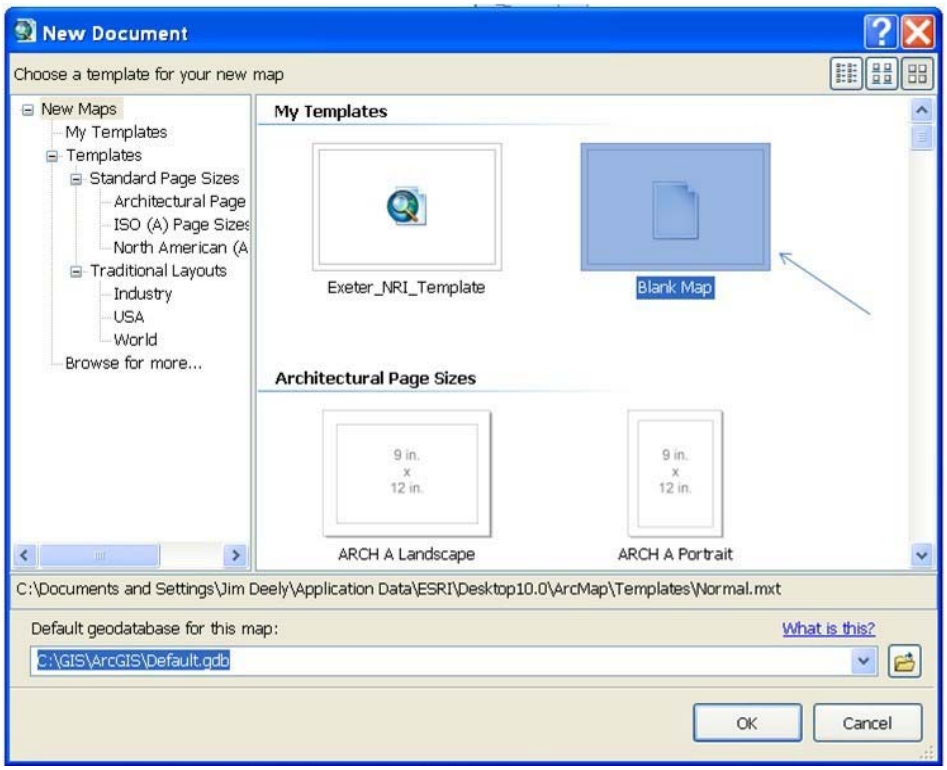
In ArcGIS, a layer stores the Symbology, query, labeling, and other qualities of a theme that you have set in your map document. Your map is really made up of layers -- the document does not contain the data files themselves, but pointers that reference the data files. But unless you explicitly save a layer file, all of the Symbology you set in your map is only saved in the map document itself, and cannot be used in other maps.

In this exercise, you will learn how to save a layer file outside of your map, so you can later add it to other maps. When you make a new map and want to include the same kind of features, you can add the layer instead of the base shapefile, and all of the Symbology will be included. Remember that a layer file does not actually include the data itself— it references a data set stored elsewhere.

1. Symbolize Using Unique Values

In this example, you will symbolize each county with a different color.

a) Open a new, empty map. If ArcMap is closed, start it up and choose a blank map at the template/intro screen. If ArcMap is already open, click the NEW MAP FILE button at the upper left (on the STANDARD TOOLBAR).



a) Choose Blank Map from the New Document dialog.

b) Click the SAVE button and navigate to C:\INTROGIS\PROJECTS

c) Name your map Symbology.mxd.

d) In the ArcCatalog pane, browse to INTROGIS\DATA and add DEMO_TOWNPOPN_POLY and Boundary_CNTYBNDS

e) Right-click on the name Boundary_CNTYBNDS in the TABLE OF CONTENTS and choose the last option, PROPERTIES. (Alternatively, just double-click on the name BOUNDARY_CNTYBNDS.)

f) Take a minute to browse through the PROPERTIES window (double- click a layer name or right-click | properties to open this window). This is where you can change all these different properties that affect how a layer is drawn in your map – including labels, transparency, fields to be displayed, and symbology.

g) Select the SYMBOLOGY tab at the top of the PROPERTIES window.

h) Do the following steps to symbolize each county with a unique color:

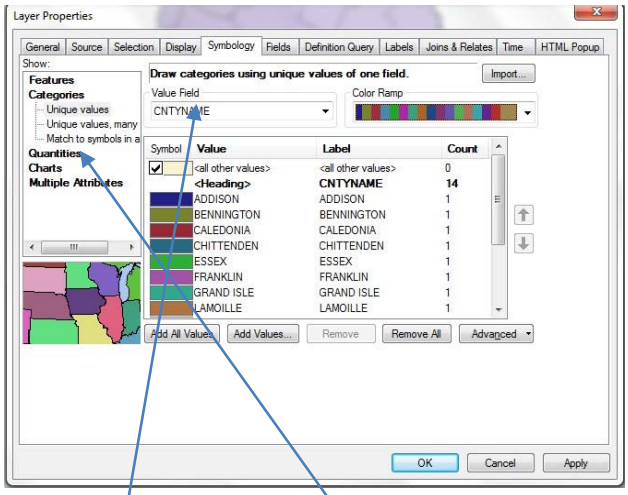
   i. On the far left, click on CATEGORIES, then on UNIQUE VALUES.

   ii. From the Value Field menu, choose CNTYNAME.

   iii. Click the ADD ALL VALUES button near the bottom of the window.

   iv. Choose a color ramp that seems appropriate.

   v. Click OK.



Each county should now have a different color on your map.

You can also classify colors based on values – try using Quantities | Graduated Colors, instead of Categories, and "area" instead if CNTYNAME – and choose a color

- Notice how your map is now ordered in color by area for each county

2. Change Line Symbology

In this exercise you will change the line symbology for DEMO_TOWNPOPN_POLY.

a) Make sure DEMO_TOWNPOPN_POLY is above Boundary_CNTYBNDS in the table of contents. You will noticed that the towns now completely hide the counties.

b) Double-click on DEMO_TOWNPOPN_POLY to open its PROPERTIES window.

c) Make sure you are on the SYMBOLOGY tab at the top of the PROPERTIES window.

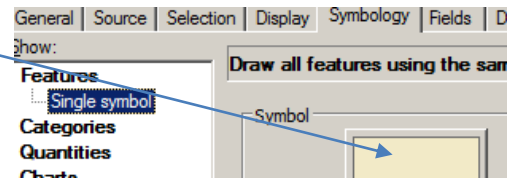
d) Do the following steps to symbolize the town boundaries:

i. double-click on the color swatch

ii. Choose the hollow color swatch

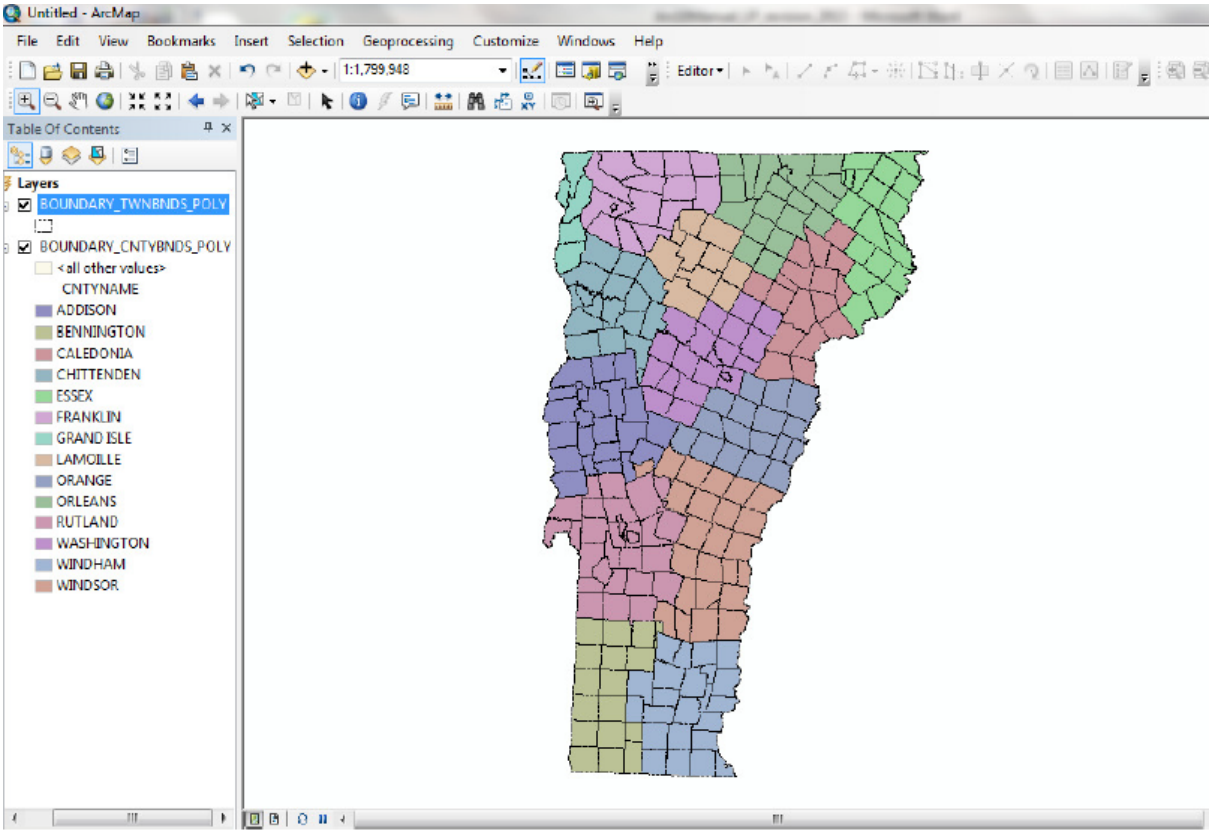
iii. Click on "edit symbol"

iv. Click on "outline"



v. Scroll down to learn about various line symbol options. Pick one and click on it.

vi. Click OK many times until you are back at your map, with the new town boundary Symbology applied.



j) Save your map!

4. Symbolize with Graduated Symbols

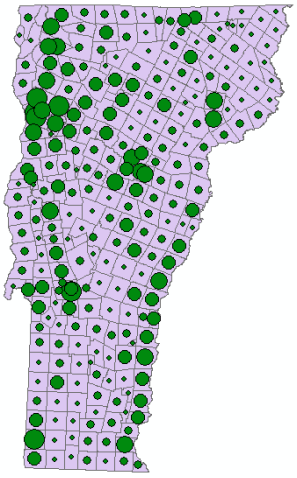
a) In the Towns layer properties window, click on GRADUATED SYMBOLS under the QUANTITIES heading.

b) Set the VALUES FIELD to POPN2000

c) Click the TEMPLATE button if you want to change the symbol.

d) Click the BACKGROUND button if you want to change the background color.

e) Click OK.



CHAPTER 10

Working With Labels

There are many different ways of adding text to your map -- some are very quick (and usually don't look great) and some will take quite a while (and can be customized until they look just the way you want them).

In this exercise, you will use graphic labels to label the counties on your census map, use dynamic labels to define road and highway shield labels, and use dynamic labels to label all the towns in the state. You will also set up scale-dependent rendering for some of the labels, so that your map is not too busy with labels when zoomed out, and finally convert labels to annotation so that they can be used again in other maps.

1. Add Graphic Labels

a) Return to your population map in ArcMap. It should be saved in the C:\INTROGIS\PROJECTS folder and is called Symbology.mxd
b) If ArcMap is not yet open, open ArcMap using the desktop icon, and select Symbology from the existing maps list. You may have to click "Browse for More" to locate it.
c) If ArcMap IS already open, click the OPEN FILE icon and browse to the population map.

Make sure that you are in DATA VIEW (not LAYOUT VIEW). One way to identify this is to see if the display looks like a page of paper, with margins around the edges – this is layout view. You can also check if the LAYOUT TOOLBAR is active; if you are in data view, each tool will be grayed out (as below).

Perhaps the easiest way to confirm that you are in Data View is simply to click the data view button at the bottom of the screen. If you are already in Data View it won't do anything; if you are in Layout view it will switch you over.

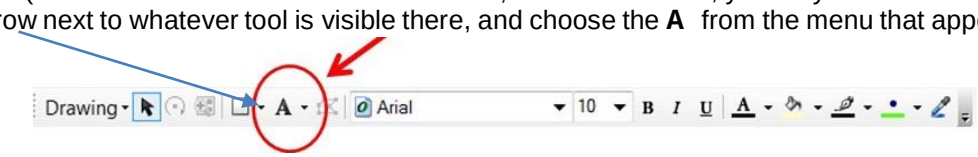
When you are labeling your data, do so in data view. If you are labeling your map page (such as adding a title or date), do so in layout view. This chapter is about labeling data, so we will work primarily in data view.

a) Make sure the DRAW TOOLBAR is visible -- it is usually docked at the bottom of the screen, and has a menu called DRAWING on its left side.

b) If it is not already visible, go to CUSTOMIZE > TOOLBARS > DRAW.

c) Turn off all layers except BOUNDARY_CNTYBNDS. You should see just the county boundaries.

d) Choose the TEXT tool from the DRAW TOOLBAR. Do this by clicking the **A** on the Draw Toolbar. (It should be the sixth tool in from the left; it is not available, you may have to click on the arrow next to whatever tool is visible there, and choose the **A** from the menu that appears.)



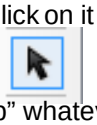
e) The NEW TEXT tool allows you to type text on your map. If you do this in Data View, the text will move with your data as you pan and zoom the data; if you add the text in Layout View it will stay in one place relative to the map page. Here, you will use the NEW TEXT tool to label the counties, so we are working in data view.

NOTE: When you use the NEW TEXT tool, you will manually type in the text you want on your map. Later you will use tools that automatically bring in text from the data's attribute table.

f) Click in the middle of any county you know and type the name. You can use the tools on the Draw Toolbar to change the font, font size, color, etc. of your text. Continue to add county names for the rest of VT's counties. You will need to pick up the text tool again (click on it) each time you want to type a new name.

If you do not already know the county names, this would actually take some effort to figure out from your GIS data -- you would need to return to the metadata, look at the numerical county codes for the towns, and find the county name that corresponds to each numerical code.

Note that the text that you add with the NEW TEXT tool is selectable and editable. If you want, you can select a piece of text and move it to a new location, change its color, double-click on it and change the text itself, etc. Use the arrow tool on the TOOLS TOOLBAR to select the text.



The arrow tool is a handy, neutral tool to return to whenever you want to "drop" whatever tool you currently are using.

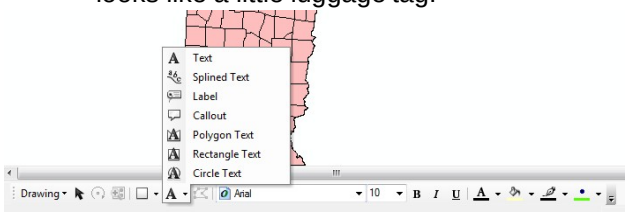
2. Use the Label Tool

In this step you will practice using the LABEL tool, which will add text to your map by drawing from the data's attribute table. You will be labeling individual towns in VT.

a) Turn on DEMO_TOWNPOPN_POLY in the Table of Contents. Turn off any other layers that might be visible.

b) Zoom in a bit to focus on a few towns. (A scale of 1:400,000 or so may be good.)

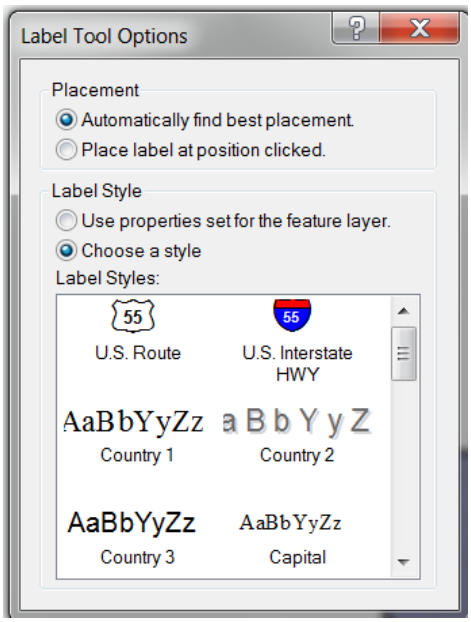
c) Choose the LABEL tool from the Draw toolbar. Do this by clicking the tiny triangle next to the **A** on the Draw toolbar -- this will give you a menu of tools to choose from. Select the one that looks like a little luggage tag.



d) With this tool, click a few times in the middle of different towns.

This tool works on whatever VISIBLE layer is on top in the Table of Contents. In this example, we have only one visible layer, so that is what it is labeling: BOUNDARY_TWNBNDS_POLY. Sometimes, you may have many visible layers and not want to turn the rest off. In that case, you can temporarily drag the layer you want to label to the top of the Table of Contents, and remember to drag it back to its original position when you are done labeling.

When you choose the tool and click on your map, you will be prompted with a LABEL TOOL OPTIONS window. You may use the default options (letting the computer choose the best placement, and using the properties set for the layer). Alternatively, you can change these options: have it place the label wherever you click, and/or choose a label style through this dialog.



e) Notice that the computer automatically labeled each town you clicked with the town name as it is recorded in the DEMO_TOWNPOPN_POLY attribute table. That is because the GIS by default set the name field as the label field. You can change these settings in the layer properties.

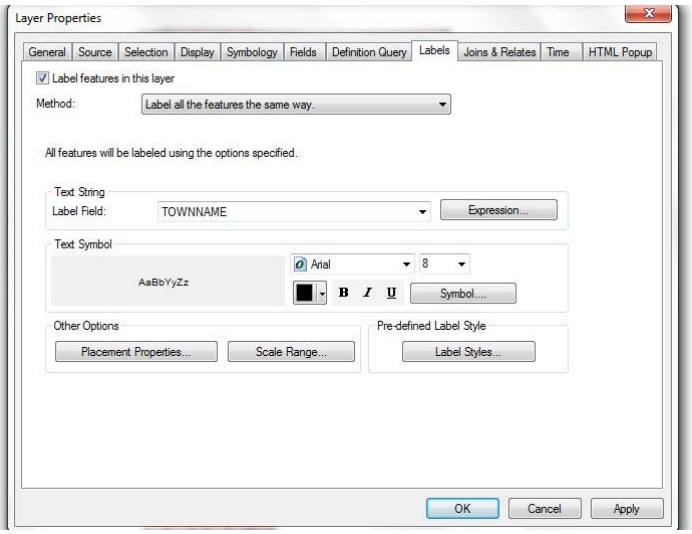
3. Use Dynamic Labels

It would be difficult and tedious to label every town in the state using the label tool. Instead, there is an easier option: dynamic labels. This will automatically label every feature in a layer -- in this case, every town in VT.

a) First, use the arrow tool to select the town labels you just added.

b) Click the Delete key on your keyboard to delete them. (You can draw a box with the arrow around multiple labels, or hold down the shift key while you click on multiple labels.)

c) Double click on DEMO_TOWNPOPN_POLY in the TABLE OF CONTENTS to open its PROPERTIES window.



d) Click on the Label tab.

For each layer that you add to a map, ArcMap chooses a Label Field -- usually “Name” if that is a heading in the attribute table. You can change these default settings -- for example, you could decide that you want to label your towns with their acreage rather than the town name. We will choose “TOWNAME”

e) Put a check mark in the box in the upper left hand corner of the window to “Label features in this layer.”

f) Click OK.

Hooray -- every town is now labeled! And if you are still zoomed in, it might even look OK. However, as you zoom out to the whole state, you will see why this method has some drawbacks: the labels are generally too large for the towns, and -- worse -- they are not selectable or editable. (Try it -- grab the arrow tool and try to select those labels: it just doesn’t work.)

4. The Label Manager

There are a number of ways that you can refine your labels: change the text size to something smaller; set a scale dependency so that they only show up when you are zoomed in; convert them to annotation so that you can edit them individually. If your map is going to always be an electronic map that you will actively zoom in and out of, changing the text size and setting a scale dependency are good options. If your map will be a printed map and/or will always be viewed at the same scale, converting to annotation will allow you to really fine-tune the labels’ appearance.

Like so many things when working with ArcGIS, there are several different paths you can take to get to the same result. Here, you can refine your labels in two different places: the LABELS tab of the PROPERTIES window, or the LABEL MANAGER available through the LABELING TOOLBAR.

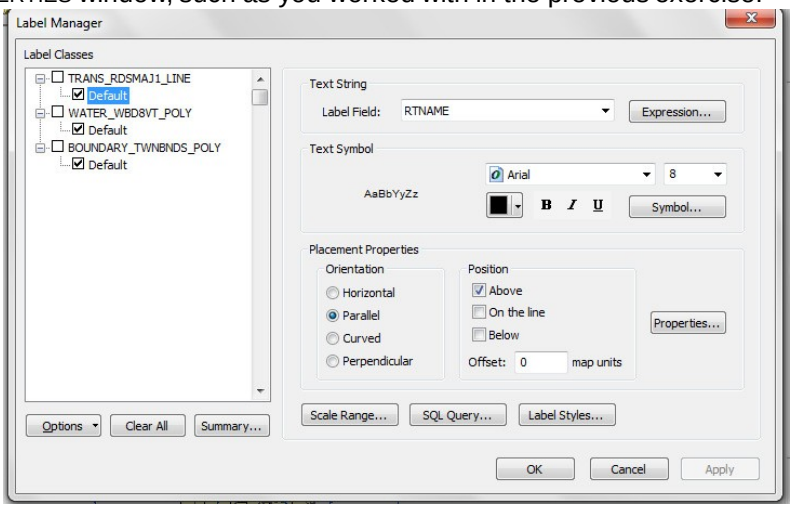
If you have ArcGIS v.10.1 or higher, you also have a choice of two different labeling methods: the standard label engine or the Maplex label engine. (Maplex was available in earlier versions, but only as an extra extension to the software.) The Maplex Label Engine has a number of special tools for controlling the labels; in general, these will probably make your labels look better, so we will use Maplex in this exercise.

a) From the CUSTOMIZE > TOOLBARS menu, choose LABELING.

b) Dock the Labeling toolbar at the top of your screen. The LABELING toolbar and the LABEL MANAGER that you can access through it work with both label engines -- standard and Maplex. First you will quickly check out how the LABEL MANAGER works and the label options available with the standard label engine.

c) Click the first icon on the toolbar to open the LABELING MANAGER.

Along its left hand side, the LABEL MANAGER displays a list of the feature layers in your TABLE OF CONTENTS. Along the right hand side, it displays basically the same label options that you would find in any layer's PROPERTIES window, such as you worked with in the previous exercise.



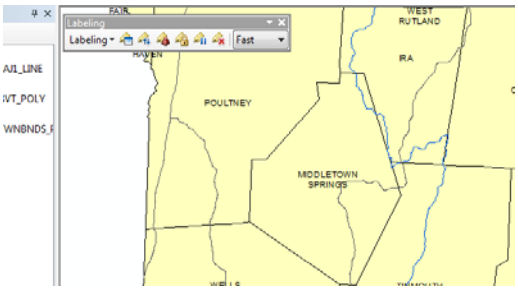
The main benefit of using the LABEL MANAGER when working with the standard label engine is simply that it collects all the different layers together in one place so you can manage their labels together.

Feel free to apply some changes to the DEMO_TOWNPOPN_POLY label settings. For example, you may want to experiment with the placement options (horizontal vs. straight (e.g., following the long axis of the polygon)) or set a scale range. When you are done, click OK to close the LABEL MANAGER.

5. The Maplex Label Engine

a) From the LABELING menu, choose USE MAPLEX LABEL ENGINE.

b) Zoom in a bit if necessary to see the effect of switching to Maplex. You should see that some town names are now on two lines ("stacked" labels).



c) Open the LABEL MANAGER by clicking the first icon on the LABELING toolbar. Note that the label options are slightly different now.

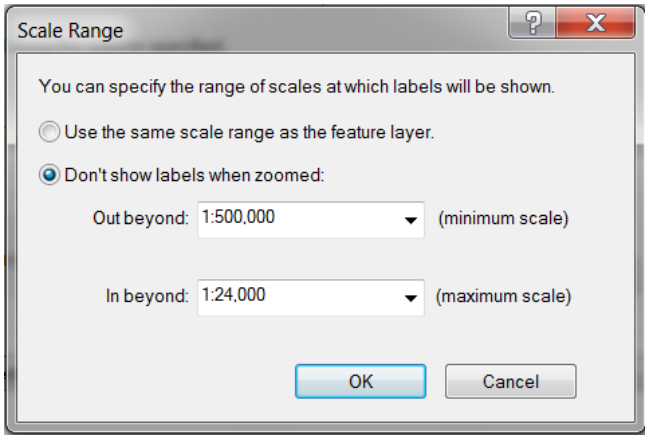
c) Change the PLACEMENT PROPERTIES from “Regular Placement” to “BoundaryPlacement”. Click OK to see the effect of your changes.

e) Scroll in and out on your map to see how the labels scale with your map. (You may find this easiest using the scroll wheel on your mouse.) Note the scale at which you think the labels get too crowded -- is it 1:100,000? 1:300,000?

f) Return to the LABEL MANAGER window again. If you like, adjust the font and font size, then click APPLY.

g) Click the SCALE RANGE button at the bottom of the window.

h) Now click the SCALE RANGE button at the bottom of the label manager window, and within the dialog that pops up, enter the smallest scale at which you think your labels looked OK. You may also want to enter a large scale beyond which you wouldn’t want them to display -- it can look strange to be zoomed in to a very localized area and have a town name in the middle of your map. Values like 1:400,000 and 1:24,000 typically work pretty well.



i) Click OK and OK to close the LABEL MANAGER window. Zoom in and out on your map to explore the scale dependent label rendering you just set up.

6. Convert to Annotation

If you want to really get into your labels and change them individually, you have two options: either you can start with graphic labels (like the County labels you added manually), or you can start with dynamic labels and convert them to annotation.

Annotation is wonderful in that it can be saved outside of your map in a geodatabase and added to multiple maps, just like any other data set. Each piece of text (such as each town label) is a separate row in an attribute table, and all of the text’s properties (font, angle, color, etc.) are attributes in that table.

The downsides to using annotation are that it can be time-consuming to set up (though if you use it frequently, it will certainly save you time in the long run); the labels are no longer dynamic -- that is if you change a value in the source data (like fix a typo in a town name), that will not be reflected in the label; and they are specific to one map scale -- they will not zoom in and out with your data. So annotation is most useful for printed maps and electronic maps that are intended for a specific scale.

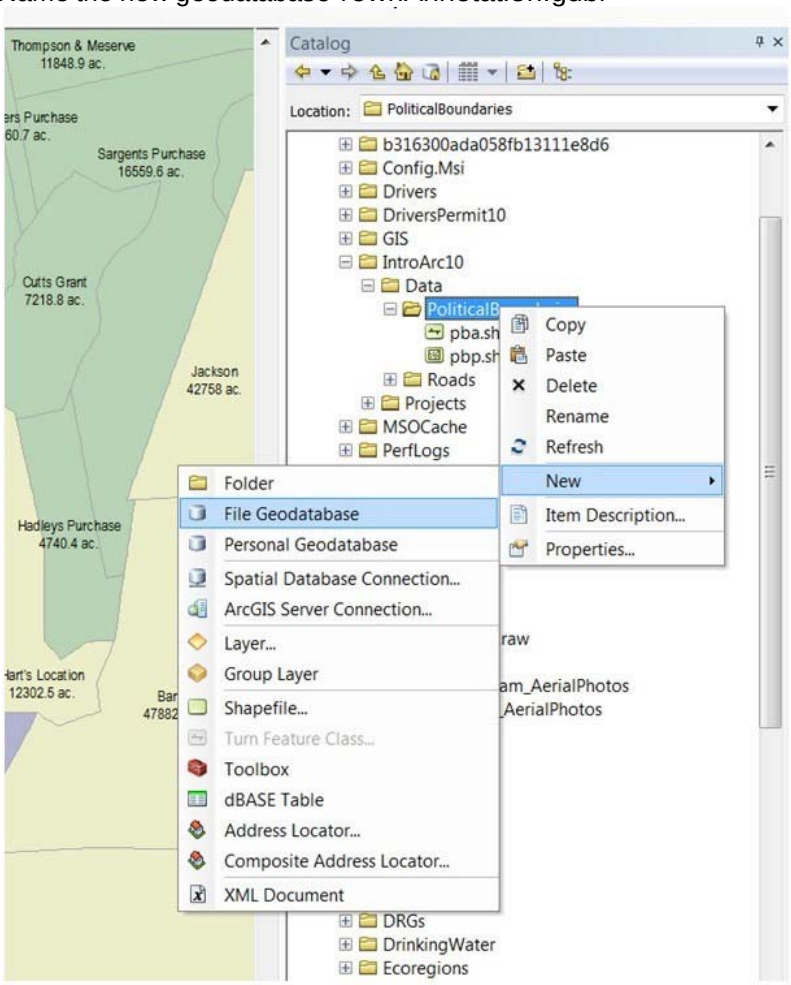
In this exercise, you will convert town labels to annotation for a hypothetical map that will be at 1:200,000.

a) Zoom your map to 1:200,000.

b) Make sure your town labels are visible and are an appropriate size for this scale. If not, make the necessary changes in the BOUNDARY_TWNBNDS_POLY properties window to fix it.

c) Create a geodatabase in which to store your annotation. From the catalog pane, expand the catalog tree so you can see the INTROGIS\DATA folder. Right click on the folder and select NEW > FILE GEODATABASE.

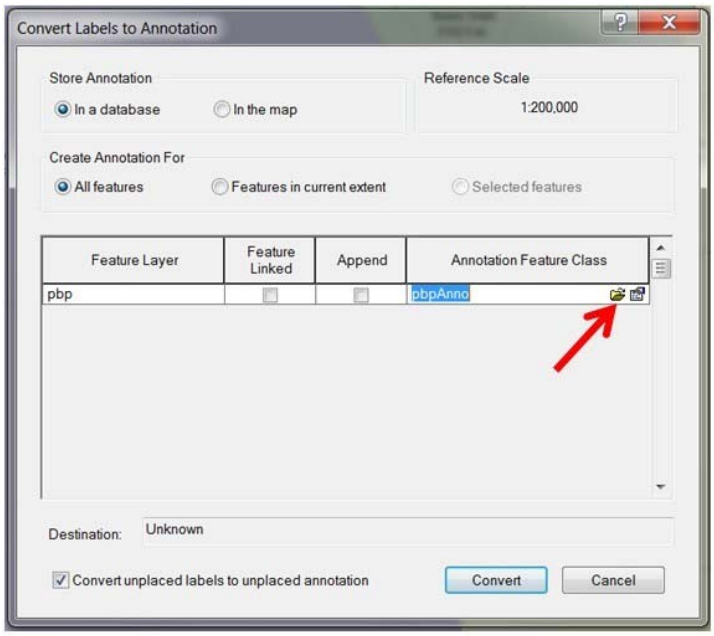
d) Name the new geodatabase TownAnnotation.gdb.



e) Right click on the layer name BOUNDARY_TWNBNDS_POLY in the TABLE OF CONTENTS and select
CONVERT LABELS TO ANNOTATION.

f) In the window that appears, confirm that the selections are to store annotation in a database and the reference scale is 1:200,000.

g) Click the browse button to identify the geodatabase where the annotation will be stored



h) Browse to the new geodatabase you just created and double-click to open it. Click SAVE.

i) Instead of the default name BOUNDARY_TWNBNDS_POLYAnno, name the new feature class BOUNDARY_TWNBNDS_POLYAnno_200k. This way you know the scale at which the annotation should be used. You could conceivably create several different annotation layers for different scales.

j) Click CONVERT.

k) Notice that a new layer has been added to the TABLE OF CONTENTS -- this is the annotation. Turn it off, and then on again.

l) Because it is a new layer, just like the other layers in your map, it can now be edited. However, that will require starting an editing session - We will work on that later in the Develop New Data chapter.

m) Turn the layer off for now, as the next exercises will work on adding other refinements to dynamic labels.

8. Use a Label Expression

So far, you have used a field directly from the attribute table to label your data. You can instead formulate an expression for your labels. In this example, you will label each town with its name AND acreage.

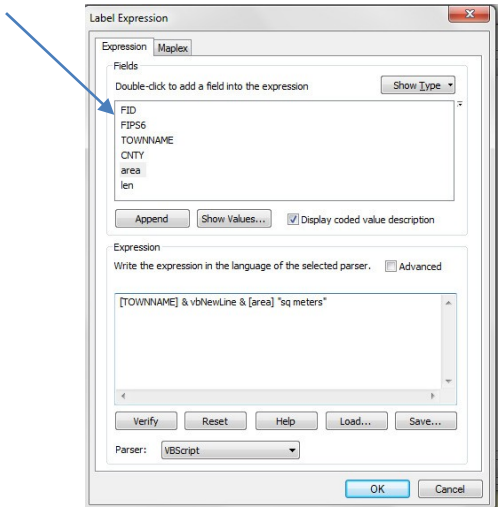
a) Open the DEMO_TOWNPOPN_POLY Properties window again. On the label tab, check the box at the top: “Label features in this layer.” (This turns the labels back on; converting to annotation earlier automatically turned them off.)

b) From the Label tab on the PROPERTIES window, click EXPRESSION.

c) Enter the following statement in the Expression window:

[TOWNNAME] & vbNewLine & round(([area]/1000000),0) & " sq. Kilometers"

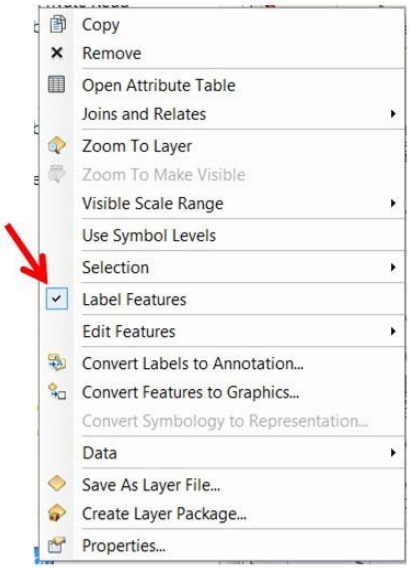
d) You can also enter the field names [TOWNNAME] and [area] by clicking on them in the field list at the top of the Expression window.



This is a great place to click the HELP button -- it gives a lot of examples of ways to build expressions, with helpful reminders of the necessary syntax.

e) Click OK, and then OK again to apply your changes. Depending upon the current scale of your map, you may need to zoom in to see the labels.

f) Once you have checked them out, you can turn them off. The quickest way to turn labels on and off is just to right click on the layer name in the Table of Contents and click on Label Features.



8. Save a Layer File

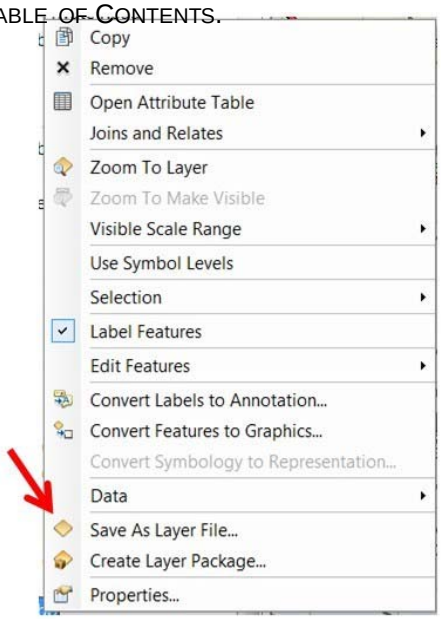
The changes you made to the layer properties for DEMO_TOWNPOPN_POLY can be saved in a layer file -- as can all the settings in the Properties window. This way, the next time you add the DEMO_TOWNPOPN_POLY.lyr layer to a map, it will include the label settings you just designed.

a) Right click on DEMO_TOWNPOPN_POLY in the TABLE OF CONTENTS.

b) Choose SAVE AS LAYER FILE.

c) Browse to C:\INTROGIS\DATA

d) Save your map.



You may have noticed that sometimes labels take a long time to draw each time you zoom or pan your map. You can click the PAUSE LABELING button on the LABELING TOOLBAR to just stop labeling for the time being. You will need to click the PAUSE LABELING button again to resume labeling.

CHAPTER 11

Introduction to Geoprocessing: Dissolve and Buffer

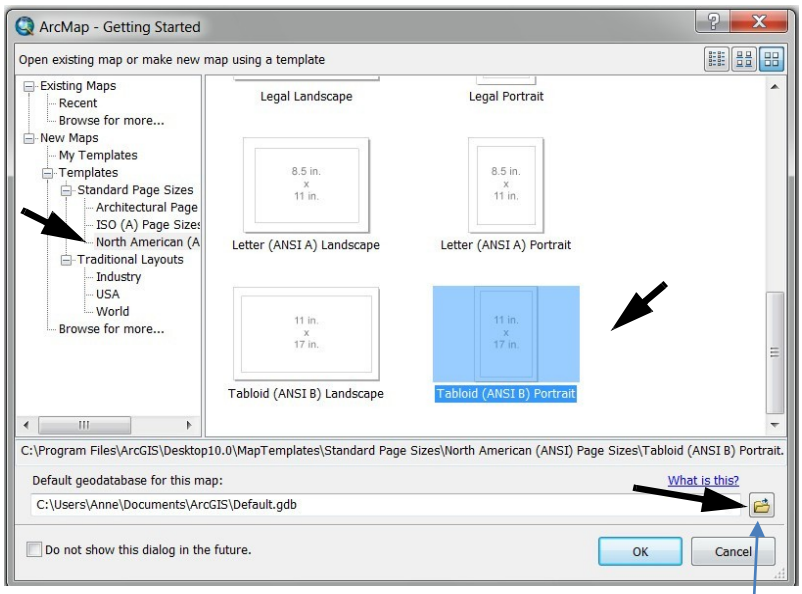
In this chapter, you will evaluate lakes and ponds in a particular county within VT. Your goal is to identify any waterbodies larger than 10 Acres, establish a 150 foot buffer zone around those waterbodies, and report the total acreage of lakes and ponds plus buffer within the watershed.

You will use the following processes and tools to complete the analysis: select by attributes, select by location, export, dissolve, buffer, calculate geometry, and statistics.

1. Set Up Map Document

a) Open ArcMap.

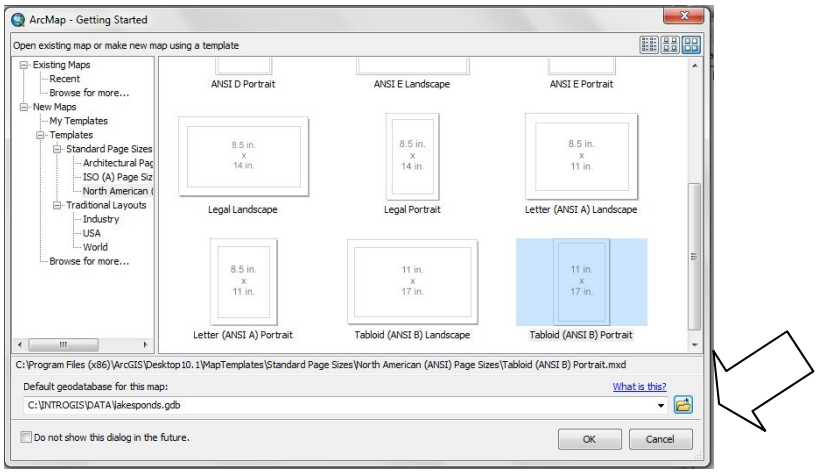
b) At the start screen, choose a template for your map. Go to TEMPLATES - STANDARD PAGE SIZES - NORTH AMERICAN (ANSI) and highlight TABLOID (ANSI B) PORTRAIT. DON'T HIT OK YET!!!



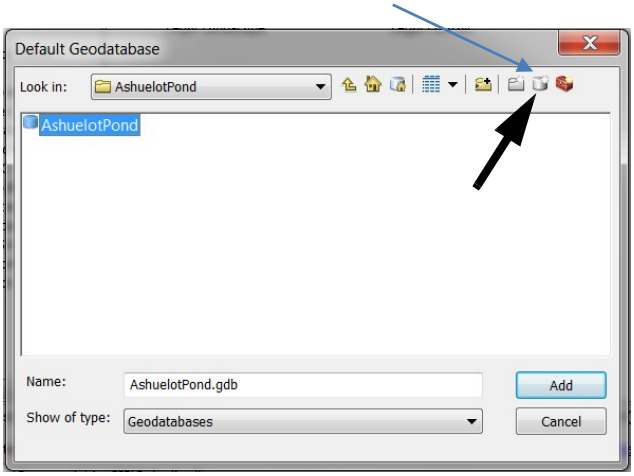
Now you will define a default geodatabase for the map -- this will be the geodatabase where you put any results of your processes. You do not need to define a default geodatabase, and in fact you could keep all of your results as shapefiles, but it is handy to put it all in one geodatabase.

c) Click the browse button next to the default geodatabase pathname.

d) Browse to C:\INTROGIS\DATA.



e) Click the NEW FILE GEODATABASE button.



d) Name your new geodatabase LAKESPONDS and hit enter.
e) Select the new geodatabase, LAKESPONDS, and click ADD.
On the opening dialog, click OK.
f) Click the DATA VIEW button to switch away from LAYOUT VIEW.
g) Save your map in the PROJECTS folder. Name it LAKESPONDS.mxd.

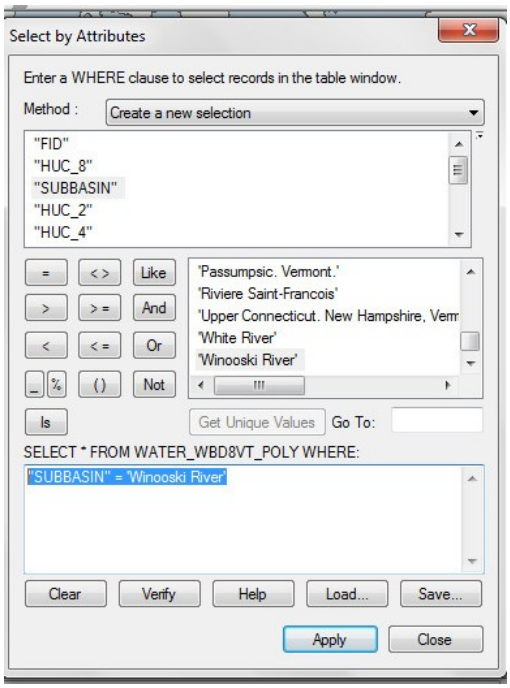
2. Select By Attributes

The first step is to figure out where the Winooski River watershed is, and then you can select all the lakes and ponds 10 acres or bigger that are within it.

a) Open the Catalog pane and add three data layers:
C:\INTROGIS\DATA\BOUNDARY_TWNBNDS_POLY.shp
C:\INTROGIS\DATA\WATER_DLGLAKE_POLY
C:\INTROGIS\DATA\WATER_WBD8VT_POLY

b) Right-click on WATER_WBD8VT_POLY and choose OPEN ATTRIBUTE TABLE.

c) Click the SELECT BY ATTRIBUTES button at the top of the table window. (If you aren't sure which button it is, hover your pointer over each until the tool tip appears and you find SELECT BY ATTRIBUTES).



d) Create the following expression: "SUBBASIN" = 'Winooski River'

e) Click APPLY, then CLOSE.

f) Click the ZOOM TO SELECTED button at the top of the table window. Close the attribute table

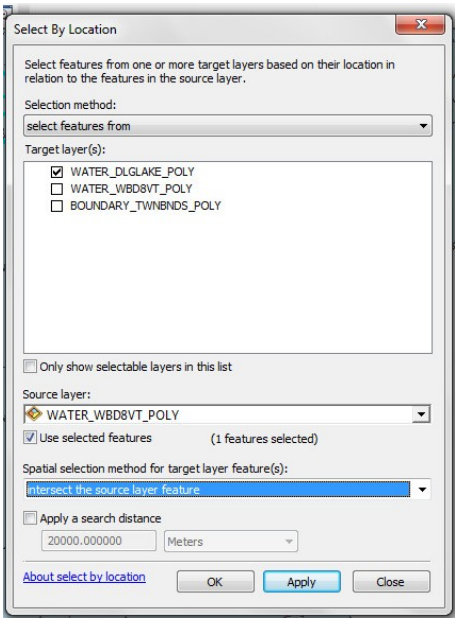
3. Select By Location

Now you will select any lakes and ponds polygons that intersect the selected watershed

a) If you haven't already, turn on the WATER_DLGLAKE_POLY layer.

b) From the SELECTION menu, choose SELECT BY LOCATION.

c) Choose to select features from the target layer, WATER_DLGLAKE_POLY, that intersect the source layer, WATER_WBD8VT_POLY. Make sure to check the button next to "Use selected features"



d) Click OK.

The lakes and ponds within the Winooski Watershed should all have been selected. If all the lakes and ponds in the state were selected, you may have forgotten to check the "Use selected features" option, or you may have accidentally cleared your selected watershed. Repeat the above steps if necessary to select the appropriate wetlands.

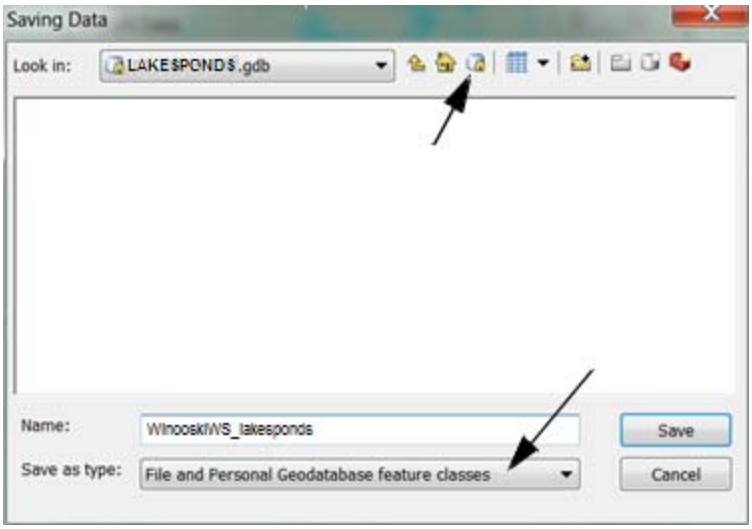
4. Export to New Layer

Right now the lakes and ponds within the Winooski Watershed are all selected, but that selection would be easily lost if you accidentally clicked the clear selection button. Make the selection permanent by exporting those lakes and ponds to their own layer (in this case, not a shapefile, but a feature class within your geodatabase).

a) Right click on WATER_DLGLAKE_POLY and choose DATA > EXPORT DATA.

b) Click the browse button to browse to your new geodatabase.

c) Click the GO TO DEFAULT GEODATABASE icon at the top of the Saving Data window to navigate directly to your default geodatabase. Name your new feature class WinooskiWS_lakesponds. Make sure that the file type is set to File and Personal Geodatabase feature classes rather than Shapefiles.



d) Click SAVE, then OK.

e) Click YES to add the resulting data as a layer.

f) Remove the state-wide lakes and ponds data. Right click on WATER_DLGLAKE_POLY and click REMOVE.

g) Click on the clear selected features button in the toolbar.

h) Save your map.

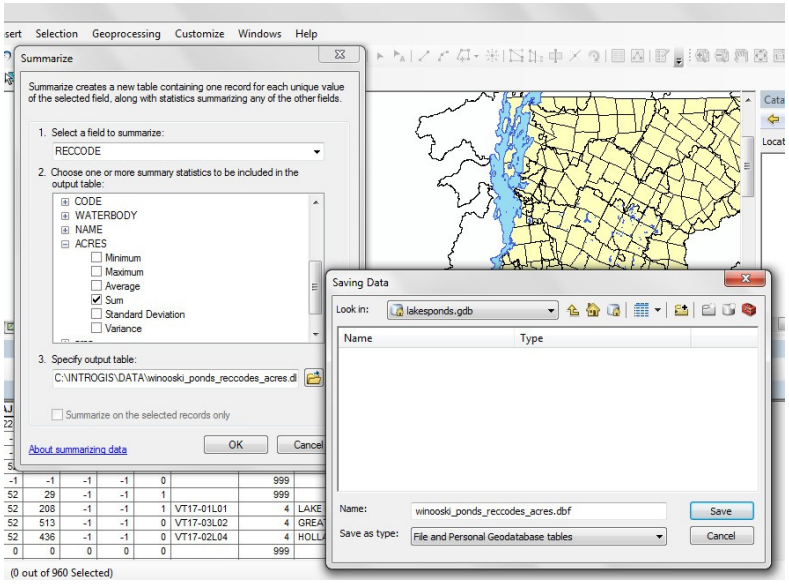
5. Summarize Data by an Attribute

The lakes and ponds in this watershed have various values for RECCODE. You can easily calculate the acreage of wetlands in each of these categories using the Summarize function. Note that this will create a new, stand-alone table not connected to the geodatabase.

a) Open the attribute table for WinooskiWS_lakesponds.

b) Right click on the field RECCODE and choose SUMMARIZE.

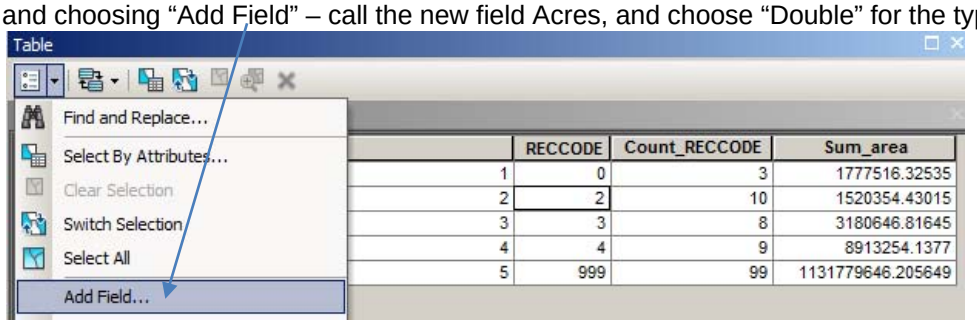
c) Expand the ACRES field and select Sum. Name the output file Winooski_ponds_types_acres and save it in your geodatabase.



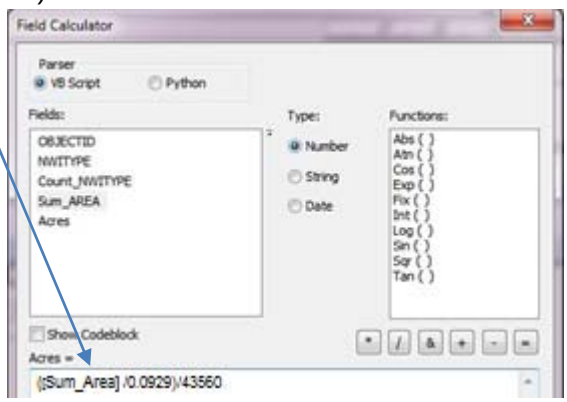
d) Click OK, and add the resulting table to your map.

e) Because it is a stand-alone table and not attached to locational data, the TABLE OF CONTENTS will switch to "Source" view so that you can see the new table. To open it, right click on its name and choose OPEN.

f) Create a new field in this table by using the Table Options drop down menu on the top left of this table and choosing "Add Field" – call the new field Acres, and choose "Double" for the type



f) Right click on the field name Acres and choose FIELD CALCULATOR. Calculate the field Acres to be equal to ([Sum_Area] /0.0929)/43560.

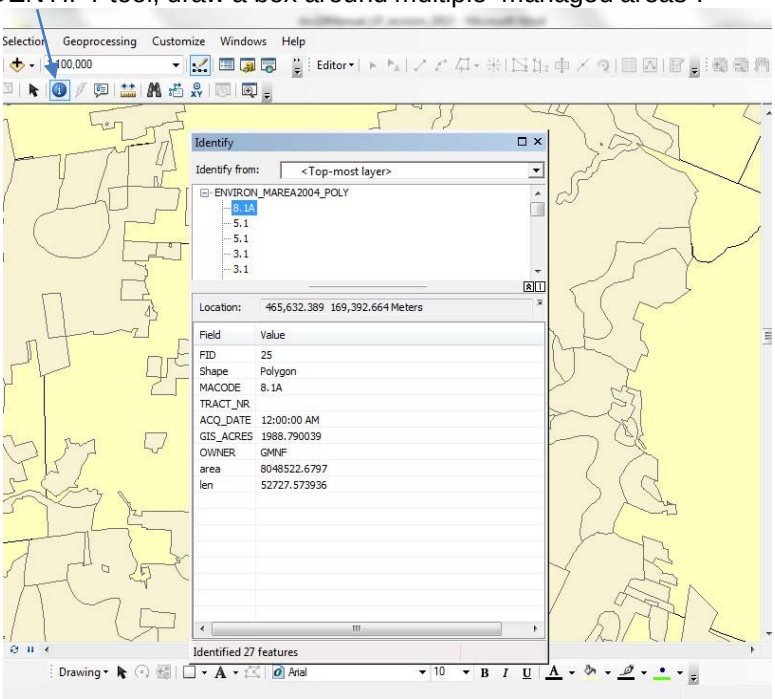


g) Notice that you could have also created this Acres field when you were making this Summarize table by choosing to sum Acres as well as area, although many Field manipulations are done using the field calculator as above

6. Dissolve Boundaries

a) Add ENVIRON_MAREA2004_POLY to your map. This is “Managed Area” that is largely within Green Mountain National Forest. Right click the layer’s name in the table of contents and choose zoom to extent. Then zoom in to a scale of about 1:100,000 and pan to an area with a lot of features.

b) Using the IDENTIFY tool, draw a box around multiple “managed areas”.



c) Click on several of the features listed in the top window. You will notice that the individual delineated areas highlight as you click on them.

d) Close the Identify Window.

We will use the dissolve tool to remove the internal boundaries between these smaller polygons.

To find the DISSOLVE tool, you can either browse through the SYSTEM TOOLBOX (found at the bottom of the Catalog window) and hunt & peck through it, or add the SEARCH window and use it to find the tool.

The search feature can be used to find maps, data, and/or tools. You can add new file folders to its index and set its indexing options by clicking the options button.

Before you can search a new folder or location, you need to set the location on your network in which you want to enable your search. This is done by adding a location and creating an index of the tools and data available (this process is not needed to search for built-in tools like Dissolve).

d) Click the SEARCH window button at the top of the screen.

e) Click the INDEX/SEARCH OPTIONS button.

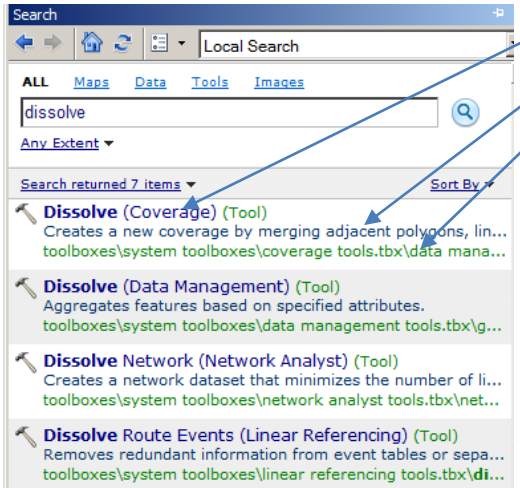
f) On the INDEX/SEARCH OPTIONS dialogue, click ADD.

g) Browse to your C:\INTROGIS\ directory and click SELECT. At the bottom of the dialogue, click INDEX NEW ITEMS. When the indexing status is set to Active, the new index is built and ready for search. Click OK.

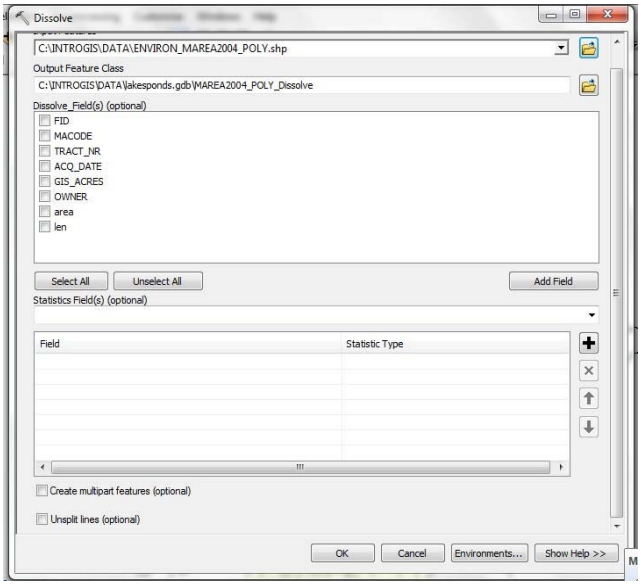
h) Dock the SEARCH window on the right hand side of the screen next to the CATALOG window. Set it to AUTO HIDE.

i) Type "Dissolve" in the text box and hit enter.

j) Select the DISSOLVE (DATA MANAGEMENT). Note that there are 3 hyperlinks for each result. The first link opens the tool itself, the second link opens a Help description of the tool, and the third link locates the tool within the toolbox folder.

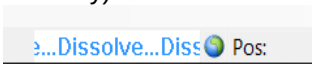


Occasionally tools from the search results can be difficult to open on the workshop computers. If your dissolve tool does not open, expand the Catalog window and scroll down to the bottom so you can see the SYSTEM TOOLBOX. Then click the third hyperlink in the DISSOLVE (DATA MANAGEMENT) search results ("toolboxes\system toolboxes\data management tools.tbx\generalization\dissolve") -- this should locate the tool within the toolbox folder, and you can open it from there.



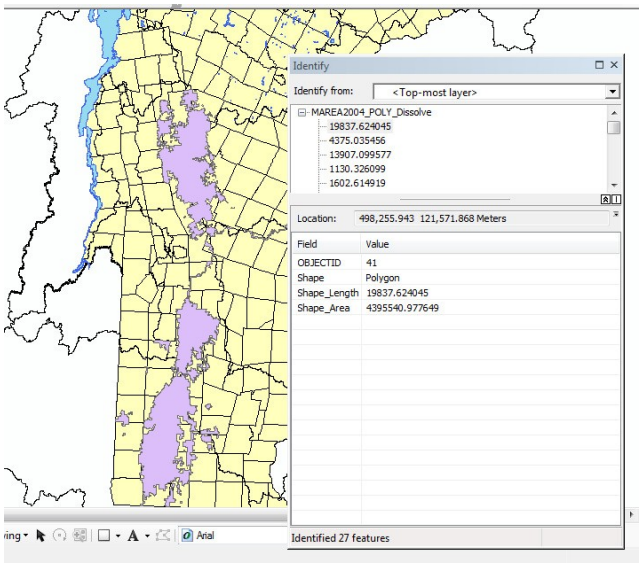
l) When the tool opens, enter ENVIRON_MAREA2004_POLY as the Input features, and set the output feature class to be C:\INTROGIS\DATA\lakesponds.gdb\MAREA2004_POLY _Dissolve. Remove the checkmark at the very bottom of the window (you will have to scroll down) so that you do not create multipart features. Click OK.

m) While the dissolve process is working, you can still work on your map. Called Background Geoprocessing, this is particularly evident during very complex, time consuming geoprocessing. If you prefer, you can also turn off Background Geoprocessing from the Geoprocessing Options window, available from the Geoprocessing menu.

n) You will know the dissolve process is working if you notice (eventually) the status "Dissolve...Dissolve..." scrolling at the bottom of your screen. 

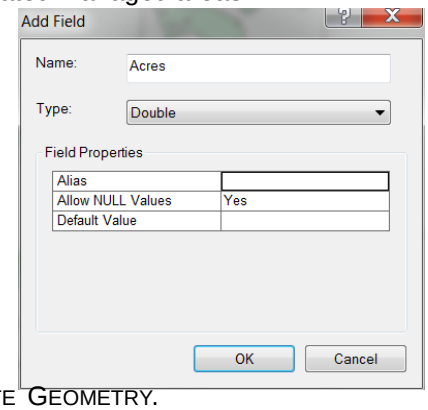
o) When it is complete a green checkmark will appear, and the new data layer will be added to your map.

p) The dissolved Managed Area layer does not contain any of those internal boundaries, nor does it contain all of the information associated with the original data (when the polygons are lumped together during this dissolve process, you are losing the attributes from the finer scale?)



7. Calculate Acreage

a) You will now calculate the acreage of your new aggregated managed areas no



b) Right click on MAREA2004_POLY_Dissolve and choose OPEN ATTRIBUTETABLE.

c) Click the OPTIONS button at the top of the table.

d) Choose ADD FIELD.

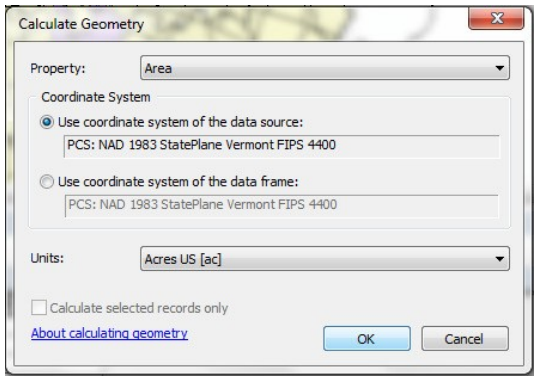
e) Name the new field "Acres" and set its type to Double.

f) Click OK.

g) Right click on the new Acres field and choose CALCULATE GEOMETRY.

h) Click YES to continue even though you are not in an edit session.

i) Set the units to Acres US (ac) and click OK.



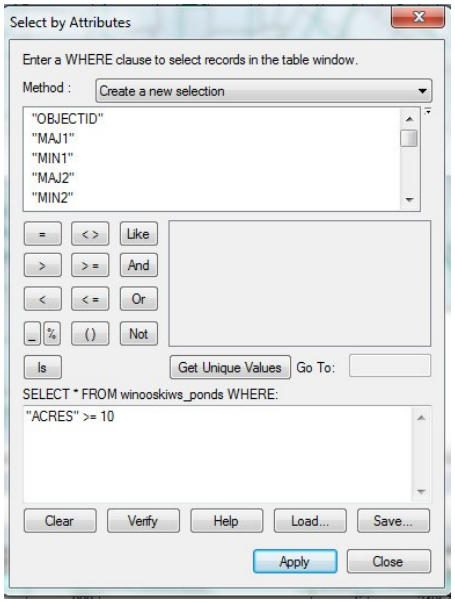
8. Buffer Polygons

Now we will go back to the ponds and lakes data and select those that are at least 10 acres and buffer them by 150 feet.

a) Click the SELECT BY ATTRIBUTES button at the top of the winooskiWS_ponds attribute table.

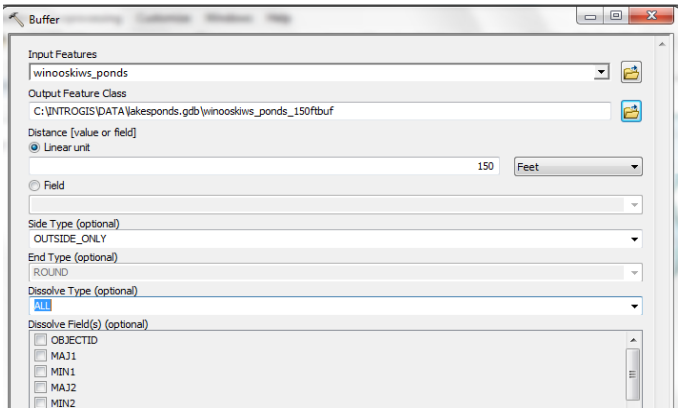
e) Select all wetlands that are greater than or equal to 10 acres. Note that you must click the operator button For >= ("greater than or equal to"). It will not work if you click the > button and then click the = button! (Doing that introduces an extra space)

c) Click APPLY, then CLOSE.



With those large ponds and lakes selected, you will now run the buffer tool. You can find the buffer tool by hunting around in the SYSTEM TOOLBOX, by using the SEARCH window, or by going to the GEOPROCESSING menu. Several of the most common Geoprocessing tools have quick links from there (including Dissolve, which you searched for earlier; it is helpful to know how to search for tools!)

a) From the GEOPROCESSING menu, choose BUFFER.



b) Set the input to WinooskiWS_ponds and name the output winooskiWS_150ftbuf.

c) Set the LINEAR UNIT to 150 feet, the SIDE TYPE to 'FULL', and the DISSOLVE TYPE to All.

d) Click OK.

e) Open the attribute table for the buffers.

f) Click the OPTIONS button and choose ADD FIELD.

g) Name the field Acres and set its type to Double. Click OK.

k) Right click on Acres and choose CALCULCATE GEOMETRY

h) Set the units to Acres US (ac) and click OK.

CHAPTER 12

Introduction to Geoprocessing: Clip and Spatial Join

In this chapter, you will determine the existence and location of boating access recreation sites in proximity to 10 acre or larger ponds and lakes in the Winooski Watershed, as well as identify the roads that could lead you to those boating access sites.

You will clip the recreation boating sites layer to Washington County and evaluate how many points (if any) fall within 150 feet of the lakes and ponds that are 10 acres or greater in area.

Next you will evaluate which roads lead to these access points. To do this, you will identify the roads and clip them with the buffers. Then you will conduct a spatial join of the road segments to the recreation sites. This will add attributes to the recreation sites table describing the nearest section of road and its distance to the recreation site. Finally, you can work to symbolize the resulting data in a way that effectively communicates your results.

1. Set Up Your Map Document

a) Open ArcMap. If it is already open, save the existing map and click the NEW MAP FILE button.

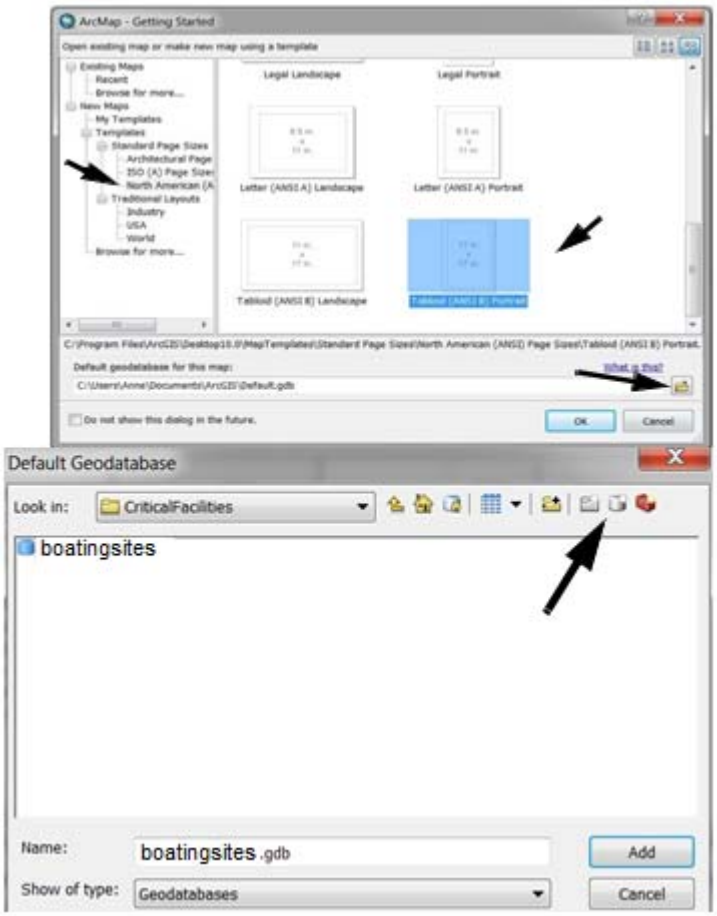
b) At the start screen, choose a template for your map.
Go to TEMPLATES - STANDARD PAGE SIZES
- NORTH AMERICAN (ANSI) and
highlight TABLOID (ANSI B) PORTRAIT.

c) Define a default geodatabase for the map

d) Click the browse button next to the default geodatabase pathname.

g) Browse to C:\INTROGIS\DATA\

h) Click on The NEW FILE GEODATABASE button.



f) Name your new geodatabase boatingsites and hit enter.

g) Select the new geodatabase, boatingsites, and click ADD.

h) On the GETTING STARTED dialog, click OK.

i) Click the DATA VIEW button to switch away from LAYOUT VIEW.

j) Save your map in the PROJECTS folder. Name it Winooski_boating_access.mxd.

k) Add the following data layers from the C:\INTROGIS\DATA\ folder:
   i. BOUNDARY_TWNBNDS_POLY
   ii. TOURISM_RECSITES_BOATING_POINT
   iii. TRANS_RDSMAJ1_LINE

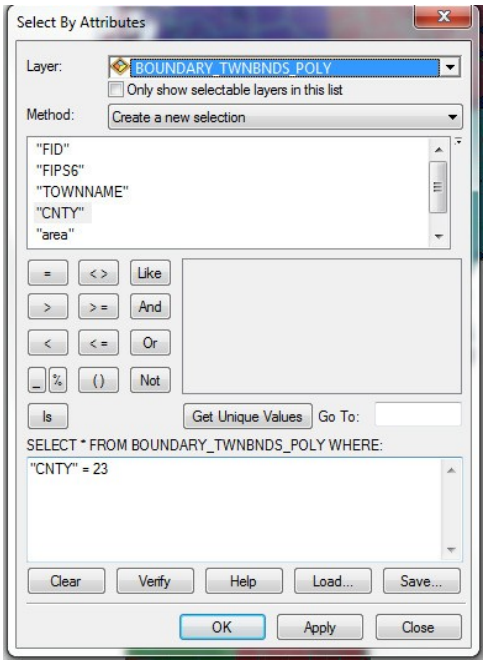
l) And the following from your lakes and ponds geodatabase:
   iv. WinooskiWS_150ftbuf
   v. WinooskiWS_lakesponds

2. Clip a Data Layer

In this step you will clip the Recreation Sites layer to the boundaries of Washington County. First you will need to select all the towns in Washington County to form your clip layer.

a) From the SELECTION menu, choose SELECT BY ATTRIBUTES.

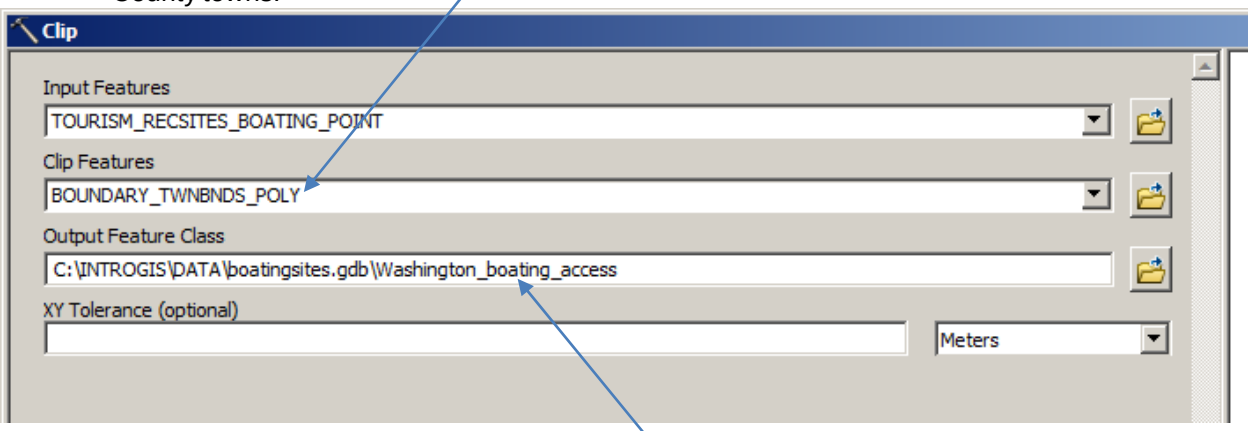
b) Set the Layer to BOUNDARY_TWNBNDS_POLY, and create the query "CNTY" = 23. (23 is the county code for Washington County.) Click OK.



c) From the GEOPROCESSING menu, choose CLIP.

d) Set the INPUT layer to Recreation Sites.

e) Set the CLIP layer to BOUNDARY_TWNBNDS_POLY. (Make sure you drag it in from the TABLE OF CONTENTS or select it from the drop-down menu -- do not browse out to the file system to find it. You need to use the layer in which you have selected the Washington County towns.



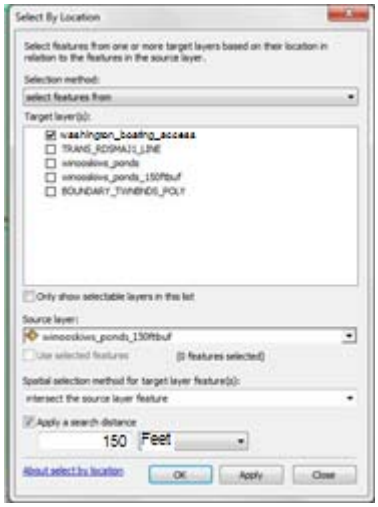
f) Name the output feature class Washington_boating_access and confirm that it is being saved in the boatingsites.gdb geodatabase.

g) Click OK.

h) When the clip is complete, remove the statewide TOURISM_RECSITES_BOATING_POINT layer from your map by right-clicking on its name and selecting REMOVE.

3. Select By Location

Now you can figure out which, if any, of the boating site are within 150 feet of a lake or pond 10 acres or more in size.



a) From the SELECTION menu, choose SELECT BY LOCATION.

b) Select features from the target layer, Washington_boating_access that intersect the source layer, WinooskiWSponds150ftbuf

c) Click OK.

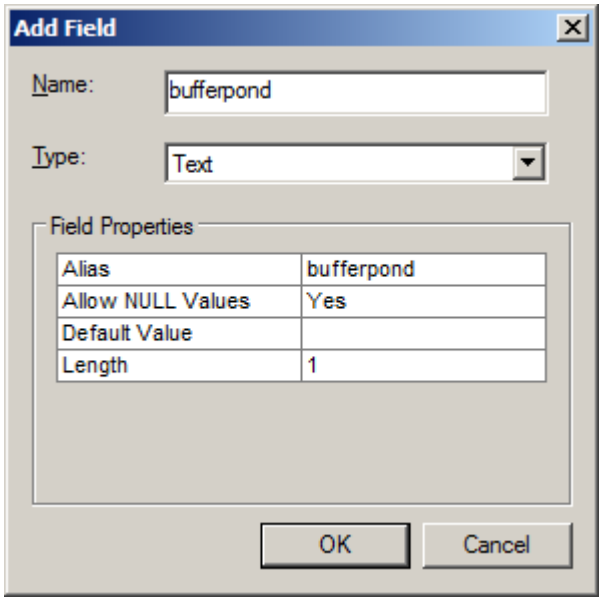
4. Create an Attribute Flag

In this step you will "record" the results of the previous step by creating a new attribute in the boating sites attribute table, and calculating its value for the selected records.

a) Open the Washington_boating_access attribute table.

b) Click the OPTIONS button and choose ADD FIELD.

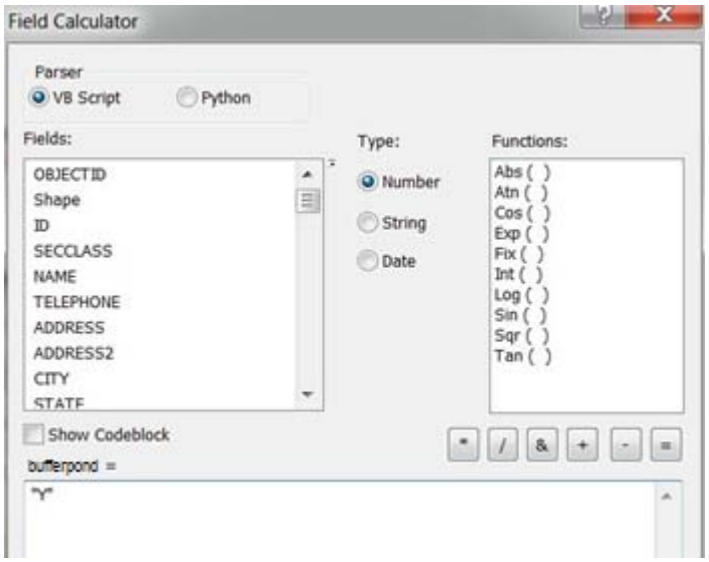
c) Set the Name to bufferpond the type to text, and the length to 1.



d) Click OK.

e) Right click on your new field (all the way at the end of the attribute table) and choose FIELD CALCULATOR.

f) Remember that the only records selected right now are those that are in the buffer area; you are going to calculate their boating access point value to “Y” for “yes.” Just type a Y in double quotes (“Y”) in the window and click OK.



g) Now you will calculate the bufferpond value for all the other records to “N”.

h) Click the switch selection button at the top of the table.

i) You should notice that different records are selected now. These are all the sites that are not within 150 feet of the selected ponds.

j) Right click on bufferpond and select FIELD CALCULATOR.

k) Type “N” in the window and click OK.

l) Clear selected features and save your map.

m) How many sites are in within 150 ft of a pond that is 10 acres or larger in size?

5. Perform a Spatial Join

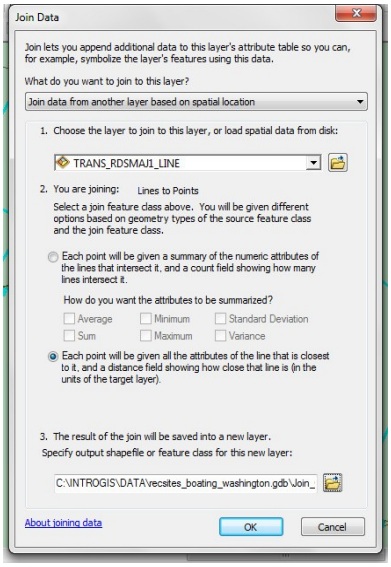
In this final analytical step, you will perform a spatial join of the roads data to the boating access points. This means that for each point the computer will calculate which is the closest road segment, and will append its attributes (with its name, road class, etc.) to the boating access attribute table. It will also add a new field, Distance, which will contain the distance (in feet) between the boating access point and the closest road segment.

a) Right click on Washington_boating_access.

b) Choose JOINS AND RELATES > JOIN.

c) Choose to join data based on spatial location, and select the layer TRANS_RDSMAJ1_LINE

d) Choose the second option-- each point will be given all the attributes of the line closest to it, etc.



e) Click the BROWSE button to name the output feature class. If necessary, browse to the default geodatabase (you can click the GO TO DEFAULT GEODATABASE button). Make sure the type is set to Geodatabase feature classes (not shapefile) or it will not work. Notice the default name or give it a new name!

f) Click SAVE and then OK.

6. Evaluate Your Results

a) Open the attribute table for the joined data.

b) Scroll all the way across to the new “Distance” field at the end.

b) Right click on the field Distance and choose SORT ASCENDING. Note that some sites are quite close (< 500 feet) to a boating access point.

How many sites are within 500’ of such roads? How many sites are within a mile of such roads? How could you symbolize your results to communicate them effectively? If you have time, try some different methods.

CHAPTER 13

Layout View

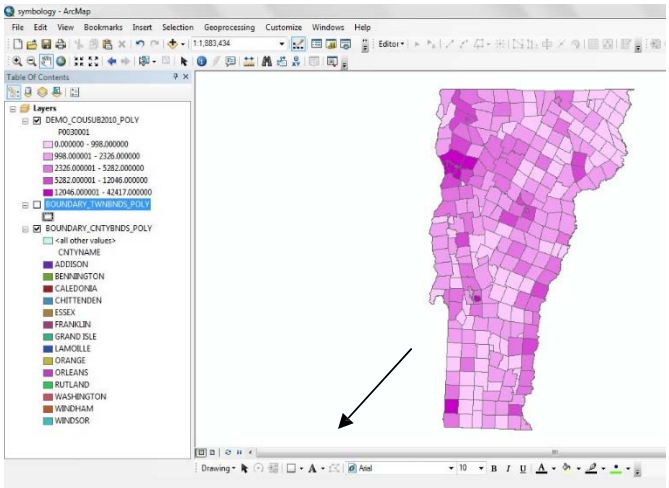
Layout View is where you prepare your map for exporting, publishing, or printing. It is where you can add all the extra elements that enable it to communicate its message to the reader: title, legend, scale bar, north arrow, date, text about data sources, etc. It also functions a bit like Print Preview for your map – you can see the page margins and how all these map elements will fit together on the page.

1. Explore Layout View

a) If it is not already open, open your Symbology.mxd map.

So far in this workshop, you have always been working in Data View. Now you will switch to Layout View. Layout View is where you can add the elements that your map needs to be understandable to someone else.

b) Click the tiny Layout View button at the bottom of the ArcMap interface.



c) When you switch to Layout View, a new toolbar becomes available to you: the LAYOUT TOOLBAR. (It was probably already docked in your ArcMap interface, but until you switch to Layout View, it is all grayed out.) If it is not yet docked, drag it toward the top of your screen and dock it up there.

The LAYOUT TOOLBAR contains several tools that probably look familiar – they are very similar to the navigation tools on the TOOLS TOOLBAR. To distinguish them, each of their icons has the image of a sheet of paper in the background.

The navigation tools (like Zoom and Pan) on the LAYOUT TOOLBAR and TOOLS TOOLBAR work quite differently. The Layout tools will zoom and pan you around the map page –for example, to look closely at the legend – while the zoom & pan from the TOOLS TOOLBAR will move you around the data itself. You can still use the data zoom and pan while you are in Layout view!

The zoom and pan tools from the LAYOUT toolbar will change your position on the layout itself -- they will zoom in to the piece of paper, or move the paper to the right or left. They will not change the position of the data in the map.

These tools zoom in, out, and pan around your page.

The zoom and pan tools from the TOOLS toolbar will zoom in or out of the data itself, or pan the data around, just like they did in data view.

d) Practice using the LAYOUT toolbar.

i. Pick up the ZOOM tool, and draw a box to zoom in to the layout.

ii. Pan around the map with the PAN tool.

iii. Zoom back out by clicking the ZOOM TO FULL PAGE button.

These tools zoom in, out, and pan around your data.

e) Now compare what happens when you use the TOOLS toolbar.

i. Pick up the ZOOM tool from the TOOLS toolbar, and draw a box to zoom into the data.

ii. Pan around the data with the PAN tool from the TOOLS toolbar.

iii. Zoom back out by clicking the ZOOM TO FULL EXTENT button.

2. Add a North Arrow and Scale Bar to your Layout

Without some standard map elements – such as a legend and scale bar – it may be difficult for others to use your map.

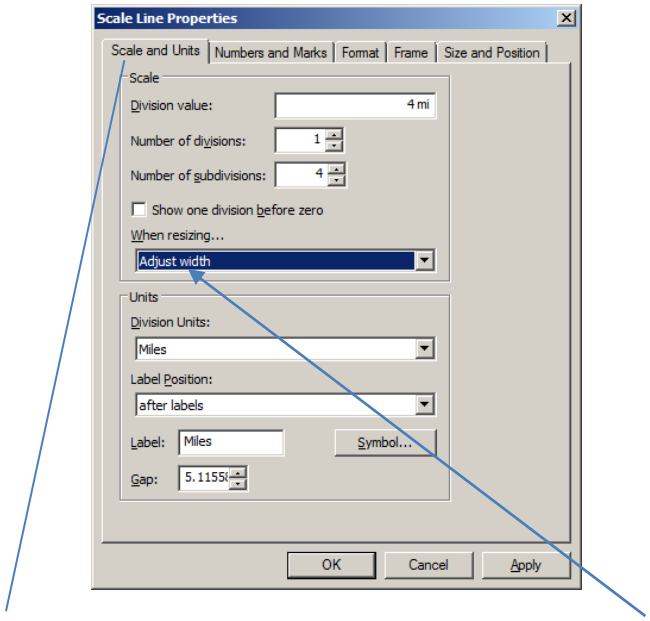
a) From the INSERT menu, choose INSERT NORTH ARROW. Choose a north arrow style, and click OK.

b) The north arrow is placed on the map. It has "handles" at the corners that allow you to resize it, and you can click in the middle and drag it anywhere on your page. If you decide you want to change its style, just double click to open its properties and then you can change it.

c) Insert Scale Bar. Choose a style and Click OK.

d) To get the scale bar to look the way you want it, you will have to open and manipulate its properties.

e) Double-click on the scale bar to open its properties.



f) On the Scale and Units tab, try changing the instructions for resizing to "Adjust width." Then you can specify exactly how wide you want each division of the scale bar.

g) Try setting the units to Miles, the division length to 10, and the number of divisions to 5. Click OK to see how this affects the scale bar. Feel free to play with these settings until you make it look the way you want.

h) Save your map.

2. Add a Legend to your Layout

a) From the INSERT Menu, choose INSERT LEGEND. The Legend Wizard will appear.

b) In the first window, choose which layers to include in the legend. You may want to choose just the census data, or the census data and the political boundaries. To add layers to the legend, use the arrow button to move them from the left-hand pane to the right-hand pane.

c) Click Next through the next several windows until you can click Finish.

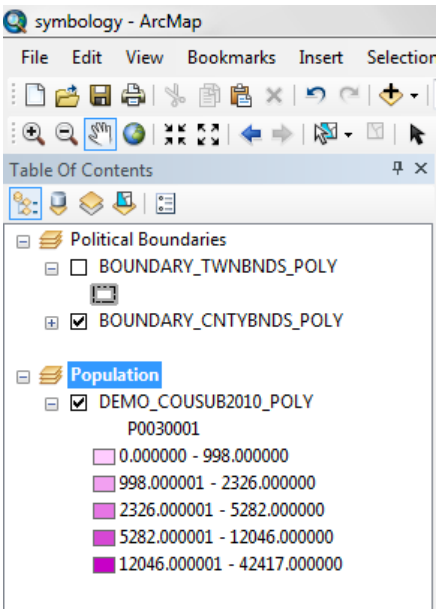
d) The Legend is placed on your map.

4. Insert a New Data Frame

Now you will insert a new data frame so your final map can include two geographic areas -- one a view of political boundaries, and the other a view of Census Data.

a) Right click on the name Layers at the top of your Table of Contents -- this is the name of your current data frame (the only one now in your map). It is the default name that ArcGIS always gives to the first data frame in a map. Select PROPERTIES.

b) On the GENERAL tab, make the name "Political Boundaries." Click OK.



c) From the INSERT menu, choose DATA FRAME. Your map may disappear -- that is ok! In data view, you can only look at one data frame at a time, and you are now looking at your new, empty one.

d) Scroll down (if necessary) in the Table of Contents, and right click on NEW DATA FRAME. Select PROPERTIES.

e) On the GENERAL tab, make the name “Population”

f) Click OK.

5. Copy Layers between Data Frames

The current “active” data frame will be in **Bold** type text in the Table of Contents, and only the layers from this active Data Frame will be visible in Data View. If your new Population Data Frame is active (you can make it active if it is not by right-clicking on its name and choosing “Activate”) and if you were to click the Add Data button right now, the data would be added to the Population data frame, not the Political Boundaries one. Another way to get data in to the data frame is just to copy or drag it in from the other data frame – this will make a virtual copy of the data for viewing and mapping, not a real copy.

a) Drag the Census data from the Political Boundaries data frame down to the Population data frame

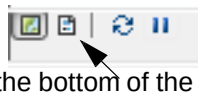
6. Become comfortable Changing the Active Data Frame

Right now, the data frame Population is active--that is, it is visible in the DISPLAY AREA, and its scale is reflected in the scale box at the top of the window, and if you were to pan or zoom, you would be doing so in the Population data frame.

a) To view the Political Boundaries data frame, right click on Political Boundaries in the TABLE OF CONTENTS, and select ACTIVATE. – note the scale

b) Return to the Population data frame by right clicking on Population and selecting ACTIVATE, and notice that you are in a different scale now.

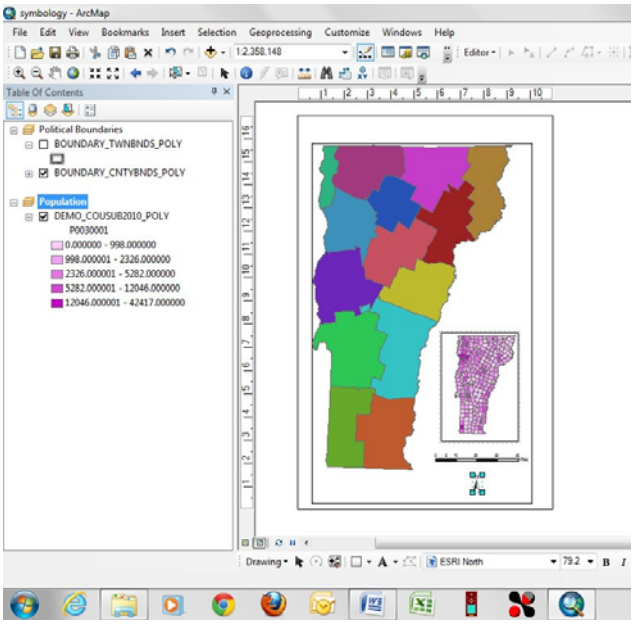
9. Arrange Data Frames in Layout View



a) Switch to LAYOUT VIEW by clicking the small paper icon at the bottom of the screen.

b) Temporarily turn off the census data in each data frame to speed up the time it takes your map to redraw as you move things around.

c) Adjust the sizes of the two data frames so that Political Boundaries takes up the entire page, and Population is just a small box. You can adjust the size of a data frame by selecting the data frame and dragging on any of its handles.



Remember to use the ZOOM and PAN tools from the TOOLS toolbar, not the LAYOUT TOOLBAR

d) Save your map.

8. Insert Text

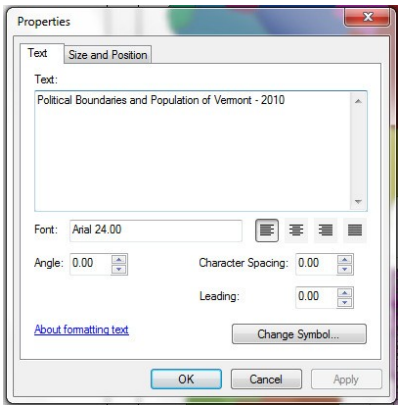
a) Click on the NEW TEXT tool on the DRAWING toolbar.

b) Click anywhere at the top of the page to insert a text box.

You are adding text in Layout view, so the text will stay with your map page as you zoom around or change the extent of your data. This is just like how you added text labels in Chapter 6, but in that case you added them in Data view, so the text stayed with your data as you changed its extent.

c) Change the font size to 24 (type it in the font drop down box, and press enter).

d) Double-click on the text box to bring up the TEXT PROPERTIES dialogue.



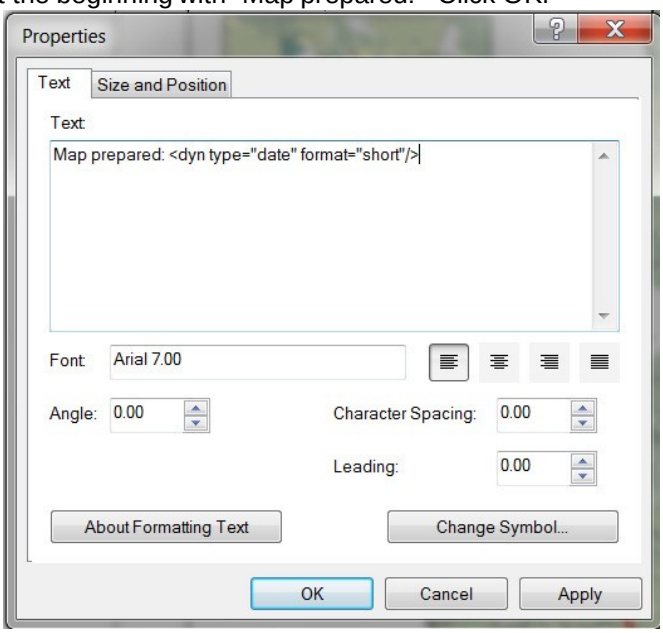
e) Type "Political Boundaries and Population of Vermont - 2010" in the title text box. Press OK.

f) Drag the title to the top of the map.

g) From the INSERT menu, choose DYNAMIC TEXT > CURRENT DATE.

h) The date is added as a text box in the center of your map. Drag it to a bottom corner, and make the font smaller.

i) Double click on the date to open its properties. You will see that it has the word Date: followed by some tagged text that contains the code to insert whatever the current date is. Replace the word "Date" at the beginning with "Map prepared:" Click OK.



9. Adjust Legend Text in the Table of Contents

It is somewhat counter-intuitive, but in order to change the text in your legend, you need to make adjustments to the layers themselves – either in the TABLE OF CONTENTS or through the layers' Properties windows.

a) Make sure that the Population frame is the active frame.

b) Add a legend by selecting LEGEND from the INSERT menu. Note that the layers available in the legend wizard are based on whatever frame is active right now.

c) Click Next through the rest of the wizard pages to add the legend to your map. You will refine it later.

d) Remember that the legend is looking at the data in the Population data frame. Therefore, to change the legend, you need to change the look of the census data in the Population data frame not the Political Boundaries one.

e) In the TABLE OF CONTENTS, change the layer name “DEMO_COUSUB2010_POLY” to “Population 2010.” You can do this by simply selecting the text and then clicking it again to make it editable. Hit enter when you are done.

e) You can change the number formats for the housing vacancy categories in this same manner. For example, if the text reads, “0.000 - 0.03000”, you can select it and change it to “Less than 3%” . “0.03001 - 0.08955” can become “3 - 9%”, and so on.

f) If you want to change the actual symbology or classification of the data (e.g., make the classes break at whole numbers, or at equal intervals), you will need to go back to the Symbology tab on the Properties window, click Classify, and make your changes to the Label associated with each Range.

g) Change the name Boundary_CNTYBNDS in the Political Boundaries data frame to “County Boundaries”.

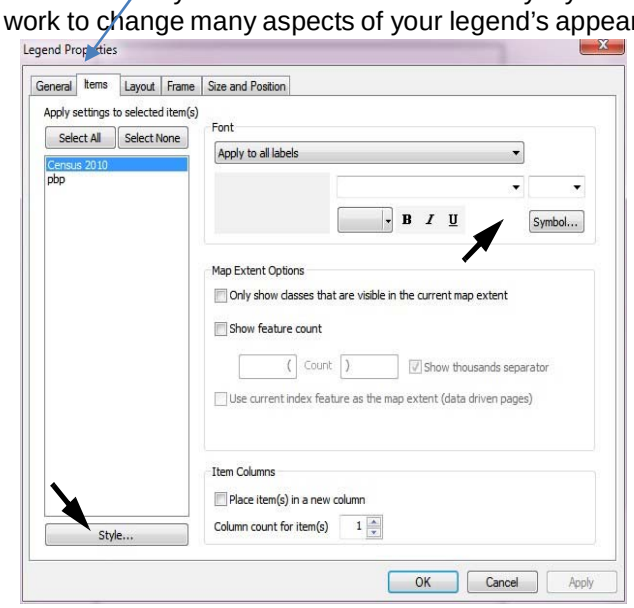
g) Save your map.

10. Tips for Working with Legend Properties

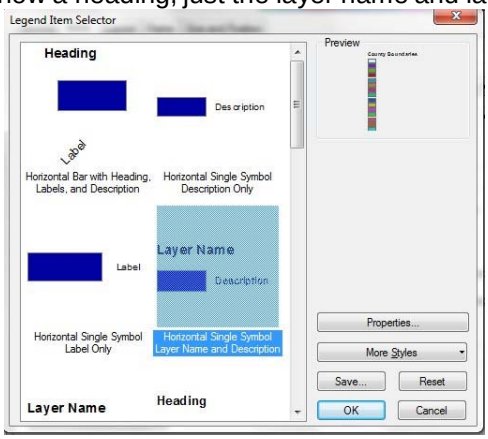
NOTE: See below (step 11) if you are working with ArcGIS version 10.0 or earlier. The legend editor has changed in version 10.1, and the instructions here pertain to v.10.1. or greater

To change the appearance of your legend (other than the wording, which you changed in the TABLE OF CONTENTS, above), you need to open the legend properties. Do this by double-clicking on it or by right-clicking and selecting PROPERTIES.

The Properties window has five tabs: LEGEND, ITEMS, LAYOUT, FRAME, and SIZE & POSITION. Use the arrow buttons on the General tab if you want to add or remove any layers from your legend. The ITEMS tab is where you will work to change many aspects of your legend’s appearance.



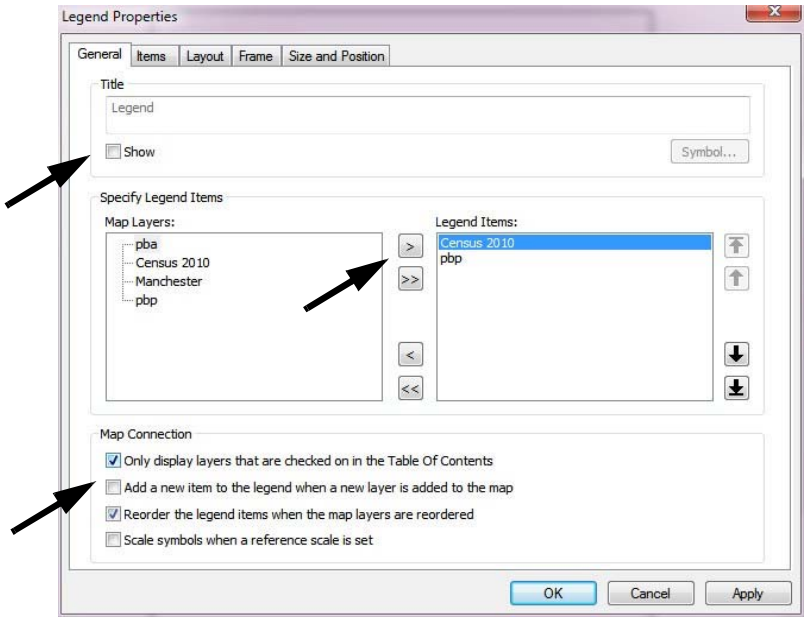
For example, if you want to remove the heading P003001 from the population item in the legend -- so that it only says "Population 2010" with the symbol colors and labels below it -- you would start on the Items page. First you need to understand that "Population 2010" is the layer name, and "P003001" is the heading, and text like "0-998" is a label. Click the Style button, and then choose from the list of legend thumbnails one that does not show a heading, just the layer name and labels.



As you click on different styles, your choice is displayed in the preview thumbnail. The default is to show the Layer Name, Heading and Label; it is often nice to instead choose a style that includes only Layer Name and Label, or even just Label.

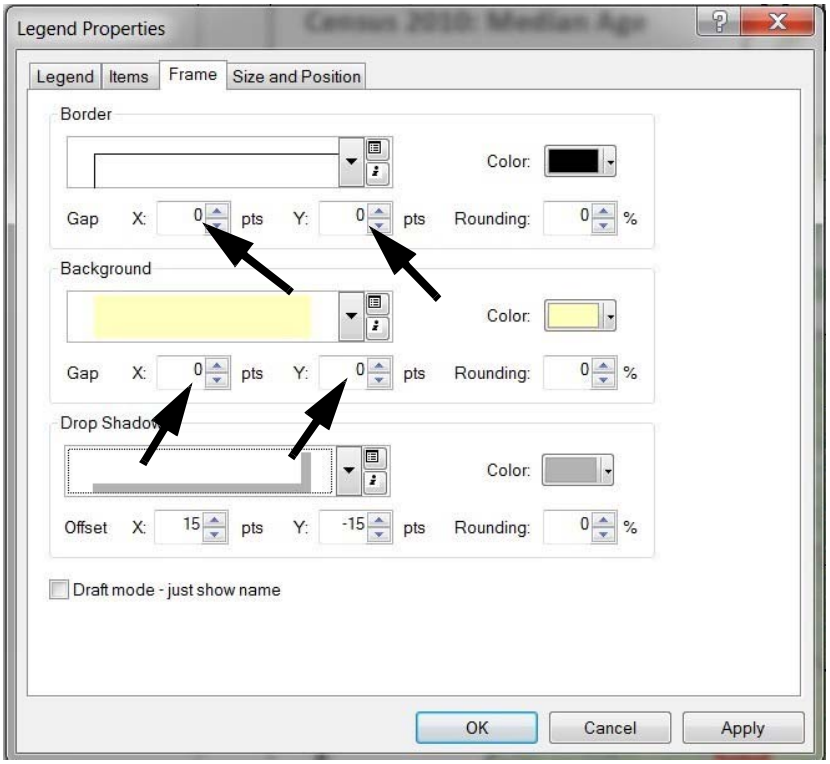
11. Working with Legend

If you want to make the "Legend" title go away (or change it to a different word), go to the LEGEND tab and either click the check mark next to "SHOW" (to hide the title) or type new text in the text window.



Remove the checks from the check boxes at the bottom if you want items to stay displayed in the legend even if turned off or re-ordered in the TABLE OF CONTENTS. It can be very frustrating to set up your legend just the way you want it, only to have ArcGIS reorder it for you when you rearrange layers in your map.

Use the FRAME tab to give your legend a frame (draw a line around it), a solid background (rather than transparent) or a drop-shadow. Adding a value for a gap in both the X & Y directions for the border and the background will make increase the size of the margin from the legend to the border.



12. Aligning Elements in a Layout

a) Hold down the CTRL key, and select the both title text box and the Political Boundaries data frame.

b) Right-click and select ALIGN - ALIGN TO MARGINS. This turns on the ALIGN TO MARGINS option, which means that the next alignment command you give will occur relative to the margins, not to other objects on the page.

c) Right-click again, and select ALIGN - CENTER. Both objects are centered between the left and right margins.

d) Hold down the CTRL key, and select the Population data frame, and then select the Political Boundaries data frame (in that order).

e) Right-click and select ALIGN - ALIGN TO MARGINS. (This turns off the ALIGN TO MARGINS options.)

f) Right-click again select ALIGN - LEFT. The left side of the Population data frame, which was the first object you selected, is aligned to the left side of the Political Boundaries data frame, which was the last object you selected.

g) It may also be useful to add Guides to your map -- these are lines (invisible when printing) to which you can snap and align objects. To add guides, simply click in the ruler area at the top and side of the layout display window. If you don't see the ruler or the guides, go to the View menu and make sure both are turned on.

h) Save your map.