Introduction to ArcGIS II

(Final)

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Introduction

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EXERCISE 1: INSTALL THE CLASS DATABASE

In this exercise you will install the database that you will use for certain other exercises in the course.

STEP 1: INSTALL THE CLASS DATABASE

☐ Ask your instructor whether the database has already been installed.

☐ If not, turn to the last page of the exercise book and remove the database CD-ROM from the sleeve attached to the back cover.

☐ Insert the CD-ROM into the CD-ROM drive.

☐ From the *Start* menu, start *Windows Explorer*.

Before running the setup program, you will change the view setting of Windows Explorer.

☐ From the *Tools* menu, click *Folder Options*.

☐ Click the *View* tab.

☐ In the *Advanced settings* area, verify that the *Hide file extensions for known file types* check box is unchecked.

☐ Click *OK*.

Now you will execute the Setup program on the CD-ROM to install the training data.

☐ Navigate through the tree structure to the CD-ROM and click on the CD-ROM drive.

☐ In the contents of the CD-ROM, double-click *Setup.exe*.

☐ On the *Welcome* panel, click *Next*.

☐ Ask your instructor for the destination folder for the database.
Destination Folder: _____.

If the destination folder is C:\Student:	If the destination folder is *not* C:\Student:
☐ Click *Typical*.	☐ Click *Custom*.
☐ Click *Next*.	☐ Click *Browse*.
☐ Click *Finish*.	☐ Enter the path to the destination folder.
	☐ Click *OK*.
	Now you are ready to install the class database.
	☐ Click *Next.*
	☐ Click *Finish*.

The database is installed in the destination folder. From now on the destination folder for the installation will be referred to as your working folder.

☐ Remove the CD from the CD-ROM drive and keep it with this book.

EXERCISE END

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Working with layers and maps

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EXERCISE 2: WORKING WITH LAYERS AND LAYOUTS

In this exercise, you will learn more about layer properties. You will work with vector and raster data, and you will create a style set to apply a standard symbolization to a layer.

STEP 1: START ARCMAP AND ADD LAYERS TO A MAP

In this step, you will add layers to a map document.

☐ Start *ArcMap* and create *A new empty map*.

☐ From the *C:\Student\igis2\TillamookWshd* folder, add the *blockgr* coverage as a new layer to your map.

☐ Right-click on the *blockgr polygon* layer and click *Properties.*

☐ On the *General* tab, change the *Layer Name* to **`Census Block Groups`**

☐ Click *OK*.

STEP 2: CHANGE THE ARCMAP DATA VIEW AND TABLE OF CONTENTS OPTIONS

You can alter the properties of ArcMap to better suit your personal preferences. In this step, you will experiment with different ArcMap property settings. First, you will explore the Source tab.

☐ In the *Table of Contents*, click the *Source* tab at the bottom.

Notice how the Table of Contents display changed to reflect more details about the location of the source data for your layer.

☐ Move your cursor to the bottom right corner of the *ArcMap* application. Click and drag to enlarge or reduce the size of the application window.

Notice how the map data increases or decreases in scale to fit within the ArcMap window. Now you will modify the ArcMap application. First, you will modify ArcMap's display area to maintain the same scale of the displayed data even if ArcMap's application window changes in size.

☐ Click *Tools* > *Options*.

☐ Click the *Data View* tab.

☐ In the area titled *When the application window is resized*, click *Don't redraw the display to fit inside the window.*

Next, you will modify ArcMap's Table of Contents to disable the Source tab.

☐ Click the *Table of Contents* tab.

☐ Under *Table of Contents* tab options, uncheck *Source*. You do not want to display the *Source* tab.

☐ Under *Patch Shape*, click the black arrow next to the *Area* symbol.

☐ Choose *Urbanized Area* from the dropdown list of area symbol types. You want to display cartographically sophisticated shapes for your legend symbols in the Table of Contents.

☐ Click *OK* on the *Options* dialog.

Notice the changes in your ArcMap Table of Contents. The Source tab is no longer displayed and the symbol used for the block group polygons is no longer a simple rectangle. Next you will resize the display window to see what effect your changes to the Data View options have on the display.

☐ Resize your *ArcMap* display by clicking and dragging a corner. Notice that the scale of your display does not change regardless of how small or large you make the *ArcMap* window.

☐ Use the *Options* dialog to set your ArcMap properties back to their original settings.

STEP 3: ADD FIELDS FROM A RELATED TABLE

Attributes can be stored in separate related tables rather than being stored directly on the layer table. To access the values, you can create a join or relate that defines the relationship between the two tables. In this step, you will use a join to access the related attributes. First, examine the attribute fields for census block groups.

☐ In the Table of Contents, double-click *Census Block Groups*.

☐ Click the *Fields* tab.

Census Block Groups contains seven fields. Most of them are standard fields for storing feature shapes and ID numbers. There is one user-added field, UNIQBG. This field contains a unique identifying number for each block group. This is the field that links the block group areas to their demographic data, which is stored in another table.

To access the demographic data, you will create a join.

☐ In the *Layer Properties* dialog, click the *Joins & Relates* tab.

☐ In the *Joins* area, click *Add*.

☐ For *What do you want to join to this layer?*, confirm or click *Join attributes from a table*.

☐ For *Choose the field in this layer that the join will be based on*, select *UNIQBG*.

☐ For *Choose the table to join to this layer*, click the *Browse* button and select *blockgr.dat* from the *TillamookWshd* folder.

☐ Click *Add*.

☐ For *Choose the field in the table to base the join on*, select *UNIQBG*.

☐ Click *Advanced* to view the options you have available for your join output.

☐ Click *OK* to close both dialogs.

☐ Click *Yes* in the *Create Index* message box.

Next, confirm that the join has linked the information as you expected.

☐ Click the *Fields* tab.

Notice that the joined fields are now available to the layer. The new fields have *blockgr.dat:* as prefixes to their original names. You can resize the column width if necessary.

Now you can use the additional attributes in the joined table for symbolizing this layer or making attribute selections, and so on.

STEP 4: CLASSIFY THE CENSUS BLOCK GROUPS

Data can be classified using several techniques: Manual, Equal Interval, Defined Interval, Quantile, Natural Breaks (Jenks), and Standard Deviation.

In this step, you will use the Natural Breaks and Quantile classification methods to classify the Census Block Groups based on a related field from the demographic data table.

☐ In the *Layer Properties* window, click the *Symbology* tab.

☐ For *Show*, click *Quantities* > *Graduated Colors* (this is the default method, and it should select automatically).

☐ For *Value*, click *blockgr.dat:AGE5*.

Five year-old populations are important for school board planning operations; they may need to consider the development of new schools, bus routes, or classrooms. You will symbolize the census block groups based on their population of five year-olds. The default classification method is Natural Breaks (Jenks).

☐ For *Color Ramp*, choose a range of dark greens.

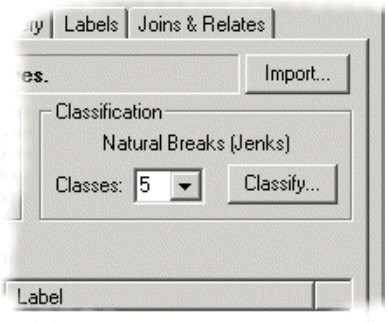
☐ Click *OK*.

The map is updated to show the Census Block Groups classified based on their population of five year-olds. Next, try another type of classification.

☐ Double-click the *Census Block Groups* layer to open the *Layer Properties* dialog.

☐ Click the *Symbology* tab, if necessary.

☐ Click *Classify.*



The Classification dialog shows a visual representation of data values and classification breaks in a histogram. The attribute values are displayed along the x-axis and the number of features along the y-axis. The break points for each class are displayed in the histogram with a blue line and a number (3, 9, 15, 19). You can drag and drop the blue break lines to define your own class breaks.

☐ Experiment with dragging the break lines. Notice how the breakline value changes both in the histogram display area as well as in the *Break Values* area on the right.

Next, classify the census block groups based on a Quantile classification.

☐ On the *Classification* dialog, for *Classification Method* dropdown list, click *Quantile*.

The Quantile method will group features into classes of equal size. While examining the histogram, note that several block groups have zero five year-olds. This has occurred because reliable data was not available for those census block groups. Because no data was recorded for those block groups, it does not make sense to include them in the classification. In ArcMap, you can exclude features from a classification.

☐ Click the *Exclusion* button.

☐ On the *Data Exclusion Properties* dialog, click the *Query* tab if necessary.

☐ For the selection statement, either build or type the expression
`"blockgr.dat:AGE5" = 0`

☐ On the *Data Exclusion Properties* dialog, click the *Legend* tab.

☐ Click the *Show symbol for excluded data* check box.

☐ Click the *Symbol* button.

☐ On the *Symbol Selector* dialog, choose the *Grey* symbol and click *OK*.

☐ On the *Data Exclusion Properties* dialog, for *Label*, type **`No data recorded`**

☐ Click *OK* on the *Data Exclusion Properties* dialog.

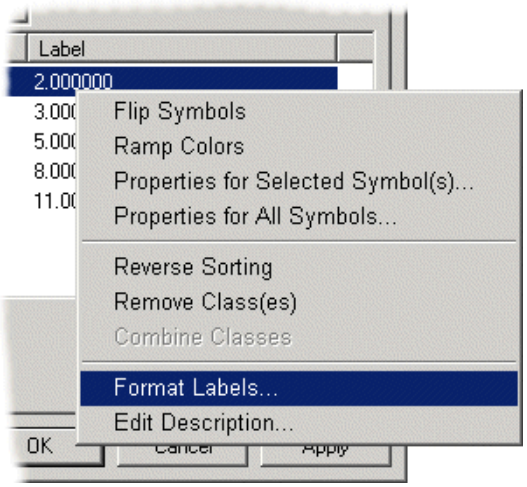
☐ Click *OK* on the *Classification* dialog.

Currently, the class labels show several decimal places. These could be distracting in the legend on your final map because you cannot have half of a five year-old. Next, you will change the labels.

☐ Check the *Show class ranges using feature values* check box.

There are two ways to modify labels for a classification in this window. You can click the values and manually change them, or you can right-click the labels and click Format Labels, which will display the Number Format dialog. This dialog has different categories such as Currency, Numeric, and Percentage for formatting your numeric labels.

☐ In the *Layer Properties* dialog, right-click one of the labels and click *Format Labels*.



☐ Click the different categories to see the available formatting options.

☐ Confirm or set the *Category* to *Numeric*, and for *Rounding* set the *Number of decimal places* to `0`

☐ Click *OK* on both dialogs.

The census block groups are displayed with a Quantile classification based on the number of five year-olds within each census block group. The census block groups with larger populations of five year-olds are easy to see, while the block groups with zero five year-olds are shaded grey and excluded from the classification. Now you will change the Table of Contents label above the population categories to make it more meaningful.

☐ In the *Table of Contents*, change the label for the categories from *blockgr.dat:AGE5* to **`Five-year-old Population`**

Hint: Click, wait, and click again on the *blockgr.dat:AGE5* label. Now, type over the new label.

STEP 5: CREATING A LAYER FILE

ArcMap layers store information on the storage path for the source data, and properties for how that data is displayed. These layers may be shared to standardize symbology and reduce the need to store spatial data files more than once.

You can save any layer in the Table of Contents to a stand-alone layer file. For example, instead of e-mailing actual data to a colleague, you can e-mail a layer file, provided your colleague has access to the same underlying data source. Or you can create a folder on your network that stores layer files for commonly used base map layers, and anyone in your organization can have access to consistent symbology for their cartographic needs.

In this step, you will create a layer file that will store the current symbology for the Census Block Groups.

☐ In the *Table of Contents*, right-click on the *Census Block Groups* layer, and select *Save As Layer File*.

☐ Save the *Census Block Groups.lyr* file to the *C:\Student\igis2* folder.

STEP 6: WORK WITH THE LAYER FILE

☐ On the *Standard* toolbar, click *New Map File*.

☐ Click *No*, as you do not want to save the current map document.

☐ Add the *Census Block Groups.lyr* file from the *C:\Student\igis2* folder.

Notice that your symbology has not changed. Now add the geographic places and city boundaries to your map.

☐ From the *C:\Student\igis2\TillamookWshd* folder, add the *geoplaces* and *citylim* coverages.

Hint: You can hold down the *Ctrl* key to select them to open simultaneously.

☐ Change the names of the new layers to **`Geographic Places`** and **`City Boundaries`**

☐ Make sure the layers are in the following order in the Table of Contents (from top to bottom): *Geographic Places, City Boundaries, Census Block Groups.*

☐ Change the symbology of the *City Boundaries* layer so only the city outlines are displayed. (Choose a color and outline thickness that will stand out against the other features.)

☐ Change the symbology of *Geographic Places* so it is clearly visible.

STEP 7: SHOW MAP TIPS

Map tips reveal more information about map features. Like tool tips for toolbar buttons, map tips pop up as the mouse pointer hovers over a feature. The value displayed as a map tip is based on the primary display field. First, you will examine the field properties for the Geographic Places layer to make sure the primary display field is appropriate for map tips.

☐ Double-click *Geographic Places*.

☐ Click the *Fields* tab.

The Primary display field is NAME by default. This is an appropriate field as it contains the names for the geographic places.

☐ Click the *Display* tab.

☐ Check the *Show Map Tips* box.

☐ Click *OK*.

☐ Hover your mouse pointer over several geographic places so their names display.

STEP 8: CREATE A DEFINITION QUERY

A definition query lets you display a subset of features for a layer. The source data is not affected. You will create a definition query so only schools are displayed from the Geographic Places layer. The source data will still contain all the geographic places, but only the schools will be displayed on your map.

☐ Double-click *Geographic Places*.

☐ Click the *Definition Query* tab.

☐ Click *Query Builder*.

The Query Builder lets you create an expression to identify particular features in the layer you want to display. You will learn more about building expressions later in the course.

☐ Double-click *DESIG* to add it to the expression.

☐ Click *Get Unique Values*.

The list of unique sample values is updated on the right-hand side of the dialog.

☐ Click the *Equal Sign (=)* button to add an equal sign to the expression.

☐ For *Unique sample values*, scroll and double-click *'school'*.

Your expression should be: *"DESIG" = 'school'*

☐ Click *OK* to both dialogs.

Your map is updated to show only the four schools. It may be necessary to click *Refresh View* to see the change.

☐ Change the name of the *Geographic Places* layer to **`Schools`**

☐ Click the symbol for schools to display the *Symbol Selector*.

☐ Click the *School 2* symbol (It is about halfway down the list.)  .

☐ Change the color to *red*.

☐ Change the size to **`25`** pt. and click *OK*.

A definition query also affects the layer table.

☐ Right-click *Schools* and click *Open Attribute Table*.

Notice that only records meeting the school designation are displayed.

☐ Close the table.

STEP 9: CREATE STYLES FOR SCHOOL PLANNING MAPS

A style is an organized collection of elements such as symbols, scale bars, north arrows, and color ramps used to make maps. You might create different styles containing new custom elements for the specific types of maps you make, or one that contains elements from many of the categories supplied with ArcMap in one central location. In this step, you will create a new style set with styles for school planning maps.

You can create styles using the Symbol Selector or the Style Manager. First, create a style using the Symbol Selector.

☐ Click on the symbol for *Schools*.

☐ In the *Symbol Selector,* click *Save*.

☐ For *Symbol Name*, type **`School`**

☐ For *Category*, type **`Default`**

☐ Click *OK* on the *Save Symbol to Style* dialog.

☐ Scroll to the bottom of the list to view the new *School* symbol in the *Symbol Selector*.

Notice that the School symbol was added to the Default style.

☐ Click *OK* to close the *Symbol Selector*.

The symbol is saved in your personal style set. Next, you will open the Style Manager to view several style sets.

☐ Click *Tools* > *Styles* > *Style Manager*.

The Style Manager shows two style sets on the left-hand side. The style sets have folder icons next to them. One is named ESRI.style, and one is the personal style set that is stored in your Documents and Settings folder. By default, symbols and other style elements are displayed from both the ESRI.style set and your personal style set. Next, view the active style sets.

☐ Click *Styles*.

Notice the check marks next to your style set and the ESRI style set. When you click symbols in the Table of Contents to display the Symbol Selector, the displayed symbols are from these two style sets.

☐ On the left-hand side on the Style Manager, click the *plus sign (+)* next to *ESRI.style* to open the style set.

☐ Click *Marker Symbols*.

These symbols should look familiar. They are the marker symbols that were available in the Symbol Selector. Next, add the Civic style set so you have more marker symbols to choose from.

☐ Click *Styles* > *Civic*.

The Civic style set is added to the list of available styles on the left.

☐ Click the *plus sign* next to *Civic.style* to open the style set.

☐ Click *Marker Symbols*.

The Civic style set contains many more marker symbols that you may want to use in your maps.

Now you will remove the reference to the Civic style set.

☐ Click *Styles* > *Civic* to uncheck the *Civic* style set.

You will create a new style set to hold styles for school planning projects. By using a new style set rather than your personal style set, you will be able to share the style set with others who make maps for school planning projects. The style set will be useful for standardizing the symbols you use.

☐ Click *Close*.

You will create the new style set by exporting styles used in the current map, and then you will add, modify, and delete styles to finalize the style set.

☐ Click *Tools* > *Styles* > *Export Map Styles*.

☐ Navigate to your *C:\Student\igis2* folder and save the style as **`SchoolPlan`**

As you will soon discover, the SchoolPlan.style is automatically populated with the elements currently defined in your map document. Now open the style in the *Style Manager* and modify it.

☐ Click *Tools* > *Styles* > *Style Manager*.

☐ Click *Styles* > *Add*.

☐ Navigate to the *SchoolPlan* style set and click *Open*.

☐ Click the *plus sign* next to the *SchoolPlan* style set.

The folders shown in color represent elements containing styles.

☐ Click the *Colors* folder. You will see the colors you used in your map.

☐ Click the other folders containing styles and examine their styles.

Notice they are named according to their labels in the Table of Contents. Next, change the style names.

☐ Click *Marker Symbols*.

☐ Click *Schools*, then click again and change the name to **`School`**

Now that you have a SchoolPlan style set with a symbol for School, you can remove the school symbol you saved in your personal style set, as you do not need to store this symbol twice.

☐ Click the *plus sign* next to your personal style set.

C:\Documents and Settings\<your_name>\Application Data\ESRI\ArcMap\<your_name>.style

☐ Click *Marker Symbols*.

☐ Right-click *School* and click *Delete*.

☐ Collapse the display for your personal style set.

Now you will go back to the SchoolPlan style set and continue to change the style names.

☐ Click the *Fill Symbols* folder under the *SchoolPlan* style set.

☐ Change each of the green fill symbol names according to the following table:

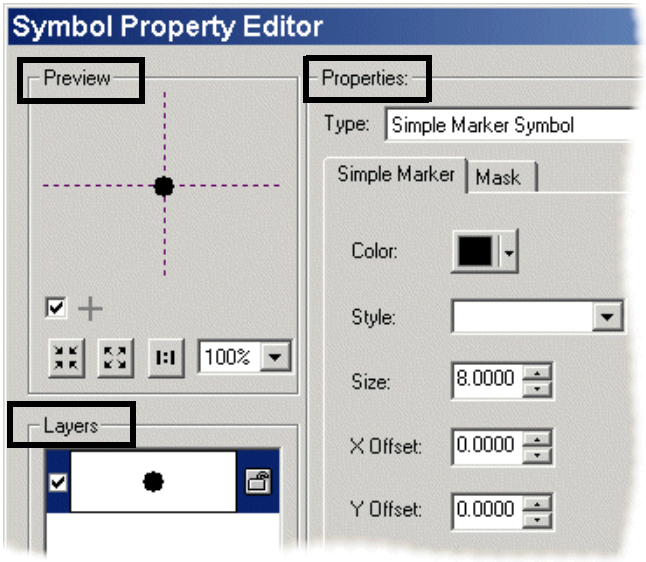
Name	Category
2	**`Very low population`**
3	**`Low population`**
5 - 6	**`Medium population`**
8 -10	**`High population`**
11 - 19	**`Very high population`**

Next, add a new symbol for environmental sites in school planning maps.

☐ Click *Marker Symbols*.

☐ Right-click the symbol display area and click *New > Marker Symbol*.

The Symbol Property Editor appears. You will define the new symbol here. The editor contains three sections: Preview, Properties, and Layers. The Preview section shows you a preview of your symbol as you change its properties. Symbols are made up of one or more layers. The Layers section helps you manage the layers. The Properties section lets you change the properties of the current layer.



You will create a symbol that has two layers. The background layer will be a solid fill green circle, and the foreground layer will add a brown outline with a brown triangle in the center. First, create the solid fill green circle.

☐ Under *Properties*, from the *Type* dropdown list, click *Character Marker Symbol*.

☐ On the *Character Marker* tab, for *Character*, click character *33*, the circle. The character numbers display if you select them. Alternatively, type `33` in the *Unicode* box.

☐ For *Color*, choose the *Macaw Green* color (sixth column, fourth row).

☐ For *Size*, specify `18` pt.

Notice the *Preview* panel reflects your modifications.

Now you will add a layer with a brown outline and a triangle in the center.

☐ In the *Layers* section, click the *Plus Sign* button.

A layer is added with the default character and size (a small black box). Notice that the characters are shown separately in the Layers section, but are shown together in the Preview section. The Preview section shows the symbols as they will appear on a map.

☐ In the *Properties* section, choose the *Character Marker Symbol* type, and enter `85` for the *Unicode* value, which is a circle with a triangle in the center.

☐ For *Color*, choose a brown color.

☐ For *Size*, specify `18` pt. (same size as the green circle).

☐ Click *OK*.

The symbol is added to the SchoolPlan.Style style set under the Marker Symbols. Now you need to rename the symbol.

☐ Change the name to **`Environmental Sites`**

You could follow this same procedure to create symbols for other items common to school planning maps. Next, modify the City Boundaries symbol.

☐ Click *Fill Symbols*.

☐ Double-click *City Boundaries*.

☐ Modify the symbol to have a *Rose Dust* (second column, seventh row) fill and a *Poinsettia Red* (second column, fourth row) outline with a width of **`1.25`**

☐ Click *OK*.

☐ Name the symbol **`City Boundary`**

☐ Click *Close*.

Now use one of your new styles to display the city boundaries.

☐ In the *Table of Contents*, click the symbol for *City Boundaries*.

☐ Scroll down to the bottom and click your new *City Boundary* symbol.

☐ Click *OK*.

The new style set can be given to others so they can use consistent symbology for school planning maps.

STEP 10: USE A TEMPLATE TO CREATE A LAYOUT

In the next step, you will explore the time-saving advantage of using a previously created map template to format a layout.

☐ Change your current view to *Layout View.*

☐ On the *Layout* toolbar, click the *Change Layout* button  .

The Select Template dialog appears allowing you to select a template. ArcMap contains several predefined templates created for general applications and specific industries. You will use a general template to quickly format your layout. Then you will be able to adjust and fine tune the details of your layout as you see fit.

☐ If necessary, click the *General* tab. Notice the variety of general purpose templates.

☐ Select the *PortraitModern.mxt* template, then click *Finish*.

Notice that the legend overlaps other elements of the map, you will need to re-create the Legend to fit in the box provided on the template.

☐ Use the *Select Elements* tool  to select the legend.

☐ Click *Delete.*

☐ Select *Insert* > *Legend.*

☐ On the first panel of the *Legend Wizard*, change *Set the number of columns in your legend* to 2.

☐ Click *Next.*

☐ Change the *Legend Title* to **`School Planning`**

☐ Click *Next* until you get to the last panel, then click *Finish.*

☐ Resize the legend to fit in the blue box at the bottom left corner of the map template.

☐ For *Scale* (on the Standard toolbar), type **`150,000`** and press *Enter.*

The display inside the data frame zooms in to 1:150,000.

☐ If necessary, use the *Pan* tool on the *Tools* toolbar to center the geographic data in the data frame.

A map template can speed up production by providing standard map elements.

☐ Change the text for the title to something more meaningful, e.g., **`Demographic Studies for the Tillamook Region`**

☐ Add and adjust any of the map elements as you see fit. Some map elements you might want to add are a scale bar, north arrow, and reference grid. You may also choose to change the Data Frame background color.

Hint: Like layers, Data Frames have properties, too.

☐ Save your new map as **`SchoolMap.mxd`** under the *C:\Student\igis2\TillamookWshd* folder.

☐ If you want to continue with the challenge step, then open a new empty map without saving your changes. Otherwise, close *ArcMap*.

In this exercise, you learned how to symbolize data using layer properties. You also learned how to create your own symbols using styles. Finally, you used a map template to enable you to quickly create a new map with a standard layout. If you have the time, go on to the challenge step.

CHALLENGE: EXPERIMENT WITH QUANTITATIVE SYMBOLOGY METHODS

There are many ways to display the magnitude or concentration of attribute values in maps. In the previous exercise, you used only the color ramp method to show the relative populations of five year-olds in the Tillamook census block groups. In this challenge step, you will compare the use of graduated, proportional, and dot density symbology to show relative differences in the number of mobile homes in some Texas counties.

☐ In your new empty map, click the *Add Data* button and navigate to the *C:\Student\igis2\National* geodatabase and add the *USA_Counties* feature class.

☐ Using the *Select by Attributes* dialog, construct a query to select *Bexar* County from the *USA_Counties* layer.

☐ Click *Apply* and then close the *Select By Attributes* dialog.

☐ When *Bexar* County is selected, zoom to the selected feature, and clear the selection.

☐ Now you want to view the surrounding counties, as well as *Bexar*, so change the scale of the display to `1:3,000,000`

☐ Label the counties with their *NAME* field using the default text properties.

The first type of quantitative display you will make is a Graduated symbols display.

☐ Open the *USA_Counties' Layer Properties* dialog and click the *Symbology* tab, then choose *Quantities > Graduated symbols* for the type of display.

☐ For the *Value* to display, choose *MOBILEHOME* from the dropdown list (it is near the bottom).

The *MOBILEHOME* attribute field represents the number of mobile homes in each county. Notice that the field is being classified by the default Natural Breaks method with five separate classes.

☐ Click *OK* on the *Layer Properties* dialog.

Notice that Bexar County appears to have far more mobile homes than most of the surrounding counties. However, this type of display could be misleading because Bexar County also has far more people than the surrounding counties, and the counties are not equal in size. Next, you will normalize the *MOBILEHOME* attribute values to give a different representation of the data.

☐ Open the *Layer Properties* dialog for *USA_Counties*.

☐ On the *Symbology* tab, for *Normalization*, choose *POP1999* from the dropdown list, then click *OK*.

By normalizing the *MOBILEHOME* values, you divided them by the total 1999 population values for each county. Now, instead of raw counts of the number of mobile homes, the classes represent the number of mobile homes per person. Notice the change this makes in the display. While Bexar County was shown to have the most mobile homes in the previous display, this display shows that it has far fewer mobile homes per person than the neighboring counties.

Another way to show the distribution of a particular attribute value is *Dot density* symbology.

☐ For the *USA_Counties* > *Properties* > *Symbology* method, click *Quantities* > *Dot density*.

☐ Under *Field Selection*, click *MOBILEHOME*, then click the right arrow to add it to the list of attributes to be displayed.

Notice that the default dot size is 2, and its value is 40.

> **NOTE:** If your value is different, then change it to 40.

☐ Click *OK*.

> **NOTE:** If the default dot color does not make good contrast with the background, go back to the Layer Properties dialog, for Background, click the Color button and chose a tan or any suitable light color.

Once again, the display represents raw counts of the number of mobile homes in each county, but this time, instead of a classification, with different size symbols representing each class, you have dots of the same size, each representing 40 mobile homes. One advantage of this type of quantitative display is that you can represent the actual number of mobile homes in each county more accurately. You simply multiply the number of dots by the dot value.

☐ Close *ArcMap*.

> **NOTE:** These dots are randomly placed within each polygon. To test this, click the Refresh View button at the bottom several times and observe how the dots change their random position each time.

In this challenge step, you compared different quantitative display techniques.

EXERCISE END

3

Creating labels and annotation

contents

EXERCISE 3: CREATING LABELS AND ANNOTATION

In this exercise, you will experiment with labeling features. You will also work with the different labeling options. Once you have set up the labels the way you want them to look, you will convert them to annotation.

STEP 1: TURN ON LAYER LABELS

In this step, you will turn on labeling for two layers, see how the labels are dynamically displayed when you zoom in and out, and lock labels using the Labeling toolbar.

☐ Start *ArcMap* using *An existing map* document.

> **! For best effect, make sure that you have maximized ArcMap to the full size of your monitor screen.**

☐ Browse to the *C:\Student\igis2\MapDocuments* folder and open the *LabelsAndAnno.mxd* map document.

☐ Right-click the *WorldCities* layer and click *Label Features*.

☐ Right-click the *WorldCountries* layer and click *Label Features*.

☐ Zoom in and out.

Notice how label placement changes based on your scale (e.g., as you zoom out, labels disappear). Rules and properties control where labels are placed for features. At the full extent of the map, notice that relatively few labels are displayed. If a label conflicts with other labels, it may not display at all. As you zoom in on features, there is more room to display labels, so more labels become visible. ArcMap uses a default conflict detection mechanism to control the placement of text to reduce clutter in the display at smaller scales.

If you want to keep the labels in a static location when you move around the map, you can use the locking functionality that is available on the Labeling toolbar.

☐ Click *View* > *Toolbars* > *Labeling* to add the Labeling toolbar.

☐ Zoom in on the map to a scale greater than 1:100,000,000 (i.e., the number should be smaller than 100,000,000).

☐ From the Labeling toolbar, click the *Lock Labels* button  .

☐ Pan around the map.

As you pan, no new labels are drawn on the map and any current labels remain in the same place. When labeling is locked, no attempt is made to draw any new labels or refresh the current ones. One of the advantages of this is that you can zoom in to look at labels that might be cluttered or difficult to see at the full extent, without having those labels move. If you do not want to change the extent of your current view, you can also use the locking labels functionality with the magnification window.

☐ Click *Window* > *Magnifier*.

☐ Move the *Magnification* window over a piece of text.

Notice that the labels remain the same size and in the same location.

☐ Close the *Magnification* window.

☐ Click the *Lock Labels* button to disable locking.

Notice that all the labels in your view extent are now displayed.

STEP 2: CHANGE THE LABEL SYMBOL

You can control the symbology for your labels. Currently, it is very difficult to see the difference between the country labels and the city labels. In this step, you will make the city labels bold and the country labels larger and dark green.

☐ Open the *Layer Properties* dialog for the *WorldCities* layer.

☐ Click the *Labels* tab.

☐ For *Text Symbol*, click *Symbol*.

☐ On the *Symbol Selector*, scroll down and click the *City* symbol.

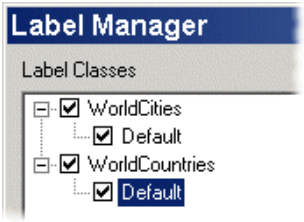
☐ Click *B* for bold.

☐ Click *OK* in both dialogs.

Now you can better distinguish the city names from the country names. This can also be done using the Label Manager. In the next few steps, you will change the symbology for the country names using the Label Manager.

☐ From the *Labeling* toolbar, click the *Label Manager* button  .

The Label Manager gives you access to all of the labeling properties for all layers in the active data frame. Each layer is listed on the left-hand side of the dialog, and all of the properties are listed on the right-hand side.



☐ Select the *WorldCountries* > *Default* class.

☐ For *Text Symbol*, click *Symbol*.

☐ Click the *Country 1* symbol.

☐ For Color, choose *Peacock Green* (dark green, eighth column, sixth row).

☐ For *Size*, choose *18* from the dropdown list.

☐ Click *OK* in both dialogs.

Because the country names are displayed with a larger symbol, there might be more conflicts between the labels, causing fewer labels to display.

> **NOTE:** From a cartographic point of view, an 18-pt. size font for country names is much too large for this map scale.

☐ Zoom to the full extent.

STEP 3: CHANGE LABEL PLACEMENT AND VISIBILITY

When you are zoomed out to the full extent of the map, it is difficult to determine which features the labels refer to. You will set the visible scale range to display labels only when you are at an appropriate scale to see them. After you set the visible scale range, you will change the placement of the city labels so they appear to the upper right of the city symbols, then you will change the position of the country labels to better fit inside the polygon features.

☐ Open the *Layers Properties* dialog for the *WorldCities* layer.

☐ On the *Labels* tab, click *Scale Range*.

☐ Click *Don't show labels when zoomed*.

☐ For *Out beyond* scale, type `20000000` (20,000,000). Leave the *In beyond* scale at its default.

Now when you zoom out to scales smaller than 1:20,000,000, the labels for the cities will no longer display.

☐ Click *OK* in both dialogs.

☐ Zoom in until you see labels for the cities.

Now change the properties for the *WorldCountries* layer so the labels do not display when you zoom out to scales smaller than 1:60,000,000.

☐ Change the *WorldCountries > Label Properties* so that the zoom *Out Beyond 1:* value is `60000000` (60,000,000).

☐ Click *OK* to close all dialogs.

☐ Zoom to the *Full Extent*. Then zoom in until you see the labels for the countries.

Now change the placement options for the WorldCountries layer so only one label is displayed for each country.

☐ Pan your map to focus on Italy.

☐ Set scale to 1: 25,000,000. The label name for Italy should appear two or three times.

☐ Open the *Layer Properties* dialog for the *WorldCountries* layer.

☐ On the *Labels* tab, click *Placement Properties*.

☐ Click the *Placement* tab, if necessary.

☐ For *Duplicate Labels*, click *Place one label per feature*.

Hint: To learn the difference between 'Remove duplicate labels' and 'Place one label per feature', click the Help button (marked by '?' in the top right corner of the Placement Properties dialog). The mouse pointer changes shape. Click your pointer on Remove duplicate labels, and read the context help on this option. Repeat this to read the help on the other option.

☐ Click *OK* in both dialogs.

Notice that Italy is now labeled only once.

The city labels do not always appear to the upper-right of the city. Some of the labels show up directly above the city, to the lower-right, or not at all. Now you will restrict label placement to the upper right side of the city symbol.

☐ In the ArcMap *Main Menu*, click *View* > *Bookmarks* > *Europe*.

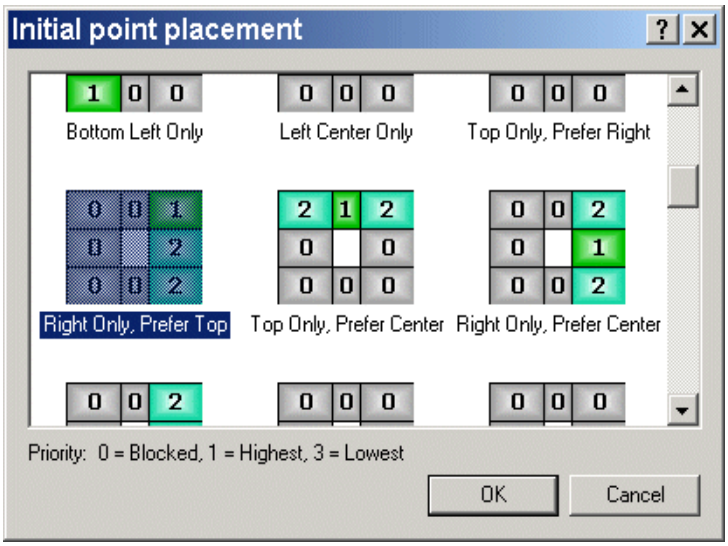
☐ Open the *Layer Properties* dialog for the *WorldCities* layer.

☐ On the *Labels* tab, click *Placement Properties*.

☐ Click the *Placement* tab, if necessary.

☐ Click *Change Location*.

☐ Scroll up and click *Right Only, Prefer Top*.



NOTE: Cartographically, Top Right Only is the ideal place.

☐ Click *OK* in all dialogs.

Observe how the labels for the cities were placed with this option. All the city names appear to the top right or right of the city feature symbol or they do not appear at all.

Label placement can also be changed within the Label Manager. Now you will change the label placement options for the country polygons.

☐ Open the bookmark named *South America*.

☐ From the *Labeling* toolbar, click the *Label Manager* button .

☐ From the *Label Classes* list box, choose *WorldCountries > Default*.

☐ For *Placement Properties*, click *Try horizontal first, then straight*.

☐ Click *OK*.

☐ Use the *Fixed Zoom* tools to zoom in and out.

Notice the behavior of the ESRI Standard Label Engine: it first attempts to place the labels horizontally where there is enough space. If the label cannot be placed horizontally, it is positioned to follow the longest direction of the polygon. Where the label cannot fit completely inside the polygon, it defaults to horizontal placement.

STEP 4: LABEL THE CAPITALS WITH A DIFFERENT SYMBOL

So far, you have modified label properties for the entire layer. In this step, you will group features within a layer so you can assign each group its own labeling properties.

☐ Open the bookmark named *South East Asia.*

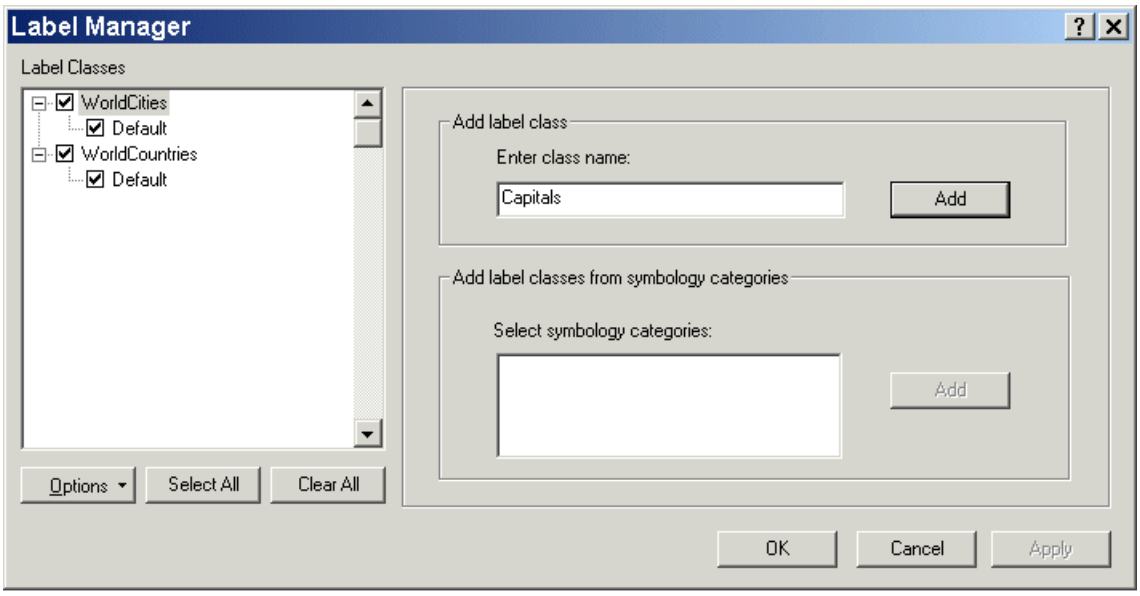
☐ Turn off the labels for *WorldCountries.*

☐ From the *Labeling toolbar*, click the *Label Manager* button.

☐ In the *Label Manager* dialog, for *Label Classes*, click the *WorldCities* layer.

You will group the capital cities into a labeling class named Capitals. A labeling class is a group of features with the same labeling properties. When you create a new class, all the labeling properties from the previous class are copied into it. In this case, all the properties you have set in this exercise for labeling cities will be in the properties for the new Capitals class.

☐ For *Add Label Class*, type **`Capitals`**



☐ Click *Add*.

Currently, this class is a grouping of all the features in the layer. Now you will create an SQL query to reduce the features in this class to only the country capitals.

☐ In the *Label Manager* dialog, click the new *WorldCities* > *Capitals* class.

☐ Click *SQL Query...* button.

☐ Build the expression **`[CAPITAL] = 'Y'`** and click *OK*.

Now change the symbology for the Capitals class.

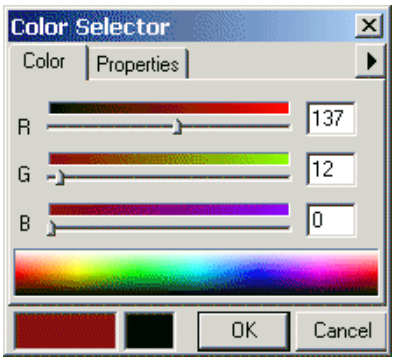
☐ Change the *Size* to **`10`** pt.

You will use RGB to symbolize the capitals.

☐ Click the arrow to the right of the color box to make the color palette visible.

☐ On the *Color palette*, click *More Colors*.

☐ in the *Color Selector*, change the *Color* to `RGB: 137,12,0`



☐ Click *OK* to close all the dialogs.

Now you have two label classes for WorldCities: Default and Capitals. Default currently represents all the features in the layer, while Capitals only represents the country capitals. Because both of the classes have country capitals in their grouping, those cities will be labeled twice. You may also notice that some of the capitals aren't displayed with the new symbology due to placement conflicts.

Now you will remove the capitals from the default class so they will be labeled only once.

☐ Open the *Label Manager*.

☐ For *Label Classes*, click *WorldCities* > *Default*.

☐ Click *SQL Query*.

☐ Build the expression `[CAPITAL] = 'N'` and click *OK*.

☐ Click *Scale Range*.

☐ For *Out Beyond 1:*, type `15000000` (15,000,000).

☐ Click *OK* in both dialogs.

☐ Zoom and pan around the map to see the label classes.

Now you should see the capitals labeled with larger text and a maroon color. You will have to zoom in to a scale larger than 1:15,000,000 to see the labels for non-capital cities. The non-capital cities remain in smaller size black text.

STEP 5: MANAGE LABEL PRIORITY

You can set the labeling priority for each layer or class on your map. Features from layers and classes with a higher priority will be labeled before those with a lower priority. Because the label priority setting affects multiple layers, you will set the priority in the Label Manager. First, examine the current label priorities.

☐ Turn on the labels for *WorldCountries*.

☐ From the *Labeling* toolbar, click the *Label Priority Ranking* button  .

Notice that the default city labels have a higher priority than the capitals.

☐ Click *Cancel* to close the *Label Priority Ranking* dialog.

☐ Open the bookmark named *Tokyo*.

☐ Zoom out to a scale beyond 1: 15,000,000. The labels for the non-capitol cities are not drawn.

☐ On the *Standard* toolbar, for *Scale*, type `9,000,000` and press *Enter*.

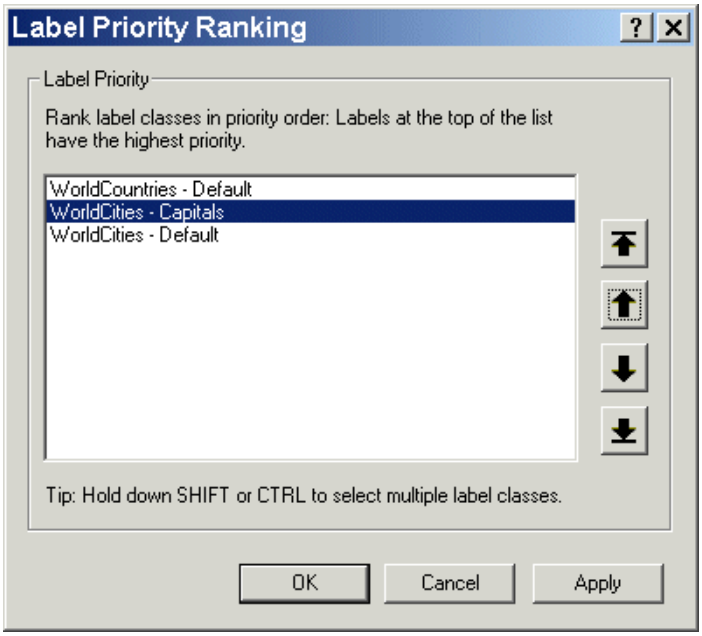
Notice that the label for Tokyo disappears when the other city labels appear because of the previously mentioned label priority. Now you will change the priority, so the capital labels can never be removed in favor of a city label.

☐ Open the *Label Priority Ranking* dialog.

☐ In the *Label Priority* list, using the arrow buttons, move *WorldCountries - Default* to the top of the list.

☐ In the *Label Priority* list, move *WorldCities-Capitals* to the second position in the list.

The dialog should look like this:



☐ Click *OK*.

Notice that Tokyo now has priority over the other labels, and the country labels are always displayed.

STEP 6: CREATE AND EDIT ANNOTATION

In this step, you will convert the country labels to annotation. Annotation gives you precise control over label placement. When you convert labels to annotation, you can either store them with the map as a group of graphics, or you can store them in a geodatabase as an annotation feature class.

To create annotation, you need to set a reference scale for your labels. When a reference scale is set, your labels are scaled with your map when you zoom in or out. First, examine how zooming in or out affects labels without a reference scale.

☐ Open the bookmark named *Africa*.

☐ Zoom in until the labels appear.

☐ Zoom in more to confirm that the size of the labels does not change as the map scale changes.

Next, you will set a reference scale for creating annotation.

☐ On the *Standard* toolbar, for *Scale*, type `50,000,000` and press *Enter*.

☐ In the *Table of Contents*, right-click the *Layers* data frame and click *Reference Scale > Set Reference Scale*.

With a reference scale set, your text will scale with the map. If you zoom out, the text will get smaller; if you zoom in, the text will get larger.

☐ Zoom in and out to see how the labels and features maintain their sizes relative to the reference scale.

When you create annotation, the current scale is used as the reference scale. Now you will zoom to the reference scale you just set.

☐ In the *Table of Contents*, right-click the *Layers* data frame and click *Reference Scale > Zoom To Reference Scale*.

☐ From the *Labeling* toolbar, click the *View Unplaced Labels* button  .

All of the unplaced labels will appear in a red font on the map. When converted to annotation, these labels will have nowhere to go, but will be saved in the annotation feature class as new features. Later, you will manage the unplaced annotation using the Unplaced Annotation Window.

☐ Click *View Unplaced Labels* to turn off the labels.

☐ Right-click the *WorldCountries* layer and click *Convert Labels to Annotation*.

☐ Accept the default settings for *Store Annotation*: *In a database*, and *Create Annotation for: All features.*

☐ Confirm that the *Feature Linked* and *Append* boxes are unchecked.

☐ Click the browse button  in the *Annotation Feature Class* column to open the *Create Annotation Feature Class* dialog.

☐ For *Database*, open the *C:\Student\igis2\National.mdb*.

☐ For the new feature class name, type in **`Country_Anno`** and click *Save*.

☐ Confirm that the *Convert unplaced labels to unplaced annotation* is checked.

☐ Click *Convert* to create the new annotation feature class.

Notice that the new Country_Anno feature class has been added to the Table of Contents as a layer. In addition, the labels for WorldCountries have been turned off automatically. You may also notice that the new annotation feature class inherited the scale range of the original label class, and therefore won't draw out beyond a scale of 1:60,000,000. You will change this property.

☐ Right-click on *Country_anno* > *Default* annotation class.

☐ Click *Visible Scale Range* > *Clear Scale Range.*

☐ Zoom to full extent.

Notice that the annotation features are drawn at the full scale, but remain set at their original 1:50,000,000 size.

☐ Go back to the previous extent.

When the labels are converted to geodatabase annotation, all the labels that could not be placed due to the placement rules are stored in the annotation feature class along with the new geodatabase annotation. Now you will use the Unplaced Annotation dialog to add the annotation that could not be placed.

Before you can add or edit any annotation, you must start an edit session.

☐ Add the *Editor* toolbar (Click *Tools* > *Editor Toolbar)* if it is not already visible, and add the *Annotation* toolbar as well.

☐ On the *Editor* toolbar, click Editor > *Start editing*.

☐ From the *Editor* toolbar, from the *Target* dropdown list, click *Country_Anno* if it is not already selected.

☐ On the *Annotation* toolbar, click the *Unplaced Annotation Window* button .

☐ Place and resize the window so that you can see your map as well as the *Visible Extent* and *Draw* check boxes.

☐ In the *Unplaced Annotation* dialog, from the *Show* dropdown list, choose *Country_Anno*.

☐ Confirm the *Visible Extent* and *Draw* options are checked.

☐ Click *Search Now.*

☐ Right-click an unplaced annotation feature and click *Zoom to Annotation*.

☐ Right-click the same piece of unplaced annotation and click *Place Annotation*.

The annotation is placed on the map and is removed from the Unplaced Annotation Window. Notice that the unplaced annotation is now a selected feature, and that your cursor has changed to the Edit Annotation tool  .

☐ Use the *Edit Annotation Tool* to move your selected annotation feature to a more fitting location.

The unplaced annotation is available every time the Country_Anno feature class is open in a map document.

☐ In the *Unplaced Annotation Window*, uncheck the *Draw* box, and close the window.

Now you will use the Edit Annotation Tool to change a parameter for an individual label. You can also use the Draw toolbar to edit annotation text attributes such as size, color, and font.

☐ Open the bookmark named *Russia*.

☐ Use the *Edit Annotation* tool  on the *Annotation* toolbar to select the "Russia" text.

☐ Right-click the selected annotation and click *Attributes*.

☐ In the *Attributes* dialog, verify that the *Annotation* tab is active.

☐ Change the font size to `100`, click *Apply,* and close the dialog. You may need to resize the window to see all of its features.

> **NOTE:** This text size is intentionally large so that you can see it easily at the small global scale; it is cartographically incorrect.

☐ Close the annotation *Attributes* dialog.

☐ Use the *Edit Annotation* tool on the *Annotation* toolbar to center the text over the country.

☐ Click *Editor* > *Stop Editing*.

☐ Click *Yes* to save the edits.

☐ Zoom to *Full Extent*.

☐ Exit *ArcMap* and Save your *LabelAndAnno.mxd* map document.

You have successfully created labels and annotation for this map of the world.

In this exercise, you experimented with labeling features, changing the label properties, how they are displayed, and their visibility with scale changes. You also learned how to customize label display for each feature, and managing priority of label display. Finally, you learned how to create and edit annotation features.

EXERCISE END

4

Displaying locations from tabular data

contents

EXERCISE 4: GEOCODING ADDRESS LOCATIONS

In this exercise, you will locate crimes in the city of Redlands. The crime data is stored as addresses and street intersections in a table. To locate this data on a map, you will start by creating an address locator in ArcCatalog. You will use that service in ArcMap to locate the crimes against street data. Then you will use the Find tool to locate individual addresses. Finally, you will plot coffee shop locations in Redlands to determine if there is any proximal relationship between crime and coffee shops.

STEP 1: EXAMINE THE DATA FOR GEOCODING

Before you can geocode addresses, you must have data containing address ranges. In this step, you will examine the reference data that you will later use to geocode.

☐ Start *ArcCatalog*.

☐ Navigate to the *C:\Student\igis2\DataSources* folder.

☐ In the Catalog tree, click on the *Geocode_str* shapefile.

☐ Click the *Preview* tab to preview its geography.

The Geocode_str shapefile was created from Census TIGER data and contains standard fields that define the street name and address ranges. This is the data you will use to reference address locations for the city of Redlands.

☐ Change the *Preview* mode to *Table* to examine the attributes of the *Geocode_str* streets shapefile.

Question 1: Which four fields combine to form all the necessary information for the street name? _____

Notice how each record representing a street segment stores address ranges for both the left and right side of the street. This information can be used to determine the side and position of the location along the street.

Question 2: Which four fields define how the addresses will be interpreted along the street features? _____

Next, examine the table containing the addresses of crime locations for the city of Redlands.

☐ In the Catalog Tree, click on the *Crime* table to preview its contents.

Question 3: Which field stores the address information? _____

The Crime table stores fictional records of burglaries, robberies and automobile thefts. Some crime locations are entered with a specific street address, for example 1075 State Street, while some locations have been entered only by the nearest street intersection, for example, Colton Av/Orange St.

☐ Scroll through the data, examining how addresses have been entered into the table.

Question 4: How are street intersection names separated in the location field?

_____

STEP 2: CREATE AN ADDRESS LOCATOR

Geocoding is the process of creating spatially referenced features from a written description of an address location, such as the addresses in the Crime table. An address locator defines the process for converting these textual descriptions of locations into geometric shapes. Properties of the address locator include:

1. The path to the Geocode_str reference data,
2. Algorithms for standardizing address descriptions and matching them to the reference data,
3. Optional parameters for reading address information, matching the address data to the reference data, and creating output.

☐ Navigate to and expand the *Address Locators* folder in the Catalog Tree.

☐ Double-click *Create New Address Locator* to display the *Create New Address Locator* dialog.

This dialog lists the available predefined address locator styles from which you may choose. These address locators styles cover the most common styles of address data used for geocoding. Each address locator style has its own requirements for address information and reference data.

☐ Scroll down in the *Create New Address Locator* dialog and select the *US Streets (File)* address locator style.

☐ Click *OK*.

The New US Streets (File) Address Locator dialog will launch. It is where you to set the reference data and other properties for this address locator.

☐ For *Name*, type **`RedlandsStreet`**

☐ For *Reference data*, click the *Browse* button and navigate to the *C:\Student\igis2\DataSources* folder.

☐ Select the *Geocode_str* shapefile and click *Add*.

Fields from the Geocode_str shapefile will automatically be mapped to the appropriate style categories for this address locator. This is a 'best guess' algorithm, and may not always accurately map the fields. You should always check that the fields for your data are matched to the appropriate fields for the locator style you have chosen.

☐ Confirm that your *Fields* information matches the following table. If not, choose the field name from each dropdown list.

House From Left	**L_ADD_FROM**
House To Left	**L_ADD_TO**
House From Right	**R_ADD_FROM**
House To Right	**R_ADD_TO**
Prefix Direction	**PREFIX**
Prefix Type	**<none>**
Street Name	**STREETNAME**
Street Type	**TYPE**
Suffix Direction	**SUFFIX**

The right side of the dialog allows you to set and adjust parameters for address matching. These settings control how the address locator will read the table of addresses to geocode, how to match addresses to features in the reference data, and what information to include in the output data.

Items listed under the Input Address Fields are the field names that the address locator will automatically assume contain the address information to be geocoded. The address information for the Crimes table is stored in a field called Location. You will add Location to the default list of input address fields.

☐ In the *Input Address Fields*, click *Add*.

☐ For *Field name*, type **Location**

☐ Click *OK*.

The Matching Options allow you to control how addresses will be matched to features in the Streets reference data. The Spelling sensitivity setting controls how much variation will be allowed in the spelling of an address. The lower the spelling sensitivity, the more candidates the address locator will consider.

The Minimum candidate score is the minimum score the address locator uses to determine if a potential candidate should be considered for matching. Candidates with a match score lower than this amount will not be considered.

The Minimum match score setting lets you control how well addresses have to match their most likely candidate in the reference data to be considered matched. Any score below the minimum match score would not be considered a match.

☐ Set the *Matching Options* according to the following table.

Spelling sensitivity	80
Minimum candidate score	30
Minimum match score	70

The intersections in the Crime table were separated by a forward slash.

☐ In the *Connectors* box, add a *forward slash* to the list of special characters. Make sure a *blank space* separates the special characters.

Under the Output Options heading, the side and end offsets control how the output geocoded features are placed relative to the reference data.

☐ Change the *Side offset* to 30 *Feet*.

This will place the new geocoded features to the left or right side of the street data at a perpendicular distance of 30 ft. from the street line.

☐ Accept the *3%* default value for the *End Offset*.

This will prevent the newly created features that are located at the end of a street feature from falling on top of other features. You will not add any additional fields to your output feature class. Now the settings for your new address locator are complete.

☐ Click *OK*.

The address locator is created and will appear under the Address Locators folder in the Catalog tree referenced as [username].RedlandsStreet.

STEP 3: PREPARE THE MAP FOR GEOCODING

In this step, you will create a map containing everything you need to geocode addresses. First you will add the appropriate data, then you will add the address locator that you just created in ArcCatalog.

☐ Start *ArcMap* and create *A new empty map*.

☐ Click the *Add Data* button, navigate to the *C:\Student\igis2\DataSources* folder, and choose the *Geocode_str* shapefile and the *Crime* table. (You can select multiple objects in the data browser by holding down the *Control (Ctrl)* button and selecting the objects with your mouse).

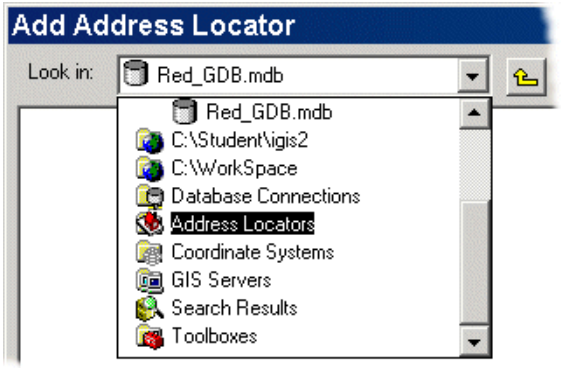
☐ In the *Table of Contents*, make sure the *Source* tab is active.

Next, you will add the new address locator you just created to the ArcMap document.

☐ Click *Tools* > *Geocoding* > *Address Locators Manager*.

☐ In the *Address Locators Manager* dialog, click *Add*.

☐ In the *Look in:* dropdown list, select the *Address Locators* folder and click *Add.*



☐ Select your *<username>.RedlandsStreet* address locator and click *Add*.

☐ Close the *Address Location Manager.*

STEP 4: GEOCODE THE CRIME LOCATIONS

Now you are ready to display your tabular addresses for crime data on a map. The result of the geocoding will be a point shapefile in the DataSources folder. Most of the points will be located directly from the service but some will have to be manually located in the next step.

☐ Right-click the *Crime* table and select *Geocode Addresses*.

A dialog box appears, prompting you to select an address locator (your RedlandsStreet address locator is the only one available).

☐ Confirm your *RedlandsStreet* address locator is highlighted and click OK.

The Geocode Addresses dialog will appear.

☐ For *Address table*, confirm that *Crime* is selected and that the *Address Input Fields* show the *Location* field.

You will create a new shapefile of geocoded point locations from the crime addresses.

☐ For *Output shapefile or feature class*, click the *Browse* button.

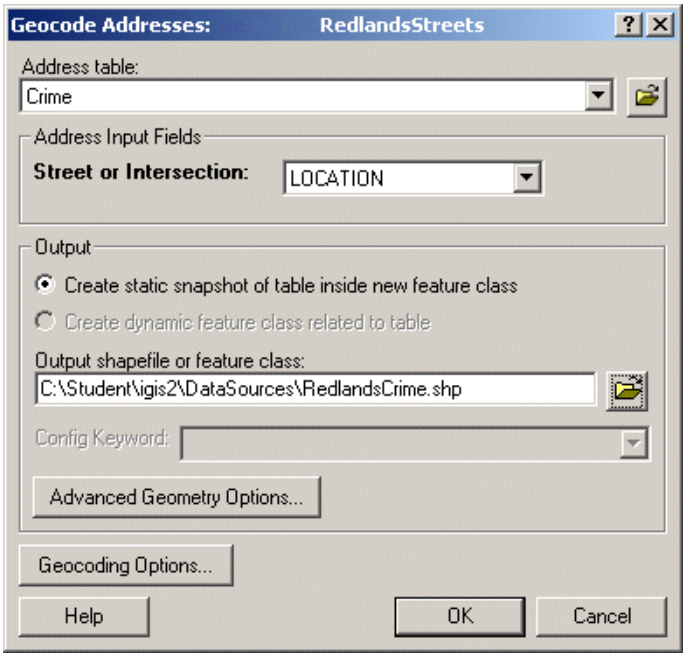
☐ For *Save as type*, click *Shapefile*.

☐ Navigate into the *C:\Student\igis2\DataSources* folder.

☐ For *Name*, type **`RedlandsCrime`**

☐ Click *Save* to close the *Saving Data* dialog.

☐ Click *OK* on the *Geocode Addresses* dialog.



A Geocoding Processing window will flash, the new point features will be added to the ArcMap display, and the Review/Rematch Addresses dialog will appear. Notice also that the Table of Contents has a new layer called Geocoding Result: RedlandsCrime.

☐ Review the statistics listed in this dialog.

Question 5: How many addresses matched with a score greater than 80? _____
Less than 80? _____
Did not match at all?_____

You will look at rematching the addresses in a moment. First, take a look at your new features.

☐ Click *Done* to close the *Review/Rematch Addresses* dialog.

☐ Zoom in to take a closer look at the crime locations. Select a congested area at the center of Redlands.

See how the new points representing the crime locations have been slightly offset to either the left or right side of the street.

☐ Right-click on the *Geocoding Result: RedlandsCrime* layer and click *Open Attribute Table*.

Additional fields have been added to the original Crime data: the Shape field stores the new geometry; Status is M for matched, T for tied, or U for unmatched; Score for overall match value; the Side of the street the address falls on; and ARC_Street.

☐ Right-click on the *Status* field and click *Sort Descending*.

The unmatched records will now appear at the top of the table, followed by the tied record.

☐ Examine the records that were unmatched.

Some may be spelled incorrectly or have the wrong suffix or prefix. A few of the addresses appear not to have street addresses but place names, for example, Redlands Mall.

In the next step, you will adjust the address locators options and try rematching these addresses.

☐ Close the *Attributes of Geocoding Result: RedlandsCrime* table.

STEP 5: REMATCH ADDRESSES

Unfortunately, data is not always perfect. Sometimes locations cannot be found using the service and the street data. When this happens, you can modify your settings for finding the locations or make modifications to the database. If the locations that you are trying to find are too general (names of buildings, public places, New Jersey Turnpike, etc.), you can use an alias table for mapping those names to specific addresses. To begin rematching the Crime location, first you will re-activate the Review/Rematch Addresses dialog.

☐ Click *Tools* > *Geocoding* > *Review/Rematch Addresses* > *Geocoding Result: RedlandsCrime*.

☐ Click *Yes* to start editing.

The results from geocoding the crime data will appear in the Review/Rematch Addresses dialog.

This time you will add a table of alias names to your address locator options. The alias table stores the address information for the place names listed in the crime table.

☐ Click *Geocoding Options*.

☐ Under *Matching Options* click *Place Name Alias Table*.

☐ In the *Alias Table* dialog, for the *Alias table*, browse to the *C:\Student\igis2\DataSources* folder, select the *place_aliases* table and click *Add*.

☐ For *Alias field*, use the dropdown menu to choose the *Name* field.

☐ Confirm that *Street or Intersection* is set to *ADDRESS*.

☐ Click *OK*.

☐ Click *OK* on the *Geocoding Options* dialog.

Changes made to the Geocoding Options through the Review/Rematch Addresses dialog are temporary and do not permanently alter the RedlandsStreet address locator. You will now see how many of the unmatched addresses will match with the newly added alias table.

☐ Click *Match Automatically.*

All but two records in the table should have matched. You will try matching the remaining records interactively.

☐ Click *Match Interactively*.

The Interactive Review dialog appears with the remaining two records listed at the top.

The first unmatched record, 522 NORANGE ST, appears to have a typographic error and the address should probably be on N ORANGE ST. The next address, 240 EUREKA ST S, should have been entered as 240 S EUREKA ST. You will edit the addresses and see if there are any matching candidates.

☐ Confirm that the first record is highlighted, and for *Street or Intersection*, edit *522 NORANGE ST* to **`522 N ORANGE ST`**

☐ Click *Search*.

A candidate with a score of *100* is shown in the Candidate's list.

☐ Click *Match*.

☐ Select the second record for *240 EUREKA ST S*.

☐ In the *Street or Intersection* input box, edit *240 EUREKA ST S* to **`240 S EUREKA ST`**

☐ Click *Search*.

Two candidates were found for 240 S EUREKA ST.

☐ Select the candidate with the score of *100* and click *Match*.

All records have now been successfully geocoded.

☐ Click *Close* to close the *Interactive Review* dialog.

Notice in the Statistics panel that there are now 0 Unmatched addresses.

☐ Click *Done* to close the *Review/Rematch Addresses* dialog.

STEP 6: USE THE FIND TOOL TO LOCATE ADDRESSES

Once you have an address locator loaded into your ArcMap document, you can use it to find addresses in ArcMap. It is not necessary to have the reference data loaded in the document, although it may help you visualize and choose an appropriate candidate for an address.

☐ From the *Edit* menu, click *Find*. You can also use the *Find* tool on the *Tools* toolbar.

☐ Click the *Addresses* tab.

Your RedlandsStreet address locator should already be the active address locator.

☐ For *Street or Intersection*, type in **`365 Terracina Blvd`** and click *Find*.

One candidate with a score of 100 is listed.

Position the Find dialog on your screen so you can see both it and your map display.

☐ Right-click on the candidate and click *Zoom to Candidate(s) and Flash*.

☐ Right-click again on the candidate and click *Add as Graphic(s) to Map*.

You have added a graphic at 365 Terracina Boulevard.

☐ Close the *Find* dialog.

STEP 7: PLOT XY DATA ON YOUR MAP

Now you will add coffee shop locations to your map. The data for the Redlands coffee shops is stored in a table with the XY locations and names of each shop. You will plot these coffee shop locations on a map with the crime data.

☐ Click the *Add Data* button.

☐ Navigate to the *C:\Student\igis2\DataSources* folder.

☐ Add the *coffee_shops* table to the map.

☐ In the *Table of Contents*, make sure the *Source* tab is active.

☐ Right-click on the *coffee_shops* table and click *Display XY Data*.

In the Display XY Data dialog, you can specify which fields contain the X and the Y data. Because the fields in this table are called X-COORD and Y-COORD, the dialog automatically detected which is the X and which is the Y field.

☐ Click *OK*.

The points are added as an *Event Table*. This layer looks and behaves just like any other layer in ArcMap (i.e., you can symbolize, query, and edit attributes), but is not stored as a feature class. It can be saved within your map document, but if you want a more permanent record, you will need to save the 'events' as a new feature class.

☐ Right-click on the *coffee_shops Events* layer, and click *Zoom To Layer* to view the results.

☐ In the *Table of Contents*, click the *coffee_shops Events* symbol.

☐ On the *Symbol Selector* dialog, click *More Symbols*.

☐ From the *More Symbols* menu, click *Business*.

☐ Click the *Café 2* symbol (You may want to turn off some of the other styles so that you can just see the *Business* styles).

☐ Click *OK*.

Congratulations. You now have a map of coffee shops and crime location in Redlands.

☐ Exit *ArcMap*. When prompted, save your edits and the map document to a name of your choice.

EXERCISE END

ANSWERS TO EXERCISE 4 QUESTIONS

Question 1: Which four fields combine to form all the necessary information for the street name?

Answer: PREFIX, STREETNAME, TYPE, SUFFIX

Question 2: Which four fields define how the addresses will be interpreted along the street features?

Answer: L_ADD_FROM, L_ADD_TO, R_ADD_FROM, R_ADD_TO

Question 3: Which field stores the address information?

Answer: LOCATION

Question 4: How are street intersection names separated in the location field?

Answer: With a '/'

Question 5: How many addresses matched with a score greater than 80? Less than 80? Did not match at all?

Answer: 109, 8, 5

5

Modifying the ArcGIS interface

contents

EXERCISE 5: MODIFYING THE ARCGIS INTERFACE

This exercise will introduce you to the customization power within ArcGIS software. You will learn how to modify the existing interface using the Customize dialog to add and remove controls, create new menus and toolbars, and program shortcut keys.

STEP 1: START ARCMAP AND LOAD DATA

☐ Start *ArcMap* and open *A new empty map* document.

First, you will create a new interface template file, which will insure that all your modifications to the interface will be available only in this template file. This will allow you and other users in your organization to use different templates depending on the project.

☐ Click *File* > *Save As*.

☐ Navigate to the *C:\Student\igis2* folder.

☐ For *Save as type*, choose *ArcMap Templates (*.mxt)*.

☐ For the *File name*, type **`modify.mxt`**

☐ Click *Save*.

STEP 2: DOCK AND UNDOCK TOOLBARS

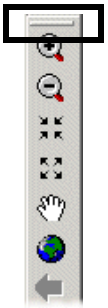
Docking and undocking toolbars in ArcMap is an easy way to modify the user interface.You will first dock and undock the Tools toolbar.

☐ If your *Tools* toolbar is currently docked to the interface, click on the bar at the top, and drag it out into the display area.

☐ Click and drag the *Tools* toolbar to the left edge of the *ArcMap* display area.

☐ The toolbar outline will change shape allowing you to dock it onto the interface.

☐ Select the *Tools* toolbar (click on the bar at the top) and move it to the top of the interface.



☐ Click the *Tools* toolbar again and drag it into the display section of ArcMap. The toolbar is now undocked.

STEP 3: OPEN THE CUSTOMIZE DIALOG AND TURN TOOLBARS ON AND OFF

The Customize dialog allows the user to modify the interface menus and toolbars. You can turn menus and toolbars on/off by checking/unchecking the check boxes next to their names.

First you will open the Customize dialog.

☐ Click *Tools* > *Customize*.

> **NOTE:** You can also either right-click the menu bar or any toolbar and select Customize or double-click anywhere on an empty gray area on the ArcMap application.

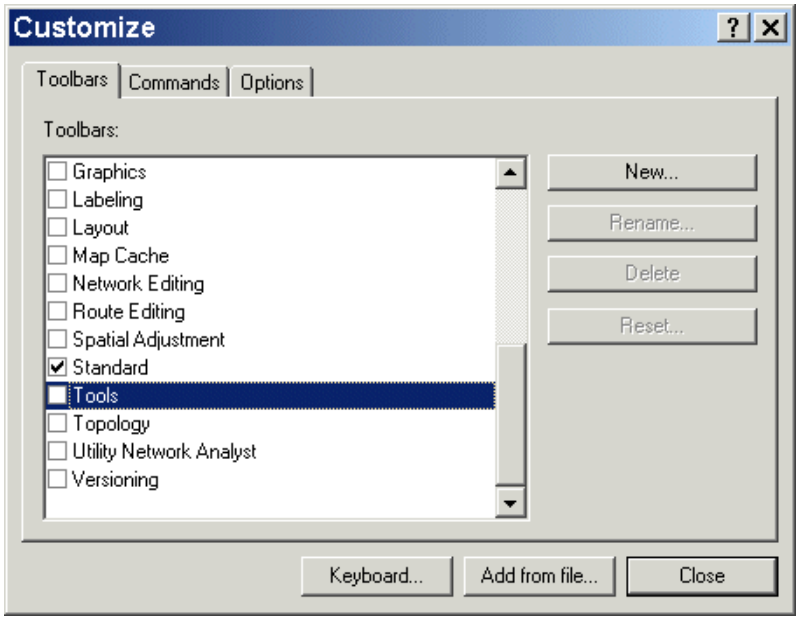
Next, you will turn off the Tools toolbar using the Customize dialog.

☐ Click the *Commands* tab.

☐ For *Save in*, click *modify.mxt*.

☐ Click the *Toolbars* tab.

☐ Uncheck the box next to the *Tools* toolbar.



Notice that the Tools toolbar is no longer visible on the interface.

Next, you will turn on more toolbars.

☐ Check the selection box next to some additional toolbars.

Notice that the toolbars appear on the ArcMap interface.

☐ Turn off all the toolbars except *Main Menu*, *Standard*, and turn on *Tools* again.

☐ Leave the *Customize* dialog open.

STEP 4: ADD, REMOVE, AND MOVE CONTROLS

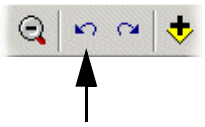
With the Customize dialog open, you can adjust the menu and toolbar controls. Next, you will add, remove, or move the controls on the menus and toolbars in ArcMap. First, you will remove the Zoom In button from the Tools toolbar.

☐ Click the *Commands* tab.

☐ Click and drag the *Zoom In* button (located on the *Tools* toolbar) into the display.

Next, you will move the Zoom Out button to another toolbar.

☐ Click and drag the *Zoom Out* button (located on the *Tools* toolbar) next to the *Undo* button on the *Standard* toolbar.



☐ Click and drag the *Zoom Out* button back to the *Tools* toolbar.

Next you will add a new Zoom In button back onto the Tools toolbar.

☐ In the *Commands* > *Categories* list, click *Pan/Zoom*.

☐ In the *Commands* scroll down list, click and drag the *Zoom In* command onto the *Tools* toolbar and place it next to the *Zoom Out* button.

☐ Verify that the *Zoom Out* and *Zoom In* buttons are on the *Tools* toolbar.

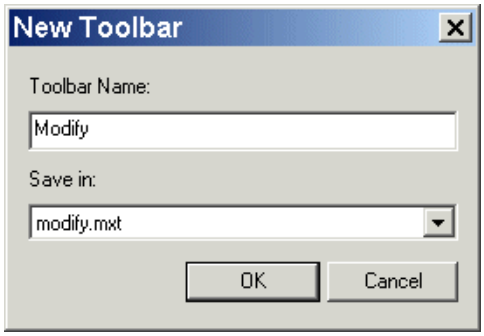
☐ On the *Customize* dialog, click the *Toolbars* tab and turn off the *Tools* toolbar.

☐ Leave the *Customize* dialog open.

STEP 5: CREATE A NEW TOOLBAR

Next, you will create a new toolbar using the Customize dialog.

☐ On the *Customize* dialog, click *New*.



☐ For *Toolbar Name*, replace the current name with **`Modify`**

☐ For *Save in*, verify that *modify.mxt* is selected.

☐ Click *OK*.

Notice that there is a small new toolbar floating on the interface, and that it has been added to the Toolbars list.

You will rename the new toolbar.

☐ Click *Rename*.

☐ For *Toolbar name*, type **`Add/Pan/Zoom`**

☐ Click *OK*.

The name on the toolbar has changed to Add/Pan/Zoom. You will be able to see the full name of the toolbar when you start adding controls to it.

☐ Leave the *Customize* dialog open.

STEP 6: ADD EXISTING CONTROLS TO THE NEW TOOLBAR

You will now add buttons to this new toolbar.

☐ On the *Customize* dialog, click the *Commands* tab.

☐ In the *Categories* scroll down list, click *Pan/Zoom*, if necessary.

☐ In the *Commands* scroll down list, click and drag the *Zoom In* command onto the new *Add/Pan/Zoom* toolbar.

☐ Use the same drag-and-drop function to add the *Zoom Out* and *Continuous Zoom and Pan* commands to the *Add/Pan/Zoom* toolbar.

☐ In the *Categories* scroll down list, click *File*, and in the *Commands* scroll down list, click and drag the *Add Data* command to the new toolbar.

☐ There should be four buttons on the new toolbar. 

☐ Dock your new toolbar.

STEP 7: ADD A COMMAND TO A CONTEXT MENU

Next, you will add a new command to the Selection context menu. The command will be available when you right-click a layer in the Table of Contents and use the Selection sub-menu.

First, you will display the context menu.

☐ In the *Customize* dialog, click the *Toolbars* tab.

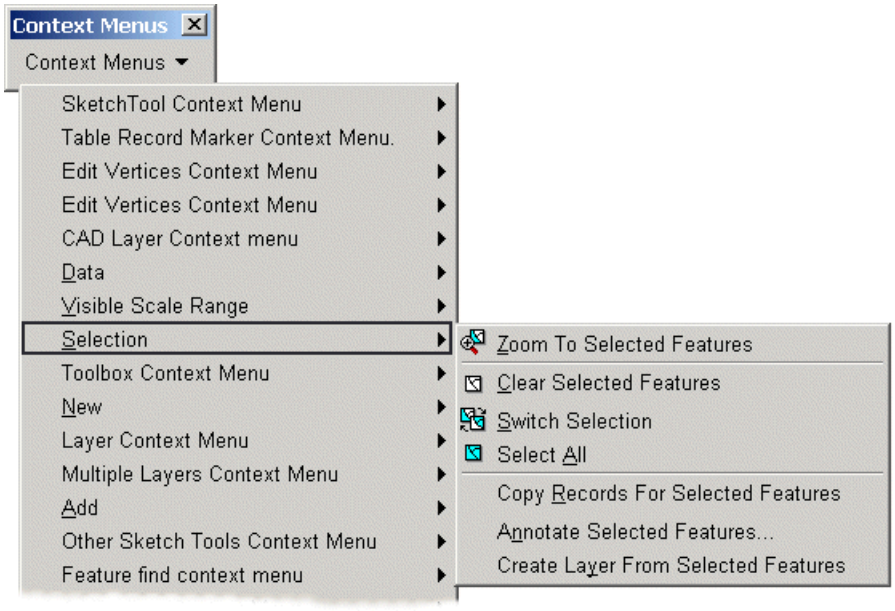
☐ Under *Toolbars*, click the selection box for the *Context Menus*.

☐ In the *Customize* dialog, click the *Commands* tab.

☐ In the *Categories* list, click *Selection*.

You will add the Statistics command to the context menu.

☐ Click the down arrow on *Context Menus*.



NOTE: Your list for this menu may be different depending on which ArcGIS extensions you have available.

☐ Click *Selection*.

☐ In the *Customize* dialog, click and drag the *Statistics* command to the Selection menu, and drop it under the *Zoom To Selected Features* menu choice.

☐ In the *Customize* dialog, click the *Toolbars* tab, and uncheck *Context Menus*.

☐ Leave the *Customize* dialog open.

STEP 8: PROGRAM A SHORTCUT KEY

Often, it is very useful to have a shortcut key for operations that are performed frequently such as zooming to the full extent or adding data. Next, you will program a shortcut key.

☐ Click the *Commands* tab.

☐ Click the *Keyboard* button.

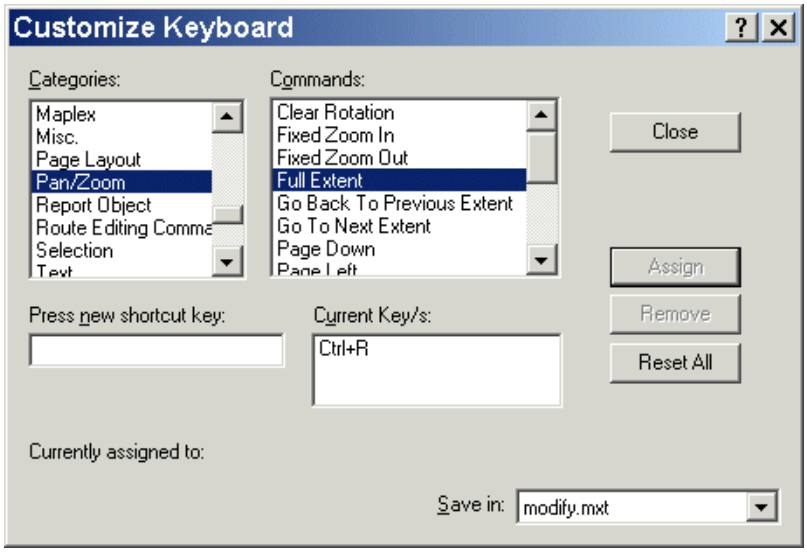
☐ In the *Categories* scroll down list, click *Pan/Zoom*.

☐ In the *Commands* scroll down list, select *Full Extent*.

☐ Click in the *Press new shortcut key* text box.

☐ On the keyboard, press *Ctrl+R* for the new shortcut key.

☐ Click *Assign*.



☐ Click *File* in the *Categories* scroll down list.

☐ Click *Add Data* in the *Commands* scroll down list.

☐ Click in the *Press new shortcut key* text box.

☐ Press *Ctrl+Q* for the new shortcut key.

☐ Click *Assign*.

☐ Click *Close* in the *Customize Keyboard* menu.

☐ Click *Close* in the *Customize* dialog.

You will now save the template file.

☐ Click the *Save* button.

STEP 9: OPEN THE SAVED TEMPLATE TO VIEW THE CHANGES

Now that you have completed a series of customizations, you will open the modify.mxt template to see them.

☐ Close *ArcMap*.

☐ Restart *ArcMap*.

Verify that the changes you made previously are not in the Normal ArcMap template.

☐ Click *Start using ArcMap with A template*.

☐ Click *OK*.

☐ Click the *Browse* button.

☐ Navigate to your *C:\Student\igis2* directory.

☐ Click *modify.mxt*.

☐ Click *Open*.

Next, you will test your modifications. First, you will use the new Add/Pan/Zoom toolbar to add data.

☐ Click the *Add Data* button.

☐ Navigate to and add *C:\Student\igi2\REGIS\Redlands_GDB\EmergencyFacility.*

Next, you will use your new shortcut key to add more data.

☐ Press *Ctrl+Q*.

> **! In order for this piece of customization to work correctly, make sure that no layers are selected or highlighted in the ArcMap Table of Contents.**

☐ Add ...*\REGIS\Redlands_GDB\CrimeLevel*.

☐ Use the *Pan* and *Zoom* tools on your new *Add/Pan/Zoom* toolbar to change the display. Make sure you have zoomed in on the data.

Next, you will use your shortcut key to zoom to the entire spatial extent.

☐ Press *Ctrl+R*.

Notice that the display is the entire extent of all the datasets in the Table of Contents.

Next, you will zoom to an area in the display and use the Full Extent toolbar selection to display the entire spatial extent.

☐ Zoom in to an area.

☐ Click *View* > *Zoom Data*.

Notice that the shortcut key is listed next to Full Extent.

☐ Click *Full Extent*.

☐ Close *ArcMap* without saving. The template you created has already been saved and is available for you to use at any time.

In this exercise, you modified the ArcMap interface by docking and undocking toolbars; turning toolbars on and off, creating new toolbars and adding existing controls to them using the Customize dialog; adding, removing, and moving controls on the menus and toolbars in ArcMap; adding new commands to a context menu; and programming shortcut keys.

EXERCISE END

6

Designing a GIS database

contents

EXERCISE 6A: ORGANIZING A GIS DATABASE

In order to improve decision making for city planning and management, the beautiful City of Redlands, California, has decided to develop a GIS database. As the consultant hired to do the job, you have already completed the first (and often the most time consuming) task—the needs assessment. In this exercise, you will use the results of the needs assessment to create a simple conceptual/logical design for the database.

Keep in mind that this needs assessment and your resulting logical design are highly simplified versions of products and procedures you would deal with in an actual database design.

STEP 1: EVALUATE THE NEEDS ASSESSMENT

Read through the following information carefully.

REDLANDS ENTERPRISE GIS NEEDS ASSESSMENT

OBJECTIVE

Many agencies in the City of Redlands rely on geographic or locational information for a variety of planning and management operations. Examples range from creating more cost-effective routing of trash collection based on street conditions to more efficient use of police resources based on locations of crime incidents.

The *Redlands Enterprise Geographic Information System (REGIS)* will provide a centralized, standard, digital repository for the creation, administration, and distribution of the spatial and attribute data necessary for City agency tasks and operations. Using REGIS, City agencies will increase operational efficiency, limit task redundancy, and enhance interdepartmental communication, because all agencies involved will be working from a common database.

The following needs assessment outlines the specifics of the REGIS goals.

1. PARTICIPANTS

Four core city agencies took part in the initial REGIS needs assessment. They were:

- Environmental Quality Department
- Police Department
- Public Works Department
- Planning and Economic Development Department

2. Geographic tasks

REGIS will simplify many location-related tasks that the four core City agencies commonly perform. Examples include:

2.1 Environmental Quality Department tasks

- Issuing environmental permits
- Hazardous materials incident management

2.2 Police Department tasks

- Resource allocation
- Substation facility siting
- Crime trend analysis

2.3 Public Works Department tasks

- Street maintenance and construction
- Landfill operation and maintenance
- Trash collection routing

2.4 Planning and Economic Development Department tasks

- Building Code enforcement
- Location and impact analysis for development projects
- Land use planning

Many of these tasks or processes involve interaction between several departments, ranging from informal exchanges of information to mandated procedure reviews.

3. Data

Considering their most important and common geography-related tasks, the core city agencies identified the data layers most crucial for inclusion in REGIS.

- Census boundaries and demographic information
- Parcel boundaries
- Land use and zoning
- Street network
- Railroad locations
- Emergency facility locations
- Crime level areas
- Hazardous materials locations

These layers are generalized examples of the data that will be stored and maintained by REGIS. In addition to the spatial component of the data, each layer will also contain descriptive attributes. These attributes will be identified and articulated during the conceptual design phase of this project.

4. Applications and systems

The key to the success of REGIS is the ability to store and maintain the necessary data in a centralized repository while seamlessly distributing it to a variety of client applications. The GIS software selected for this project must demonstrate this ability as well as platform independence, ease of use, and customizability.

5. Pilot studies

To ensure that REGIS will meet the goals outlined in this document, specific pilot studies will be conducted for each of the core agencies prior to full implementation of the project. The proposed pilot studies are outlined below.

5.1 Environmental Quality

Determine if there is a relationship between household income and proximity to facilities that handle hazardous materials. The study will compare the following data:

- One thousand meter area around locations of facilities that handle hazardous materials
- Median household income

5.2 Police Department

Determine the best location for a new police substation given the following criteria:

- Within or bordering a high crime-level area
- Zoned for light industrial or commercial use
- Not within one kilometer of another police station

5.3 Planning and Economic Development Department

Identify potential locations for an amusement theme park facility given the following criteria:

- Within 500 meters of a highway

- Agricultural or vacant land use
- Within a census block group containing high levels of target market individuals
- At least one kilometer from the Redlands Historical Driving Tour

STEP 2: SELECT FEATURE CLASSES

The needs assessment identified several crucial data layers in the database. Using the information you have just studied, along with information from the lectures and your own imagination, complete the following questions.

For each layer, select an appropriate feature class. Keep in mind the way the geographic data will be used by each department. The first layer is completed as an example.

Crucial data layers	Suggested feature class
Census block groups	*polygons*
Parcels	
Zoning	
Land use	
Locations of hazardous materials handlers	
Police and fire station locations	
Railroads	
Streets	
Crime level areas	

STEP 3: IDENTIFY ATTRIBUTES

Evaluate each of the data layers and identify the descriptive attributes that should be included in the database. For some layers, it will help to consider the criteria used in the pilot studies. The first layer is completed as an example.

Crucial data layers	Possible attributes
Census block groups	*unique identifier, income level, education level, population density, age ranges*

Parcel boundaries	
Zoning	
Land use	
Hazardous materials handlers	
Police and fire station locations	
Railroads	
Streets	
Crime level areas	
Driving tour	

STEP 4: ORGANIZE LAYERS

Although you have regarded the layers as separate pieces of data, some of them may logically be combined, especially if their spatial features are coincident. For example, both Zoning and Land Use could be stored as attributes of the parcel data layer.

Question 1: Which layer or layers do you think might be naturally combined?

_____
_____
_____
_____

Question 2: If you choose to combine multiple data layers, will the new combined layer have a different feature class type than the original sources'? _____

STEP 5: SELECT DATABASE SCALE

Although the scale of digital data can be altered at will, the original scale of automation will determine the resolution or amount of detail for the geographic features. Certain resolutions may be necessary to perform some desired operations. Review the pilot studies again, and look over the table below.

Question 3: In order to satisfy the needs of your operations, what scale would you select for your entire database?_____
Hint: REGIS could be considered a regional application.

Question 4: Would you need to store data digitized from different scale maps?

_____

Question 5: What issues would you need to consider if you did this? _____

_____

Type of application	Scale
Design	
Critical	1:100 to 1:500
General	1:500 to 1:20,000
Planning	
Micro	1:1,000 to 1:10,000
Local	1:5,000 to 1:25,000
Regional	1:10,000 to 1:100,000
National	1:100,000 to 1,000,000

STEP 6: SELECT A PROJECTION/COORDINATE SYSTEM

Choosing a projection for the database is an important consideration. Projections can distort the spatial properties of shape, area, distance, and direction differently, making it necessary to select a projection with the potential geographic operations in mind. Referring to the pilot studies and the previous lecture covering projections, select a projection that meets these criteria:

- Minimizes distortion in properties important to pilot study tasks
- Universally conventional, used by other agencies
- Easily converted

Possible projection	Advantages	Drawbacks
UTM	Minimizes distortion of all spatial properties within each zone. Standard, well recognized.	Troublesome for data that does not fall completely within one zone. Cannot seamlessly combine data with data from neighboring zones.
State Plane coordinate system	Minimizes distortion of all spatial properties within each zone. Standard, well-recognized within the United States.	Troublesome for data that does not fall completely within one zone. Cannot seamlessly combine data with data from neighboring zones. United States specific.

Albers Equal Area	Preserves area and minimizes distortion within the standard parallels. Good projection for small regions.	Best results for regions predominantly east-west in extent and located in the middle latitudes. Can distort shape at the expense of preserving area.
Lambert Conformal Conic	Preserves shape and minimizes distortion within the standard parallels. Good projection for small regions.	Best results for regions predominantly east-west in extent and located in the middle latitudes. Can distort area at the expense of preserving shape.

EXERCISE END

ANSWERS TO EXERCISE 6A QUESTIONS

Question 1: Which layer or layers do you think might be naturally combined?

Answer: Data layers that have the same geometry type and share a common theme have the potential to be combined into one layer. For example, in the class database, *police* and *fire stations* have already been combined into an *emergency facilities* layer. *Zoning* and *land use* could be stored as attributes in the *parcels* layer as this information could have the same boundaries as the *parcels*. *Roads* and *railways* could also be combined into a *transportation* layer.

Question 2: If you choose to combine multiple data layers, will the new combined layer have a different feature class type than the original sources'?

Answer: No, only features with the same feature class (geometry) type may be combined.

Question 3: In order to satisfy the needs of your operations, what scale would you select for your entire database?

Answer: 1:10,000 to 1:100,000

Question 4: Would you need to store data digitized from different scale maps?

Answer: Yes

Question 5: What issues would you need to consider if you did this?

Answer: You would need to address issues about the availability of data at different scales. How and at what cost could the data be acquired? As well, you would need to ensure the correct data was used with the appropriate application.

EXERCISE 6B: EXPLORE THE REGIS DATABASE

In the last exercise, you studied the REGIS needs assessment in order to become acquainted with the scope of the project and the types of data involved. Acquiring all of the data for the database is often a time-consuming and costly process. Fortunately, most of the necessary data has already been assembled and stored in a personal geodatabase named Redlands_GDB. Another folder, named DataSources, contains the remaining pieces of the REGIS puzzle which you will ultimately incorporate into the Redlands_GDB. In this exercise, you will explore the existing data in the Redlands_GDB and the DataSources folder.

STEP 1: OPEN THE REDLANDS_GDB

☐ Start *ArcCatalog* and navigate to the *REGIS* folder.

☐ Expand the *C:\Student\igis2\REGIS\Redlands_GDB* to see its contents.

The Redlands_GDB contains two feature datasets named Census and LandRecords with their own feature classes. This geodatabase also has several stand alone feature classes. You will examine the Census feature dataset first.

☐ Expand the *Census* feature dataset.

Notice the four feature classes within the Census feature dataset. Each polygon feature class—BlockGroups, Blocks, Tracts, and VotingDistricts—represents different area features used by the U.S. Census Bureau to calculate population statistics.

☐ Click the *Blocks* feature class, and click the *Preview* tab.

Blocks are the smallest of census geographical areas, averaging about 100 persons each nationwide. Each block is contained within one of the larger census area features: block groups, tracts, or voting districts.

☐ For *Preview*, click *Table* from the dropdown list located at the bottom of the *Preview* panel.

Notice that the attributes in the Blocks table do not obviously deal with population counts. That information is kept in a separate table you will examine later. Instead, the fields on the Blocks table store the identifiers of other census area features that each block is a part of.

☐ Look at the very first record in the table and record the values for the following fields:

BLOCK90
TRACT90
COUNTY90
STATE90

By examining these values, you can determine that block 104B is contained in tract 0078, county 071, and state 06. Because the borders of one feature class often define the borders of another, the feature classes contain many features that are coincident. This is why these feature classes are grouped into a feature dataset.

The coincidence of the Census feature classes is best illustrated when all the feature classes are displayed together. In the next step, you will use ArcMap to display all four Census feature classes and observe their coincident boundaries.

Step 2: Display the Census feature classes in ArcMap

☐ In *ArcCatalog*, navigate to the *C:\Student\igis2\MapDocuments* folder, and double-click on the *Ex6B.mxd* map document.

ArcMap will start and display the four feature classes from the Census feature dataset. The borders of the polygons in each feature class are rendered with a different symbol.

☐ Starting with the bottom layer, *Blocks*, turn off each layer.

Notice how each feature class is nested within the previous ones. The Census Bureau uses these area features to provide increasingly detailed population statistics, and each feature class is really a subdivision of the previous one.

☐ Starting at the top layer, *Tracts*, turn each layer back on.

Notice how Tracts are really an aggregation of VotingDistricts. Voting Districts are an aggregation of BlockGroups, and BlockGroups are an aggregation of Blocks (this is not how these boundaries are created or maintained in reality; we have simplified the data for the purposes of this course). This means that the boundaries for each feature class are coincident with boundaries in other feature classes. If you wanted to change a Census Tract boundary, you would want coincident boundaries in the other feature classes to reflect the same change. In a later lesson, you will learn how storing these feature classes in the same feature dataset allows you to take advantage of ArcMap software's topology capabilities, which will insure that an edit made to any feature will also be made on the coincident features.

☐ Close *ArcMap* and do not save the changes in the map.

Now you will examine some of the other contents of the Redlands_GDB.

STEP 3: EXAMINE THE STAND-ALONE FEATURE CLASSES IN THE REDLANDS_GDB

☐ In *ArcCatalog*, click on the *C:\Student\igis2\REGIS\Redlands_GDB*.

☐ Click the *Contents* tab and click the *Thumbnails* button.

☐ In the *Contents* panel, examine the thumbnail snapshots of the stand-alone feature classes in *Redlands_GDB*.

These feature classes are all independent. They are not coincident with features in other feature classes, and they do not intersect or connect, so there is no need to store them in a feature dataset.

☐ Click on the *EmergencyFacility* feature class, and click the *Preview* tab.

This point feature class contains the emergency response facilities in the Redlands study area.

☐ Click on *Redlands_GDB* again, and click the *Contents* tab.

☐ Take some time to examine each feature class. Preview both the attributes and the geography for each one. After reviewing the entire contents of *Redlands_GDB*, answer the following questions.

Question 1: What critical data identified in the needs assessment is already included in *Redlands_GDB*? _____

Question 2: What projection is being used for the *Census* feature dataset?

_____

Question 3: What critical data is currently missing from *Redlands_GDB*?

_____

Now that you have examined the Redlands_GDB geodatabase, you will take a look at the content DataSources folder.

STEP 4: EXAMINE THE CONTENTS OF THE DATASOURCES FOLDER

☐ In *ArcCatalog*, click to select the *DataSources* folder.

☐ Click the *Contents* tab, and view the thumbnails for the data in the *DataSources* folder.

Notice that there are several kinds of data in the DataSources folder: tables, imagery, CAD files, shapefiles, and coverages. All of this differently formatted data will eventually need to be imported to Redlands_GDB. In later lessons, you will learn how to use the data conversion tools available in ArcGIS to accomplish this task.

☐ Click on the *RedStreets.shp* file and click the *Preview* tab.

These street features were extracted from the same Census TIGER/Line data as the polygon feature classes you observed earlier. Because these lines represent a different kind of geographic entity (a real street as opposed to an imaginary statistical area like a census tract), you will eventually put these features into their own feature dataset, instead of grouping them with the other Census feature classes.

☐ Click *Table* from the *Preview* dropdown list to display the *RedStreets.shp* attribute table.

Notice the address information available for the various street features. Because the primary role of the Census Bureau is to count the number of residents in the United States, the data it collects, such as address ranges, is geared towards achieving that goal.

☐ Now, preview all of the data in the *DataSources* folder.

Question 4: Determine which files will be used to create the future *Redlands_GDB* feature classes listed below.

Streets:

Railroads:

Tour:

In this exercise, you explored the various datasets in the Redlands_GDB geodatabase, and in the DataSources folder. You learned that the polygon feature classes in the Census feature dataset had coincident boundaries, and you learned that you will use various data formats to complete the Redlands_GDB. In the next exercise, you will explore the metadata of the different data that make up this REGIS project.

EXERCISE END

ANSWERS TO EXERCISE 6B QUESTIONS

Question 1: What critical data identified in the needs assessment is already included in Redlands_GDB?

Answer: Census blocks, parcel boundaries which include data on land use and zoning, emergency facilities, and crime level

Question 2: What projection is being used for the Census feature dataset?

Answer: UTM, Zone 11 north

Question 3: What critical data is currently missing from Redlands_GDB?

Answer: Hazardous material handlers, railroads, streets

Question 4: Determine which files will be used to create the future *Redlands_GDB* feature classes listed below. The first answer is provided for you.

Answer: The remaining files which will be used to create the future *Redlands_GDB* feature classes are:

Streets: ***RedStreets.shp***
Railroads: ***railroad.dxf***
Tour: ***tourmap.tif***

EXERCISE 6C: EXPLORING THE REGIS PROJECT METADATA IN ARCCATALOG

Metadata is the documentation for your database. Good metadata will contain all the information necessary for someone unfamiliar with the database to be able to interpret its contents and understand how to use it. Unfortunately, metadata is also time consuming and expensive to maintain. For this reason, it is often under-emphasized or ignored completely in GIS database projects. In the *REGIS* project, you will try to maintain comprehensive and current metadata for all the data you add to the *Redlands_GDB* geodatabase. Begin by exploring the metadata that already exists for *Redlands_GDB*.

STEP 1: EXPLORE METADATA DOCUMENTATION FOR THE CENSUS FEATURE DATASET

☐ IN *ArcCatalog*, navigate to *C:\Student\igis2\REGIS\Redlands_GDB*.

☐ Click on the *Census* feature dataset, and click the *Metadata* tab.

Notice how the metadata is automatically displayed with the *FGDC ESRI* stylesheet. You will display the metadata with different stylesheets later in this exercise.

☐ Make sure that the *Description* tab is highlighted on the *Metadata* stylesheet.

☐ If necessary, click on the *Abstract* link to expand it.

Notice how the *Abstract* has already been written for this feature dataset. This is an example of metadata documentation. Documentation is information that the data provider supplies to help potential data users better understand the data. Now you will examine some more metadata documentation for this dataset.

☐ Click on the rest of the links on the *Description* tab and answer the following questions:

Question 1: Is the *Census* feature dataset complete or will it continue to be updated?

_____

Question 2: When was the data in the feature dataset produced?_____

_____

Question 3: Who would I contact with questions about this metadata document?

_____

STEP 2: EXPLORE METADATA PROPERTIES FOR THE CENSUS FEATURE DATASET

In the previous step, you viewed and examined metadata documentation, which must always be created manually by the data provider. In this step, you will examine those metadata properties which ArcCatalog automatically creates and maintains.

☐ Click the *Spatial* tab on the *FGDC ESRI* metadata stylesheet.

☐ Under *Horizontal coordinate system*, click the *Details* link to expand it.

The spatial reference information listed in this part of the metadata is automatically generated from the properties of the feature dataset. If you were to change the projection, ArcCatalog would, by default, automatically display the new spatial reference information the next time you viewed the metadata. This is just one of the important metadata properties that ArcCatalog automatically maintains.

☐ Click the *Attributes* tab.

Another metadata property automatically maintained by ArcCatalog is the number of features in a feature class. Just like the spatial reference information, if you were to add or remove features from any of the feature classes listed on the Attributes tab, the metadata would automatically reflect the changes.

Spend a few minutes browsing the rest of the metadata for the various feature classes in *Redlands_GDB*.

Now you will learn how to edit the metadata.

STEP 3: EDIT METADATA

Most of the metadata has already been created for the data in *Redlands_GDB*, but you will make some minor updates to reflect your control of this *REGIS* project.

☐ In the *ArcCatalog* tree, click the *Census* feature dataset.

☐ On the *Metadata* toolbar, click the *Edit metadata* button  .

☐ On the *Metadata Editor* dialog, click the *Contact* tab, then click the *Details* button.

Because you are the lead consultant for the *REGIS* project, you will be the contact for issues concerning all of the data in *Redlands_GDB*. Therefore, you will fill out the *Contact Information* dialog with your personal contact information.

☐ This is your chance to be creative, so make up any name that suits you for yourself and your organization. For example:

Person: **Wile E. Coyote**
Organization: **ACME GIS Consultants**
Position: **Data Carnivore**

> **NOTE:** Ignore the fields for phone numbers, fax, and email addresses. Naturally, in a real GIS database, this would be crucial information, but in the interest of time, you can skip it.

☐ When finished adding the contact information, click *OK*, then click *Save*.

Now you will view the updates to the metadata.

STEP 4: VIEW METADATA WITH A DIFFERENT STYLESHEET

ArcCatalog *Metadata* is stored in *eXtended Markup Language (XML)* format. This means that a stylesheet must be used to display the metadata. The stylesheet interprets the different elements of the metadata (like *Abstract* and *Contact Person*) and assigns formatting to them. ESRI provides different stylesheets within ArcCatalog. You could also create your own, using *eXtended Style Language (XSL)*.

In the last step, you made some changes to the metadata for the *Census* feature dataset. In this step, you will view those changes. However, you will use a different stylesheet to do it.

☐ In the *ArcCatalog* tree, verify that the *Census* feature dataset is selected.

☐ From the *Metadata* toolbar, choose the *FGDC FAQ* stylesheet from the *Stylesheet* dropdown list.

This stylesheet formats the ArcCatalog metadata into an *FGDC* compliant *FAQ* (Frequently Asked Questions) list.

☐ Under the heading *Who produced the data set?*, click on the third link, *To whom should users address questions about the data?*

You should see the edits you made in the last step now listed in the link.

In this exercise, you viewed metadata properties and documentation using different stylesheets. You also edited metadata properties to add your name as a contact regarding the Census feature dataset.

EXERCISE END

ANSWERS TO EXERCISE 6C QUESTIONS

Question 1: Is the Census feature dataset complete or will it continue to be updated?

Answer: Data is complete.

Question 2: When was the data in the feature dataset produced?

Answer: January 2001

Question 3: Who would I contact with questions about this metadata document?

Answer: ESRI, 380 New York Street, Redlands, CA

7

Populating the geodatabase

contents

EXERCISE 7A: DIGITIZING DATA IN ARCMAP

In the last exercise, you used a needs assessment to identify the data layers and attributes necessary for the proposed Redlands Enterprise Geographic Information System (REGIS). Now it is up to you to acquire those layers and put them into the appropriate format for the database. Fortunately, the city has already collected the majority of the data, much of which is stored in a personal geodatabase named Redlands_GDB. However, there are still a few missing pieces of information that you need to fill in. Below is a list of the REGIS data layers you will need to automate or create, along with their current format and the automation operations you will perform to make them part of the Redlands_GDB geodatabase.

Data Layer	Format	Automation operation
City limit	text file	convert to ArcInfo coverage, import to geodatabase
Historical driving tour	tif image	heads-up digitize the tour into a geodatabase feature class
Street	shapefile	import directly into geodatabase
Railroads	dxf file	import directly to geodatabase
Tract and block group demographic attributes	dbf tables	import directly into the geodatabase

STEP 1: CREATE A NEW FEATURE CLASS WITHIN AN EXISTING GEODATABASE

In this step, you will add an empty feature class named Tour to the Redlands_GDB personal geodatabase. You will use this feature class to store the historical driving tour that you will be digitizing later. As you create the Tour feature class, you will import the spatial reference from an existing feature class. This will insure that the new Tour feature class will have the same extent and projection as the rest of the database.

☐ Start *ArcCatalog* and navigate to the *C:\Student\igis2\REGIS\Redlands_GDB* geodatabase.

☐ Right-click the *Redlands_GDB* geodatabase, and click *New* > *Feature Class*.

☐ For *Name*, type **`Tour`**, and click *Next*.

☐ Make sure the *Configuration Keyword* option is set to *Default*, then click *Next*.

☐ Under *Data Type*, click the *Geometry* data type box. Notice the change in the *Field Properties* section.

☐ Under *Field Properties*, notice that the value for the *Geometry Type* property is *Polygon* (the default). Click on the *Polygon* value to expose a dropdown dialog list with geometry choices, then click *Line*.

☐ Under *Field Properties*, for the *Spatial Reference* property, click the *ellipses* button to reveal the *Spatial Reference Properties* dialog.

☐ Click *Import* to import a coordinate system for the new feature class.

☐ Using the *Browse for Dataset* dialog, navigate to the *\REGIS\Redlands_GDB\LandRecords* feature dataset and select the *Parcels* feature class.

☐ Click *Add*.

Notice that the coordinate system is updated in the *Spatial Reference Properties* window.

☐ Click *OK*.

☐ Click *Finish*.

The new (empty) *Tour* feature class now appears in the *Contents* panel.

STEP 2: PREPARING THE DIGITIZING ENVIRONMENT

In the previous step, you created a new empty feature class in Redlands_GDB. Now you will add features to the feature class by heads-up digitizing the historical driving tour features over a georeferenced image.

☐ In *ArcCatalog*, navigate to the *C:\Student\igis2\MapDocuments* folder and double-click on *Ex7A.mxd*.

This map document contains a georeferenced TIFF image that was created by scanning a Redlands Chamber of Commerce map that shows the location of the historical driving tour. You will use it to trace the driving tour. Before adding the lines for the tour, you will prepare your digitizing environment. Begin by adding the Tour feature class to the map as layer.

☐ Click the *Add Data* button.

☐ Use the browser to navigate to the *C:\Student\igis2\REGIS\Redlands_GDB\Tour* feature class, and click *Add*.

The empty Tour layer will appear in the Table of Contents.

☐ If necessary, click the *tourmap* image layer and drag it to the bottom of the Table of Contents so the added lines will display on top of the image.

Now you will change the default symbol for the Tour layer to one that will be easily visible while you are digitizing.

☐ Click the symbol for the *Tour* layer in the Table of Contents.

☐ Click the *Highway* symbol, then click *OK*.

The thick red line symbol will make the new features you add very easy to see.

Now you are ready to start an edit session and set your snapping tolerance.

☐ Click *View* > *Toolbars* > *Editor*.

☐ Click *Editor* > *Start Editing*.

☐ On the *Editor* toolbar, confirm that the edit *Task* is *Create New Feature,* and *Tour* is the *Target* feature class you are editing.

Before digitizing any features, you will set some tolerances to make your digitizing session more efficient and accurate.

☐ Click *Editor* > *Options*.

☐ If necessary, select the *General* tab.

☐ For *Snapping tolerance*, type `10` and choose *map units* from the dropdown list. This sets your snap tolerance to 10 meters.

☐ For *Stream tolerance*, type `100`. This tolerance controls the interval between shape points when you digitize in stream mode.

☐ Leave the remaining options at their defaults.

☐ Click *OK*.

☐ Click *Editor* > *Snapping*.

☐ On the *Snapping Environment* window, click *Edge*.

Edge snapping will ensure that your new sketches will snap to any previously added lines in the *Tour* feature class. Now when your pointer is within 10 meters (the snap tolerance) of an existing line, it will automatically snap to that location.

☐ Close the *Snapping Environment* window.

STEP 3: ADDING THE TOUR LINE FEATURES

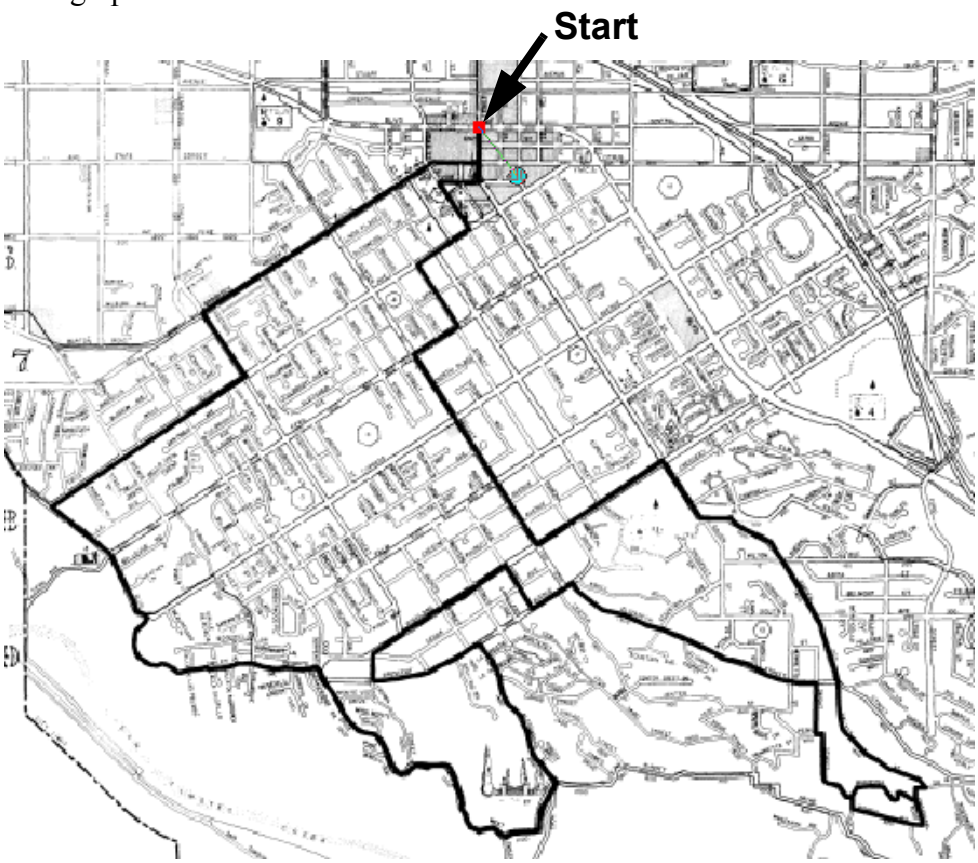
Now you will digitize the tour lines by tracing over the tour on the tourmap image. For classroom purposes, a high degree of detail is not necessary, so do not try to capture every bend and twist in the image. Just capture the general shape of the tour.

To create the tour features, you will use the Sketch Tool on the Editor toolbar.

☐ Click the *Sketch Tool*  .

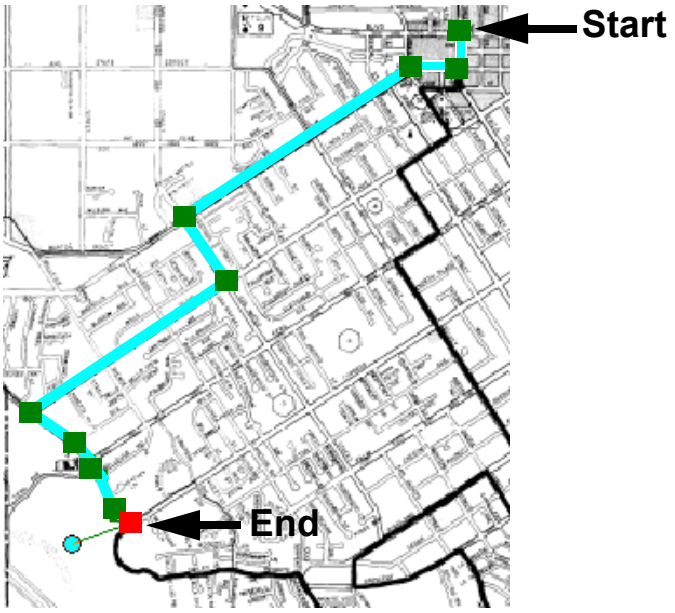
> **NOTE:** If you want to see the image in more detail as you trace it, you can experiment with using the Magnifier window (click Window > Magnifier), and digitize the Tour features within it. To change the percentage of the Magnification, right-click on the title bar, and click Properties.

☐ Start your sketch by clicking the northern most edge of the highlighted tour path shown in the graphic below.



☐ Click to add vertices (shape points) as you trace the tour path.

☐ Trace the tour path towards the western side of the map first until your sketch looks like the graphic below.



So far you have been digitizing in point mode, where you must click the mouse for each vertex you want to enter. For the straight segments of the tour this is the most effective digitizing mode, but for the sinuous portions of the tour, you will use stream mode digitizing.

☐ Drag your cursor a short distance away from the sketch you are digitizing and right-click. This brings up the *Sketch Tool* context menu.

☐ Click on *Streaming* (notice that the *F8* key is the default shortcut key for this option).

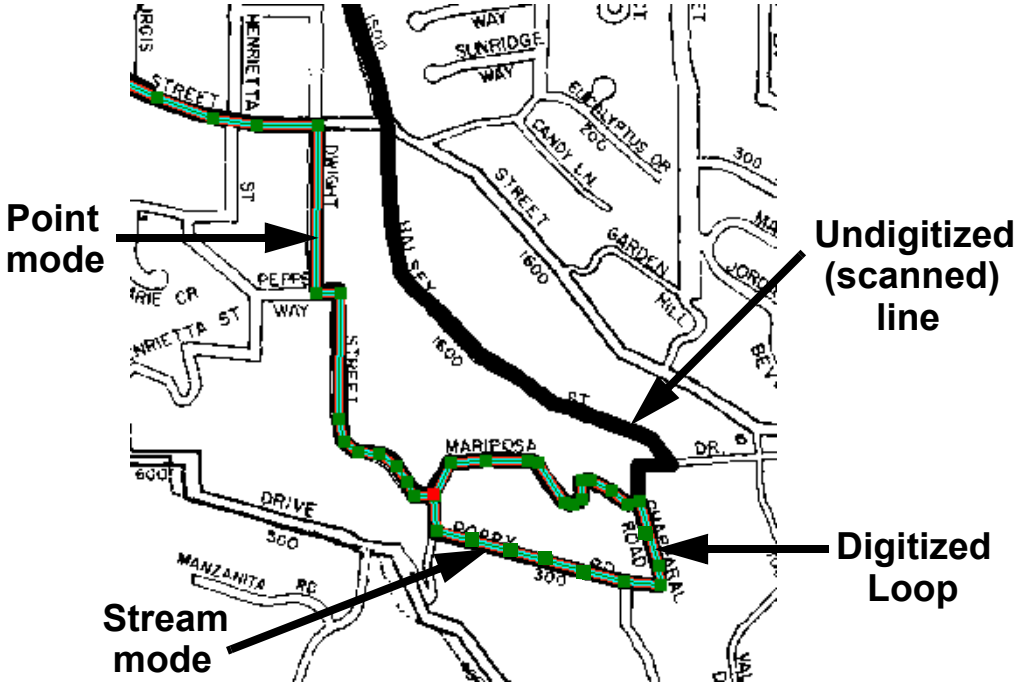
☐ Click the mouse once to continue digitizing the curving portion of the tour.

You will notice that after clicking the first shape point, subsequent shape points are automatically added at 100 meter intervals, the stream tolerance you set in the previous step.

> **NOTE:** Even though stream mode will automatically add a vertex every 100 meters, you can still left-click to add a vertex where you feel it necessary.

☐ Continue tracing the *Tour* until you reach the looping portion shown in the graphic below.

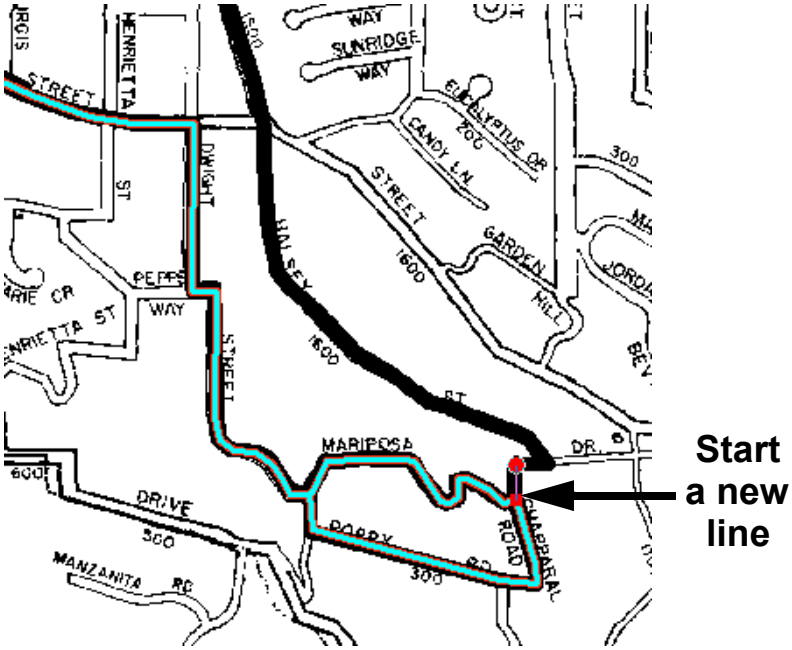
If you do not like the way your sketch is going, right-click, then click *Delete Sketch* and start over.



☐ Double-click to finish the sketch.

☐ Start a new sketch to digitize the remainder of the *Tour*. Begin the new sketch by clicking on the one you just finished digitizing as shown in the graphic below.

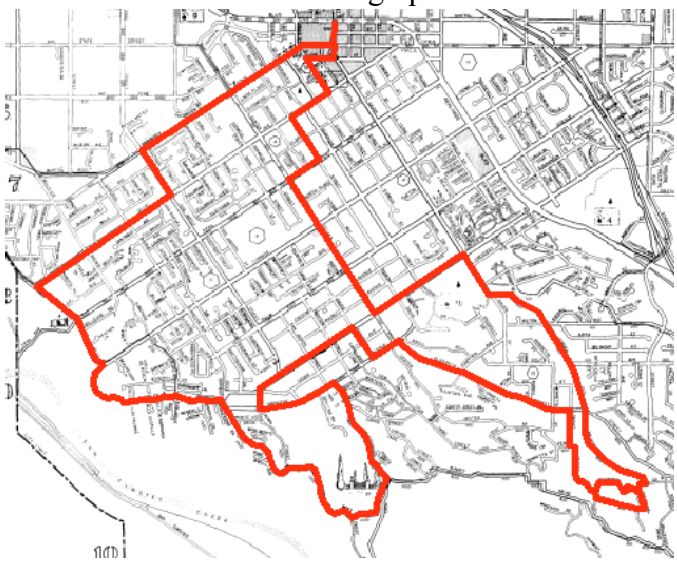
The snapping tolerance you set in the previous step should insure that your second sketch snaps to the first one.



You can continue to use stream mode or you can press the F8 key to switch back to point mode.

☐ When finished digitizing, right-click > click *Finish Sketch*.

The *Tour* feature class should look similar to the graphic below.



If you are not satisfied with your digitizing output, you can simply click the *Undo* button  to remove the sketches you do not like, then digitize them again.

The Undo button will remove an entire feature.

☐ When completely finished digitizing, click *Editor* > *Stop Editing* and make sure to *Save* your edits.

☐ Close *ArcMap* and do not save the changes to the map.

STEP 4: CREATE METADATA FOR THE NEW TOUR FEATURE CLASS

Now that you have created a new feature class, you need to provide documentation for it in the metadata.

☐ In *ArcCatalog*, navigate to *C:\Student\igis2\REGIS\Redlands_GDB*.

Before editing the metadata, you will create a thumbnail image of the new feature class.

☐ Click on the *Tour* feature class, and click the *Preview* tab.

You should see the driving *Tour* features you just digitized.

☐ Make sure that the *Geography* toolbar is exposed on the interface. If it is not, click *View* > *Toolbars* > *Geography* to add it.

☐ Click the *Create Thumbnail* button  on the *Geography* toolbar.

Now you will edit the metadata for the Tour feature class.

☐ Click the *Metadata* tab and make sure you have the *FGDC ESRI Stylesheet* selected.

Notice that the thumbnail you just created is displayed in the metadata.

☐ If necessary, add the *Metadata* toolbar to the interface.

☐ Click the *Edit metadata* button  .

The *Editing Tour* dialog will initialize.

☐ In the *General* tab, for *Abstract*, type **`A general representation of the Redlands historical driving tour`**.

☐ For *Purpose*, type **`For general locational use only. Not for navigational use`**.

☐ For both *Access* and *Use Constraints*, type **`None`**

☐ Click the *Contact* tab.

☐ Click *Details* to reveal the *Contact information* dialog.

☐ Fill in the *Person, Organization,* and *Position* fields with the same information you used in the last exercise.

☐ Click *OK* on the *Contact Information* dialog.

☐ Click *Save* on the *Editing Tour* dialog.

☐ In the *Metadata* panel, click on *Abstract* and *Purpose* to see if they reflect the edits you just made.

If you have time, you can experiment with the Metadata editor to add more metadata for the Tour feature class.

In this exercise, you created an empty feature class, digitized features into it, created a thumbnail, and documented the new feature class in the metadata.

EXERCISE END

EXERCISE 7B: BRINGING EXISTING DATA TO THE GEODATABASE

In the previous exercise, you created new data for the Redlands_GDB geodatabase by digitizing the historical driving tour from a georeferenced image. In this exercise, you will continue to fill in the missing pieces of the REGIS by importing or converting existing digital data into the geodatabase.You will import a CAD file, a coverage, and two separate .dbf tables. Once you have converted these files, you will need to add fields to these tables for use in later exercises. You will also use the Simple Data Loader to load an existing shapefile into an existing geodatabase feature class.

STEP 1: EXAMINE A CAD FILE TO PREPARE FOR EXPORT INTO THE GEODATABASE

In this step, you will import a CAD file into the geodatabase. Begin by examining the *Railroad.dxf* CAD file.

☐ In *ArcCatalog*, navigate to the *C:\Student\igis2\DataSources* folder.

☐ Click on the plus sign next to the *railroad.dxf* file to expand it.

☐ Click on the *Polyline* feature class, and click the *Preview* tab.

> **NOTE:** DXF files, like other CAD formats, can store multiple feature types within the same file. The railroad.dxf file contains only line features.

☐ Preview the *railroad.dxf* file geography and table.

Notice that the railroad.dxf table has attributes that describe how the features are drawn (e.g., thickness, color). These CAD attributes will not be relevant in the geodatabase, so you will remove them during the data export. In a later step, you will add more relevant attributes.

☐ Right-click the *railroad.dxf* file and click *Properties*.

☐ Click the *Spatial Reference* tab.

Notice that the projection is undefined. You will use the *Parcels* feature class to define the spatial reference during the conversion process.

☐ Click *Cancel* to close the *CAD Feature Dataset Properties* dialog.

Now you are ready to export the *dxf* file.

STEP 2: EXPORT THE RAILROAD.DXF INTO THE REDLANDS_GDB

☐ If necessary, expand the *railroad.dxf* to view the component feature classes.

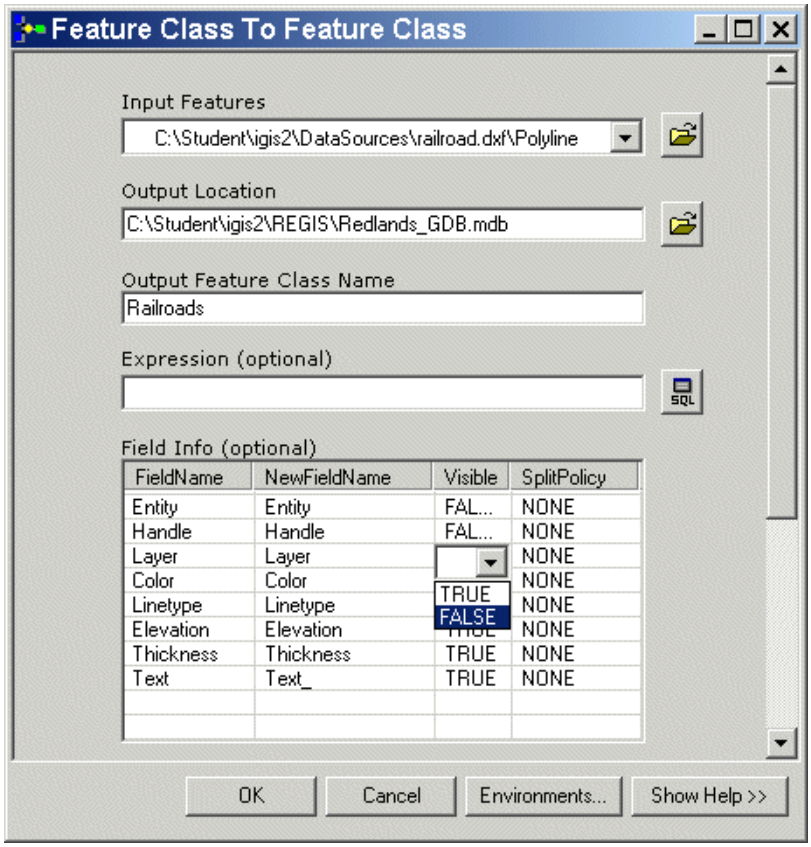
☐ Right-click on *Polyline* and click *Export > To Geodatabase (single)*.

☐ For *Output Location*, click the *Browse* button and navigate to *C:\Student\igis2\REGIS*.

☐ Select *Redlands_GDB.mdb* and click *Add*.

☐ For the *Output Feature Class Name*, type **`Railroads`**

☐ In the *Field Info (Optional)* section, switch the *Visible* value from TRUE to FALSE for all of the field names.



This will prevent the fields from being copied into the new geodatabase feature class.

☐ Click *OK* on the *Feature Class To Feature Class* dialog.

The Command Line Window will open, and show the geoprocessing steps as they are performed.

☐ Close the Command Line Window when the export process has finished.

The new Railroads feature class is created in the Redlands_GDB.

☐ If the *Railroads* feature class does not show in the Catalog Tree, right-click on *Redlands_GDB* and click *Refresh*.

Next, you will import the spatial reference from the *Parcels* feature class to complete the CAD to Geodatabase conversion.

☐ Right-click on the *Railroads* feature class, and select *Properties.*

☐ Select the *Fields* tab.

☐ Click on the *Geometry* Data Type to access its Field Properties.

☐ Click the *ellipses* button to the right of the *Spatial Reference* property  .

☐ Click *Import* in the *Spatial Reference Properties* dialog.

☐ Navigate to *Redlands_GDB\LandRecords,* select the *Parcels* feature class, and click *Add.*

☐ Click *OK* to close the *Spatial Reference Properties*.

Note that the Spatial Reference information has been populated.

Question 1: What is the name of the updated Spatial Reference?

_____

☐ Click *OK* to close the *Feature Class Properties* dialog.

☐ Preview the new feature class's *Geography* and *Table*. Pay special attention to the attribute fields.

STEP 3: UPDATE THE METADATA FOR THE RAILROADS FEATURE CLASS

In the previous exercise, you added Abstract, Purpose, Access, Constraint, and Contact information to the metadata documentation for the Tour feature class. You also created a thumbnail for it.

☐ If you have time add the Abstract, Purpose, Access, Constraint, and Contact information to the metadata documentation for the Railroads feature class.

STEP 4: IMPORT THE REDCITYLIM COVERAGE INTO THE REDLANDS_GDB

In this step, you will create a new feature class by importing a coverage that contains the Redlands city limit boundary polygon feature. First, you will examine the spatial reference information available for the coverage.

☐ In *ArcCatalog*, navigate to the *C:\Student\IGIS2\DataSources* folder.

☐ Right-click on the *redcitylim* coverage, and select *Properties.*

☐ Select the *Projection* tab to view the information.

Question 2: What is the Coordinate System for the *redcitylim* coverage?

_____

☐ Close the *Coverage Properties* window.

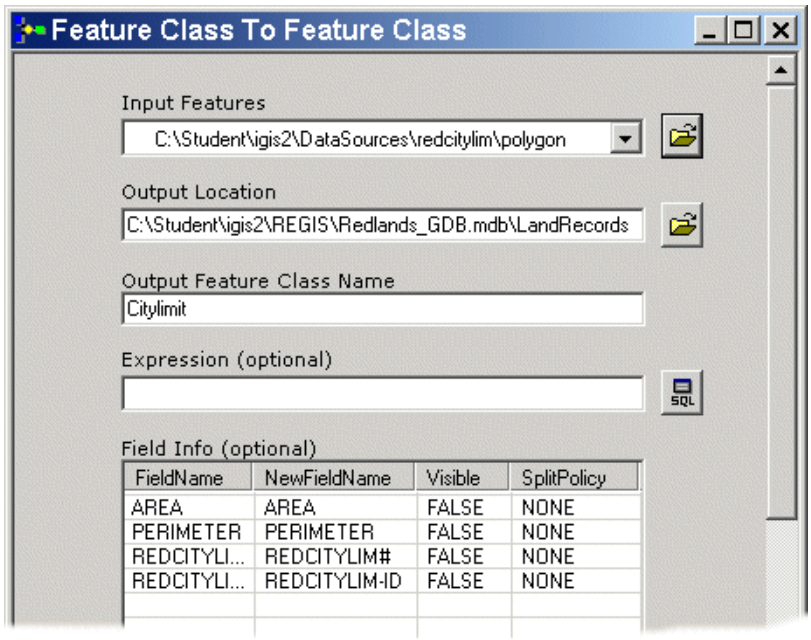
☐ In the *C:\Student\igis2\REGIS\Redlands_GBD*, right-click the *Land Records* Feature Dataset and click *Import > Feature Class (single)*.

☐ For *Input Features*, click the *Browse* button and navigate to the *C:\Student\igis2\DataSources\redcitylim* coverage.

☐ Select the *polygon* feature class and click *Add.*

☐ For the *Output Feature Class Name*, type `Citylimit`

☐ Change the *Visible* property for the input *Field Info* to *FALSE* for all fields *(AREA, PERIMETER, REDCITYLIM#, REDCITYLIM-ID)*. When finished, the dialog should look like the graphic below.



☐ Click *OK* on the *Feature Class To Feature Class* dialog.

☐ Close the Command Line Window once the import is finished.

The Redlands city limit boundary is now stored in a polygon feature class within the Land Records feature dataset Redlands_GDB geodatabase. Next, preview it in ArcCatalog.

☐ Click the new *Citylimit* feature class, and click the *Preview* tab.

☐ Preview both the *Geography* and *Table*. Notice how the old coverage fields are not in the geodatabase feature class table, and new *Shape_Length* and *Shape_Area* fields are added.

☐ Click the *Metadata* tab, and click the *Spatial* tab in the *FGDC ESRI* stylesheet.

Under Horizontal coordinate system, notice that the spatial reference information is the same as the Parcels feature class. This is because you imported the original coverage data directly into the Land Records feature dataset, and automatically assigned the same spatial reference to the data as part of the conversion process.

STEP 5: UPDATE THE METADATA FOR THE NEW CITYLIMIT FEATURE CLASS

☐ If you have time, create a thumbnail for the *Citylimit* feature class. Add the *Abstract, Purpose, Access, Constraint,* and *Contact* information to the metadata documentation for the *Citylimit* feature class.

STEP 6: IMPORT DBF TABLES INTO THE GEODATABASE

In addition to storing spatial feature classes, the geodatabase can also store tables without spatial features. This is useful if you want to keep attributes on a table separate from the feature attribute table. In the DataSources folder, there are two tables in .dbf (dBase) format. They contain the demographic attribute data for the census tracts and block groups. In this step, you will import both tables into the geodatabase.

☐ In *ArcCatalog*, right-click the *Redlands_GDB* geodatabase and click *Import* > *Table (Single)*.

☐ For *Input Table*, navigate to the *C:\Student\igis2\DataSources* folder, select *BG_dmg.dbf*, and click *Add*.

☐ For *Output Table Name*, type **`Demography`**

☐ Click *OK*.

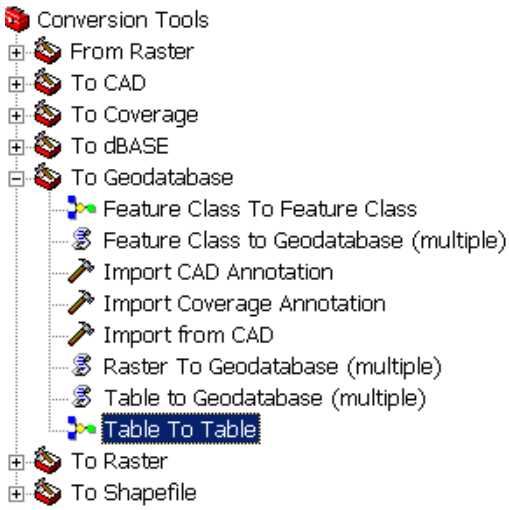
☐ Close the Command Line window when the conversion has finished.

Next, you will import another dbf table into the geodatabase but you will use ArcToolbox to access the import functionality.

☐ Open the *ArcToolbox* window in ArcCatalog.

☐ In *ArcToolbox*, expand the *Conversion Tools* > *To Geodatabase.*

☐ Double-click on *Table To Table* to open the tool dialog.



☐ For *Input table*, navigate to the *C:\Student\igis2\DataSources* folder, select *Trct_dmg.dbf*, and click *Add*.

☐ For *Output Location*, click the *Browse* button and add the *Redlands_GDB* geodatabase.

☐ For *Output Geodatabase table name*, type **`TractInfo`**

☐ Click *OK*.

☐ When the processing is finished, close the Command Line window.

☐ If necessary, refresh the geodatabase (right-click and click *Refresh*) and observe the new tables as part of the geodatabase.

Later in the course you will join these attribute tables to their appropriate feature classes.

☐ Preview the new tables in ArcCatalog. Compare the new geodatabase tables to the original *.dbf* tables. They should be identical.

STEP 7: ADD NEW FIELDS TO THE NEWLY IMPORTED TABLES

In this step, you will add a field to two individual tables, using a different technique for each. The first field you add will be to the Railroads feature class attribute table. You will add a NAME field to the table to store the name of each railroad that owns a particular track.

☐ In the *Redlands_GDB*, right-click on the *Railroads* feature class and click *Properties*.

☐ On the *Feature Class Properties* dialog, click the *Fields* tab.

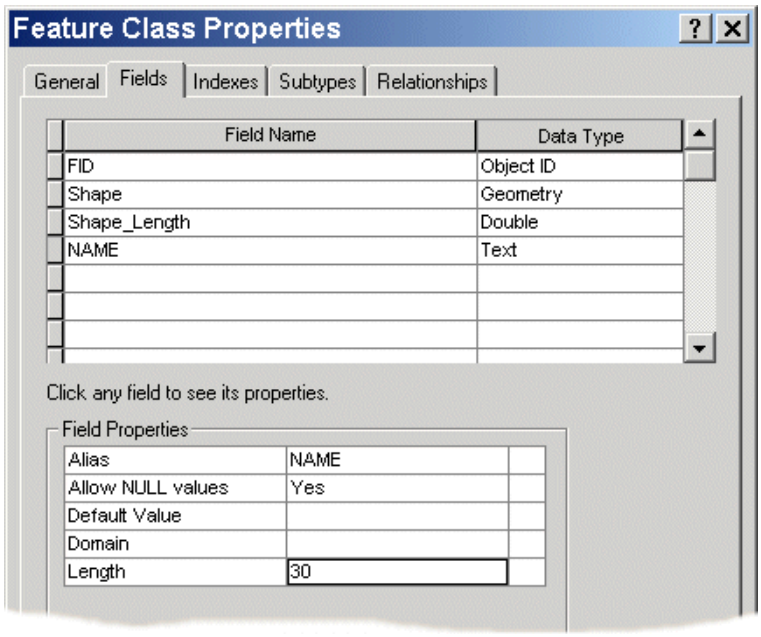
☐ Click the row underneath the *Shape_Length* field and type **`NAME`** for the *Field Name*.

☐ Make sure that *Text* is the selected *Data Type*.

☐ Under *Field Properties*, change the *Length* to `30`

☐ Click *OK*.

☐ Now preview the table for the *Railroads* feature class.



You should notice the new *NAME* field now exists on the table. You will use ArcMap to add values for this field in a later exercise.

The next field you add will be on the Demography table which you just imported. This table contains population and demographic data for the census block groups.

☐ Preview the *Demography* table.

Notice all of the fields that deal with the number of individuals within a certain age range. Recall that one of the pilot studies mentioned in the needs assessment for the REGIS project was locating an appropriate site for an amusement park. One of the criteria for a good location is its close proximity to the target age market, namely people between 5 and 24 years old. You will add a new field to this table that will eventually contain the combined values from several of the age range fields specifically for your target age market.

You will use a different technique to add a field, this time using ArcToolbox.

☐ If necessary, open the *ArcToolbox* window in ArcCatalog.

☐ Expand the *Data Management Tools* > *Fields* toolbox.

☐ Double-click *Add Field* to open the tool.

☐ For *Input Table*, navigate to *C:\Student\IGIS2\REGIS\Redlands_GDB*.

☐ Select the *Demography* table, and click *Add*.

☐ For *Field Name*, type **TARGET_AGE**

☐ For *Field Type*, select *Long* from the dropdown list.

☐ Click *OK*.

☐ Close the Command Line window when finished.

☐ Preview the *Demography* table. Notice the new *TARGET_AGE* field at the very end of the table.

You will calculate the values for this field in a later exercise.

☐ Close the *ArcToolbox* window.

STEP 8: UPDATE THE METADATA DOCUMENTATION FOR THE TWO TABLES

☐ If you have time add the Abstract, Purpose, Access, Constraint, and Contact information to the metadata documentation for the two new geodatabase tables.

STEP 9: EXPLORE THE SHAPEFILE BEFORE LOADING IT INTO THE GEODATABASE

In this step, you will use the ArcCatalog Simple Data Loader to load data, in the form of a shapefile, directly into an existing geodatabase feature class. The data you will load is a shapefile that contains Redlands streets. Like the feature classes in the Census feature dataset, the RedStreets.shp shapefile was derived from 1999 TIGER/Line files produced by the U.S. Census Bureau. Start the exercise by examining this shapefile.

☐ Navigate to the *C:\Student\igis2\DataSources* folder.

☐ Click the *RedStreets.shp* shapefile and click the *Preview* tab.

☐ After previewing the *RedStreets* geography, preview the table.

Notice the fields on the RedStreets attribute table. In addition to address information, there is a field named CFCC. This stands for Census Feature Class Code. In this table, the different CFCC values will describe what kind of street the feature is (highway, local street, etc.). Now examine the spatial reference of the shapefile.

☐ Click the *Metadata* tab, then click the *Spatial* tab on the *FGDC ESRI* stylesheet.

☐ Under *Horizontal coordinate system*, click *Details*.

As you can see, the RedStreets.shp shapefile is stored in a geographic coordinate system (Latitude/Longitude) with decimal degree units. The data for the Redlands_GDB analysis project is stored using the UTM projection for Zone 11. Recall that the geodatabase itself does not have a spatial reference, but feature classes and feature datasets *within* the geodatabase do store this information.

Now you will prepare to load the shapefile into a geodatabase feature class. You will create a new feature class just for this purpose.

> **NOTE:** A direct conversion from the shapefile to the geodatabase could be done. However, in this exercise, you want to examine the functionality of the Simple Data Loader.

STEP 10: CREATE A NEW FEATURE DATASET AND FEATURE CLASS

You will create a new feature dataset called Transportation to store the Streets feature class.

☐ In *ArcCatalog*, navigate to the *C:\Student\igis2\REGIS\Redlands_GDB*.

☐ Right-click the *Redlands_GDB* and click *New* > *Feature Dataset*.

☐ On the *Feature Dataset* dialog, for *Name*, type **`Transportation`**

☐ For *Spatial Reference*, click *Edit*.

☐ On the *Spatial Reference Properties* dialog, confirm that the *Coordinate System* tab is active, and click *Import*.

☐ On the *Browse for Dataset* dialog, navigate to the *C:\Student\igis2\REGIS\Redlands_GDB\LandRecords* feature dataset, click *Parcels*, and click *Add*.

☐ Click *OK* to close all open dialogs.

Next, you will create an empty Streets feature class inside the new Transportation feature dataset.

☐ Right-click the *Transportation* feature dataset and click *New* > *Feature Class*.

☐ On the *New Feature Class* dialog, for *Name*, type **`Streets`** and click *Next*.

☐ Make sure the *Default* storage parameters option is selected, then click *Next*.

At this point, you could add fields to your new feature class by manually creating them. However, at the beginning of the exercise, you previewed the RedStreets.shp shapefile and found that it already had the appropriate fields defined. You will simply import the field definitions of the RedStreets.shp shapefile into this new geodatabase feature class.

☐ Click the *Import* button, then navigate to the *C:\Student\igis2\DataSources\RedStreets.shp* shapefile and click *Add*.

Notice how the fields are automatically transferred from the shapefile to the new feature class. Remember that no actual data has been transferred. You simply used the shapefile attribute table as a template for the new Streets feature class attribute table. However, the SHAPE field needs to be more specifically defined.

☐ Under *Field Name*, click the *SHAPE* field to expand its properties.

☐ Under *Field Properties*, notice that the value for the *Geometry Type* property is Polygon.

> **NOTE:** Polygon is the default geometry selected for any feature class you create from scratch in ArcCatalog.

☐ Click on the *Polygon* value to expose a dropdown list with geometry choices, then click *Line*.

☐ Under *Field Properties*, for the *Spatial Reference* property, click the ellipses  to reveal the *Spatial Reference Properties* dialog.

Notice that the new feature class inherited the spatial reference of the Transportation feature dataset.

☐ Click *OK*.

☐ Click *Finish*.

Notice that the Streets feature class now exists in the Redlands_GDB geodatabase (you may have to refresh the geodatabase to see it). If you preview the table for the Streets feature class, you will see the empty fields you imported from the RedStreets.shp shapefile. Now you are ready to use the Simple Data Loader in ArcCatalog to load the RedStreets.shp shapefile into the Streets feature class.

STEP 11: USE THE SIMPLE DATA LOADER TO LOAD THE SHAPEFILE

☐ Right-click the *Streets* feature class and click *Load* > *Load Data*. The *Simple Data Loader* wizard will appear.

☐ The introduction panel appears. Click *Next*.

☐ For *Input data*, click the *Browse* button and navigate to the *C:\Student\igis2\DataSources* folder, then click *RedStreets.shp* shapefile and click *Open*.

☐ Click the *Add* button at the bottom of the *Simple Data Loader* dialog to transfer the *RedStreets.shp* shapefile to the *List of source data to load*, then click *Next*.

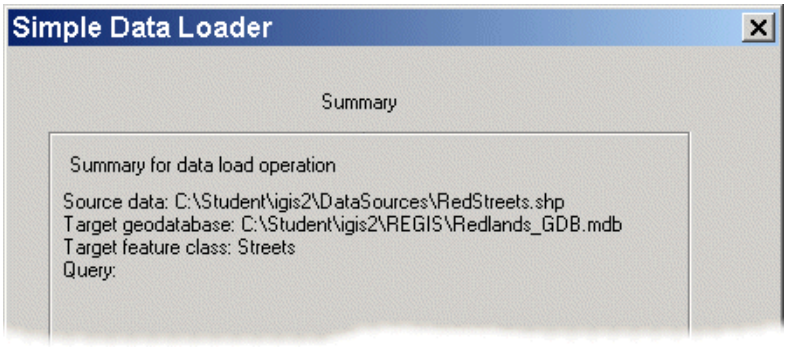
☐ There are no subtypes in this feature class, so click *Next*.

The next panel allows you to match fields from the source table to fields in the destination table. This is necessary if there are different field names between the tables. Because you imported the fields straight from the shapefile when you created the feature class, all of your fields match.

☐ Click *Next*.

☐ Make sure that the *Load all of the source data* choice is selected, then click *Next*.

☐ Review your summary. It should look like the graphic below (your pathnames may be different).



☐ Click *Finish*.

The data loading will take a moment. Remember that in addition to loading the streets and their attributes, the Simple Data Loader is also projecting the data from latitude/longitude decimal degrees to UTM meters. When the loading is finished, examine the new feature class.

☐ Click on the *Streets* feature class and click the *Preview* tab.

☐ Preview the *Geography* and *Table* for the feature class.

☐ Click the *Metadata* tab.

☐ On the *Metadata* toolbar, click the *Create/Update metadata* tool.

☐ Click the *Spatial* tab on the *FGDC ESRI* stylesheet. Notice that the *Horizontal coordinate system* is now *NAD_83_UTM_ZONE_11N*.

STEP 12: UPDATE THE METADATA FOR THE NEW STREETS FEATURE CLASS

☐ If you have time add the *Abstract, Purpose, Access, Constraint,* and *Contact* information to the metadata documentation for the *Streets* feature class. Also create a thumbnail for it.

STEP 13: IMPORT DATA FROM THE GEOGRAPHY NETWORK

The Internet has become one of the primary sources of GIS data. A wealth of free or low cost data is available to anyone with a network connection. The census data in the Redlands_GDB is one example. The feature classes that are stored in the Census feature dataset and the Streets feature class were originally downloaded as TIGER/Line files from the U.S. Census Bureau Web site.

In this step, you will download data from another U.S. government agency, the Environmental Protection Agency (EPA). The EPA provides a feature service, available through the Geography Network, that contains feature classes dealing with potential environmental hazards. This is where you will find information on the locations of hazardous material handlers.

> **! You may be taking this class at a facility that does not have an Internet connection. If this is the case, a pre-downloaded shapefile named hazards.shp has been stored in the DataSources folder. Simply use this shapefile in place of the EPA Internet data discussed in this exercise.**

☐ Open *ArcMap* with *A new empty map*.

☐ Click the *Add Data* button.

☐ Navigate to the *Redlands_GDB\LandRecords* feature dataset and add the *Citylimit* feature class to the map.

☐ Click the *Add Data* button again.

☐ Under the *Look In* dropdown list, select *GIS Servers*.

☐ Double-click the *Geography Network Services Hosted by ESRI* link.

☐ Double-click on the *EPA_Hazards_FS* feature service to expand it and view all of the available data layers.

☐ Click the *Hazardous Waste Handlers (EPA)*, and click *Add.*

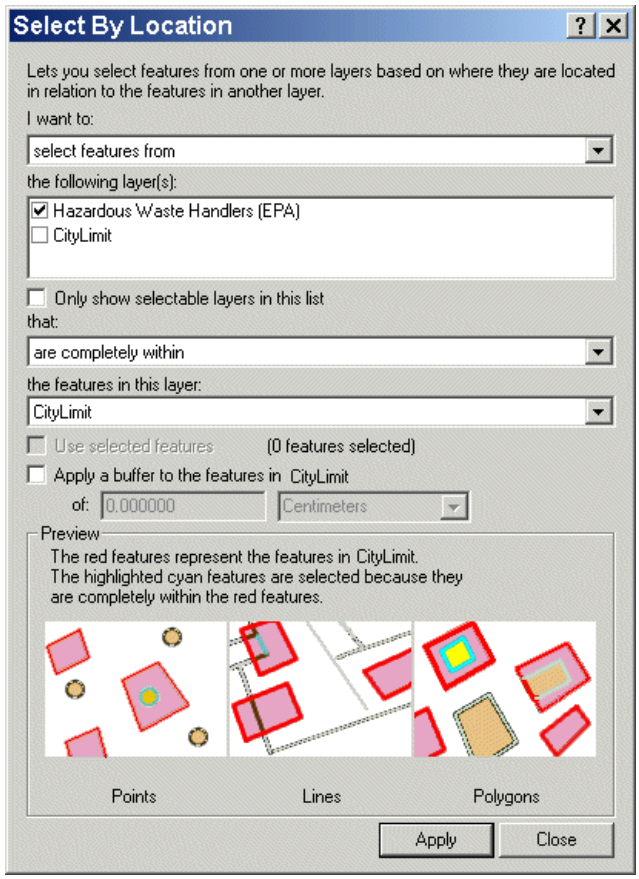
☐ On the *Warning* message box, click *OK to all*.

> **! Depending upon the speed of your Internet connection, it may take a few moments to load the 2500 points in this dataset.**

As you can see, there are a few sites that are outside the city limits. Before you export the features to the Redlands_GDB, you will use a spatial query to select just the sites that are completely within the Redlands city limit.

☐ Click *Selection* > *Select By Location*.

☐ Modify the *Select By Location* dialog to look like the graphic below.



☐ Click *Apply*.

☐ When the selection is finished, click *Close*.

There should be four sites selected within the Redlands city limits. Now you will export those features from the EPA Internet feature service to the Redlands_GDB geodatabase on your computer.

☐ Right-click the *Hazardous Waste Handlers (EPA)* layer and click *Data* > *Export Data*.

☐ On the *Export Data* dialog, for the *Export* option, make sure that *Selected features* choice is displayed.

☐ Click the *Use the same Coordinate System as the data frame* choice.

☐ For *Output shapefile or feature class*, click the *Browse* button.

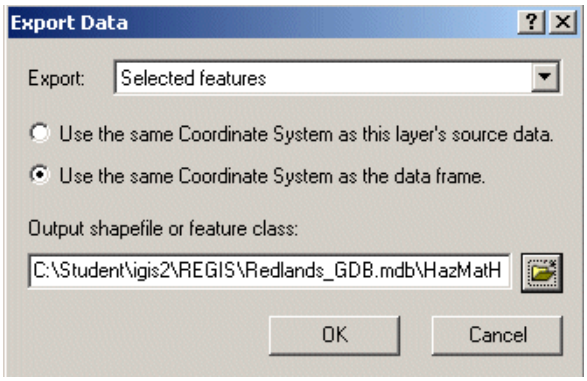
☐ On the *Saving Data* dialog, for *Save as type*, confirm the *Personal Geodatabase feature classes* choice from the dropdown list.

☐ Navigate to the *Redlands_GDB* geodatabase, so that the feature classes and feature datasets are displayed.

☐ For the output feature class *Name,* type **`HazMatHandlers`**

☐ Click *Save* on the *Saving Data* dialog.

Your Export Data dialog should now look like the graphic below.



☐ Click *OK*.

☐ Click *Yes* to add the exported data to the map as a layer.

☐ Remove the *Hazardous Waste Handlers (EPA)* layer.

You should see the new HazMatHandlers sites displayed in your map.

☐ Close *ArcMap*, and do not save changes to the map.

STEP 14: UPDATE THE METADATA FOR THE NEW HAZARDS FEATURE CLASS

☐ If you have time add the *Abstract, Purpose, Access, Constraint*, and *Contact* information to the metadata documentation for the *HazMatHandlers* feature class. Also create a thumbnail for it.

EXERCISE END

ANSWERS TO EXERCISE 7B QUESTIONS

Question 1: What is the name of the updated Spatial Reference?

Answer: NAD_1983_UTM_ZONE_11N

Question 2: What is the Coordinate System for the redcitylim coverage?

Answer: Answer: Unknown Coordinate System

8

Setting geodatabase validation rules

contents

EXERCISE 8A: ATTRIBUTE VALIDATION

Creating subtypes and domains, and applying them to the appropriate feature classes and fields in your Redlands_GDB geodatabase will allow you to store, update, and analyze your data more efficiently. In this exercise, you will learn how to create subtypes and domains to help you ensure that attribute data being entered into the database is correct.

STEP 1: DEFINING SUBTYPES

One of the great advantages of using the geodatabase to store geographic data is the ability to create subtypes and domains for your features and attributes. Subtypes allow you to divide rows in a feature class or table into different groups based on the value of one attribute. By allowing you to work with a subset of features in a feature class, subtypes make it possible to assign consistent attributes and behavior to those subsets. In this step, you will create subtypes for the Streets feature class based on their CLASS value. Begin by examining the Streets attribute table.

☐ If necessary, start *ArcCatalog* and navigate to the *C:\Student\igis2\REGIS\Redlands_GDB\Transportation* feature dataset.

☐ Preview the *Streets* attribute table.

Examine the values in the CFCC field. Each unique CFCC value describes a different type of road feature. The table below provides the general description for each unique CFCC value in the Streets attribute table.

CFCC	Description
A11	*Primary Road or Interstate Highway*
A31	*Secondary or Connecting Road*
A41	*Local Street*
A63	*Access Ramp*
A64	*Service Drive*
A73	*Alley*

It would make sense to divide the Streets feature class into subtypes based on their unique CFCC values. However, the CFCC field is a text field, and it is only possible to define subtypes using an integer field. Therefore, a new integer field named CLASS was added to the table specifically to serve as the subtype field. Each unique value in the CLASS field corresponds to a specific CFCC value.

☐ In the *Preview* panel, scroll to the end of the *Streets* table and click on the *CLASS* field to select it.

☐ Right-click at the top of the field and click *Freeze/Unfreeze Column*.

☐ Scroll through the table until the *CFCC* field is next to the frozen *CLASS* field.

☐ Right-click at the top of the *CLASS* field and click *Sort Ascending*.

Notice that each unique CFCC value is associated with a unique CLASS value. The table below shows the relationship between the fields and their descriptions.

CFCC	CLASS	Description
A11	*1*	*Primary Road or Interstate Highway*
A31	*2*	*Secondary or Connecting Road*
A41	*3*	*Local Street*
A63	*4*	*Access Ramp*
A64	*5*	*Service Drive*
A73	*6*	*Alley*

Now you will create the subtypes using the CLASS field.

☐ Right-click on the *Streets* feature class and click *Properties*.

☐ On the *Feature Class Properties* dialog, click the *Subtypes* tab.

☐ For *Subtype Field*, click *CLASS* from the dropdown list.

> **NOTE:** *CLASS* is the only field listed because it is the only integer field data type in the *Streets* attribute table. If more than one integer field is available in a table, you need to select which one contains your subtype values.

☐ For *Subtypes: Code*, click the first cell and overwrite the 0 value by typing `1`

☐ For *Subtypes: Description*, overwrite the *NewSubtype* value by typing **`Highways`**

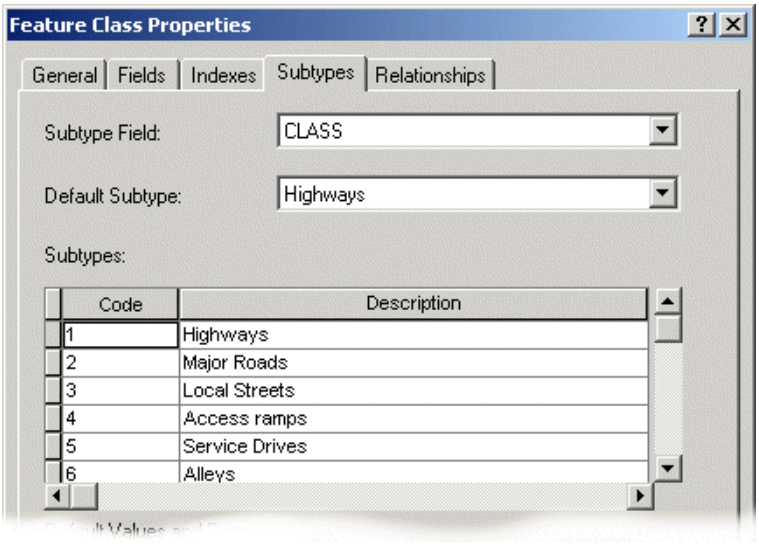
> **NOTE:** The description is important. This is how the subtype will actually be identified in the ArcMap Table of Contents and other places on the interface, so it should be something brief and intuitive.

You have just created the first subtype: Highways.

☐ Now add the rest of the *CLASS* values and their descriptions using the values supplied in the table below.

CLASS	Description
1	Highways
2	Major Roads
3	Local Streets
4	Access Ramps
5	Service Drives
6	Alleys

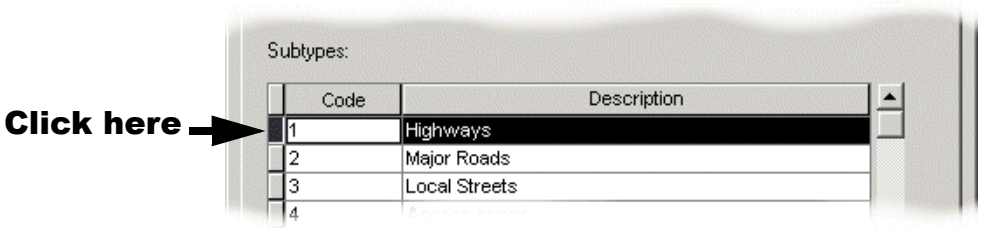
☐ When finished, the remaining *Code* and *Description* values should look like the graphic below.



☐ Click *Apply.*

Now that the subtypes are defined, you can specify a Default Value for selected attributes for each of them. This means that whenever you create new features that belong to a particular subtype, the default values for those attributes will automatically populate the table. You will see this demonstrated in the next exercise.

☐ Click the button to the left of *Code 1* to highlight the entire subtype row.

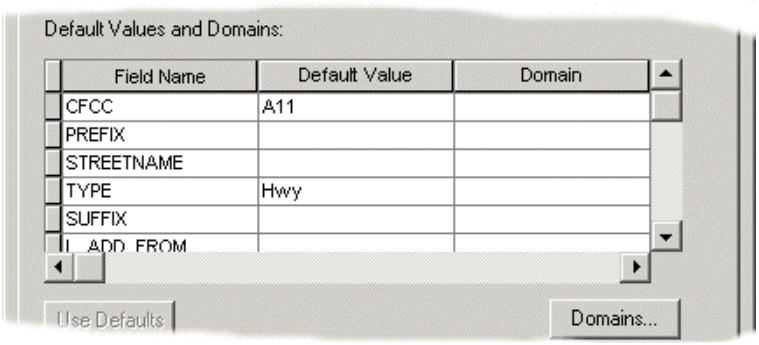


☐ In the *Default Values and Domains* panel, click the empty *Default Value* cell next to the *CFCC* field name.

☐ Click the *Default Value* field next to the *CFCC* field name, and type in **`A11`**

☐ Click the *Default Value* field next to the *TYPE* field name, and type in **`Hwy`**

☐ The *Default Value and Domain* panel of the dialog should look like the graphic below.



☐ Now using the same procedure, add the default *CFCC* and *TYPE* values for the rest of the subtypes. The correct values are in the table below.

Subtype	CFCC default value	TYPE default value
Major Roads	**A31**	**Blvd**
Local Streets	**A41**	**St**
Access Ramps	**A63**	**Hwy**
Service Drives	**A64**	**Rd**
Alleys	**A73**	**Aly**

☐ When all the subtypes along with their default values for *CFCC* and *TYPE* fields have been defined, click *OK* on the *Feature Class Properties* dialog.

☐ Preview the *Geography* for the *Streets* feature class.

Do you notice something different? The street features are automatically displayed with a different symbol for each subtype. This makes it easy to distinguish features like Major Roads from Local Streets (you may need to zoom in to see this clearly in ArcCatalog).

Now that you have created the subtypes, you will complete the exercise by defining a couple of attribute domains.

STEP 2: CREATE A DOMAIN FOR AN ENTIRE ATTRIBUTE FIELD

A domain defines the valid values for a given attribute, which provides you with a powerful method for maintaining data integrity. If you create a new feature, attribute fields with a domain applied to them will have a restricted list of values that can be used. In this step, you will add a domain to the Redlands_GDB and associate it with the proper field. The domain you define will be the valid values for the Parcels LU_CODE attribute. Begin the process by examining the values for the LU_CODE field.

☐ In *ArcCatalog*, navigate to *C:\Student\igis2\REGIS\Redlands_GDB\LandRecords* feature dataset, and preview the *Parcels* feature class attribute table.

☐ Right-click on the top of the *LU_CODE* field and click *Sort Descending*.

☐ Scroll down the table and examine the different *LU_CODE* values.

Notice that many of the parcels have the same landuse code. In fact, although there are over 20,000 parcels, there are only 10 unique land use codes. Even so, it would be very easy for someone editing a parcel to type in an incorrect code value, such as AGRI instead of AGR for agriculture. Setting a domain for this field will solve this problem.

☐ Right-click the *Redlands_GDB* and click *Properties*.

> **NOTE:** Remember that domains are stored as a property of the geodatabase; subtypes as a property of a feature class or table.

☐ Click the *Domains* tab.

☐ Under *Domain Name*, click the first empty cell and type the name of your first domain, **`Landuse Codes`**

☐ Under *Description*, click in the first empty cell and type **`Landuse codes for Redlands parcels`**

☐ Under *Domain Properties*, for *Field Type*, click *Text* from the dropdown list of choices available. Remember that unlike subtypes, domains can be applied to different data types.

☐ For *Domain Type*, make sure that *Coded Values* is the displayed choice.

☐ For *Split Policy*, click *Duplicate* from the dropdown list of choices. This means that when a parcel is split, the resulting parcels will have the same *LU_CODE* value as the original.

☐ Under *Coded Values*, click the first code empty cell and type in the first landuse code, `000` (three zeros).

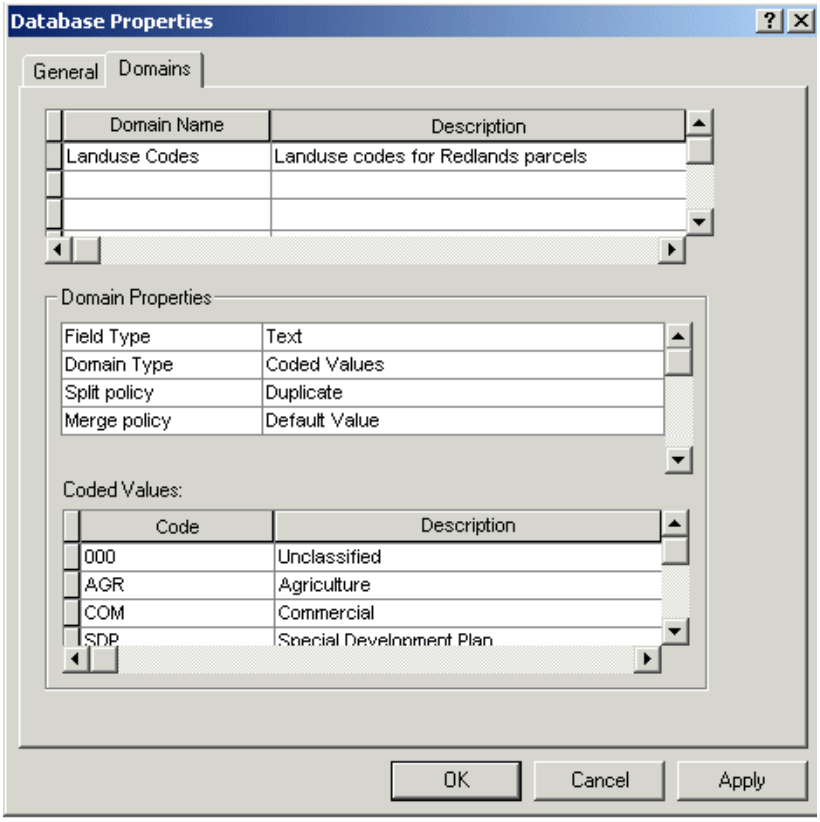
☐ For *Code Description*, type **`Unclassified`**

> **NOTE:** As with the subtypes, this description is important. This is what users will now see when they display the LU_CODE attribute values for the Parcels feature class. Therefore, the descriptions should be concise and intuitive.

☐ Continue to add the rest of the landuse codes and their descriptions, which are provided in the table below.

Landuse Code	Description
AGR	Agriculture
COM	Commercial
SDP	Special Development Plan
IND	Industrial
INS	Institutional
OS	Open Space
RES	Residential
TNS	Transitional
VAC	Vacant

☐ When finished, the *Database Properties* dialog should look like the graphic below (the dialog cannot display every code that you entered).



☐ Click *OK* to save the *Landuse Codes* domain information.

Now that you have defined the domain, you will associate it with the LU_CODE field in the Parcels feature class. You will also define the default value for the LU_CODE field.

☐ Right-click the *Parcels* feature class and click *Properties*.

☐ On the *Feature Class Properties* dialog, click the *Fields* tab.

☐ In the *Field Name* column, click the *LU_CODE* field. Notice the *Field Properties* for *LU_CODE* appear in the bottom portion of the dialog.

☐ Under *Field Properties*, click the empty cell next to *Default Value* and type `000` (three zeros).

☐ Click in the empty cell next to *Domain*, and click *Landuse Codes* from the dropdown list.

> **NOTE:** In this example, you have only created one domain, so it is the only one listed. If your geodatabase has many domains, the only ones listed will be those with the same data field type as the attribute you have selected.

☐ Click *OK* on the *Feature Class Properties* dialog.

In this step, you defined a domain for all of the valid values for the LU_CODE field. You then associated the domain with the LU_CODE field and set the field's default value.

In the next step, you will define one more coded value domain, but instead of associating the domain to an entire field, you will associate it with one of the subtypes you created for the Streets feature class.

STEP 3: CREATE A DOMAIN FOR ONE OF THE STREETS FEATURE CLASS SUBTYPES

You have now created a domain, or list of valid values, and assigned them to an entire field (LU_CODE has 10 possible codes). It is possible to apply different domains to subtypes within the same feature class. For example, the Streets feature class has six different subtypes which are general classifications of the road features (Major Roads, Local Streets, etc.). However, the Streets feature class table also contains a TYPE text field that stores the official street type (ST, AVE, HWY, etc.). Using domains, it is possible to define the valid TYPE values for each street subtype. For example, you can prohibit someone from assigning a TYPE value of HWY to a street with the Local Streets subtype. To save time, you will create only one domain for the Local Streets subtype.

☐ In *ArcCatalog*, navigate to *C:\Student\igis2\REGIS\Redlands_GDB\Transportation* feature dataset, right-click on the *Streets* feature class, and click *Properties*.

☐ In the *Feature Class Properties* dialog, click the *Subtypes* tab.

☐ Click the *Domains* button in the bottom right-hand corner.

Notice that the Landuse Codes domain is listed, which confirms that a domain is a property of the entire geodatabase.

☐ Click the first empty cell in the *Domain Name* column (directly under *Landuse Codes*), and type **`Local Types`**

☐ For *Description*, type **`Type codes for local streets`**

☐ Under *Domain Properties*, for *Field Type,* click *Text* from the dropdown list of choices.

☐ For *Domain Type*, make sure that *Coded Values* is the displayed choice.

☐ Accept the *Split* and *Merge Policy* default values.

☐ Under *Coded Values*, click the first empty cell in the *Code* column, and type **`St`**

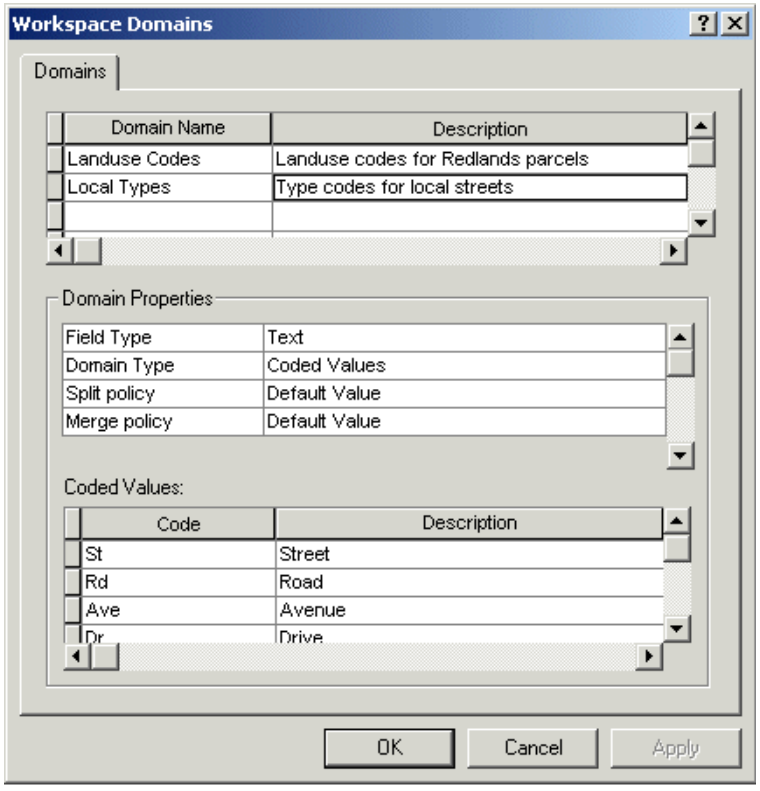
☐ For the *Description*, type **`Street`**

☐ Continue to add the rest of the *Local Streets* codes and their descriptions, which are provided in the table below.

Local Streets code	Description
`Rd`	`Road`
`Ave`	`Avenue`
`Dr`	`Drive`
`Ct`	`Court`

☐ Click *Apply*.

The Workspace Domains dialog should now look like the graphic below.

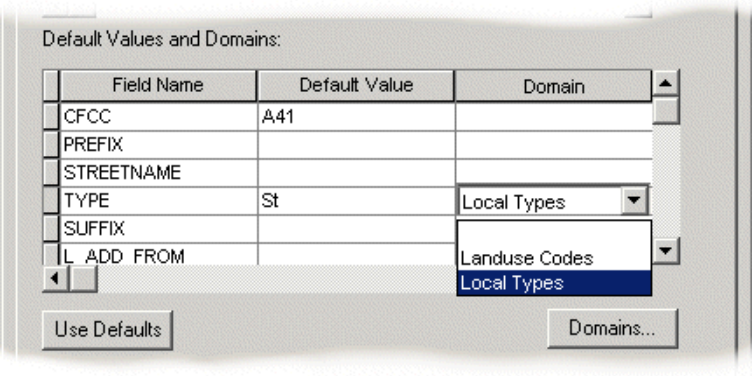


☐ Click *OK* to close the *Workspace Domains* dialog.

Now that the domain is defined, you can associate it with the appropriate street subtype.

☐ On the *Subtypes* tab of the *Feature Class Properties* dialog, click the button to the left of *Code 3 - Local Streets* to highlight the entire subtype row.

☐ Under *Default Values and Domains*, click in the *Domain* cell for the *TYPE* field and select the *Local Types* domain.



☐ Click *OK* on the *Feature Class Properties* dialog.

So far, you have created subtypes for the Streets feature class, one domain for the Parcels LU_CODE field, and one domain for the Local Streets subtype TYPE field. You have applied one domain to a field in an attribute table, and one domain to a subtype field.

STEP 4: EXAMINING YOUR SUBTYPES AND DOMAINS

In the final step of this exercise, you will see how the fields in your feature classes use these subtypes and domains. In the next exercise, you will see how these changes will pay off in terms of easier data maintenance.

☐ Start *ArcMap* and create *A new empty map*.

☐ Add the *Parcels* feature class from the *Redlands_GDB* geodatabase > *LandRecords* feature dataset.

Remember that in a previous step, you created the Landuse Codes domain and associated it to the LU_CODE field in the Parcels feature class. Now every parcel will be restricted to one of these valid values.

☐ If the *Editor* toolbar is not visible, click *View* > *Toolbars* > *Editor*.

☐ Click *Editor* > *Start Editing.*

☐ Using the *Edit Tool*  , select any parcel from the *Parcels* feature class.

☐ Click the *Attributes* button  .

☐ Click the *Value* for *LU_CODE*.

Notice that the list of valid values is displayed for the LU_CODE field. Every parcel that you edit and every new parcel you create will be restricted to one of these values for the LU_CODE field. Having the domain set up on this field will allow you to maintain your database more efficiently.

☐ Close the *Attribute* window.

☐ Click *Editor* > *Stop Editing*.

☐ If prompted to save your edits, click *No*.

☐ Exit *ArcMap*. Do not save changes to the map.

EXERCISE END

EXERCISE 8B: SPATIAL VALIDATION

In this exercise, you will learn how to build a topology in a geodatabase. Using a topology will help you maintain the spatial integrity of your data sets. You will work with topology in an edit session where you will practice simple error fixes. Rules that you will explore include: Must Not Overlap (for the Parcels feature class) and Must Not Have Dangles (for the Streets feature class). You will also learn how to set Exceptions for features that violate your rules (cul-de-sacs for Streets). The feature classes you will be using are Parcels and Streets. They are stored in the LandRecords and Transportation feature datasets respectively. In this exercise, you will create a topology for each of these feature datasets.

STEP 1: CREATE A TOPOLOGY FOR THE PARCELS

A geodatabase topology can only be created within a feature dataset. Not all of the feature classes in the feature dataset have to participate in the topology. You can set topology rules between feature classes, and also between subtypes within one feature class. In this step, you will create a new topology for the polygons in the Parcels feature class.

☐ In *ArcCatalog*, navigate to *C:\Student\igis2\REGIS\Redlands_GDB* geodatabase.

☐ Right-click on the *LandRecords* feature dataset and click *New* > *Topology* to launch the *New Topology* wizard.

☐ After reading the introduction panel, click *Next*.

☐ For the name of the topology, enter **`Parcels_Topology`**

> **NOTE:** The name of your topology cannot contain spaces.

A cluster tolerance value has been calculated for this data. This value must be very small to limit the movement of your vertices.

☐ For the *Cluster tolerance*, accept the default and click *Next*.

☐ Check the **`Parcels`** checkbox to enable this feature class to participate in the topology and click *Next*.

☐ Accept the default of `5` for *Number of Ranks* and `1` for the *Parcels* feature class *Rank*. Click *Next*.

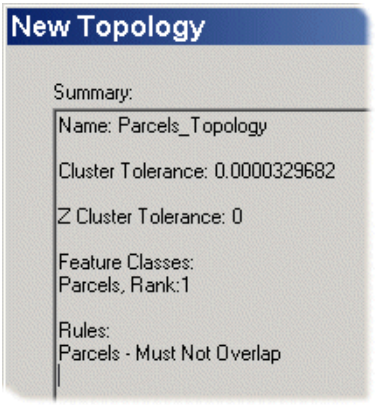
Now you will set the Must Not Overlap rule.

☐ Click *Add Rule*.

☐ Confirm that the *Rule* is set to **`Parcels Must Not Overlap`** and click *OK*.

☐ Click *Next.*

☐ Confirm the summary information on the *New Topology* panel matches the graphic at right.



☐ Click *Finish*.

☐ Click *No* when prompted to validate the new topology. You will validate the new topology in the next step.

☐ Note that the topology has been added to the *LandRecords* feature dataset.

STEP 2: VIEW THE PROPERTIES OF THE PARCELS TOPOLOGY

In this step, you will view the properties of the topology, validate the topology, and create a list of errors.

☐ In the *ArcCatalog Tree*, and under *LandRecords,* preview the *Parcels_Topology.*

The *Preview* tab in ArcCatalog shows a blue-hatched rectangle, this is the *Dirty Area* and it shows you the extent of the area of the topology that has not been validated. Because you haven't validated the topology yet, the entire extent of the Parcels feature class is seen as a Dirty Area.

☐ Right-click on *Parcels_Topology* and click *Properties*.

☐ If necessary, click the *General* tab.

The General tab allows you to change the name, cluster tolerance, or both for the topology.

> **NOTE:** If you change any properties of the topology, the name, cluster tolerance, feature classes, or any of the rules, the entire extent of the data will be covered in dirty areas and you will need to revalidate.

☐ Notice that the *Status* of the topology is *Not Validated*. This means that there are dirty areas covering the topology. These areas must be validated to determine if there are any rule violations.

☐ Click the *Feature Classes* tab.

The Feature Classes tab allows you to add or remove feature classes from the topology. You can also change the x,y and z ranks for your feature classes.

> **NOTE:** The *Z Properties* button will only become active when you have a feature class which contains Z (elevation) values within the feature geometry.

☐ Click the *Rules* tab.

You can add and remove topology rules using this tab.

☐ Double-click on the *Must Not Overlap* rule.

For each rule you can get a detailed description of the spatial relationships that the rule will validate.

☐ Examine what happens if you uncheck and recheck the *Show Errors* check box.

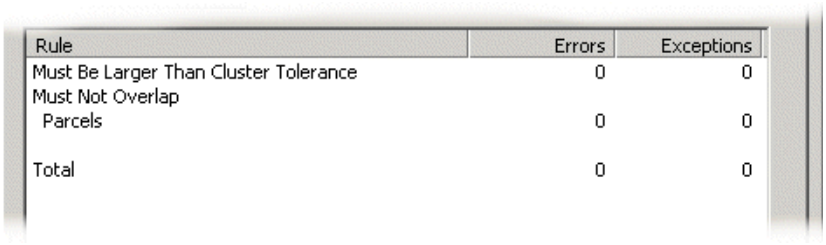
☐ Click *OK*.

You can save your rules out to a file, or load them from one already created. When you load the saved rules from a file, you are prompted to map the names of the feature classes that participated in the saved topology to the names of the feature classes in your new topology.

☐ Click the *Errors* tab.

The Errors tab allows you to generate a list of all the errors and exceptions currently in your topology.

☐ Click *Generate Summary.*



Rule	Errors	Exceptions
Must Be Larger Than Cluster Tolerance	0	0
Must Not Overlap		
Parcels	0	0
Total	0	0

Although you did not set the Must Be Larger Than Cluster Tolerance rule yourself in this exercise, it appears in the Errors list because ArcCatalog automatically adds this rule. Once you have validated the topology you will discover if there are any features whose sizes are smaller than the cluster tolerance (remember how small the cluster tolerance is for the Parcel_Topology), which you will decide to delete, leave, or mark as an exception.

When you generate a summary of the errors and exceptions, only discovered Errors and marked Exceptions are listed. Because you have not yet validated this topology, nor made any edits to mark exceptions, ArcGIS has no way of knowing if there are any errors in the topology and reports zero for all rules.

☐ Click *OK* to close the *Topology Properties* dialog.

☐ Right-click *Parcels_Topology* and click *Validate*. The validation may take a while.

☐ Click *OK* on the *Validate* message.

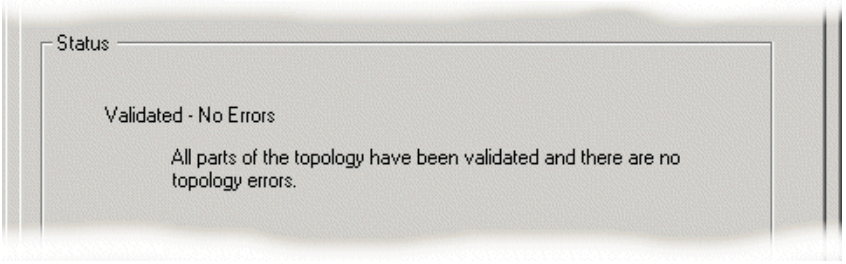
☐ Select the *LandRecords* feature dataset, and click *View* > *Refresh*.

☐ Preview the *Parcels_Topology* topology.

The Preview is blank. The blue-hatched rectangle has disappeared, indicating that there are no violations to the topology rule you assigned.

☐ Display the properties for *Parcels_Topology.*

☐ Click the *General* tab.



Notice that the state is now Validated - No Errors. This tells you that there are no dirty areas left to validate in the topology and no errors exist. You can use the Generate Summary button on the Errors tab to get a specific list of the errors that were found.

☐ On the *Errors* tab, click *Generate Summary.*

Notice that nothing has changed since you last viewed this dialog because no errors were found. To keep a permanent record of this report, you could click the Export To File button and save these errors in a text file. If any errors were found, you would need to fix them in ArcMap.

☐ Click *OK* to close the *Topology Properties* dialog.

You have just learned how to create and validate a topology for a feature dataset. You also learned how to generate a list of errors that might be found during validation. You discovered that this data did not violate the topology rule you set. However, in the next step, you will see that a different data set will violate a topology rule.

STEP 3: CREATE A TOPOLOGY FOR THE STREETS

In this step, you will create a new topology for the Streets feature class in the Transportation feature dataset. You will apply the Must Not Have Dangles rule. This rule will check for overshoots or undershoots of lines that may have occurred while digitizing. When validating this topology, you will see that there are a large number of errors which violate the Must Not Have Dangles rule. However, most of these errors represent cul-de-sacs, which you will mark as exceptions.

☐ In *ArcCatalog*, navigate to the *C:\Student\igis2\REGIS\Redlands_GDB* geodatabase.

☐ Right-click on the *Transportation* feature dataset and click *New* > *Topology*.

☐ Click *Next* on the introduction panel.

☐ For the name of the topology, enter **`Streets_Topology`**

☐ For the cluster tolerance, accept the default and click *Next*.

☐ Check the **`Streets`** checkbox to enable this feature class to participate in the topology and click *Next*.

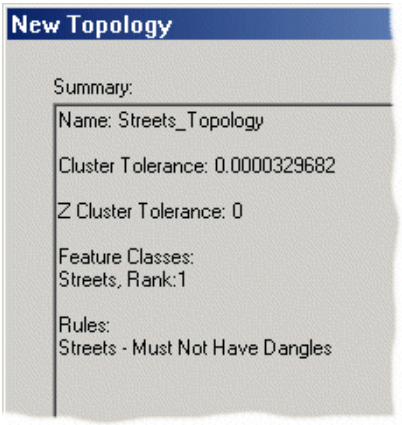
☐ Accept the default of `5` for *Number of Ranks* and `1` for the *Streets* feature class *Rank*. Click *Next*.

☐ Click *Add Rule*.

☐ Set *Rule*: **`Streets Must Not Have Dangles`**

☐ Click *OK*.

☐ Click *Next*, and confirm the *New Topology Summary* information matches the graphic below.



☐ Click *Finish*.

☐ Click *No* on the *New Topology* message box, because you will validate the new topology in the next step.

STEP 4: VIEW THE PROPERTIES OF THE STREETS TOPOLOGY

In this step, you will view the properties of the topology, validate the topology, and create a list of errors.

☐ Under *Transportation*, preview the *Streets_Topology*.

Notice that the Preview tab in ArcCatalog shows a blue-hatched rectangle indicating that the topology has not been validated.

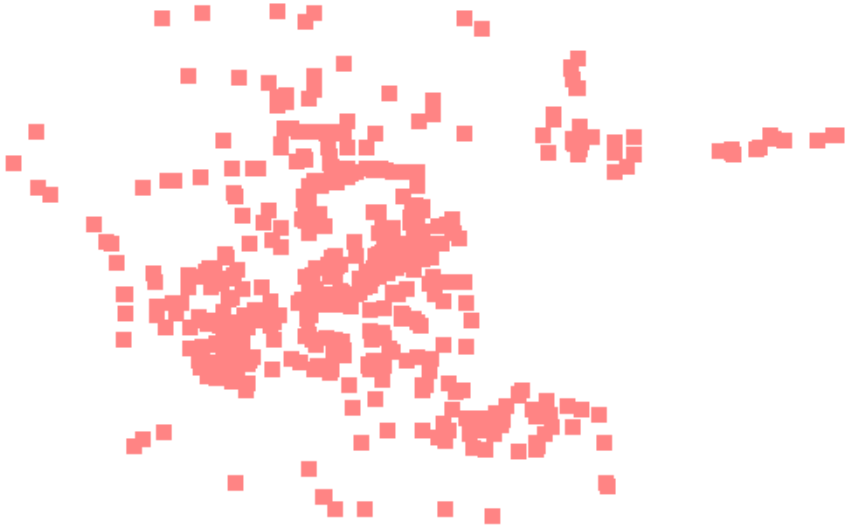
☐ Right-click *Streets_Topology* and click *Validate*. This operation may take a while.

☐ Click *OK* on the *Validate* message.

☐ Right-click the *Transportation* feature dataset and click *Refresh*.

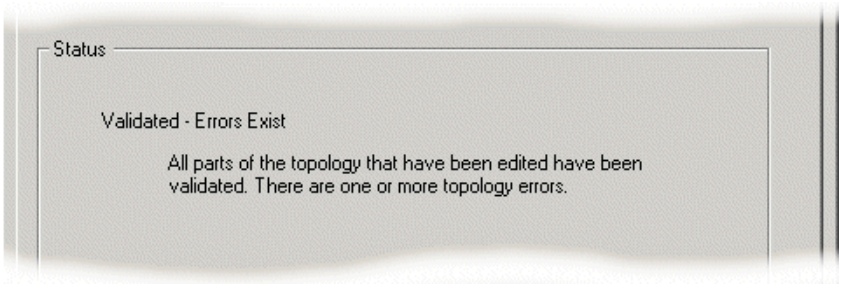
☐ Click on *Streets_Topology* > *Preview* tab.

The blue-hatched Dirty Area rectangle has been replaced with red dots which indicate violations to the Must Not Have Dangles rule.



☐ Display the properties for *Streets_Topology*.

☐ Click the *General* tab.



Notice that the Status is now Validated - Errors Exist. This tells you that there are no dirty areas left to validate in the topology and all the current errors were found. You can use the Generate Summary button on the Errors tab to get a specific list of the errors that were found.

☐ On the *Errors* tab, click the *Generate Summary* button.

Notice that all of the errors are dangle errors. You will fix them later in ArcMap.

☐ Close the *Topology Properties* dialog.

☐ Exit *ArcCatalog*.

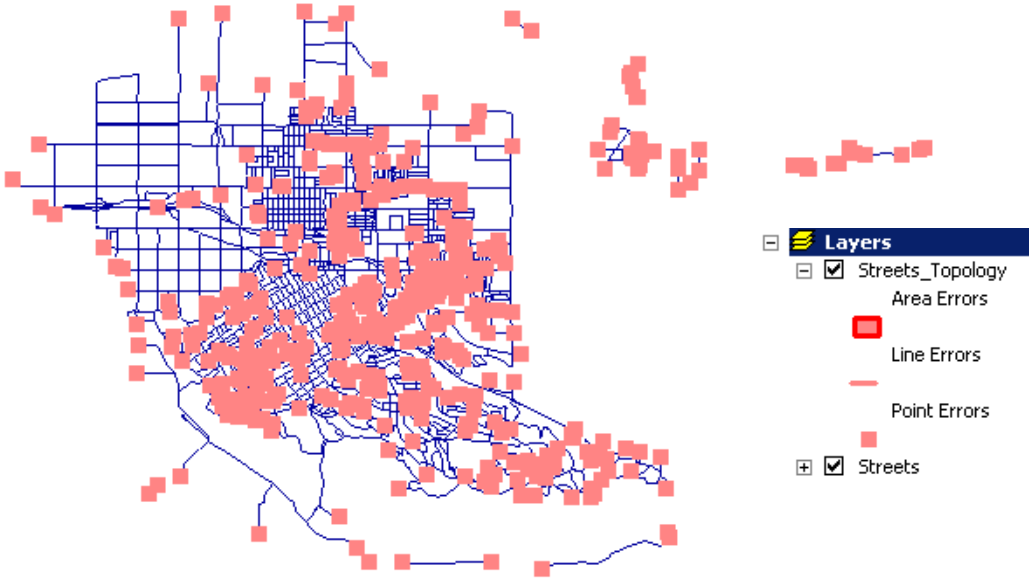
You have just discovered that the topology rule for the Streets has been violated, and that the Streets feature class has dangle errors. In the next step, you will learn how to manage errors.

STEP 5: WORK WITH THE RULES AND ERRORS IN ARCMAP

In this step, you will add your topology to a map and query your errors to get a better idea of what is happening in the topology. You will then be able to better decide which topology errors will be marked as exceptions, and which will need to be fixed.

☐ Start *ArcMap*, using *An existing map*.

☐ Browse to *C:\Student\igis2\MapDocuments* and open *StreetsTopo.mxd*.



NOTE: Although you created subtypes for the Streets feature class, this map document displays the streets using a uniform symbol.

Notice that there is a layer for the topology itself. The topology layer contains symbology for the three types of special features contained within a topology: Errors, Exceptions, and Dirty Areas. By default, only the Errors are shown in the Table of Contents.

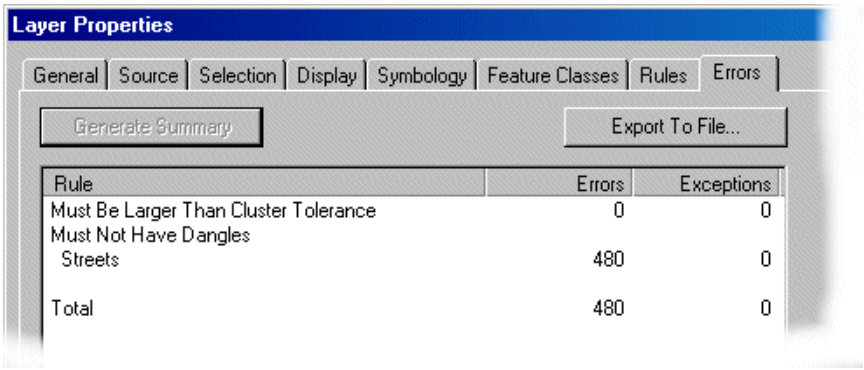
NOTE: The Topology has properties like any other layer. The *Symbology* tab allows you to add Exceptions and Dirty Areas to the ArcMap Table of Contents, and to assign a unique symbol to each rule violation.

Because the Exceptions or Dirty Areas are not checked at this point, you only see a list of Errors. The geometry for the Error and Exception features can be point, line, or polygon, depending on the rule and feature geometries involved. The geometry of the Dirty Areas is always polygon, because it represents the extent of the topology features that have not been validated.

☐ Open the *Layer Properties* for the *Streets_Topology* layer.

☐ Click the *Errors* tab.

☐ Click *Generate Summary*.



Notice the number of errors that you have for each rule.

Question 1: How many errors are in the topology? _____

Question 2: Which rules are being violated? _____

_____

☐ Click OK to close the *Layer Properties*.

In this step, you used the Errors tab to find out which rules were violated and how many errors were discovered. You will use this information during editing to fix the features that have the most errors first.

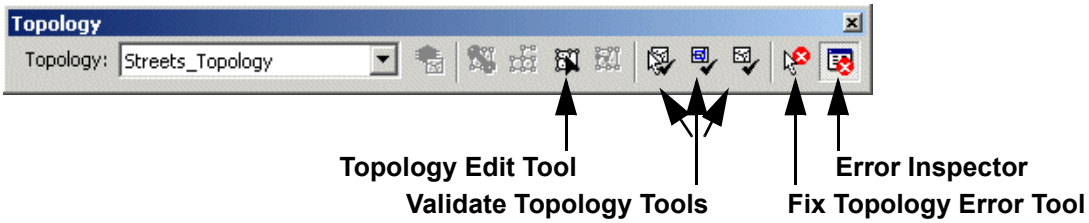
STEP 6: CLEAN UP THE DANGLES

Once you have determined what types of errors you have, you can begin to figure out how to fix them. In this step, you will fix all of the undershoots. This will actually resolve most of the errors in the topology.

☐ If necessary, add the *Editor Toolbar*.

☐ From the *Editor* menu, click *Start Editing*.

☐ From the *Editor* menu, click *More Editing Tools* > *Topology* to add the Topology toolbar.

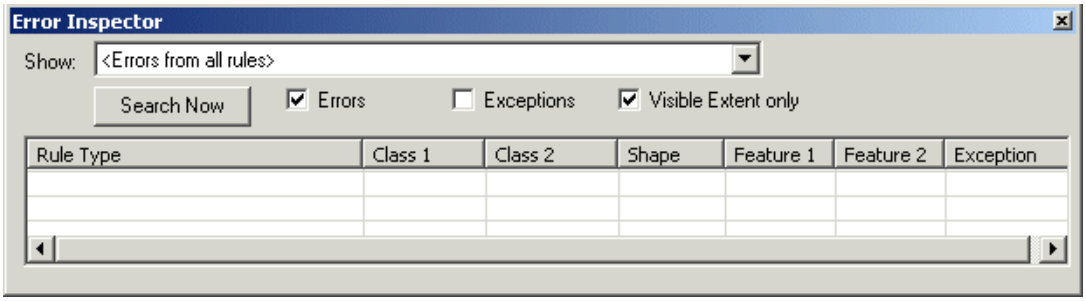


The Topology toolbar has two tools for finding and fixing topology errors:

- The *Error Inspector* allows you to search for errors and exceptions by category and extent.
- The *Fix Topology Error Tool* allows you to select errors in the map and right-click on them to apply one of the standard fixes.

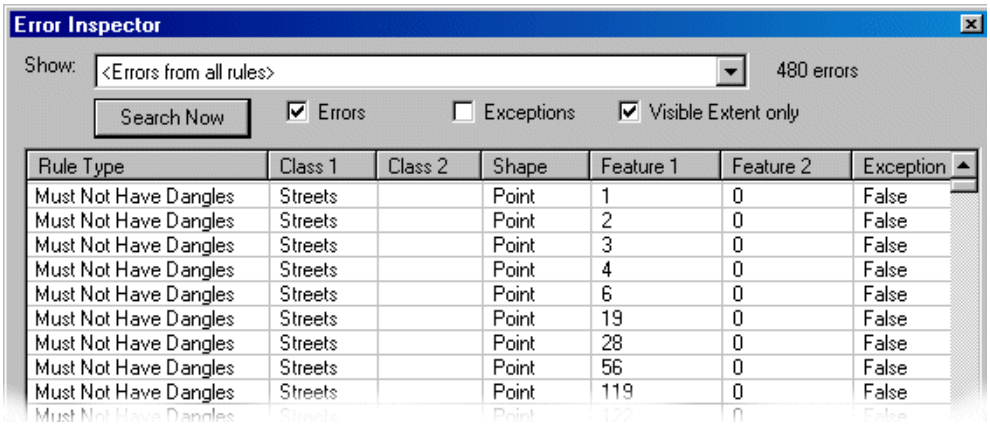
First, you will use the *Error Inspector* to get a list of all the errors.

☐ Click the *Error Inspector* button .



☐ If necessary, dock the *Error Inspector* on the ArcMap interface. You may need to expand it to see its full contents.

☐ Click *Search Now*, to get a list of all the errors that are being violated.



NOTE: You can adjust the Error Inspector column widths.

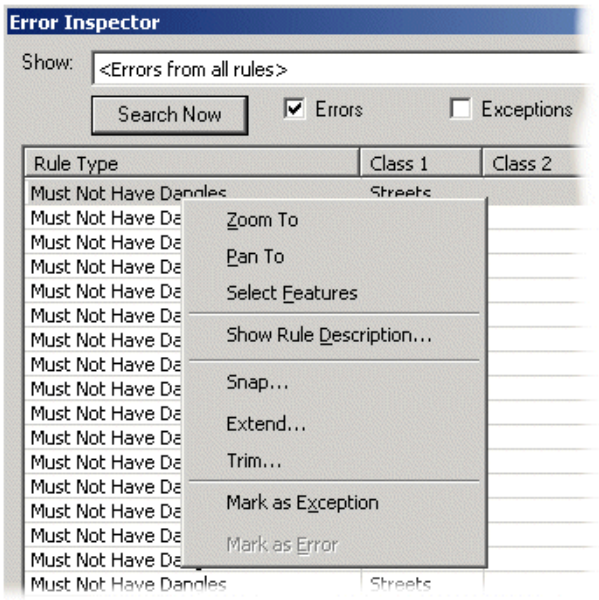
You would see different error types listed here if you had included more topology rules for this particular feature dataset. In this case only one error, Must Not Have Dangles, is listed.

NOTE: If you have more than one rule, you might want to limit your search to just a certain kind of error. You can do this by clicking the type of error in the Show dropdown list.

Notice that 480 errors were found. This number appears to the right of the Show dropdown list. Also notice the values under the Exception column, on the extreme right. They are all False, i.e., at this moment they are all considered to be errors.

☐ Click on several errors in the *Error Inspector,* and notice that as you click, the selected error turns black in the map.

☐ Right-click on the first error in the list.



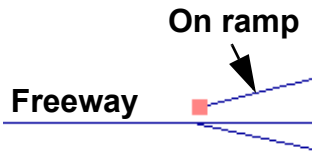
Notice the different options. You can fix some errors with Extend and Trim, or you can Mark as Exception.

Except one, none of these are real errors. These lines represent actual cul-de-sacs (dead-end streets), or are the street ends that were clipped to the Redlands city boundary. However, they will violate the Must Not Have Dangles rule until you mark them as exceptions. You will now correct the true dangle error and set the others as exceptions to the rule. A bookmark to the error has been created so you do not need to visually inspect all the errors.

☐ Click *View* > *Bookmarks* > *OnRamp Error.*

There is a dangle error where the on and off ramps converge on the freeway. This error probably occurred when the data was originally digitized. The on-ramp to the freeway does not connect and needs to be corrected. You will use the Error Inspector to search for this error.

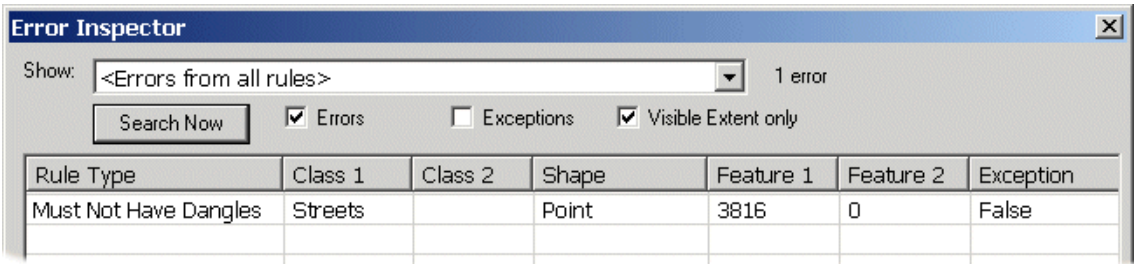
☐ Zoom in on the error so that you can see the gap where the on-ramp does not meet the freeway.



☐ On the *Error Inspector,* verify that the check box for the *Visible Extent only* is checked.

☐ Click *Search Now.*

The Error Inspector updates and only the one error is listed. The on-ramp needs to be extended to meet the freeway.



☐ Right-click on the error listed in the *Error Inspector* and click *Extend*.

For *Maximum Distance*, you will type in a value greater than the actual distance needed to ensure that the ramp line will snap to the freeway. In this example, the ramp needs to be extended about 6 meters.

☐ Type `10`, and press *Enter* on the keyboard.

The on-ramp extends to snap to the freeway and the error has been removed from the the Error Inspector. Now you will mark the rest of the streets as exceptions.

☐ Click on *Full Extent* on the *Tools* toolbar so you can see all the street features.

☐ On the Error Inspector, click *Search Now.*

☐ Click on the first error row listed in the *Error Inspector* to select it.

☐ Press *Shift* on the keyboard, scroll down, and click the last error row to select the entire list.

☐ Right-click anywhere on the selected errors in the *Error Inspector* and click *Mark as Exception*.

All the errors are cleared from the ArcMap display and removed from the Error Inspector. Once you fix errors, you need to validate to make sure your fixes did not violate any other rules.

☐ On the *Topology* toolbar, click *Validate Entire Topology* .

☐ Click *Yes* to validate the full extent of the topology.

Notice that even though you are validating the entire topology, this validate operation takes much less time than the original validation. This validation is faster because it is only processing the dirty area generated by your edit of the ramp feature. The original validation had to process all the features in the topology.

☐ In the *Error Inspector*, for *Show*, click *<Errors from all rules>*.

☐ Click *Search Now*.

There are no errors in the topology.

☐ Stop editing and save your edits.

☐ Exit *ArcMap* without saving the changes to the *StreetsTopo.mxd*.

You have just learned how to fix dangle errors using the topology rules. This is an introductory example of the edits and error management that can be done with topology rules.

EXERCISE END

ANSWERS TO EXERCISE 8B QUESTIONS

Question 1: How many errors are in the topology?

Answer: 480

Question 2: Which rules are being violated?

Answer: The Must Not Have Dangles rule

9

Editing spatial and attribute data

contents

EXERCISE 9: EDITING FEATURES AND ATTRIBUTES

In the previous exercises, you added new data to the Redlands_GDB geodatabase, and you applied validation rules by creating subtypes, defining domains and specifying topology rules. However, a lot of work still remains before the Redlands_GDB geodatabase is ready to be used in GIS applications. Many of the existing layers need to be updated to reflect changes that have taken place since they were created. Fortunately, the ArcMap application offers the tools you need to accomplish these editing tasks.

STEP 1: ADD FEATURES TO AN EXISTING DATA LAYER

The Parcels feature class in the Redlands_GDB geodatabase contains over 20,000 separate parcels. Some of those parcels have recently been subdivided and sold to various interests. You need to edit the Parcels feature class to reflect these changes.

☐ Start *ArcMap* and choose to open *An existing map*.

☐ Navigate to the *C:\Student\igis2\MapDocuments* folder, and double-click *Ex9_Features.mxd*.

This map document contains the Parcels and Parcels_Topology layers. It is important to include the Parcels_Topology layer while editing the parcels as you will want to discover, display, and correct any topology errors that might occur while editing the data. In Exercise 8, you created the Parcels_Topology and applied the rule that features Must Not Overlap, meaning one parcel can not overlap another parcel. To achieve this, adjacent parcels must have coincident boundaries. When you edit the Parcels layer, you will use tools on both the Editor and Topology toolbars to edit and maintain this topology rule.

You will edit the Parcels layer first. A bookmark has been prepared to automatically zoom to the location of the parcels you will edit.

☐ Click *View* > *Bookmarks* > *Cutpoly1*.

This bookmark displays a portion of the Parcels feature class, labeled with their LU_CODE values. It is important to realize that the labels are actually the descriptions you created for the Landuse Codes domain; this is why you took care to create meaningful descriptions.

The large, square parcels in the display need to be edited to reflect recent subdivisions. Before you begin editing, you will adjust the symbology for the Parcels_Topology layer to include symbols for Dirty Areas. This will allow you to visually identify areas that have been edited and need to be validated.

☐ Right-click on the *Parcels_Topology* layer and click *Properties*.

☐ Click on the *Symbology* tab.

☐ For *Show*, check the *Dirty Areas* checkbox.

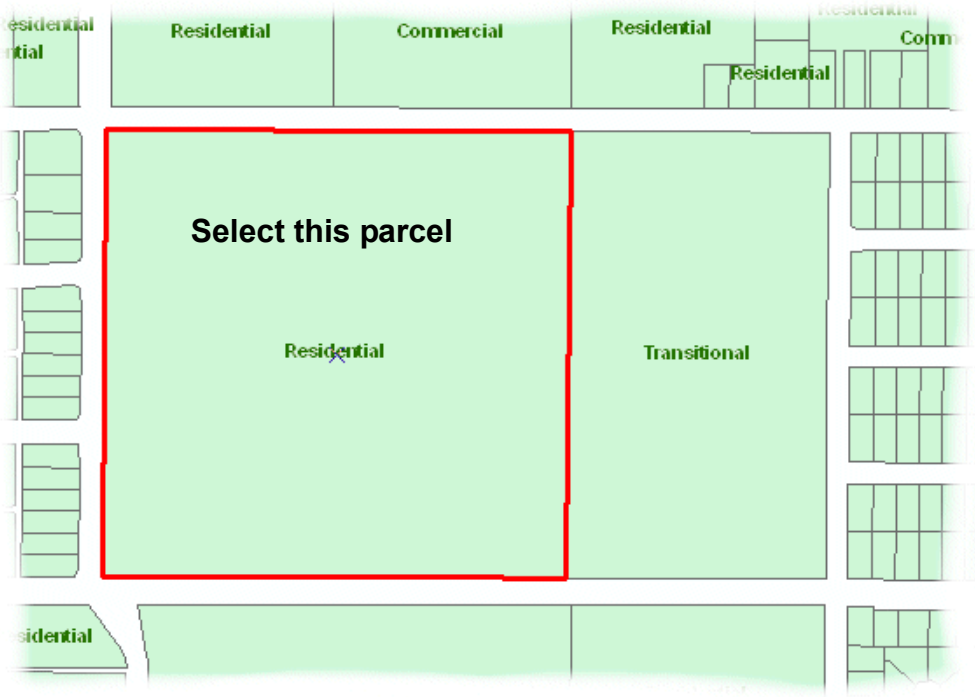
☐ Click *OK* to close the *Layer Properties* dialog.

This parcel needs to be divided down the center into two parts. You will use the Cut Polygon Features task in conjuction with the Snap to Feature command to divide this parcel.

☐ Click *Editor* > *Start editing*.

☐ Click the *Edit Tool*  .

☐ Select the first parcel to edit as shown in the graphic below.

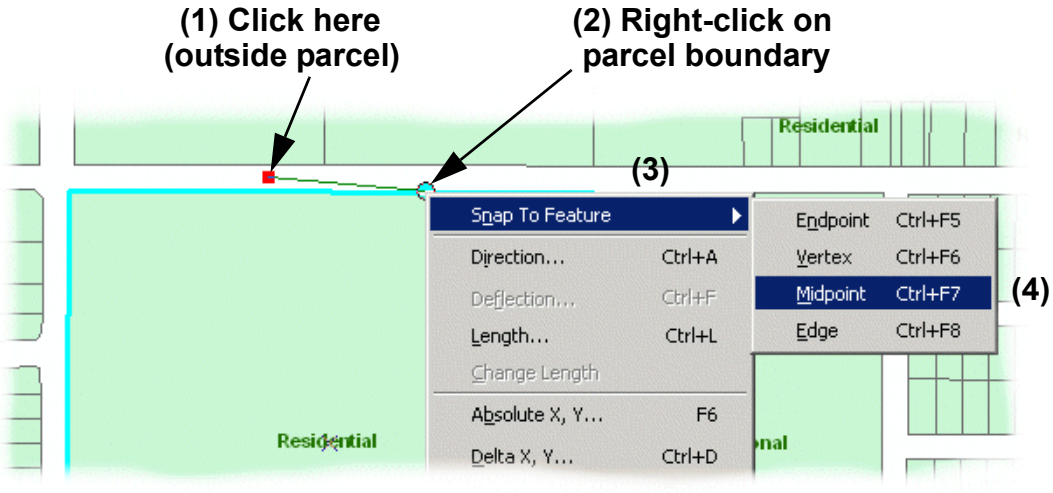


☐ For the edit *Task*, click *Modify Tasks* > *Cut Polygon Features*.

☐ Confirm that the *Target* layer is set to *Parcels*.

Next, you will cut the selected parcel to create two new parcels. The Cut Polygon Features task requires that your sketch crosses the outside boundaries of the polygon. You will start the sketch on the outside of the parcel and then use the Snap to Feature command on the Sketch Tool context menu to snap to the midpoint of the parcel boundary.

☐ Click the *Sketch Tool* and click on the outside of the northern boundary to place the first vertex of the sketch.

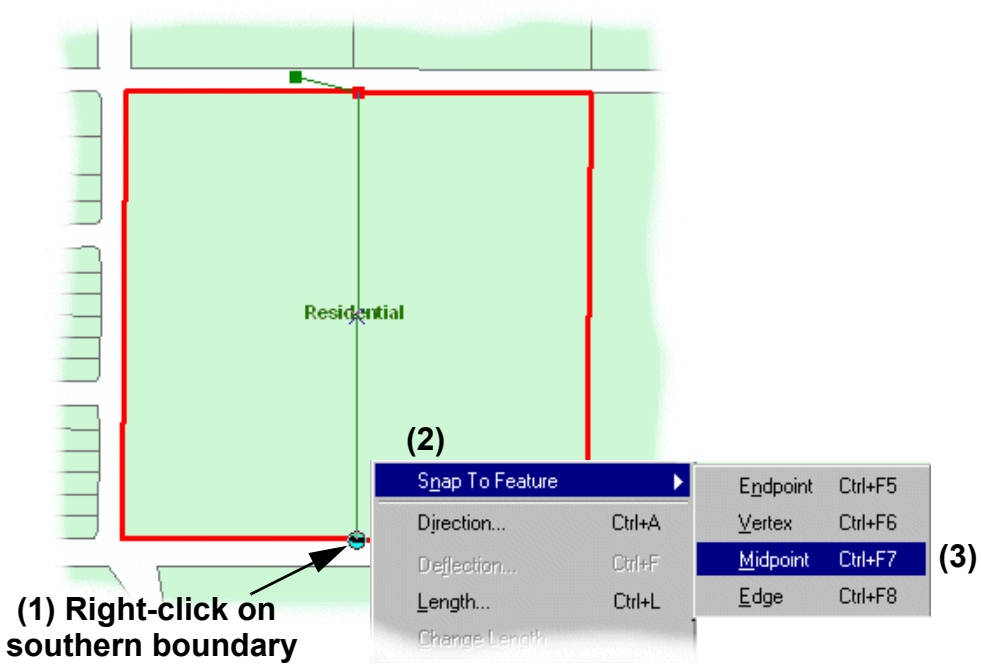


☐ Right-click over the northern boundary of the parcel and click *Snap to Feature* > *Midpoint.*

> **NOTE:** You have not set the snapping environment for this edit session, therefore you will need to be precise with your cursor placement for these sketch vertices. The *Snap To Feature* operation will ensure feature coincidence for you.

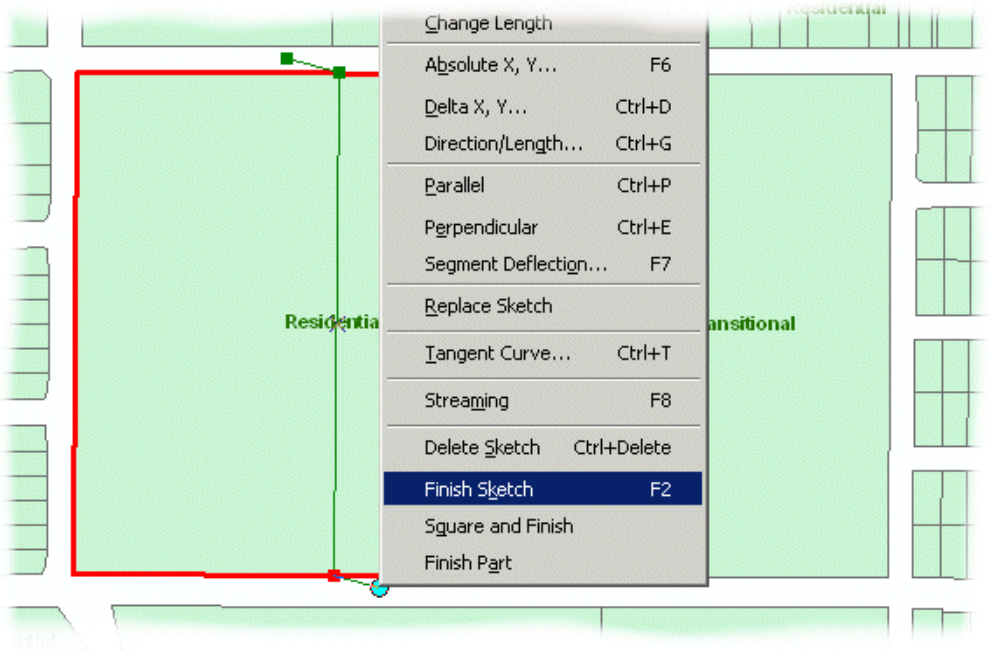
ArcMap will automatically place a new sketch vertex at the midpoint of the selected feature.

☐ Right-click over the southern boundary of the parcel and click *Snap to Feature* > *Midpoint.*

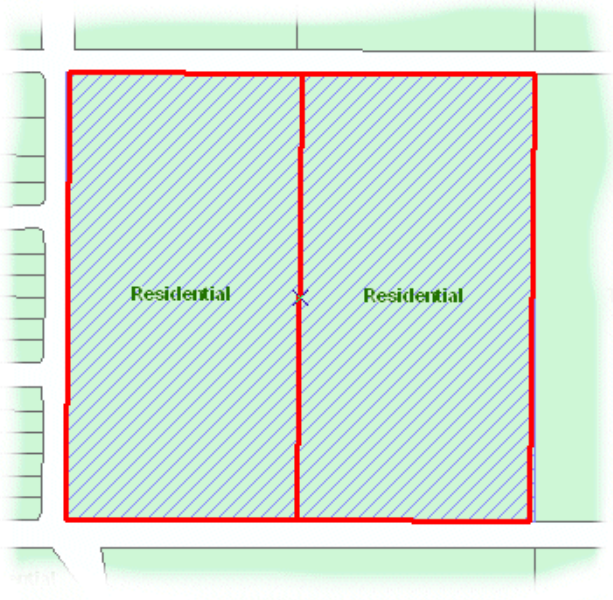


NOTE: Midpoint location is between two vertices. You have already observed where these vertices are for this parcel.

☐ Move the pointer to the outside of the parcel, right-click, and click Finish Sketch.



The single parcel is now divided into two and the area over the entire cut parcel has been symbolized as a Dirty Area.



Dirty Areas are regions in the topology that have been edited since the last time they were validated. You can verify that the two parcels are separate by selecting one and moving it. It will be independent of its neighbor. Remember to click the Undo button to return the parcel to its original location. Next, you will validate the topology.

☐ On the *Topology* toolbar, click *Validate Entire Topology* .

☐ Click *Yes* on the *Validate Topology* window.

☐ If necessary, click *Selection* > *Clear Selected Features*.

The Dirty Area disappears and no errors were found. The Cut Polygon Features task created two perfectly coincident boundaries for the new parcels.

Notice also that the two parcels resulting from this split both have an LU_CODE value of Residential. You may recall that in the last exercise, you set the split policy for the Landuse Codes domain to Duplicate Value. This means that when you split the parcel, the resulting parcel subdivisions received the same LU_CODE value as the original.

In this step, you learned how to divide existing polygon features. In the next step, you will learn how to create new polygons that are adjacent to existing ones.

STEP 2: CREATE ADJACENT POLYGONS

Polygons in a geodatabase are stored as simple shapes, which means that the borders between the parcels in your map are actually coincident, individual lines, not one line shared between two features.

This issue presents a challenge when you want to add a new polygon that is adjacent to one or several existing polygons. How do you add the borders so that you are sure that they are coincident with the neighboring polygons? ArcMap contains an edit task specifically for this purpose.

☐ In *ArcMap*, click *View* > *Bookmarks* > *autocomplete1*.

This bookmark displays a close up view of a location where you will digitize in a new parcel. The new parcel will share a boundary with several existing parcels.

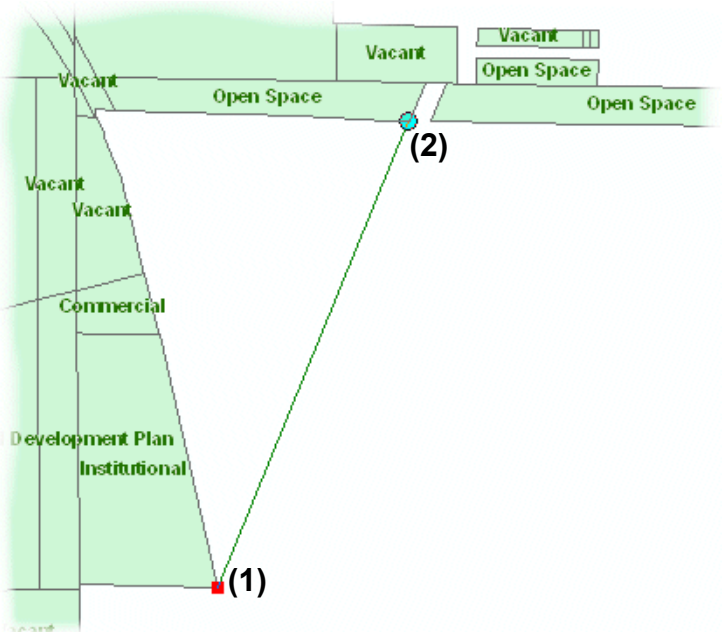
☐ On the *Editing* toolbar, for edit *Task*, click *Topology Tasks* > *Auto-Complete Polygon*.

☐ Click *Editor* > *Snapping*.

☐ In the *Snapping Environment* window, check *Vertex* snapping for the *Parcels* layer.

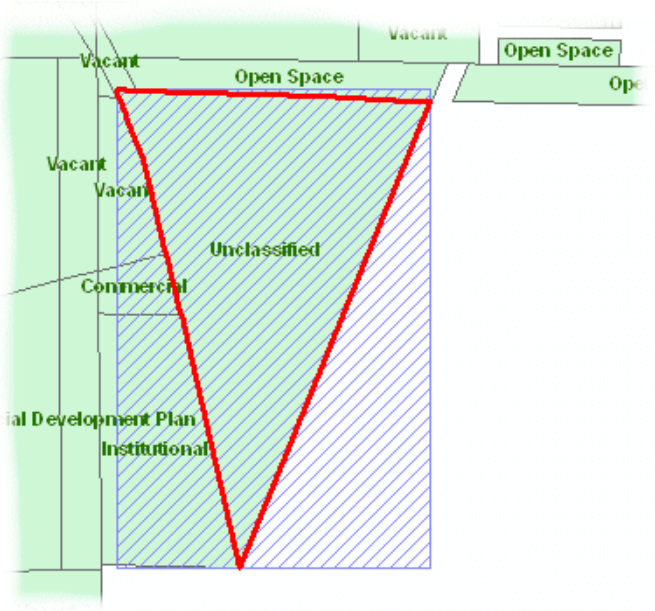
☐ Close the *Snapping Environment* window.

☐ Click the *Sketch Tool* and digitize one line connecting two parcels as shown in the graphic below.



☐ Double-click to finish the sketch.

The new parcel has been added and the area is covered by a Dirty Area. Notice that the LU_CODE Unclassified is assigned to the new polygon. This is the default value you assigned in the previous exercise.



☐ Use the *Edit Tool* to select the new *Unclassified* parcel and drag it slightly to the right.

Notice how the Auto-Complete Polygon edit task automatically created the coincident boundaries between the new parcel and the adjacent ones without your having to digitize them.

☐ Click *Undo* to undo the parcel move.

You will now validate the topology in the current extent because the Dirty Area is within the current extent on your display.

☐ On the *Topology* toolbar, click *Validate Topology In Current Extent* .

The Auto-Complete Polygon task has created coincident boundaries between the parcels and no errors were found.

☐ Click *Editor* > *Save Edits*.

☐ If necessary, click *Selection* > *Clear Selected Features*.

STEP 3: CREATE POLYGONS FROM LINE FEATURES

Occasionally you may need to create polygons from line features. For example, you have received data with line features that outline new parcels or contain lines that will subdivide an existing polygon.

In this step, you will use the Construct Features tool on the Topology toolbar to create new parcel polygons based on line features, which have been supplied to you in a shapefile.

☐ Click *View* > *Bookmarks* > *Createpoly1*.

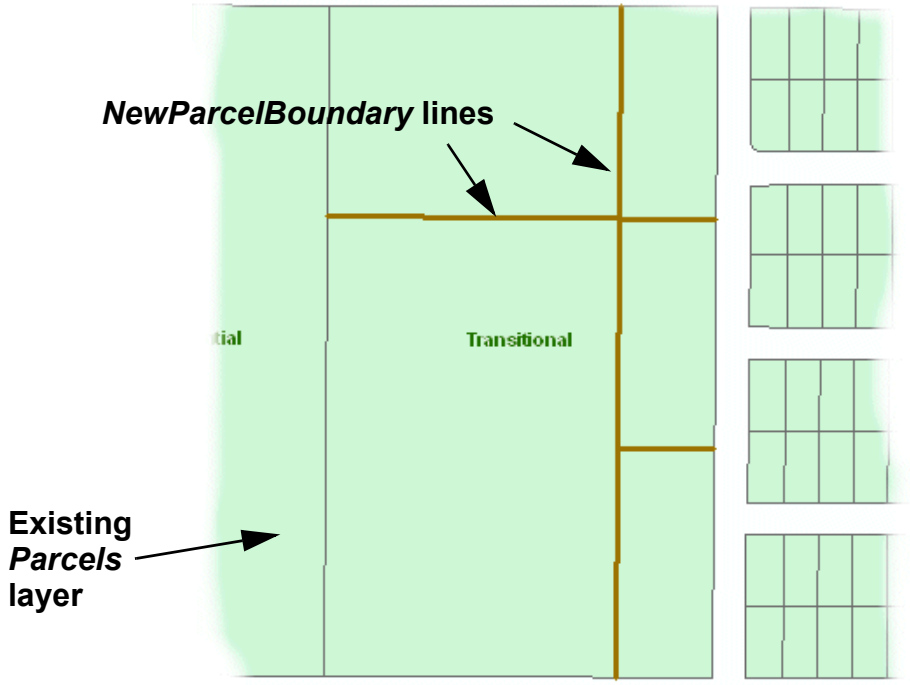
☐ Click the *Add Data* button, and navigate to *C:\Student\igis2\Data Sources*.

☐ Select *NewParcelBoundary.shp* and click *Add*.

The shapefile contains lines that will create the interior boundaries for subdividing an existing parcel.

☐ Change the default line symbol for the *NewParcelBoundary.shp* to a line width of 2.

You can now see how these lines match up to an existing parcel. This parcel, labeled as Transitional, is going to be split into five smaller parcels based on the lines in the NewParcelBoundary layer.



☐ Right-click on the *NewParcelBoundary* layer and click *Selection* > *Select All*.

☐ Verify that *Parcels* is the *Target* layer.

☐ On the *Topology* toolbar, click *Construct Features*  .

☐ Accept the default *Cluster Tolerance* value, and verify that *Consider existing features of the target layer in the current extent* is checked.

☐ Click *OK*.

The original parcel has been divided into five parcels, and all the parcels that were affected by this operation have been covered by a Dirty Area. Also notice that the five new parcels have a Transitional land use attribute because you set the Split Policy for the attribute validation rules to Duplicate (in Exercise 8A). Therefore, when the original parcel was split, the new parcels' land use attribute was populated with the same value as that of the original. This relieved you (or your intern) of a lot of typing, and potential data entry errors.

☐ In the *Table of Contents*, right-click on *NewParcelBoundary* and click *Remove*.

You will now validate the entire topology because the Dirty Area seems to exceed the current extent on your display.

☐ On the *Topology* toolbar, click *Validate Entire Topology*.

☐ Click *Yes* on the *Validate Topology* window.

Again, coincident boundaries have been created between the parcels and no errors were found.

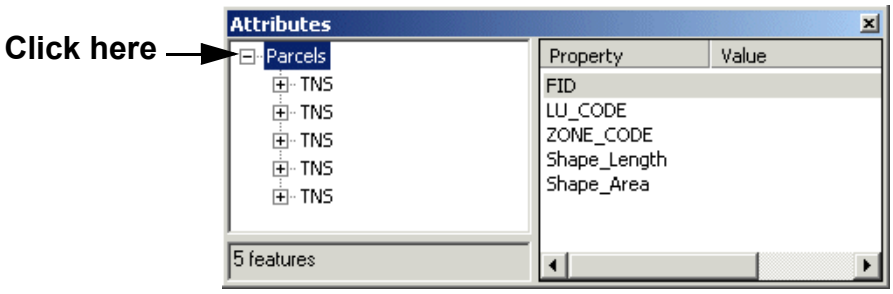
STEP 4: CHANGE ATTRIBUTES FOR THE NEW PARCELS

Suppose the Planning Department of the city decided to convert these parcels to a commercial land use in order to allow some grocery and other services to use these parcels to serve the nearby residential area. You will now convert these five parcels to commercial land use.

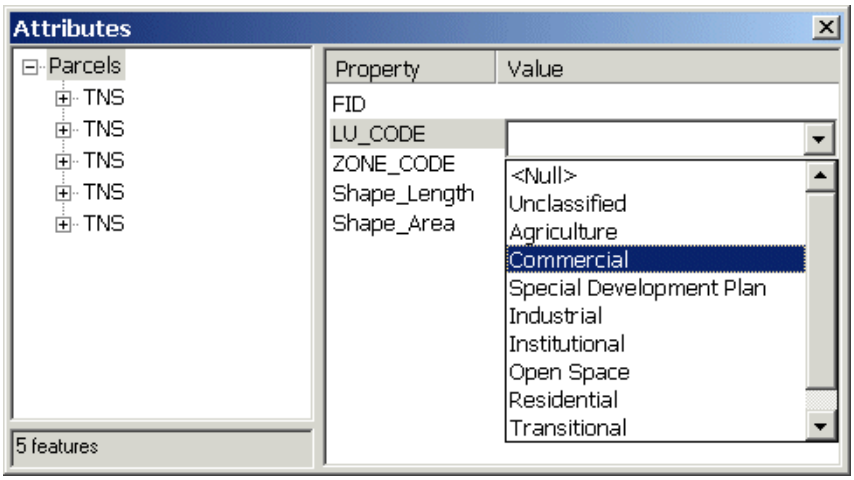
☐ Select the five new parcels that are labeled *Transitional*. You can hold down the *Shift* key while using the *Edit Tool* to select multiple features.

☐ Click the *Attributes* button  .

☐ In the left-hand side of the *Attributes Editor*, click on *Parcels*.



☐ Under the *Value* column, click on the blank area next to *LU_CODE* to reveal a dropdown list of domain values. Change the *LU_CODE* to *Commercial*.



Once Commercial is selected, all the values in the left panel turn into COM which is the equivalent code to Commercial land use. Also notice the map labels update to reflect the new land use change.

☐ Close the *Attributes Editor*.

☐ Click *Editor* > *Save Edits*.

☐ Click *Selection* > *Clear Selected Features*.

STEP 5: MERGE FEATURES

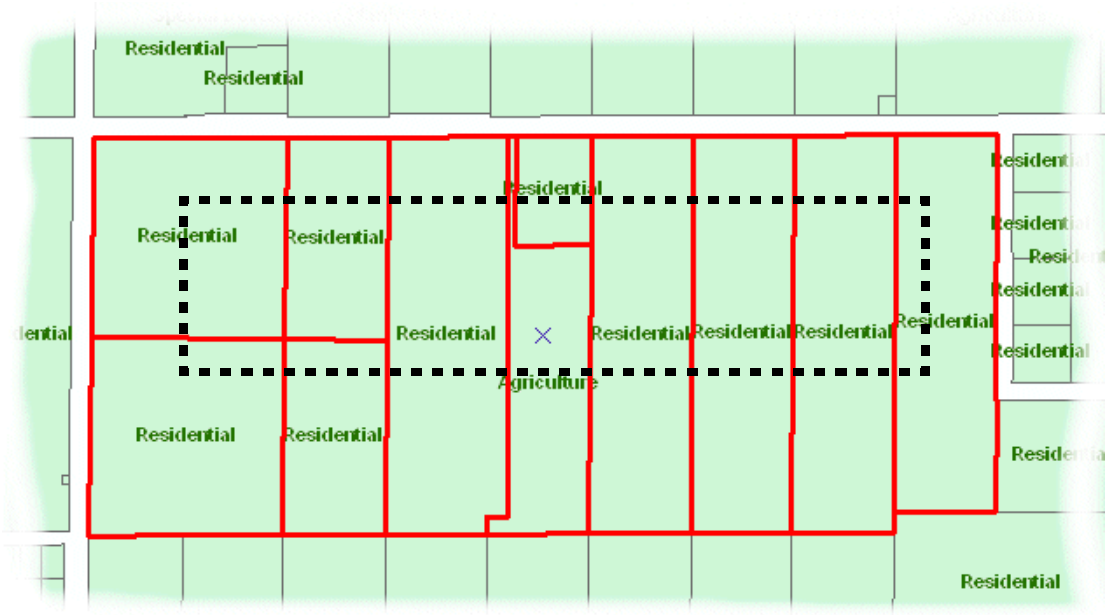
In the previous steps, you added new features to the existing parcel feature class. In this step, you will use ArcMap to merge several parcel features into one.

☐ Click *View* > *Bookmarks* > *Merge1*.

The area displayed shows several long, thin parcels. A Texas rancher recently bought all of these parcels with the intention of opening Redlands' first armadillo ranch (they make great pets). You are going to consolidate all of the Texan's separate parcels into one holding.

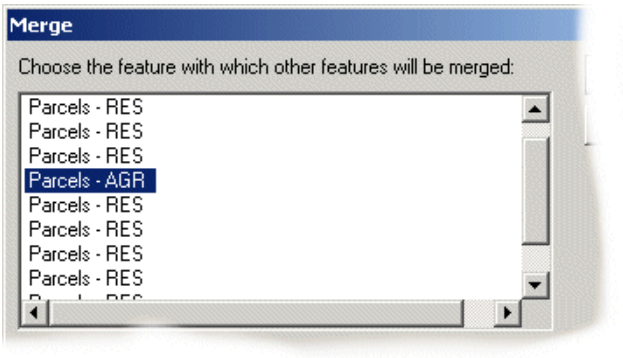
☐ Click the *Edit Tool*.

☐ While holding down the left mouse key, drag and draw a box within the parcels highlighted in the graphic below.



☐ Click *Editor* > *Merge*.

☐ On the *Merge* dialog, for *Choose the feature with which other features will be merged*, click *Parcels - AGR*.



NOTE: Notice that the selected polygon feature will flash when you select it. This helps confirm that you have chosen the correct attributes.

☐ Click *OK*.

A dirty area appears where changes have been made. You will now define the area where you want to validate the topology.

☐ Click *Validate Topology In Specified Area*  .

☐ Drag and draw a box which completely surrounds the dirty area generated by your edits.

The Dirty Area will disappear and no errors have been found in the topology. Notice that the final parcel is labeled with the Agriculture land use code.

☐ Click *Editor* > *Save Edits*.

☐ Turn off the labels.

☐ Zoom to the full extent.

☐ If necessary, click *Selection* > *Clear Selected Features*.

☐ Collapse the *Parcels_Topology* symbols in the *ArcMap Table of Contents*.

STEP 6: MODIFY EXISTING LINEAR FEATURES

So far, you have completed several edits to the parcel feature class. You will now use some different tools to update the streets feature class. The streets participate in the Streets_Topology that you created in Exercise 8. The topology rule you applied was that streets Must Not Have Dangles. This will allow you to identify any data entry errors, under or overshoots, where streets should connect. You marked dead end or cul-de-sac streets as Exceptions to the rule. While editing the streets, you will need to check if any errors were created and fix them. First, you will add the Streets_Topology and all the feature classes that participate in this topology.

☐ Click the *Add Data* button.

☐ Navigate to *C:\Student\igis2\REGIS\Redlands_GDB* > *Transportation* feature dataset, and add the *Streets_Topology*.

☐ Click *Yes* to add all the feature classes that are participating in the topology.

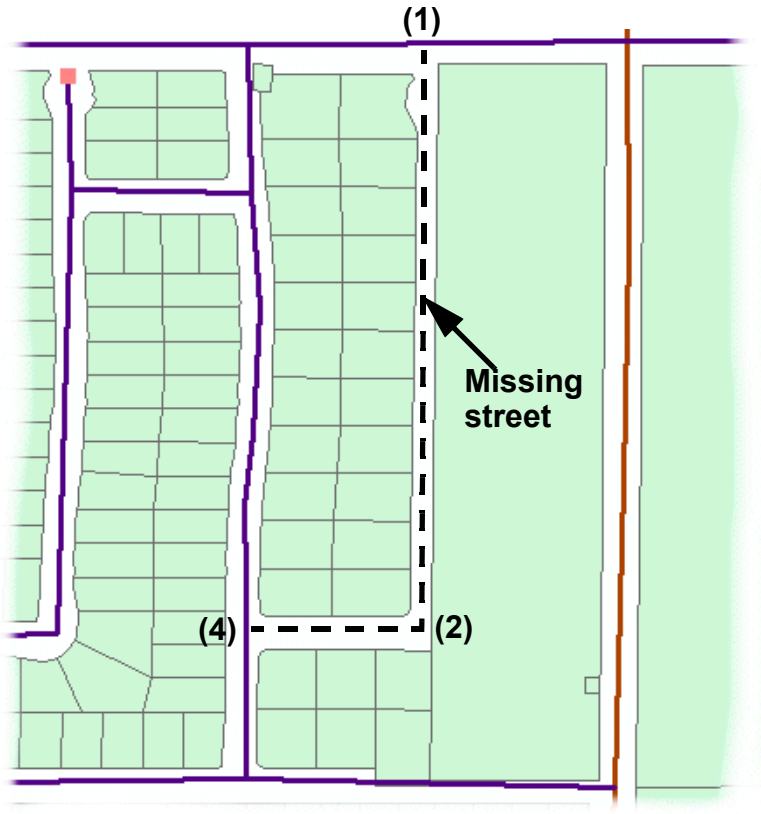
Notice that the streets are assigned symbols based on the subtypes you created in an earlier exercise. If you like, change the symbols for any of the streets layer. You will also need to change the symbology for the Streets_Topology to include Dirty Areas.

☐ Right-click on the *Streets_Topology* layer and click *Properties*.

☐ Click the *Symbology* tab.

☐ Check the *Dirty Areas* checkbox to turn the display on for *Dirty Areas* and click *OK*.

☐ Click *View* > *Bookmarks* > *Street1*.



In the display, you should notice that there is a street missing. This is a relatively new housing development, and the street was only recently constructed. You will add it to the database now. First, you will set the snapping environment to help you add the new street feature.

☐ Click *Editor* > *Snapping*.

☐ On the *Snapping Environment* dialog, click *Vertex* and *Edge* snapping for the *Streets* layer. Uncheck the *Vertex* snapping for the *Parcels* layer.

☐ Close the *Snapping Environment* dialog.

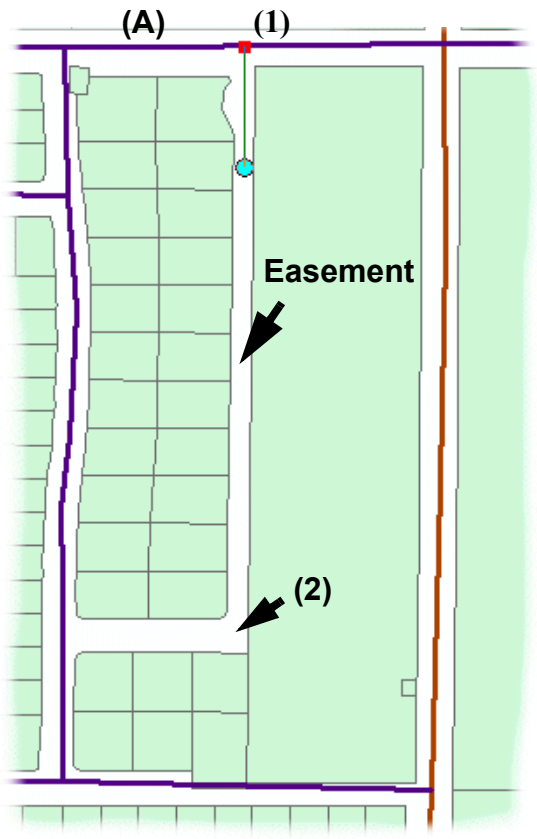
☐ For the edit *Task, Create Tasks > Create New Feature*.

☐ For the *Target*, click *Streets > Local Streets* from the dropdown list.

☐ Click the *Sketch Tool*.

☐ Click to add the first vertex as shown in the graphic, vertex *(1)*. You want the street you create to travel down the middle of the easement between the parcels.

☐ Hold your pointer over the existing street *(A)*, as shown in the graphic at right, and press the *Ctrl* and *E* keys at the same time.



This is the shortcut for adding perpendicular sketch segments.

☐ Click the end of this perpendicular line at point *(2)*, where the new street will make a right turn.

☐ Move the cursor to hover over the north/south street to the left of your last vertex.

☐ Right-click and select *Perpendicular* from the *Sketch Tool* context menu.

☐ Move the cursor to snap to the street on the right.

☐ Double-click to finish the sketch.

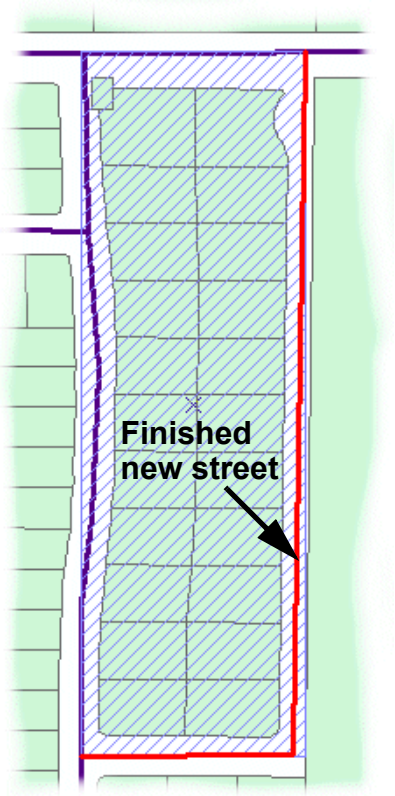
> **NOTE:** You can also use the *F2* shortcut key to finish the sketch.

☐ On the *Topology* toolbar, for *Topology*, make sure you select *Streets_Topology*.

☐ Click *Validate Topology In Current Extent*.

☐ Click *Editor* > *Save Edits*.

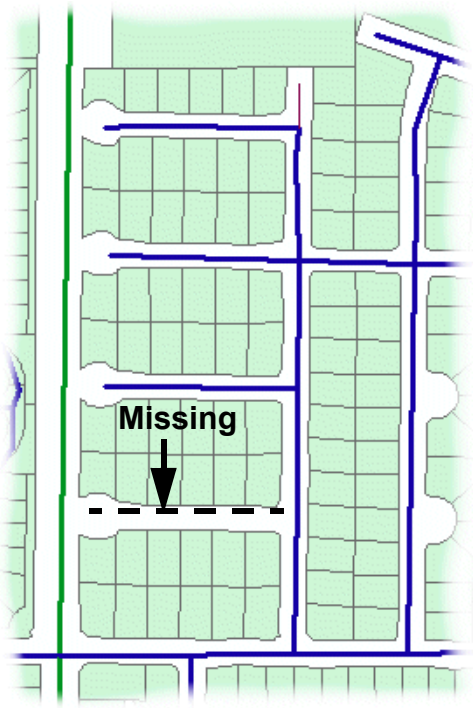
Your final result should look like the graphic to the right, but do not worry if it is a little different. The purpose of this step is to assist you in getting used to incorporating geodatabase topology functions with your regular editing skills.



You will now add a couple more features to the Streets layer using different tools.

☐ Click *View* > *Bookmarks* > *Street2*.

Notice there is also a street missing from the bottom cul-de-sac in the display. It is identical to the other streets above it, so a simple way to add a new one would be to use the Copy Parallel command.



☐ Click the *Edit Tool*.

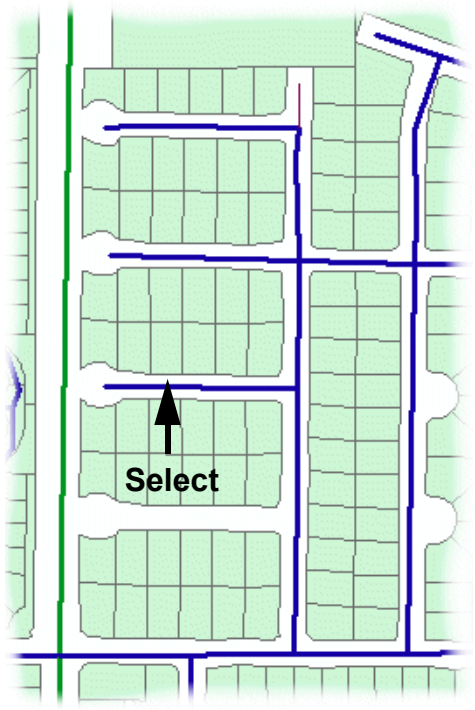
☐ Select the bottom cul-de-sac street.

☐ Click *Editor* > *Copy Parallel*.

☐ For *Distance*, type `-90` and press *Enter*.

Question 1: The new street will be added parallel to the copied one at the specified distance. How could you have estimated the distance to move the street if the value had not been provided in the exercise?

_____

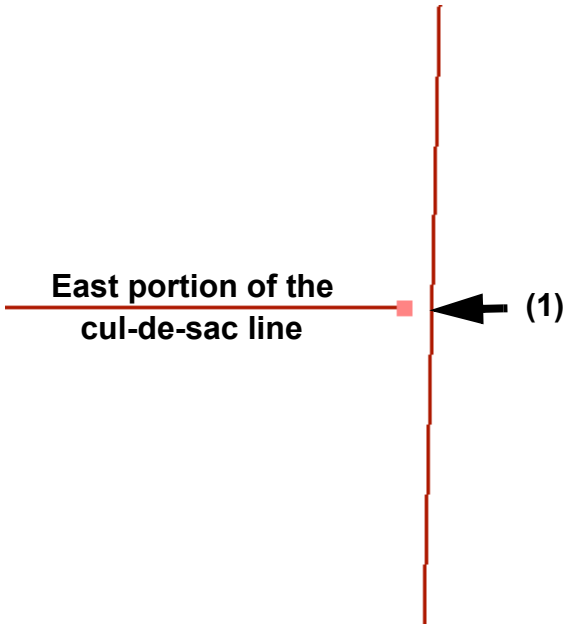


The new street feature will be placed 90 meters to the south of your original feature. It may appear as though the new feature has been added with a different symbol, but upon closer examination (zoom in to a very large scale), you will see that the new feature is surrounded by a dirty area, and this is what you see.

☐ Click *Validate Topology In Current Extent*.

Point errors appear on both ends of the new line feature. The cul-de-sac should connect to the street on the right but because it is on a slight angle, a gap has been created between it and the cul-de-sac. You will use the Fix Topology Error Tool to correct this error.

☐ Zoom in on the error at the east side of this line until you can see the gap.



☐ On the *Topology* toolbar, click the *Fix Topology Error Tool* and use it to select the point error. It may be easier to draw a small box around the point feature to select it.

The point error will turn black once it is selected.

☐ Right-click on the topology error and click *Extend*.

The gap between the two streets is very small, less than a meter. You will enter a distance greater than the gap, and the cul-de-sac centerline will extend eastward until it snaps to the perpendicular street at point (1).

☐ For *Maximum Distance*, type `1` and press *Enter*.

Because you are greatly zoomed in, the Dirty Area may not be entirely inside the current extent of your display; you will validate the entire topology to be safe.

☐ Click *Validate Entire Topology*.

☐ Click *Yes* on the *Validate Topology* window.

☐ Zoom out until you can see the point error at the other (west) end of the cul-de-sac centerline.

This is not a true error, as this end of the street is not meant to connect to another street. You will mark this end as an Exception to the Must Not Have Dangles rule you set in the previous exercise.

☐ With the *Fix Topology Error Tool*, select the remaining point error.

☐ Right-click on the point error and click *Mark as Exception*.

☐ Click *Editor* > *Save* Edits.

STEP 7: UPDATE ATTRIBUTES FOR THE NEW STREET FEATURE

In the previous step, you added and updated several features in the Streets feature class. Now you will change the feature attributes to be consistent with the spatial edits. In an actual project, you would need to check and possibly alter the attributes of all the features you edited, but due to the time constraints of the course, you will only perform a couple of updates.

☐ Click the *Edit Tool*, and select the cul-de-sac street you just added.

☐ Click the *Attributes* button.

When you copied the existing street to the new location, the attributes were copied too, resulting in two streets named Yvette Court. You need to give the new street unique attributes.

☐ Click the value for *STREETNAME*, and type your own name. This is your chance to be famous.

☐ Click the *Value* for *TYPE* and choose your favorite street type from the dropdown list, however, *Court* is probably correct.

> **NOTE:** The values that were listed for the TYPE field are the domain values that you created earlier.

☐ Close the *Attributes* editor.

☐ Click *Editor* > *Save Edits*.

Now you will return to the first street you added. This one was not a simple copy of an existing street, so you will notice a difference in the attribute values already present.

☐ Click *View* > *Bookmarks* > *Street1*.

☐ Select the street you previously created.

☐ Click the *Attributes* button.

Notice that there are several attributes with empty or null values. This is because you created the feature from scratch instead of copying an existing feature. However, some values have been populated; notice that the CLASS field contains the value *Local Streets*. Because you added the feature using the Local Streets subtype defined in the previous exercise, the class field defaulted to Local Streets. Another field with a value is TYPE, which contains the default value *Street*.

☐ Click the value for *STREETNAME* and type another original street name. This time, choose a friend or pet to immortalize as part of the *REGIS* database.

☐ Close the *Attribute Editor.*

☐ Click *Editor* > *Stop Editing*, and click *Yes* to save the edits.

☐ Click *Save* to save the map document.

So far in this exercise, you have performed simple attribute edits using the Attributes Editor. In the next step, you will update attribute values by directly editing the table.

STEP 8: EDIT ATTRIBUTE TABLE VALUES

You have already learned how to edit feature attribute values by selecting the feature and clicking the Attributes button on the Editor toolbar to reveal the Attributes Editor. In this step, you will learn how to edit the tables directly.

☐ Click the *Open* button, and navigate to the *C:\Student\igis2\MapDocuments* folder and double-click on *Ex9_Attributes.mxd*.

This map contains a Census Group Layer, which you will work with in the next step, and the Railroads layer, which displays the features from the Railroads feature class in the Redlands_GDB geodatabase. In the last exercise, you added a NAME field to the Railroads feature class attribute table to store the name of the railroad company that operated the track. Now you will add the NAME values.

☐ In *ArcMap*, click *Editor* > *Start Editing*.

☐ Right-click on the *Railroads* layer and click *Open Attribute Table*.

As you can see, there are only two records because there are only two railroads. The NAME field is at the end of the table and has null values.

☐ Resize the *Attributes of Railroads* table so that both the table and the map are visible.

☐ Click the first record in the *Attributes of Railroads* table so that the entire row is highlighted. Notice that this also selects the longest railroad feature.

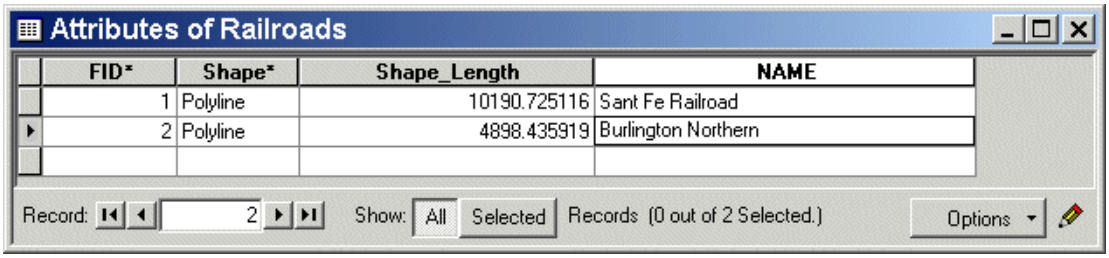
> **NOTE:** You may need to turn off the Census Group Layer so you can see this.

☐ Click in the first row cell under the *NAME* field and replace the null value by typing **`Santa Fe Railroad`**

☐ Click the second record in the *Attributes of Railroads* table so that the entire row is highlighted. Notice that this also selects the remaining railroad feature.

☐ Click in the second row cell under the *NAME* field and replace the null value by typing **`Burlington Northern`**

☐ When finished, your table should look like the graphic below.



☐ Click *Editor* > *Save Edits*.

☐ Close the *Attributes of Railroad* table.

☐ Clear the selected features.

Now that you have performed some simple edits to a table, you will use the Field Calculator tool to edit another table. First bring in the table to your map.

☐ Click *Add Data*.

☐ Navigate to *C:\Student\igis2\REGIS\Redlands_GDB* geodatabase, select the *Demography* table, and click *Add*.

Notice that the Table of Contents view has changed to Source, and the Demography table is displayed at the bottom of the ArcMap Table of Contents. This table stores the demographic attributes for the BlockGroups feature class in the Redlands_GDB geodatabase. In a previous exercise, you added a field called TARGET_AGE to this table. Now you will calculate the values for the new field.

☐ Right-click on the *Demography* table and click *Open*.

☐ On the *Attributes of Demography* table, scroll to the very end and locate the *TARGET_AGE* field. You may need to resize the window.

This field will store the concatenated values for several of the age range fields into one specifically for the target age market, 5-24 years old.

☐ Right-click on the *TARGET_AGE* field and click *Calculate Values*.

☐ On the *Field Calculator*, in the *Fields* scrolling list, click the *AGE05_09* field.

Notice that it automatically is added to the expression at the bottom. The calculation expression now should read:

```
[TARGET_AGE] = [AGE05_09]
```

☐ Click the plus sign from the group of arithmetic operators on the right side of the *Calculator*.

☐ Click the next field, *AGE10_14*.

☐ Keep adding fields and plus signs until the expression reads

```
[TARGET_AGE] = [AGE05_09] + [AGE10_14] + [AGE15_19] + [AGE20_24]
```

> **NOTE:** You do not need to type in [TARGET_AGE] yourself, as *ArcMap* has already added this parameter to the statement.

☐ Click *OK*.

Notice the new values for the *TARGET_AGE* field.

☐ Click *Editor* > *Save* Edits.

☐ Close the table.

In the next step, you will use the Map Topology tool to edit coincident features.

STEP 9: EDIT COINCIDENT FEATURES

You can store coincident feature classes within a feature dataset. In these types of feature classes, an edit made in one feature class could have repercussions on features in other feature classes. In this step, you will perform edits to multiple features in different feature classes simultaneously in order to maintain their coincidence.

☐ In *ArcMap*, click the *Display* tab in the *Table of Contents*.

☐ Turn off the display of the *Railroads* layer, and, if necessary, turn on the display of the *Census Group Layer*.

The Census Group Layer consist of four layers: Blocks, VotingDistricts, BlockGroups, and Tracts. These represent four feature classes with the same names under the Census feature dataset in the C:\Student\igis2\REGIS\Redlands_GDB personal geodatabase. The four layers were symbolized with different colors and thicknesses in order to clarify the coincidence between line features from different layers.

You will now start editing with the Map Topology tool, but first you will zoom in to a location via a bookmark.

☐ Click *View* > *Bookmarks* > *Census1*.

☐ In the *Table of Contents*, turn off and on the different layers and observe the coincidence of the lines from the different layers.

The boundary displayed in the map is obviously coincident between the feature classes. Now you will perform an edit that effects all of the feature classes displayed in this group layer.

☐ On the *Topology* toolbar, click the *Map Topology* tool .

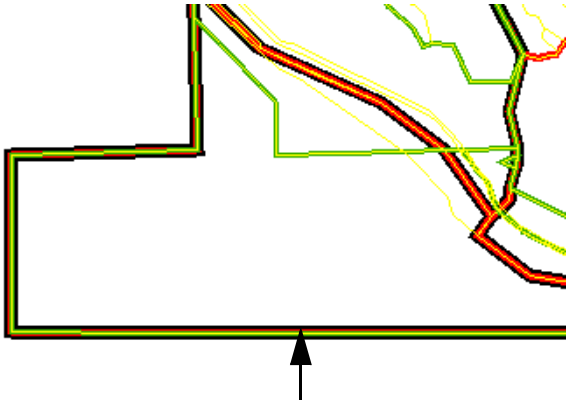
Map topology lets you use the Topology Edit Tool and the Modify Edge and Reshape Edge edit tasks on shapefiles and feature classes that do not participate in a topology in a geodatabase.

☐ On the *Map Topology* dialog, click *Select All*, uncheck *Railroads*, then click *OK*.

On the Topology toolbar, another tool becomes active; the Topology Edit Tool.

☐ On the *Topology* toolbar, click the *Topology Edit Tool* .

☐ Click on the coincident features, as shown in the graphic below.

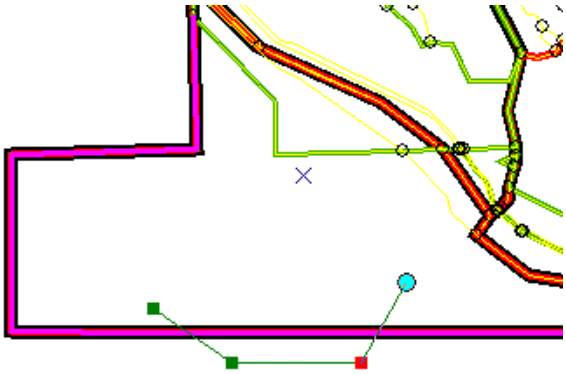


The coincident features are all selected and appear as magenta.

☐ On the *Editor* toolbar, click *Task* > *Topology Tasks* > *Reshape Edge* from the dropdown list.

☐ On the *Editor* toolbar, click the *Sketch Tool*.

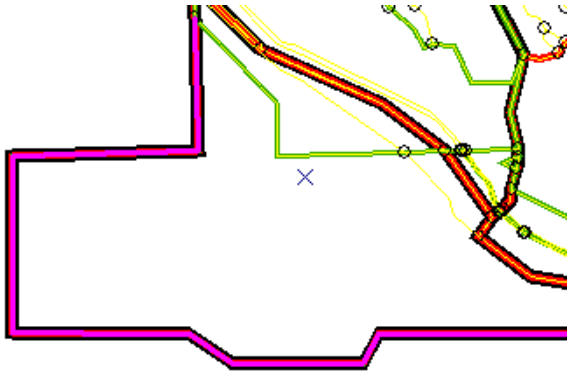
☐ Digitize a sketch similar to the one below to define a new shape for the selected features. Make sure that the beginning and end of the sketch cross the selected features.



☐ Finish the sketch using the method of your choice.

Hint: Use the F2 shortcut key, double-click or right-click, and select *Finish Sketch* from the context menu.

When you finish the sketch, the boundary will be reshaped and should look similar to the graphic below.



Notice that the edit was performed on all of the coincident features simultaneously. This is just the type of behavior you would want for this kind of data. The census tracts, block groups, voting districts, and blocks all share common boundaries. If you change one, they should all change.

☐ Save your edits.

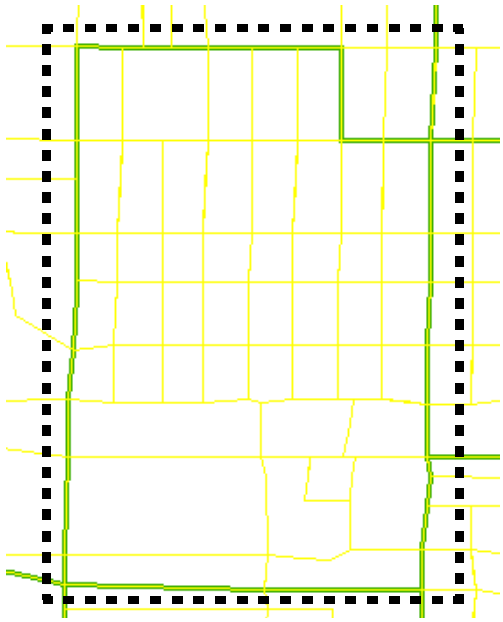
STEP 10: USE FEATURE CREATION TOOLS

In this step, you will create a new voting district by selecting the census blocks that comprise it.

☐ Click *View* > *Bookmarks* > *Census2*.

☐ Turn off the display for the *BlockGroups* and *Tracts* layers.

The voting district in the center of the map, highlighted with a dotted line in the graphic below, has undergone a large increase in population and needs to be subdivided. Because all of the voting districts share boundaries with the block features, you will define the new voting district using the block features within the original voting district.



☐ For *Target*, click *VotingDistricts* in the dropdown list.

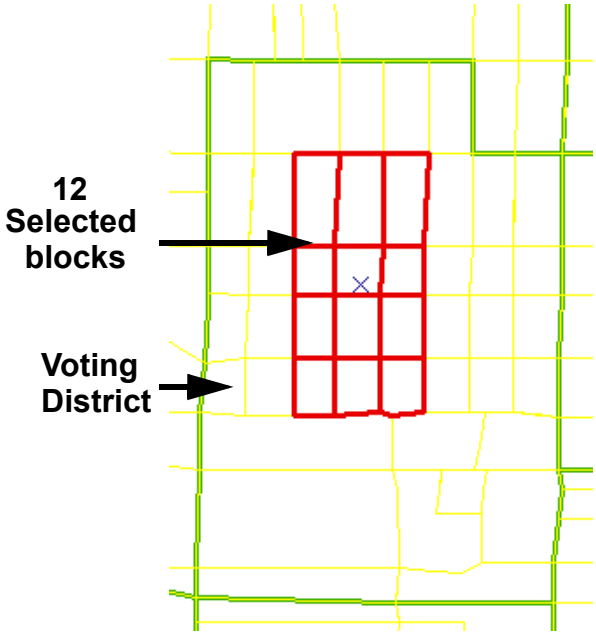
Next, you will set the selectable layer to only the block features.

☐ Click *Selection* > *Set Selectable Layers*.

☐ Uncheck all the layers except the *Blocks* layer.

☐ Click *Close*.

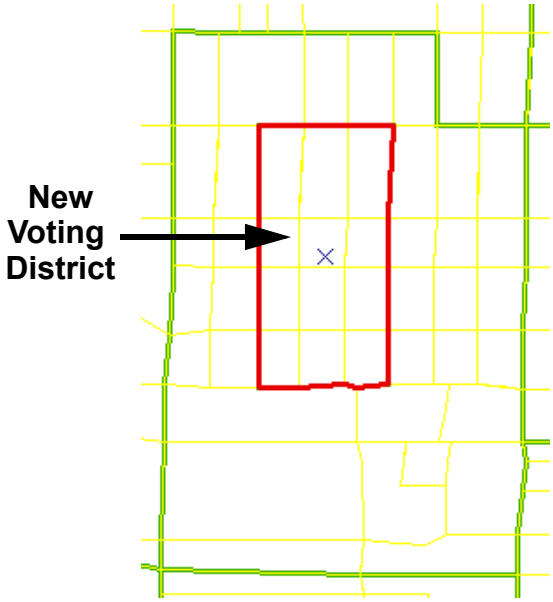
☐ With the *Edit Tool*, select the census blocks highlighted in the graphic below.



HINT: With this selection, it might help to set your interactive selection options to Select features completely within the box or graphic. Bring up the Selection Options dialog by clicking Selection > Options.

☐ Click *Editor* > *Union*.

☐ Click *Selection* > *Clear Selected Features*, so that you can see the new voting district more clearly.



The Union feature creation command created the new voting district from the aggregation of the selected block features. Union is only one of the tools that can create features in one feature class based on the selected features in another. Other commands on the Editor dropdown list with similar functionality are Intersect, Buffer, and Copy Parallel.

☐ Click *Editor* > *Stop Editing* and click *Yes* to save the edits.

☐ Exit *ArcMap* and do not save the changes to the map.

In this exercise, you performed multiple types of editing. You edited simple features with various edit tasks and feature creation tools. When editing features that participated in a topology, you validated the edits against the topology rules and made any necessary corrections or marked errors as exceptions. You edited attribute values through the Attribute Editor, directly on the table, and using the Field Calculator. You simplified the editing process by using subtypes and domains. Lastly, you learned how to perform coincident editing in ArcMap without creating a topology, and also learned how to use the Feature Creation tools.

EXERCISE END

ANSWERS TO EXERCISE 9 QUESTIONS

Question 1: The new street will be added parallel to the copied one at the specified distance. How could you have estimated the distance to move the street if the value had not been provided in the exercise? _____

Answer: Use the Measure tool.

10

Spatial adjustment

contents

EXERCISE 10: SPATIAL ADJUSTMENT

In this exercise, you will perform some spatial adjustment and data management operations to complete the preparation of your data for use in analysis.

First, you will load the street centerlines for a new subdivision from an AutoCAD Drawing Exchange File (dxf) into a new feature class in the Redlands geodatabase. The new subdivision's street data CAD file is currently stored in SubDivStsin digitizer units. You will transform them to match the existing streets in UTM Zone 11, using the Spatial Adjustment tools in ArcMap. You will also use the Spatial Adjustment tools to perform an edge snap operation to align two adjacent stream layers. Once the stream features are aligned, you will use the Append tool to combine these layers into one.

STEP 1: PREVIEW THE DXF FILE OF NEW STREET CENTERLINES

☐ In *ArcCatalog,* navigate to *C:\Student\igis2\DataSources* and expand the *SUB_DIGUNITS.DXF* feature dataset.

☐ Click on the *Polyline* feature class and preview the features.

☐ Right-click on *SUB_DIGUNITS.DXF* and click *Properties*.

☐ Click on the *Spatial Reference* tab. Notice there is no projection information associated with this file and the values for the *CAD Dataset Extents* are very small, as they represent the units of the digitizer, in this case inches.

☐ Click *OK* to dismiss the *CAD Drawing Properties* dialog.

STEP 2: CREATE A NEW FEATURE CLASS

You will create a new feature class in the Redlands geodatabase into which you will load the features from the DXF file. You will need to update the spatial extent for this new feature class to contain both the coordinate extent that the streets are currently stored in (digitizer units) as well as the UTM that the features will be moved to.

☐ Navigate to the *C:\Student\igis2\REGIS\Redlands_GDB* geodatabase.

☐ Right-click the *Redlands_GDB* geodatabase, and click *New > Feature Class*.

☐ For Name, type **`SubDivSts`**, and click *Next*.

☐ Make sure the *Configuration Keyword* option is set to *Default*, then click *Next*.

☐ In the *Field Properties*, under *Data Type*, click the *Geometry* data type box to expand the field properties on the dialog.

☐ Change the *Geometry Type* property to *Line*.

☐ For the *Spatial Reference* property, click the *ellipses* button to reveal the *Spatial Reference Properties* dialog.

☐ Click *Import* to import a coordinate system for the new feature class.

☐ Using the *Browse for Dataset* dialog, navigate to the *\REGIS\Redlands_GDB\LandRecords* feature dataset and select the *Parcels* feature class.

☐ Click *Add*.

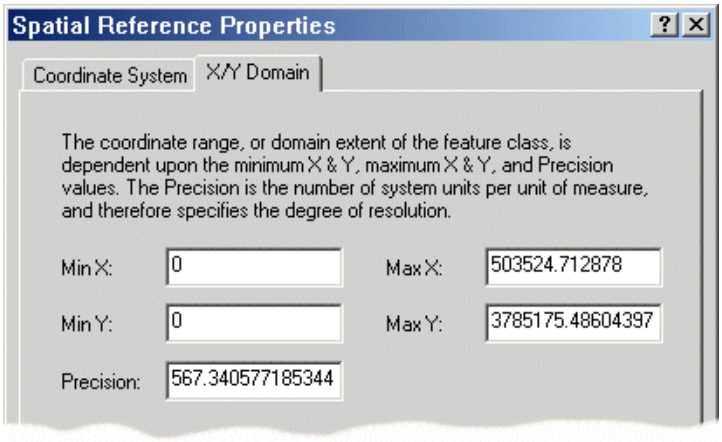
☐ Click on the *X/Y Domain* tab.

The extents of the Parcels feature class have been copied for the minimum and maximum X and Y values. The SubDivSts features fall outside this range. For the transformation process to be successful, the XY domain or extents must cover the coordinate values where the features currently fall and where the coordinate values will be moved to. The minimum X and Y values need to be altered to account for where the subdivision features currently fall.

☐ For *Min X*, type `0`

☐ For *Min Y*, type `0`

☐ Click in the *Precision* box and the value will automatically be calculated. The extent values should match the graphic below.



☐ Click *OK* to dismiss the *Spatial Reference Properties* dialog.

☐ Click *Finish* on the *New Feature Class* dialog.

☐ Verify in *ArcCatalog* that the *SubDivSts* feature class was created.

Step 3: Use the Simple Data Loader to add features

Next you will load the features from the DXF file into the new feature class using the Simple Data Loader in ArcCatalog.

☐ Right-click on the new *SubDivSts* feature class and click *Load > Load Data...*

☐ Click *Next*.

☐ Click the *Browse* button, navigate to the *\DataSources\SUB_DIGUNITS.DXF* dataset and select the *Polylines* feature class.

☐ Click *Open*.

☐ Click *Add*.

☐ Click *Next* on all the following panels, then click *Finish* to load the features.

☐ Preview the *SubDivSts* feature class to confirm the street features were loaded.

Step 4: Add displacement links

The subdivision streets in SubDivSts are still in digitizer units and need to be shifted in coordinate space to match the Streets feature class. You will add the Streets_Topology to your ArcMap session so you can validate the topology rules you set once you have added the new subdivision streets.

☐ Start *ArcMap* and open *A new empty map*.

☐ Click *Add Data.*

☐ Navigate to the *C:\Student\igis2\REGIS\Redlands_GDB\Transportation* feature dataset, and add the *Streets_Topology.*

☐ Click *Yes* to bring in all the feature classes associated with this topology.

In a previous exercise, you marked all the cul-de-sac and street ends as exceptions to the rule that streets may not have dangles. You can symbolize the exceptions in the Streets_Topology layer.

☐ Right-click on *Streets_Topology* and click *Properties*.

☐ Click on the *Symbology* tab.

☐ Check the *Point Exceptions* checkbox.

☐ If necessary, check the *Dirty Areas* checkbox.

☐ Click *OK*.

Next you will add the subdivision streets to the ArcMap display.

☐ Click *Add Data*, and add *SubDivSts*.

Because the SubDivSts features are in digitizer units, they are not visible at the current map extent.

☐ Click on the symbol for *SubDivSts* to bring up the *Symbol Selector*.

☐ Change the symbol to *Highway Ramp* (*Color: red*, *Width*: `1.70`) so it will be easy to identify the new subdivision streets once they are transformed to match the *Streets* data.

☐ Click *OK*.

☐ Right-click on *SubDivSts* and click *Zoom To Layer*.

Now you are ready to begin using the Spatial Adjustment tools to move the SubDivSts into their correct coordinate space. But first, in order to use the Spatial Adjustment tools, you must begin an editing session.

☐ Add the *Editor* toolbar if necessary.

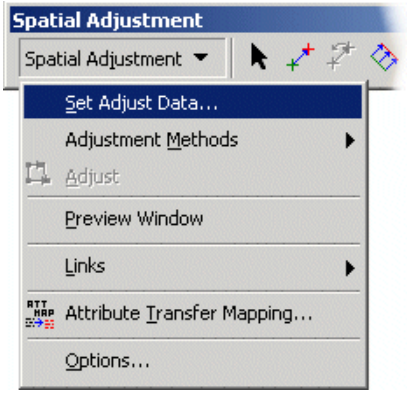
☐ On the *Editor* toolbar, click *Editor* > *Start Editing*.

☐ Turn on the *Spatial Adjustment* toolbar by clicking *View* > *Toolbars* > *Spatial Adjustment*.

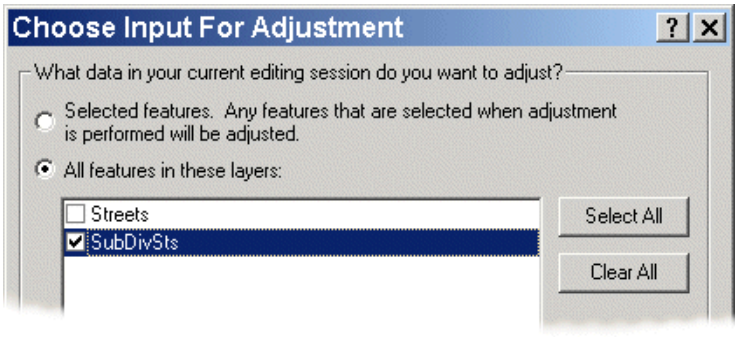
☐ Dock the toolbar.

Before you begin to add displacement links from the SubDivSts features to the Streets feature, you need to tell ArcMap which data to adjust and which adjustment method to use.

☐ On the *Spatial Adjustment* toolbar, click *Spatial Adjustment* > *Set Adjust Data*.



☐ Click the option for *All features in these layers* and uncheck the *Streets*. The dialog should match the graphic below.



☐ Click *OK*.

☐ From the *Spatial Adjustment* toolbar pulldown menu, select *Adjustment Methods* > *Transformation - Affine*.

The algorithm used in the Affine transformation requires at least three displacement links. Displacement links define the source and destination coordinates for the transformation. Displacement links can be added manually or loaded through a links file. This tab-delimited text file contains both the source and destination coordinates for each displacement link. An alternative method is to use a control points file that contains the coordinates for the destination points and to manually add the source points. For SubDivSts, the destination coordinates for street intersections/ends are already known and stored in a text file. You will open this control point file and manually add the source point to create displacement links. First, you will set up the snapping environment to snap the manual source displacement points to the street centerlines.

☐ Click *Editor* > *Snapping*, and turn on *End* snapping for the *SubDivSts* layer.

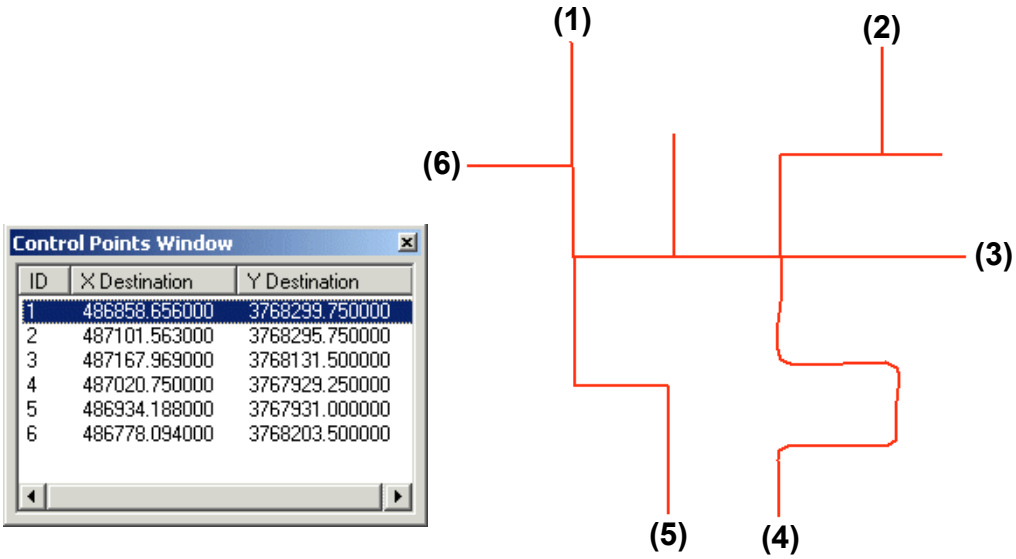
☐ Close the *Snapping Environment* window.

☐ Click *Spatial Adjustment* > *Links* > *Open Control Points File*.

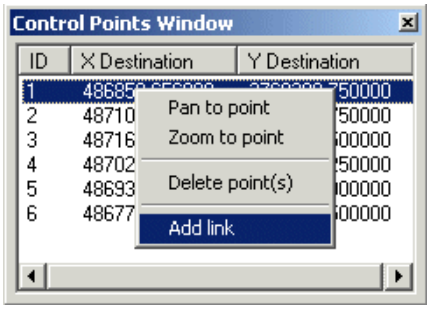
☐ Browse to *C:\Student\igis2\DataSources* and select *SubGCP.txt*. Click *Open*.

☐ Resize the *Control Points* window so that you can see all the information, but also keep the window as small as possible.

The text file containing the destination coordinates are added to a Control Points Window in the ArcMap display. There are six coordinate pairs listed in the file. The ID for each of the destination points are a match for the ID on the source end points of the Streets features marked on the graphic below. Next, you will add the source points manually in the order shown below.



☐ Right-click on the *X* or *Y Destination* value for the first *Control Point* and click *Add Link*.



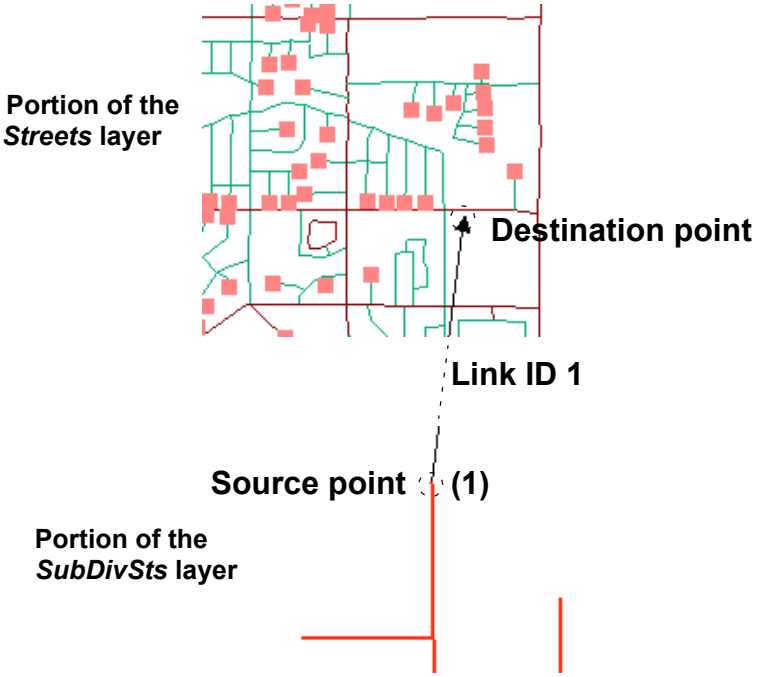
☐ Move the mouse into the ArcMap display area. You will be able to see the displacement link reaching from outside the display area.

☐ Snap to the end of the street for source point `(1)` as shown in the control points graphic.

☐ Click *Refresh View* (or the *F*5 key) to show the created displacement link.

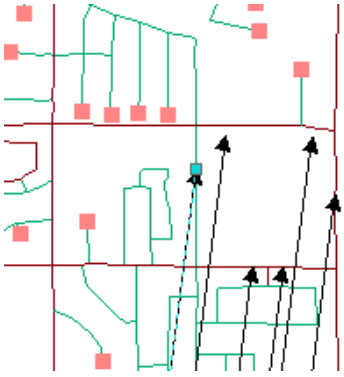
The first link is added. An arrow now extends from source point `(1)` to its destination on the Streets layer, and the first record in the Control Points Window disappeared.

NOTE: You cannot see both of these layers simultaneously as illustrated here. You need to zoom to each layer one at a time to see the entire link as shown here.



☐ Add the rest of the displacement links in the same manner.

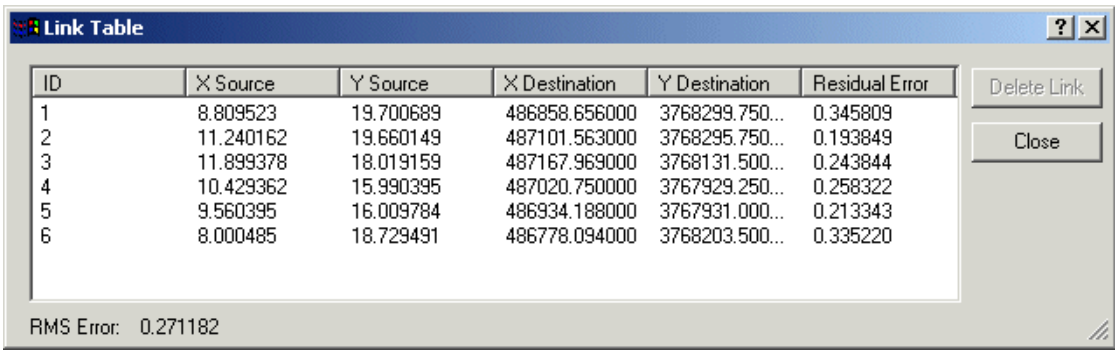
☐ Click the *Refresh View* button to show all six displacement links.



☐ Close the *Control Points Window*.

You can view both the source and destination coordinates for the links and the RMS error for each link in the adjustment by viewing the Link Table. If any of the added links do not have an acceptable RMS value, you have an opportunity to modify or delete the individual links.

☐ On the *Spatial Adjustment* toolbar, click the *View Link Table* button .



All the displacement links have values under 0.5, which is acceptable for this data. One of your links may have a slightly higher RMS error than the other links and you may choose to delete it.

☐ In the *Link Table*, click the record for the displacement with the highest RMS value.

☐ Click *Delete Link*.

> **NOTE:** If you click on the Residual Error column heading, errors will be sorted in ascending order.

Notice how the overall value for RMS error drops slightly.

☐ Close the *Link Table*.

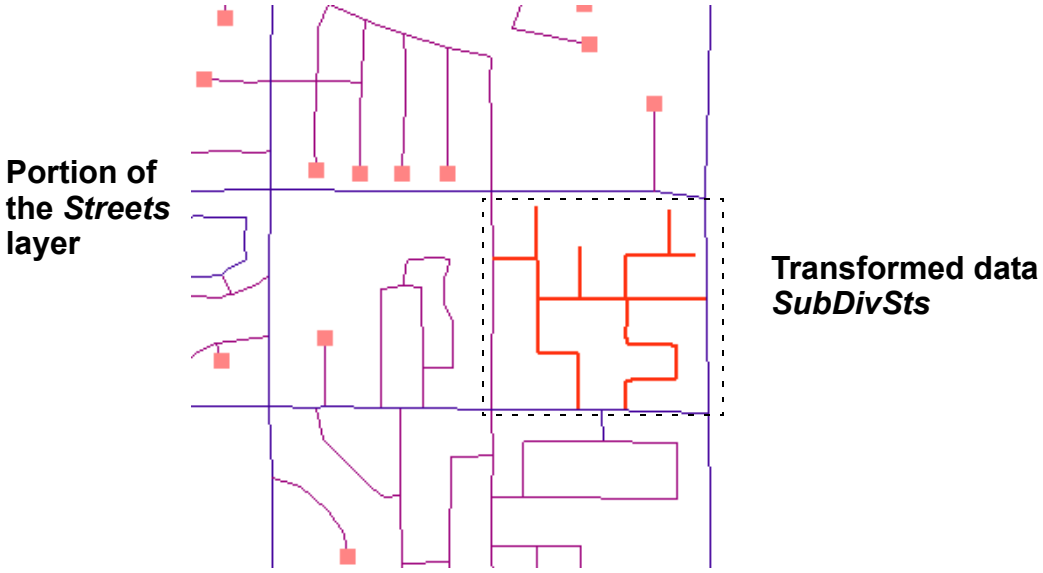
STEP 5: TRANSFORM THE DATA TO REAL WORLD COORDINATES

Now that the links between the source layer (SubDivSts) and the destination layer (Streets) have been established, you will now transform the coordinates of the SubDivSts layer to real world coordinates, so they can match the location of the coordinates in the Streets layer.

☐ From the *Spatial Adjustment* toolbar, click *Spatial Adjustment* > *Adjust*.

The SubDivSts features should disappear from the display area. They have been transformed to match the other streets.

☐ Right-click on the *Streets* layer in the *Table of Contents* and click *Zoom To Layer*.



You will be able to see the bright red streets added to a city block in the far east side of the city.

☐ Zoom in on the new streets.

☐ Click *Selection* > *Set Selectable Layers* and turn off the *Streets* layer.

☐ Using the *Select Features* tool on the *Tools* toolbar, select all the features in *SubDivSts*.

☐ Click *Copy* or *Ctrl+C* to copy the features to the clipboard.

☐ In the *Editor* toolbar, set the *Target* layer to *Streets: Local Streets*.

☐ On the *Main* toolbar, click *Paste* to paste the features into the *Streets* layer.

☐ Click *Selection* > *Clear Selected Features*.

☐ Turn off the *SubDivSts* layer.

Notice that the transformed data is now part of the Streets layer.

Next, you will check that the new streets are connected at their intersections and mark the cul-de-sacs as exceptions to the Must Not Have Dangles topology rule.

☐ If necessary, add the *Topology* toolbar.

☐ Click on *Validate Topology In Current Extent*.

☐ Click on the *Error Inspector*.

☐ Verify that *Visible Extent only* is checked.

☐ Click *Search Now*.

There are seven errors that violate the Must Not Have Dangles rule.

☐ Select all the errors by holding down the *Shift* key while you click on the first then last record.

☐ Right-click and click *Mark as Exception*.

☐ Save your edits and stop editing.

STEP 6: EDGE SNAP TWO LAYERS

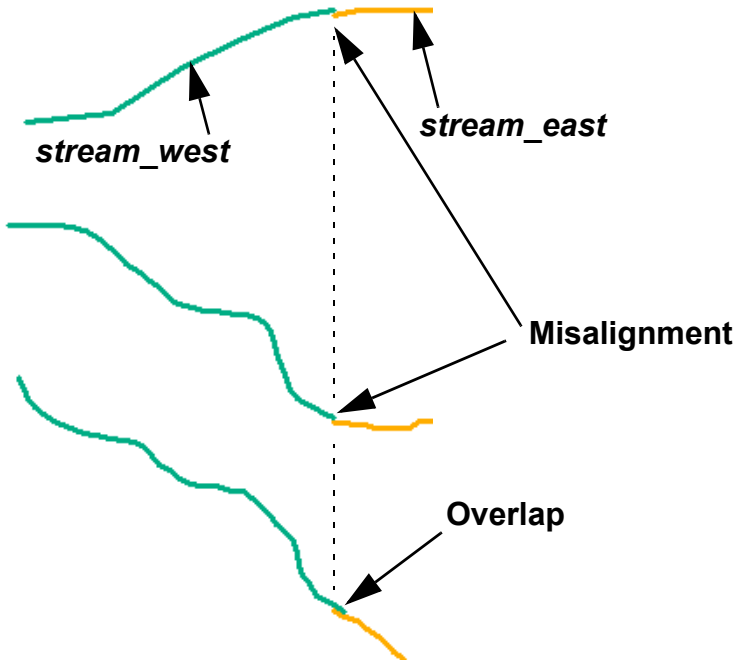
You may often find it necessary to align two layers whose borders are slightly out of alignment. This misalignment can be either the result of digitizing made by two different people or data converted from different sources. The most basic of the spatial adjustment methods, the edge snap, takes care of this alignment problem.

☐ On the *Main* toolbar, click *New Map File*.

☐ Click *Add Data* and navigate to the *C:\Student\igis2\DataSources* folder and add the *stream_west* and *stream_east* shapefiles.

☐ Change the layer symbology: *stream_west* color to *Malachite Green* (eighth column, fifth row) and *stream_east* to *Electron Gold* (fourth column, third row); change the line width for both layers to `2.00`

Notice that the stream features on the two layers do not align, and one has a slight overlap. After investigation, you have confirmed that the stream_east data is more accurate, so you will adjust the stream_west layer.



☐ Start an edit session.

You will get a warning window because the stream_west layer is in a different coordinate system than the Data Frame you are working with.

☐ Click the *Start Editing* button to continue your edit session and start editing features in projected space.

☐ On the *Editor* toolbar, click *Editor* > *Options*.

☐ Set the *Snapping Tolerance* to `10 Map Units`

☐ Click *OK*.

☐ On the *Editor* toolbar, click *Editor* > *Snapping*.

☐ Set the *Snapping Environment* to *End* for both the *stream_east* and *stream_west* layers.

☐ Close the *Snapping Environment* dialog.

☐ On the *Spatial Adjustment* toolbar, click *Spatial Adjustment* > *Set Adjust Data*.

You want to adjust the stream_west data.

☐ In the *Choose Input For Adjustment* dialog, choose *All features in these layers*, and make sure that only the *stream_west* layer is checked.

☐ Click *OK*.

You have set up your initial spatial adjustment environment. The next step is to add displacement links.

☐ Click *Spatial Adjustment* > *Adjustment Methods* > *Edge Snap*.

You will investigate two Edge Snap adjustment methods: Smooth and Line. First you will use the Line adjustment method.

☐ On the *Spatial Adjustment* toolbar, click *Spatial Adjustment* > *Options*.

☐ On the *Adjustment Properties* dialog, click the *General* tab, if necessary, and click *Options*.

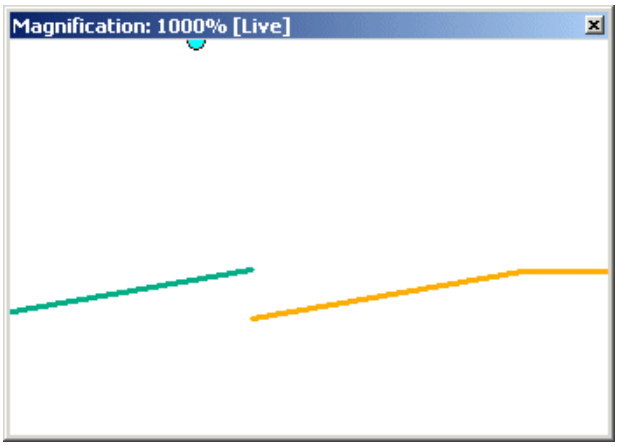
☐ On the *Edge Snap* dialog, *General* tab, for *Method*, click *Line*.

☐ Click *OK* on all dialogs to close them.

You will now more closely examine the errors you will fix.

☐ Click *Window* > *Magnifier* to open a magnifier window, and zoom to the top (northernmost) stream edge gap.

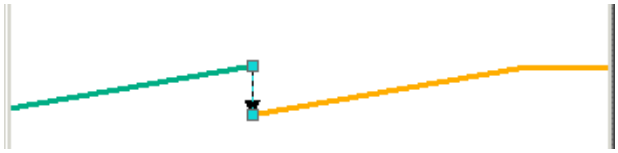
☐ Right-click on the *Magnification* title bar, click *Properties*, and change the *Zoom* factor to `1000%`



One very useful feature of the Magnifier window is the ability to use editing tools within the active window. You will use the New Displacement Link tool inside the Magnifier window; this will reduce the amount of pan and zoom steps you might otherwise need to use.

☐ On the *Spatial Adjustment* toolbar, select the *New Displacement Link* tool  .

☐ Use this tool to link the eastern end of the *stream_west* line features to the western end of the appropriate *stream_east* line features.



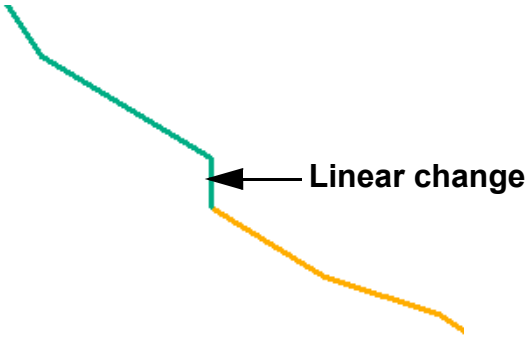
NOTE: You only need to click each end point once to add the link. Also, the direction of the displacement link will determine the movement of features.

☐ Add displacement links for the other two gaps, leaving the magnifier window over the southernmost stream for viewing the adjustment that will happen at that location.

☐ Click *Spatial Adjustment* > *Adjust*.

☐ If necessary, zoom in on the last link you added to examine the results.

Notice that the default Edge Snap method simply moved the overlapping line from the last vertex of stream_west to the displacement link on stream_east. It is unlikely that the stream makes such a distinct linear change.



☐ Click *Undo*.

The stream_west line features return to their starting positions and the displacement links will reappear.

☐ Click *Spatial Adjustment* > *Options*.

☐ On the *General* tab, confirm that *Edge Snap* is the selected *Adjustment method*.

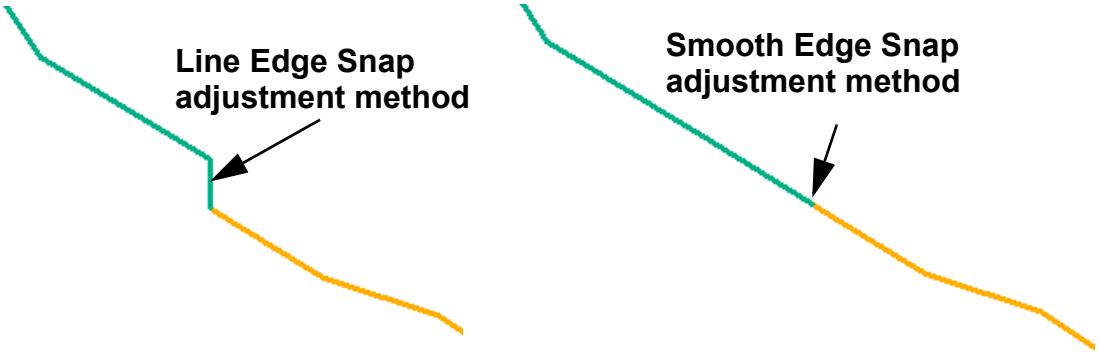
☐ Click the *Options* button.

☐ Change the *Method* from *Line* to *Smooth*.

☐ Click *OK* to close both dialogs.

☐ While still zoomed in, click *Spatial Adjustment* > *Adjust*.

Notice the difference in the Edge Snap result.



By choosing the Smooth option for the Edge Snap method, you changed the number of vertices altered by the adjustment. The Line option moves the line feature from just the last vertex, while the Smooth option spreads the change throughout all the vertices of the feature. Because you earlier used Set Adjust Data to select the stream_west layer only, those are the only features altered.

☐ Close the *Magnifier* window.

☐ Save your edits.

STEP 7: TRANSFER ATTRIBUTES

Now that you have aligned the features from stream_west to those in stream_east, you need to update the more accurate attribute values from stream_east to stream_west. In addition to not being spatially aligned, the stream_west layer does not contain attribute values for either the Name or CFCC fields. By using the Attribute transfer tool, you will accurately and quickly update the values for stream_west.

☐ Right-click on *Stream_west* and examine the attribute table.

☐ On the *Editor* toolbar, click *Editor* > *Snapping*.

☐ Change the *Snapping Environment* by choosing *Edge* snap for both stream layers and turning off the *End* snap.

☐ Close the *Snapping Environment* dialog.

☐ On the *Spatial Adjustment* toolbar, click *Spatial Adjustment* > *Attribute Transfer Mapping*.

☐ Under *Source Layer*, select *stream_east*; under *Target Layer*, select *stream_west*.

Notice that the fields for each individual layer appear in the window below, three of the four fields have the same name between the two layers.

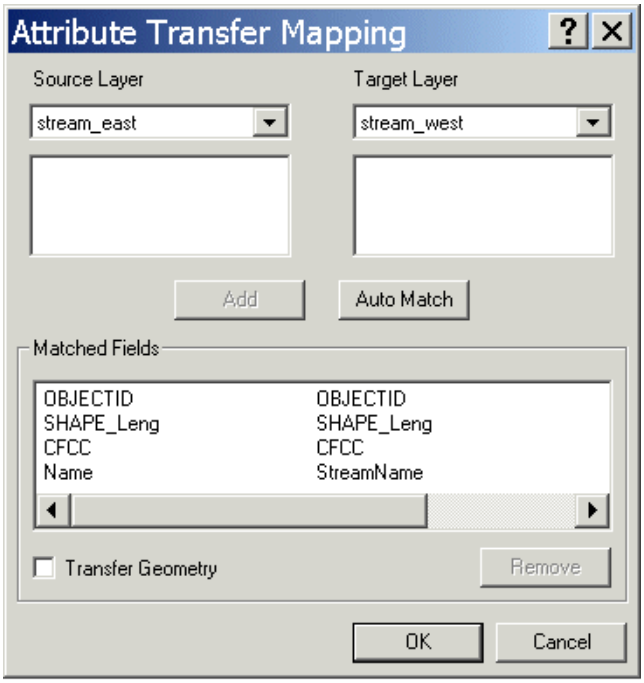
☐ Click *Auto Match*. The three same-name fields will appear in the *Matched Fields* panel.

☐ Select the remaining *Name* and *StreamName* fields by clicking on each once.

Notice that the *Add* button becomes active.

☐ Click the *Add* button; you will see that the *Name* and *StreamName* field values will be matched during your attribute transfer process.

☐ Confirm that the *Transfer Geometry* box at the bottom left corner is NOT checked.



☐ Click *OK*.

☐ Open the *stream_west* attribute table. Notice that the StreamName field has no values.

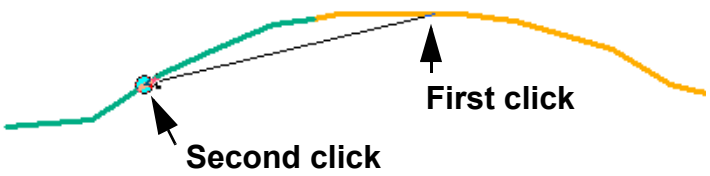
☐ Move and resize the attribute window so that you can view most of the map display and all of the stream attributes.

☐ Click the *Attribute transfer tool*, located at the right end of the *Spatial Adjustment* toolbar.

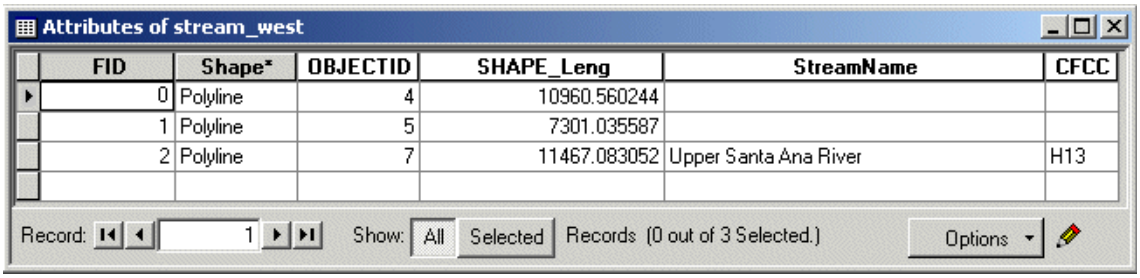
☐ Click the uppermost river in the *stream_east* layer.

You will see it flash, and the cursor will have a link anchored to your selected segment.

☐ Move the cursor left to the edge-snapped *stream_west* feature and click once.



You will see the stream flash once, and the Attribute transfer tool will revert to a simple cursor. This will indicate a successful attribute transfer.



You will see that the StreamName and CFCC columns now contain updated information.

☐ Repeat the *Attribute Transfer* for the remaining two edge-snapped streams. The column values will be updated automatically.

☐ Close the *Attributes of stream_west* table.

☐ Save your edits, stop editing, and close *ArcMap.*

You have successfully updated and corrected less accurate information in stream_west by using two spatial adjustment tools: Edge Snap and Attribute Transfer. Before moving on to additional Spatial Adjustment tools, you will need to combine the two stream layers into one. This will make your database more efficient, and make further analysis easier.

STEP 8: USE THE APPEND TOOL TO COMBINE TWO LAYERS INTO ONE

Now that you have successfully completed the spatial adjustments to your stream data, you need to combine the two layers before the information is imported into the Redlands_GDB. In this step, you will use the ArcToolbox Append tool to merge the two shapefiles containing stream information, and create a new feature class that contains the merged features. You will use the Citylimit layer to visualize the location of the merged data relative to the extent of the Redlands city boundaries. First, you will create a new empty feature class into which you will put the merged stream features.

☐ Open *ArcCatalog.*

☐ Right-click the *Redlands_GDB* and click *New > FeatureClass.*

☐ Name the new feature class *StreamCombo*, click *Next.*

☐ Click *Next* to accept the default configuration keyword.

☐ Click on the *Geometry* data type box to access its field properties.

☐ In the *Field Properties*, change the geometry to *Line.*

☐ Click the *ellipses* button to the right of the *'Unknown'* spatial reference.

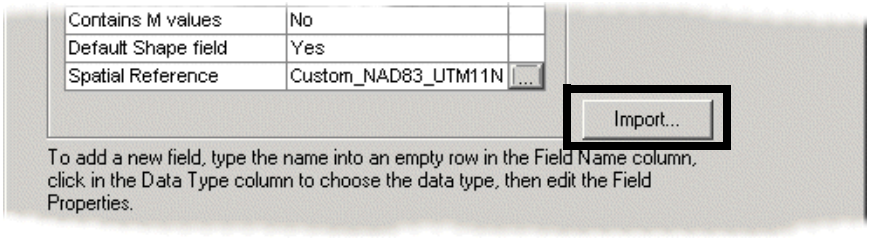
☐ In the *Spatial Reference Properties* dialog, click *Import.*

☐ Navigate to *C:\Student\igis2\DataSources.*

☐ Select *stream_west.shp*, and click *Add.*

☐ Click *OK.*

☐ In the *Feature Class Properties* dialog, click *Import.*



☐ If necessary, navigate to *C:\Student\igis2\DataSources*, select *stream_west.shp*, and click *Add.*

☐ Click *Finish.*

You have now created an empty feature class which contains the table structure of the existing shapefile as well as the projected spatial reference.

☐ Close *ArcCatalog,* open *ArcMap*, and start a new map.

☐ Add the *Citylimit* feature class to your map from the *C:\Student\igis2\REGIS\Redlands_GDB,* and the *stream_east.shp* and *stream_west.shp* shapefiles from *C:\Student\igis2\DataSources.*

☐ If necessary, open the *ArcToolbox* window, and expand the *Data Management Tools > General* toolbox.

☐ Double-click the *Append* tool to open it.

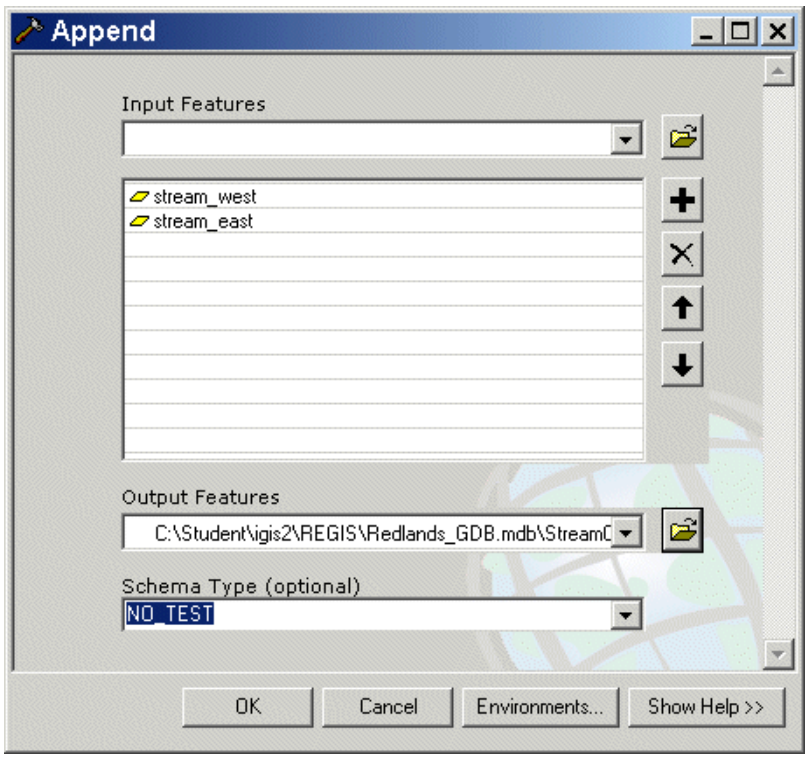
☐ For the *Input Features,* use the dropdown list to select both the *stream_west* and *stream_east* layers.

☐ For the *Output Features*, click the *Browse* button and navigate to *C:\Student\igis2\REGIS\Redland_GDB*.

☐ Select the *StreamCombo* feature class and click *Add.*

☐ In the *Append* tool dialog, change the *Schema Type* to *NO_TEST.*

Your *Append* tool dialog should look like this:



☐ Click *OK*.

☐ Close the geoprocessor window when the *Append* is complete.

☐ Remove the *stream_west* and *stream_east* layers.

The *StreamCombo* feature class has been added to your map, and contains the edge matched stream features from both input shapefiles.

☐ Exit *ArcMap* and do not save the changes to the map.

In this exercise, you learned how to convert a CAD drawing file into a geodatabase feature class, and how to transform the digitizer units of the converted CAD file into real world coordinates using the Spatial Adjustment tools in ArcMap. You also learned how to use the ArcToolbox Append tool to merge two layers together and create a new shapefile using the extent of a geodatabase feature class. These data management operations are vital for maintaining a suitable database for your projects.

EXERCISE END

11

Spatial analysis functions and geoprocessing

contents

EXERCISE 11A: CONDUCTING A PILOT STUDY

Over the course of the past few exercises, you have designed, created, edited, and aggregated a complete GIS database. Now you will perform some analyses to find out if the database meets the stated needs of your client, the City of Redlands. The first analysis is short and contains step-by-step instructions. Its purpose is to acquaint you with the analysis process and to allow you to practice some of the analytical functionality in ArcGIS.

STEP 1: PREPARE FOR THE ANALYSIS

A local developer has approached the City of Redlands Planning and Economic Development Department (PEDD) with plans to construct a family-oriented amusement park. PEDD would like to assist the developer in finding a suitable location for the facility. The ideal location must meet the following conditions:

- Agriculture or vacant land use
- Within a census Block Group with high concentrations of the target age group (5 - 24 years old) and target median household income greater than $35,000)
- At least 1 kilometer from the Redlands historical driving tour
- Within 500 meters of a highway

Before moving on to the step-by-step instructions for this section, it will be useful to review the steps you will go through to complete the first GIS analysis project.

The first step to solving the analysis is to simply state the main question:

- Where are suitable locations for the amusement park?

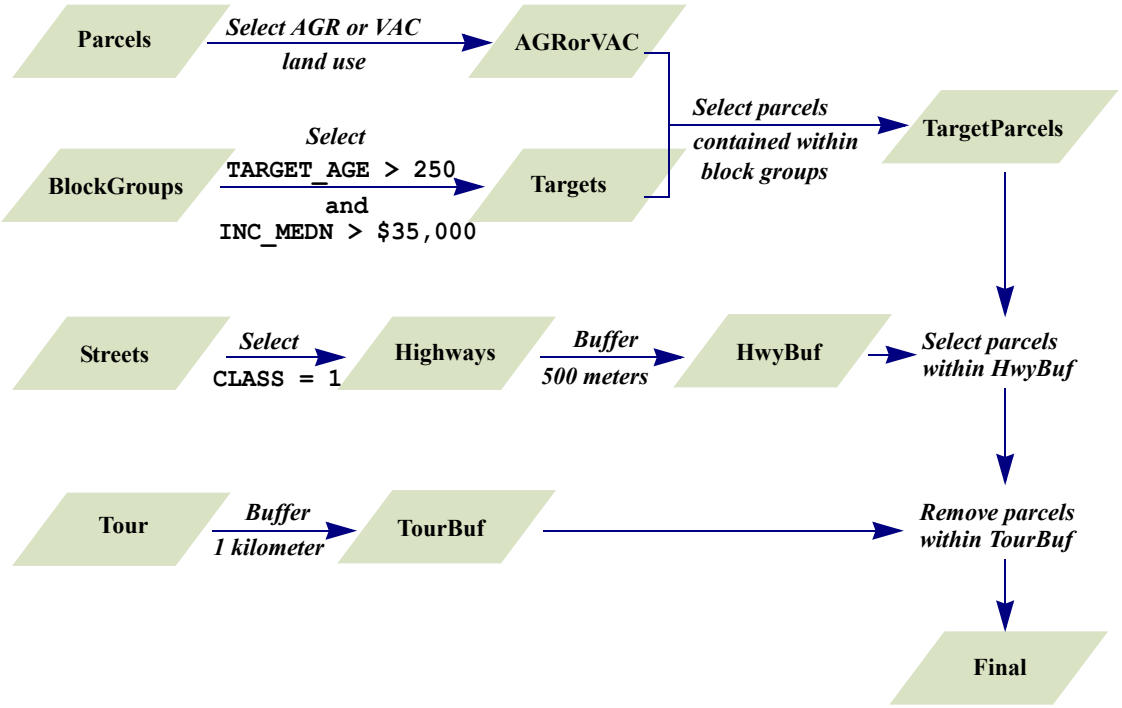
The next step is to identify the Redlands_GDB feature classes necessary to conduct the analysis. In this case, there are only four:

- *Parcels*
- *BlockGroups* (with the associated *Demography* table)
- *Streets*
- *Tour*

Next, identify the attribute fields and values you will query:

- For *Streets*: *CLASS = 1*
- For *Parcels*: *LU_CODE = AGR or LU_CODE = VAC*
- For the *Demography* table: *TARGET_AGE greater than 250 and INC_MEDN greater than $35,000*

Create a diagram of the analytical process and GIS operations.



Now you are ready to perform the analysis with ArcGIS.

STEP 2: SELECT THE TARGET CENSUS BLOCKGROUPS

☐ Start *ArcMap*, with *A new empty map*.

☐ From the *Redlands_GDB* add the following feature classes:

- *Parcels*, from the *LandRecords* feature dataset
- *BlockGroups*, from the *Census* feature dataset
- *Streets*, from the *Transportation* feature dataset
- *Tour*

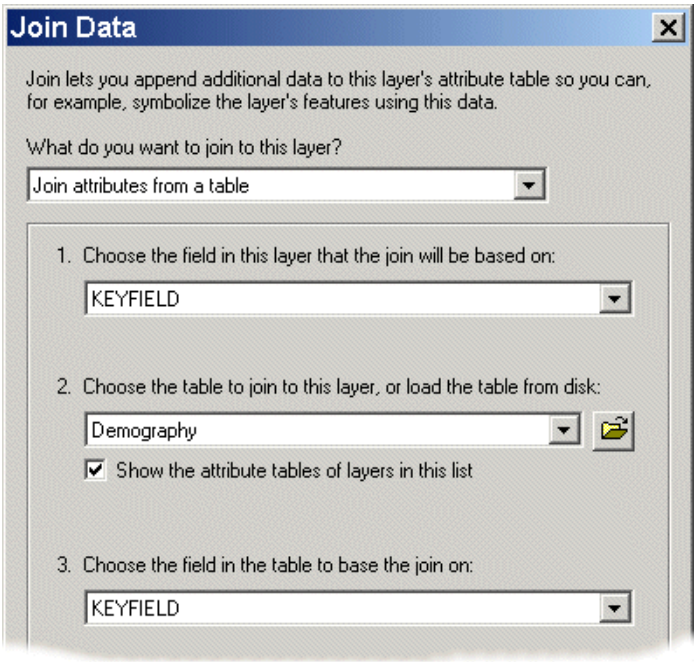
☐ From the *Redlands_GDB* add the following table:

- *Demography*

Your first step in the analysis is to select the census blockgroups with populations of the target age group greater than 250 and with a median income of over $35,000. The blockgroup demographic information is on the Demography table you imported to the geodatabase in a previous exercise. You will now perform a join between the feature class and the table.

☐ Right-click the *BlockGroups* layer and click *Joins and Relates* > *Join*.

☐ Fill in the *Join Data* dialog so that it matches the graphic below.



☐ On the *Join Data* dialog, click *OK*.

☐ Click *Yes* on the *Create Index* dialog.

Now perform a selection of blockgroups based on attributes contained in the Demography table.

☐ Click *Selection* > *Select By Attributes*.

☐ For *Layer*, choose *BlockGroups* from the dropdown list.

☐ For *Method*, verify that *Create a new selection* is chosen.

☐ For *Expression*, use the *Query Builder* or type the following query:

```
Demography.TARGET_AGE > 250 AND Demography.INC_MEDN > 35000
```

> **HINT:** These fields are near the bottom of the fields list. If you choose to use the automatic Query Builder functionality, you will need to click the *Get Unique Values* button to populate the *Unique Values* list.

☐ Click *Verify* to make sure your expression is valid, then click *Apply* and *Close*.

The selected blockgroups will be highlighted. To facilitate future analysis operations and to stay organized, you will create a new layer containing only the selected blockgroups.

☐ Right-click the *BlockGroups* layer, then click *Selection* > *Create Layer From Selected Features*.

☐ Rename the *BlockGroups selection* layer **`Targets`**

☐ Right-click the original *BlockGroups* layer again and click *Remove*.

Now the only blockgroups displayed will be the ones in the *Targets* layer.

☐ Select the *Display* tab at the bottom of the *ArcMap Table of Contents*. Because you are finished with the *Demography* table, you no longer need to view the data by source.

STEP 3: SELECT THE PARCELS

Now that the blockgroups are selected, you can query the Parcels feature class to find those with agriculture or vacant land use.

☐ Click *Selection* > *Select By Attributes*.

☐ For *Layer*, choose *Parcels* from the dropdown list.

☐ For *Expression*, use the *Query Builder* or type

```
[LU_CODE] = 'AGR' OR [LU_CODE] = 'VAC'
```

☐ Click *Verify* to make sure your expression is valid, then click *Apply* and *Close*.

The highlighted features are the parcels with agriculture or vacant land use. To simplify the display and speed up processing, you will create a new layer from the selected set.

☐ Right-click the *Parcels* layer and click *Selection* > *Create Layer From Selected Features*.

☐ Rename the *Parcels selection* layer **`AGRorVAC`**

☐ Right-click the original *Parcels* layer again and click *Remove*.

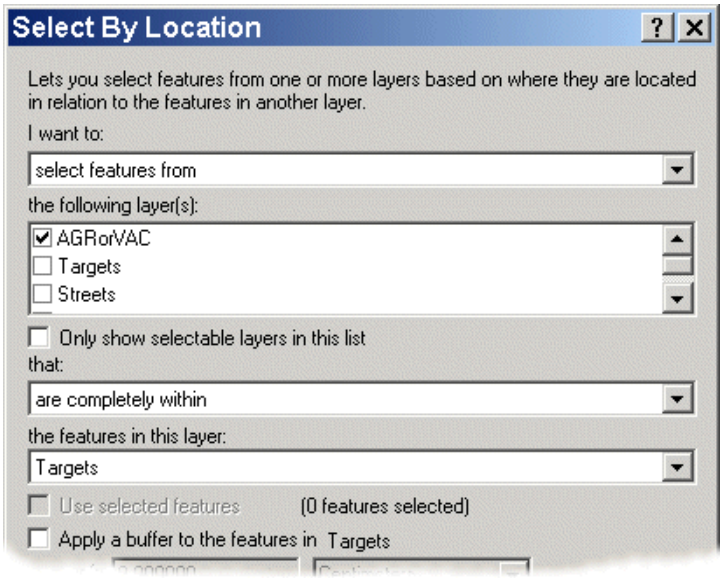
Now the only parcels in the display are the ones with agriculture or vacant land use.

STEP 4: FIND THE PARCELS CONTAINED WITHIN THE BLOCKGROUPS

Now you will select from the selection layers to find the agriculture or vacant parcels contained within the target blockgroups.

☐ Click *Selection* > *Select By Location*.

☐ Manipulate the values in the dialog box so that your selection expression reads:



☐ Click *Apply*. Click *Close*.

Once the selection is complete, create another selection layer to display only the parcels within the blockgroups.

☐ Right-click the *AGRorVAC* layer and click *Selection* > *Create Layer From Selected Features*.

☐ Rename the *AGRorVAC selection* layer **`TargetParcels`**

☐ Remove the *AGRorVAC* and *Targets* layers.

You have now narrowed down the potential locations for the amusement park from over 22,000 to a few hundred parcels. In the next step, you will use the Streets and Tour layers to further reduce the potential parcel locations.

Step 5: Buffer the Streets and Tours layers

The remaining criteria for the amusement park location are that it must be within 500 meters of a highway, but at least 1 kilometer away from the Redlands historic driving tour. In this step, you will buffer the Streets and Tour layers so that you can determine which parcels meet these criteria. Begin by selecting the highway features from the Streets feature class.

☐ Click *Selection* > *Select By Attributes*.

☐ For *Layer*, choose *Streets* from the dropdown list.

☐ For *Expression*, use the *Query Builder* or type `[CLASS] = 1`

☐ Click *Verify* to make sure your expression is valid, then click *Apply* and *Close*.

The highlighted features are the highways. To simplify the display, you will create a new layer from the selected set.

☐ Right-click the *Streets* layer and click *Selection* > *Create Layer From Selected Features*.

☐ Rename the *Streets selection* layer `Highways`

You may choose to collapse the *Highways* symbols in the Table of Contents to reduce clutter.

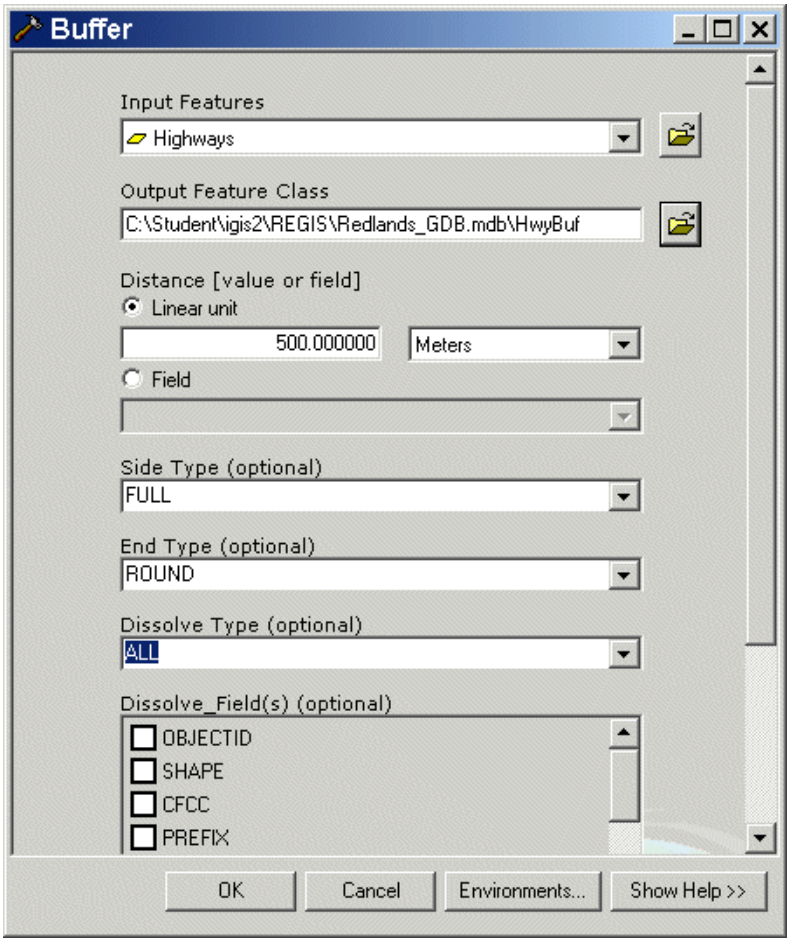
☐ Right-click the original *Streets* layer again and click *Remove*.

Now the only streets in the display are the highways. Next, you will buffer the Highways layer.

☐ Open *ArcToolbox* and expand the *Analysis Tools* > *Proximity* toolboxes.

☐ Double-click the *Buffer* tool.

☐ Complete the *Buffer* tool dialog to match the graphic below.



☐ For the *Output Feature Class* you have the choice to manually type in the target path, or browse to the output location. If you choose the latter, you will need to navigate to display the contents of the Redlands_GDB, enter the new feature class name (*HwyBuf)*, and click *Save.*

☐ Confirm that you have entered 500 meters as the *Distance Linear Unit*, and selected *All* as the *Dissolve Type (Optional).*

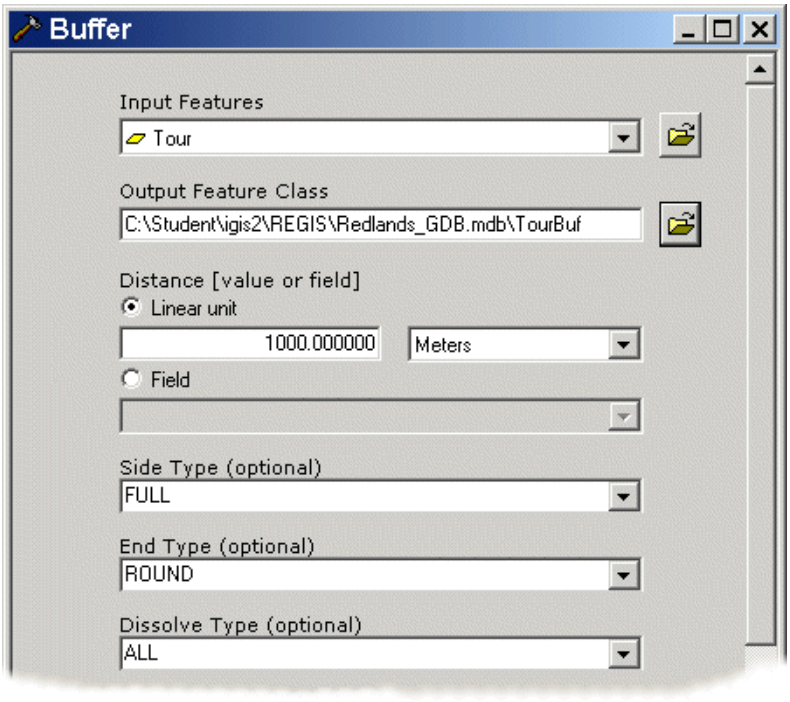
☐ Click *OK.*

☐ *Close* the Command Line window when the process has finished.

The new *HwyBuf* feature class is added to your map. Next, you will buffer the Tour layer.

☐ In *ArcToolbox,* double-click the *Buffer* tool.

☐ Complete the *Buffer* tool dialog to match the graphic below.

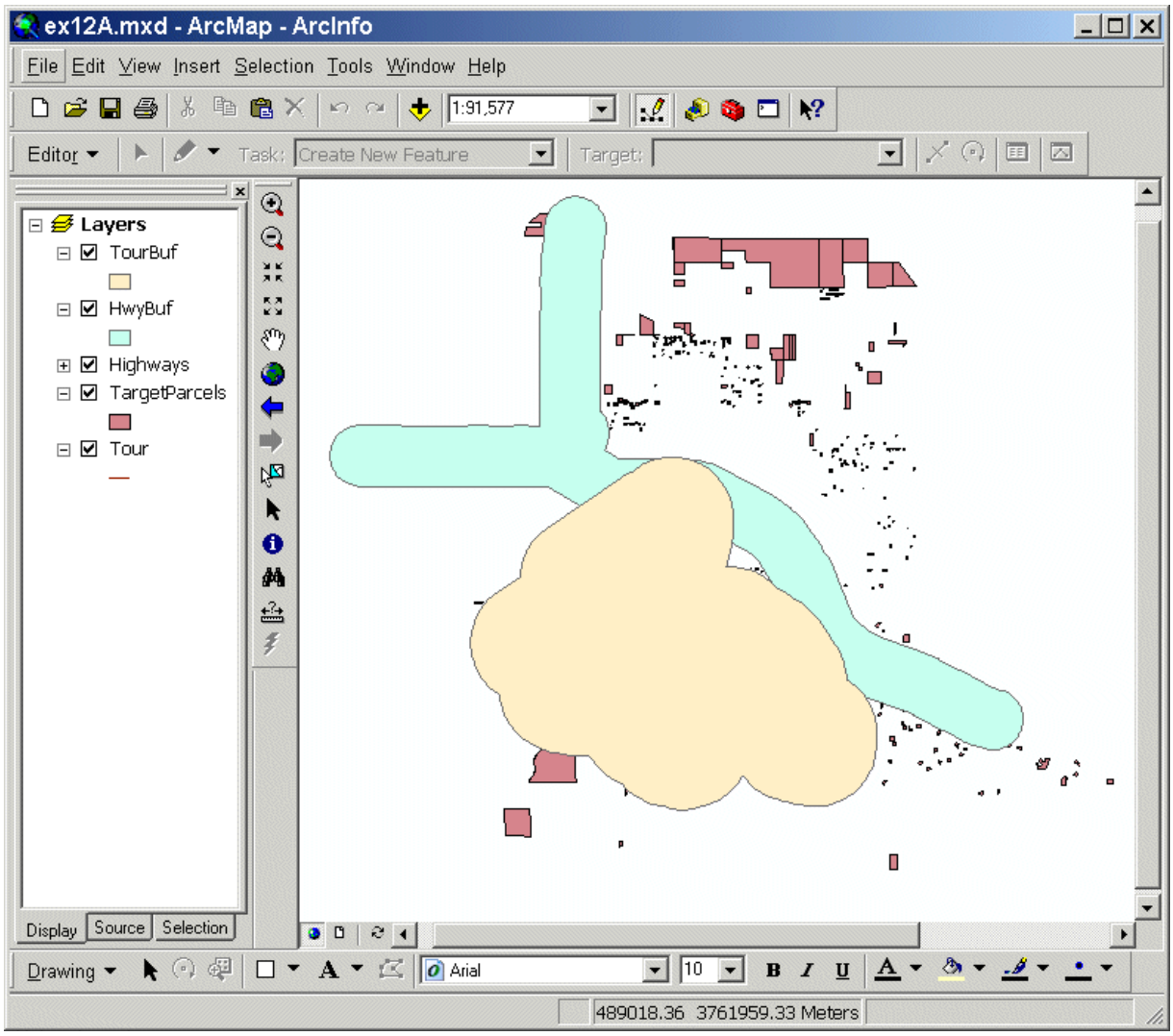


☐ Click *OK*.

☐ *Close* the Command Line window when the process has finished.

☐ The *TourBuf* feature class is added to your map.

At this point your map should look something like this:

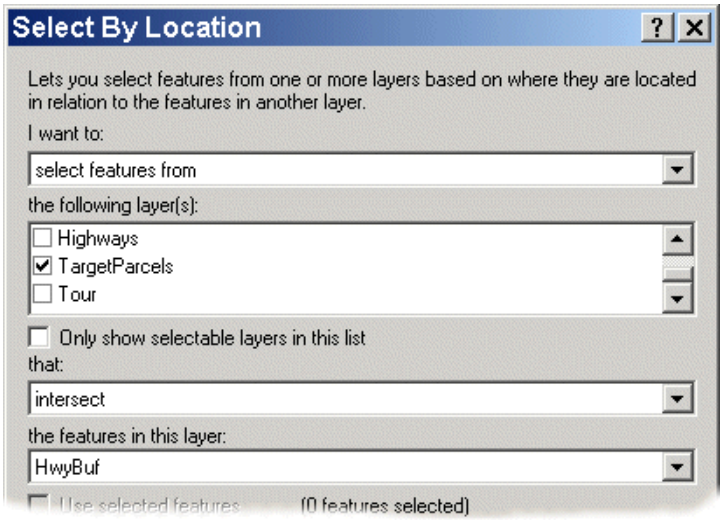


STEP 6: FIND THE PARCELS WITHIN HWYBUF AND OUTSIDE TOURBUF

Now that you have created the buffers for the highways and the driving tour, you can use them to find the parcels that meet the remaining criteria.

☐ In *ArcMap*, click *Selection* > *Select By Location*.

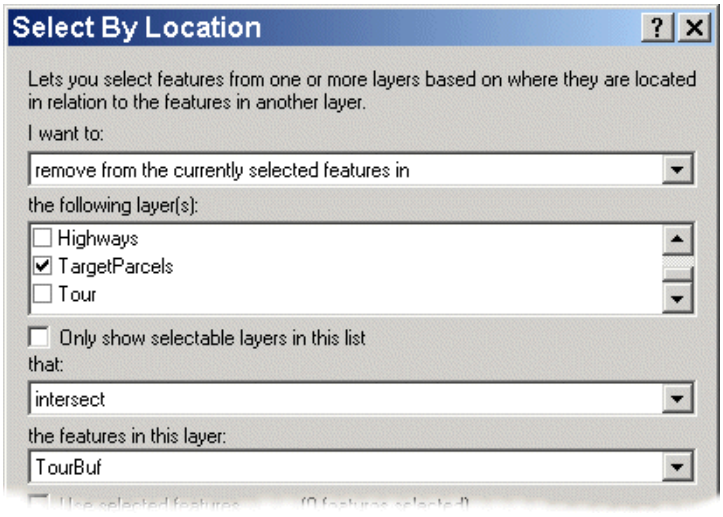
☐ Manipulate the values in the dialog box so that your selection expression reads:



☐ Click *Apply*, and click *Close* when the selection is complete.

Now that you have selected the parcels that are within 500 meters of a highway, you need to remove the ones that are also within one kilometer of the driving tour.

☐ In the *Select By Location* dialog, manipulate the values so that your selection expression matches the graphic below. Make sure you change the first clause to *remove from the currently selected features in.*



☐ Click *Apply*, then click *Close*.

☐ Turn off the *TourBuf* and *HwyBuf* polygons.

The remaining selected parcels are the ones that meet all of the stated criteria. Create a selection layer to display only the selected parcels.

☐ Right-click the *TargetParcels* layer and click *Selection > Create layer from selected features*.

☐ Rename the *TargetParcels selection* layer **`Final`**

You have succeeded in finding numerous parcels that meet all of the stated suitability criteria for an amusement park. You have one more piece of analysis to perform.

STEP 7: FINDING THE MOST SUITABLE PARCEL

In this exercise, you used several operations to locate all of the parcels that met the stated criteria. However, one important criterion was left out: parcel size. An amusement park is a big facility, so the candidate location must be at least 50 acres in size. In this step, you will discover any candidate locations that meet the size requirement. The instructions for this step are deliberately less detailed than previous steps, as they build on skills you have already acquired in previous exercises.

☐ In *ArcMap*, add a new field to the *Final* attribute table named *ACRES* (data type *Double)*.

☐ Calculate the values for the *ACRES* field. One acre equals 4046.856 square meters.

☐ Select the parcels that are at least 50 acres (there should be only one parcel that meets this minimum size requirement).

☐ Use *Export Data* to create a new feature class named *CandidateParcel*, and store it in the *\Redlands_GDB\LandRecords* feature dataset.

☐ Save your edits, stop editing, and exit *ArcMap* without saving the map document.

You have completed the first GIS analysis for the REGIS Pilot Project. You used a table join to associate additional information for the blockgroups, selected parcels based on their landuse code and their location. You then buffered the tour layer and selected highway features, and used those buffers to make additional parcel selections based on location. In the next exercise, you will perform two more GIS analyses for the REGIS Pilot Project.

EXERCISE END

EXERCISE 11B: USING GEOPROCESSING METHODS

! This section will only work with an ArcInfo license. If you have an ArcEditor license you can either conduct the analysis using the toolbar dropdown lists and layer context menus, or copy the data from the *Results* folder contained within the course CD and continue with Exercise 11C.

The needs assessment in Exercise 6 outlined three different pilot studies for evaluating the design of the REGIS. You have completed the Amusement Park location analysis in the Exercise 11A using ArcToolbox tools, the Editor toolbar, and the Select By Location menu. Now you will complete the remaining two studies by using two new techniques. You will use the Command Line Window to perform the Police Department analysis, and the Model Builder to perform the Environmental Quality analysis.

PROJECT A: POLICE DEPARTMENT PILOT STUDY ANALYSIS EXPLANATION

The Redlands Police Department has just received a grant to place a new community substation in an underserved area of town. The grant stipulates that the location for the new facility must meet the following criteria:

- Within or bordering a high crime-level area
- Light industrial or commercial zoning
- At least one kilometer from any other police facility

STEP 1: PREPARE FOR THE ANALYSIS: PROJECT A

Answer the following questions to get a complete idea of what your analysis will entail.

Question 1: What question should the analysis answer? _____

Question 2: What *REGIS* feature classes will be used in the analysis? _____

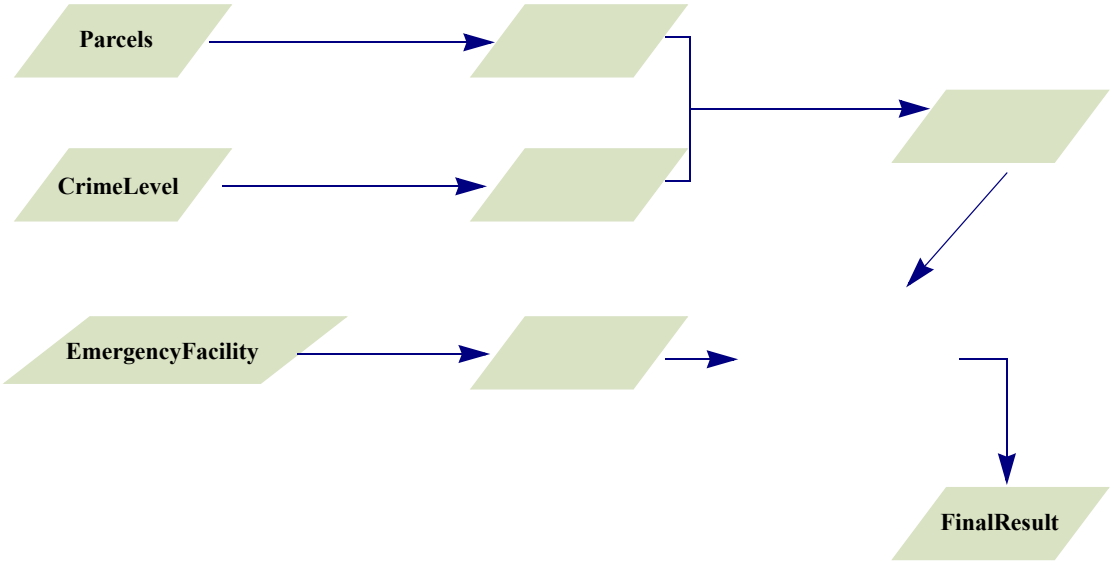
_____

_____

Question 3: What attributes and values will you query?

_____

Sketch the process and operations. Include the general names of operations or tools you will use as well as potential names of feature classes that will be created.



NOTE: In the upcoming steps, you will be supplied with names for new feature classes; you can use your own if you want, but keep track of the relationships between our names and yours.

STEP 2: PERFORM THE ANALYSIS

Now that you have thought through and diagrammed the analysis from start to finish, you will use the diagram to help guide you through the geoprocessing functions.

☐ Open *ArcMap,* and click to open *An existing map.*

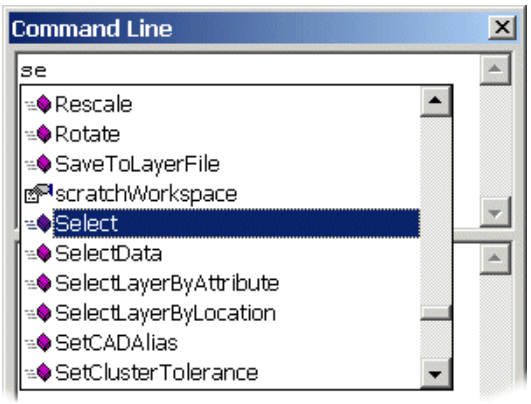
☐ Navigate to *C:\Student\igis2\MapDocuments*, and open the *Ex11B_Police.mxd.*

☐ Open the *Command Line* window .

☐ Resize the window as necessary to be able to view the map, the Table of Contents, and both upper and lower sections of the command line window.

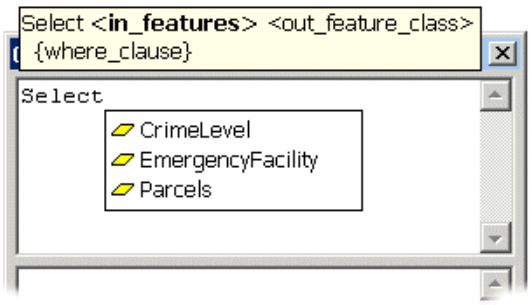
The Command Line window has behavior which prompts you for statement arguments and variables with the correct syntax. As you type in the statements provided for you, make sure you note this behavior. When you type in the command, an alphabetically sorted pop-up list will appear. Use the arrow keys to move up or down the list to make your selection and press *Enter* to select, or simply use your mouse to select the command directly in the window. When you hit the space bar after choosing the first tool or command, you will see a dropdown list appear. It will show you the arguments

needed for the command you are working with, the one you need to define will be in bold type. If the input needed is a feature class or table, you will also see a pop-up list of any datasets currently open in your map; you can use the arrow keys or mouse to select the appropriate input. Feel free to practice this functionality as you become more comfortable with the Command Line interface throughout this exercise.



(1) Type the first letter(s) of a command and the alphabetical list of tools appears, click *Enter* to choose the tool you want.

Dropdown list prompt



(2) Press the spacebar and options for the next input appear. Select with the mouse, type the first letter, or use the arrow keys, then click *Enter.*

The first geoprocess you will perform will be to select the parcels zoned Light Industrial (LI) or Commercial (COMM) and create a new layer of those polygons.

☐ In the upper section of the *Command Line* window, type the following statement:

```
Select Parcels ParcelSelect "ZONE_CODE = 'LI' OR ZONE_CODE = 'COMM'"
```

As is the case with any code, you will need to be very specific with your typing.

☐ When you have completed the statement, press *Enter* on your keyboard. Make sure that the cursor is still in the upper window.

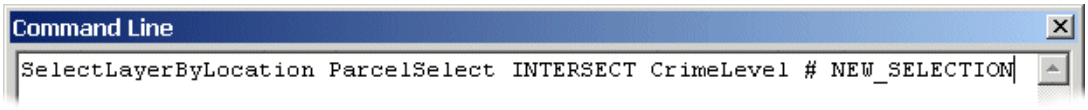
The new feature class will be added to your map. Next, you will create a new layer which contains the high crime level areas.

☐ In the *Command Line* window, type the statement:

☐ When you have finished typing the statement, press *Enter*.

Now that you have identified the Parcels with Light Industrial or Commercial use and the high crime level areas, you will use a Select By Location to further narrow the potential properties for the new Police facility.

☐ In the *Command Line* window, type the statement:



> **NOTE:** The # character acts as a placeholder for an argument or optional variable that you choose not to specify.

☐ Press *Enter*.

☐ In the *Command Line* window, type: **`Select ParcelSelect CrimeParcels`**

☐ Press *Enter*.

At this point, you no longer need to display the ParcelSelect feature class.

☐ In the *Command Line* window, type: **`Delete ParcelSelect`**

☐ Press *Enter*.

This command only removes the feature class from your map, not from the geodatabase. You may only permanently delete a feature class from within *ArcCatalog*. Now you will do a little map maintenance.

☐ Clear the selected features from *CrimeLevel*, and change the polygon symbol for *CrimeParcels* to a color that stands out against the other features in the map (perhaps a bright green or yellow).

☐ Right-click on *CrimeParcels* and click *Zoom to Layer*.

So far you have completed two of the three steps necessary to find the location of the new Police facility. Next, you will need to create a buffer around the existing police facilities.

☐ In the *Command Line* window, type: **`SelectLayerByAttribute EmergencyFacility NEW_SELECTION "FACILITY_CODE = 500"`**

☐ Press *Shift* + *Enter*. This will allow you to add another command to run after the first command has finished. You should see the cursor move to a new line.

☐ Type the command: **`Buffer EmergencyFacility PoliceBuf 1000 FULL ROUND ALL`**

☐ Press *Enter*.

☐ Clear the selected features by using *Selection* > *Clear Selected Features* menu.

☐ In the *Command Line* window, type: **`SelectLayerByLocation CrimeParcels INTERSECT PoliceBuf`**

☐ Press *Enter*.

You have selected the parcels that are within one kilometer of an existing police facility. However, the purpose of this analysis is to locate parcels at least one kilometer *away* from an existing police facility. You will need to switch your current selected set.

☐ In the *Command Line* window, type: **`SelectLayerByAttribute CrimeParcels SWITCH_SELECTION`**

☐ Press *Enter*.

☐ To export your selected candidate parcels to a new feature class, type: **`Select CrimeParcels FinalParcels`**

☐ Press *Enter*.

Question 4: How many parcels are potential sites for the new police facility?

_____

As the GIS professional involved in the REGIS Pilot Project, you have completed the analysis for the location of the new police facility based on the parameters provided to you by the Redlands Police Department. However, these parameters were not able to define a single optimal site as a solution; your analysis identified 31 potential properties. It is now up to the Redlands Police Department to make the final determination for where the new police facility will be located.

☐ Save the changes to *Ex11B_Police.mxd*. You will open another map document in the next section.

In this step of the exercise, you used the Command Line window to perform your GIS analysis and geoprocessing. You used the Select, SelectLayerByAttribute, SelectLayerByLocation, Delete, and Buffer commands to perform the analysis. In the next section, you will use the Model Builder interface to complete the REGIS Pilot Project.

ANSWERS TO PROJECT A: POLICE DEPARTMENT PILOT STUDY QUESTIONS

Question 1: What question should the analysis answer?

Answer: Where should the new police station go?

Question 2: What REGIS feature classes will be used in the analysis?

Answer: CrimeLev, Parcels, EmergencyFacility

Question 3: What attributes and values will you query?

```
ZONE_CODE = 'LI' OR ZONE_CODE = 'COMM'
CRIME_LEVEL = 'HIGH'
FACILITY_CODE = 500
```

Question 4: How many parcels are potential sites for the new police facility?

Answer: 31 (your answer may be different)

PROJECT B: ENVIRONMENTAL QUALITY PILOT STUDY ANALYSIS EXPLANATION

Over the past decade, an increasing amount of attention has been paid to the location of facilities that handle hazardous waste or materials. In many instances, an inverse relationship has been found between the number of facilities handling hazardous materials in a particular area and the income of the area residents. In other words, the less affluent the residents of a particular area are, the more hazardous materials facilities are located within their area. In this study, you will try to determine if this type of inverse relationship exists in Redlands by comparing census blockgroup demographics and the locations of facilities handling hazardous materials.

- The federal standard poverty level is an annual income of less than $15,000.
- Conduct an analysis to determine how many hazardous materials facilities are within one kilometer of low income block groups.
- Determine how many census blocks fall within both low income areas and within one kilometer of a hazardous materials facility.

STEP 1: PREPARE FOR THE ANALYSIS: PROJECT B

Answer the following questions to get a complete idea of what your analysis will entail.

Question 1: What are the main questions? _____

_____

Question 2: What are the criteria? _____

_____

Question 3: Which feature classes will be used in the analysis? _____

_____

_____

_____

Question 4: What attributes and values will you query? _____

_____

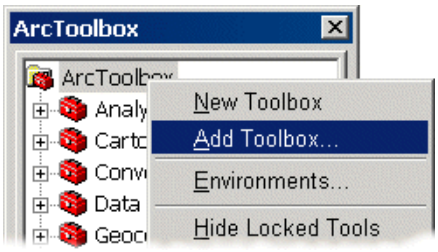
STEP 2: EXAMINE AND RUN MODEL IN MODEL BUILDER

Now that you have examined your data and considered the analytical approach, it is time to implement the GIS functions to complete this part of the REGIS project. In the previous section of this exercise, you were guided through the command line process which used a non-visual approach. In this section, you will use previously created ArcToolbox models to automate a number of GIS processes in a more visual interface.

☐ In *ArcMap,* navigate to *C:\Student\igis2\MapDocuments* and open *Ex11B_Enviro.mxd.*

☐ If necessary, open the *ArcToolbox* window.

☐ Right-click on *ArcToolbox*, and click *Add Toolbox.*



☐ Navigate to *C:|Student\igis2\MapDocuments.*

☐ Click *Custom Toolbox*, and click *Open.*

☐ In the *ArcToolbox* window, expand the *CustomToolbox.*

☐ Right-click on the *EnviroModel* and click *Edit.*

Take some time to examine the model. You can see that one of the obvious benefits of the Model Builder is that it allows you to easily visualize your geoprocessing work flow.

☐ Right-click on the *Add Join* box and click *Open.*

Note that the dialog is the same as you would see if you opened the tool from within ArcToolbox.

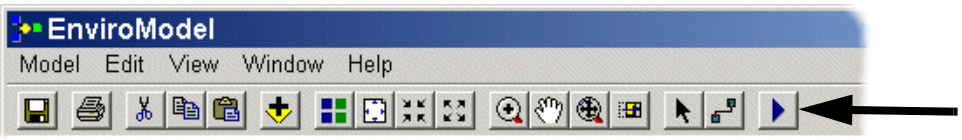
☐ Click *OK.*

☐ Right-click on the *Select Layer by Attribute* box, and click *Open.* Note that the SQL statement has been added, and will select the low income parcels.

☐ Click *OK.*

Now that you have examined this simple model and some of its parameters, you will run the model.

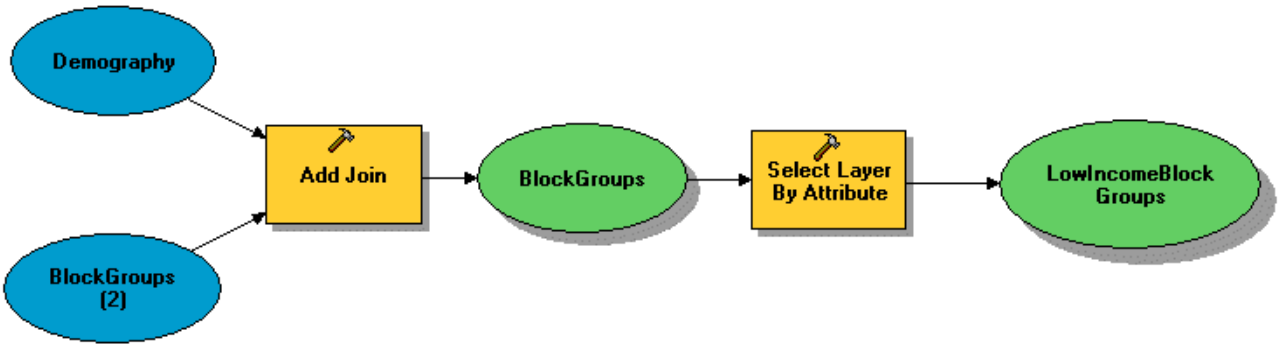
☐ Click *Run*.



The Command Line Window will appear and show the progress of the geoprocessing operations. Note that the objects in the model itself will also change color as the functions are being performed.

☐ Close the *Command Line* window when the processes have finished.

Notice that the icons within the model elements now have shadows. This indicates that the processes have been run successfully.



☐ Close the *Model Builder* window, and save your changes.

☐ In *ArcMap*, press the *F5* key or the *Refresh View* button to show the results of your selection.

STEP 3: RUN A MODEL IN ARCTOOLBOX

In the previous step, you opened the EnviroModel file to examine the parameters and then ran the processes from within the Model Builder window. In this step, you will run a model directly from ArcToolbox without the extra graphical examination. In this way the model behaves more like any tool in the toolbox. However, just so that you know what the model is doing, you will open it.

☐ Right-click *EnviroModelTwo* and click *Edit.* Examine the model and its parameters.

Question 5: Which step of the *Environmental Quality Pilot Study* analysis does this model perform?_____

☐ Close the *Model Builder* window.

☐ In *ArcToolbox,* right-click *EnviroModelTwo* and click *Open.*

☐ Click *OK* on the *ArcToolbox* dialog (you have not set any parameters for this tool).

☐ Close the *Command Line* window when the process has finished.

☐ Press the *F*5 key or the *Refresh View* button to see the newly selected features.

☐ Right-click *BlockGroups* > *Selection* > *Zoom to selected features.*

Because this is a very small sample dataset, you can easily determine the number of features which answer the questions posed by Environmental Quality Pilot Study of the REGIS analysis.

Question 6: How many hazardous materials facilities are within one kilometer of low income census block areas?_____

Question 7: How many low income block groups are within one kilometer of hazardous materials facilities?_____

Next, you will export the results of your analysis for use in the final REGIS map.

☐ Right-click *HazMatHandlers* and click *Data* > *Export Data.*

☐ Save the new feature class as *LowIncHazMat* as a stand-alone feature class in the *Redlands_GDB.mdb.*

☐ When prompted, add the layer to your map.

☐ Using the same technique, save the low income *BlockGroup* selections to the *Redlands_GDB.mdb* and name it *LowIncBlocks.*

☐ Add this layer to the map as well.

☐ Clear the selected features.

☐ Remove all the layers in the map except *LowIncHazMat* and *LowIncBlocks.*

☐ Save the map document in *C:\Student\igis2\MapDocuments*, and name it *Ex11_Final.*

You have now completed the REGIS Pilot Studies. In this last exercise, you used the Model Builder to create a join between the BlockGroup feature class and the Demography table, and then used the joined attributes to select low income areas. You used a second model to select Hazardous Materials Facilities by their location.

EXERCISE END

ANSWERS TO PROJECT B: ENVIRONMENTAL QUALITY PILOT STUDY QUESTIONS

Question 1: What are the main questions?

Answer: How many hazardous materials facilities are within one kilometer of low income areas? How many census blocks fall within both low income areas and within one kilometer of hazardous materials facilities?

Question 2: What are the criteria?

Answer: One kilometer from hazardous materials facilities. Census block groups with median income less than $15,000.

Question 3: Which feature classes will be used in the analysis?

Answer: BlockGroup, HazMatHandlers, Blocks

Question 4: What attributes and values will you query?

Answer: `BlkGrp_Dmg.INC_MEDN < 15000`

Question 5: Which step of the *Environmental Quality Pilot Study* analysis does this model perform?

Answer: Locate hazardous materials facilities within one kilometer of census block groups with a median income of less than $15,000.

Question 6: How many hazardous materials facilities are within one kilometer of low income census block areas?

Answer: 2

Question 7: How many low income block groups are within one kilometer of hazardous materials facilities?

Answer: 3

EXERCISE 11C: MAKING A MAP

Now that your analysis is complete, you will create a presentation to communicate the results for all three pilot studies. As is the case with any map, you will spend most of your time adjusting the symbology of your features to create a cartographically coherent output document.

STEP 1: BUILD THE MAP GRAPHIC BODY

☐ In *ArcMap*, close *ArcToolbox*.

☐ Add these additional feature classes to the map:

- *Streets*
- *CityLimit*
- *CandidateParcel* (for the amusement park)
- *FinalParcels* (for the police facility)

☐ Right-click the *Streets* layer and click *Properties*.

☐ On the *Layer Properties* dialog, click the *Symbology* tab.

The streets are automatically displayed by their subtype, but it is not necessary to display every subtype on this map. You will remove the subtypes you do not want displayed.

☐ Uncheck the checkbox for displaying <*all other values*>.

☐ In the list of subtypes, click the *Local Streets* subtype, then click the *Remove* button.

☐ Using this same method, remove all of the other subtypes except *Highways* and *Major Roads*.

☐ When finished removing the subtypes, click *Apply* on the *Layer Properties* dialog.

You have not deleted any data, just removed those subtypes from being displayed. Now you will change the symbology for the Streets layer features.

☐ Double-click the *Highways* subtype symbol.

☐ On the *Symbol Selector* dialog, click the *Highway* symbol and click *OK*.

☐ Double-click the *Major Roads* subtype symbol.

☐ On the *Symbol Selector* dialog, click the *Major Road* symbol and click *OK*.

Now that the Streets layer features are displayed appropriately, you will adjust the display of the other layers.

☐ If necessary, move the *CityLimit* layer to the bottom of the Table of Contents list, and click on the symbol for the layer.

☐ On the *Symbol Selector* dialog, scroll down the list of symbols and click the *Beige* symbol, then click *OK*.

☐ Left-click the symbol for *LowIncHazMat* to open the *Symbol Selector.*

☐ Click *More Symbols* and uncheck the *ESRI* symbol style. This will make it easier to find the symbol you are going to use next.

☐ Click *More Symbols* and add the *Environmental* style.

☐ Scroll down to the ninth row of symbols, and select the *Hazardous* symbol  .

☐ Change the symbol size to 12.

☐ Click *More Symbols* and turn off the *Environmental* style, and turn on the *ESRI* style.

☐ Click *OK* to close the *Symbol Selector.*

☐ Select fill colors for the remaining three polygon feature classes that you feel will look good in your final map.

☐ Right-click on *Citylimit* and click *Zoom to layer.*

The map graphic body is now complete. In the next step, you will add data frames to enhance the appearance of your final map.

STEP 2: CREATE NEW DATA FRAMES

You will have noticed that the results for each of the three REGIS pilot analyses are not equally visible in a single map. In order to more clearly present the results of the projects on one piece of paper, you will utilize inset windows to show areas of interest at a larger scale than the main map. Thus, you will need to create additional data frames in your data view that you will use when you create the final map layout.

☐ From the *Main Menu,* click *Insert > Data Frame.*

☐ Rename the new data frame *Police Sites.*

☐ In the *Layers* data frame, hold down the *Ctrl* key and select the *Streets* and *FinalParcels* feature classes.

☐ With the cursor still hovered over one of the selected feature classes, right-click and select *Copy.*

☐ Right-click the *Police Sites* data frame and click *Paste Layer(s).*

☐ In the *Police Sites* data frame, right-click on *FinalParcels* and click *Zoom to layer.*

Now that you are zoomed in to a larger scale, you can afford to add a bit more detail to the streets layer.

☐ Right-click the *Streets* layer and select *Properties* > *Symbology.*

To save you some time, a layer file has been created with symbology that works well at this scale.

☐ On the *Symbology* tab, click *Import.*

☐ On the *Import Symbology* dialog, click the *Browse* button, and navigate to *C:\Student\igis2\DataSources.*

☐ Select the *Streets.lyr* and click *Add.*

☐ Click *OK* to all the dialogs.

☐ Click the box to the left of the *Police Sites* data frame to collapse all the layers.

Now you will create a new data frame for the hazardous materials study area.

☐ From the *Main Menu,* click *Insert* > *Data Frame.*

☐ Name the new data frame *Hazards and Low Income.*

☐ In the *Layers* data frame, hold down the *Ctrl* key and select the *LowIncHazMat, Streets,* and *LowIncBlocks* layers.

☐ Right-click over one of the selected layer names, and click *Copy.*

☐ Right-click the *Hazards and Low Income* data frame, and click *Paste Layer(s).*

☐ In the *Hazards and Low Income* data frame, right-click on *LowIncBlocks* > *Zoom to layer.*

☐ Click *Fixed Zoom Out* two or three times. You want to have a bit more locational context for this data frame.

☐ Collapse the layer display tree for the *Hazards and Low Income* data frame. You will leave the symbology as is.

☐ Add a new data frame and name it *Amusement Park Site.*

☐ Copy the *CandidateParcels, Streets,* and *CityLimit* layers into the new data frame.

☐ Zoom and pan within the *Amusement Park Site* data frame to achieve a balanced view of the candidate parcel. You do not want too much white space north of the parcel, but you do not want to have the extent too small.

> **NOTE:** A scale between 1:30,000 and 1:40,000 should look appropriate, depending upon the size of your monitor and the application window (which should be maximized at this point).

☐ Collapse all layers.

☐ Save your map document.

STEP 3: APPLY A MAP TEMPLATE

The map graphic body is the most important component of a map, but the other map elements and their layout around the map graphic body can profoundly influence whether a map is clearly understood or not. ArcGIS includes several map templates that provide predefined locations for map element placement. In your organization, you may develop your own templates. In this step, you will apply a predefined map template to the layout you are creating. The template is created for a layout in landscape orientation so you will change your page setting first.

☐ Click *File* > *Page and Print Setup...*

☐ For *Orientation*, click *Landscape*.

☐ Click *OK* to close the *Page and Print Setup* dialog.

☐ Click *View* > *Layout View.*

ArcMap draws all of the data frames in your data view on top of one another in the center of the virtual page. This is because the software has no way of knowing where you want the final location of these data frames to be. You could manually select each data frame and move it around, but a template has been created that will save you some of that effort.

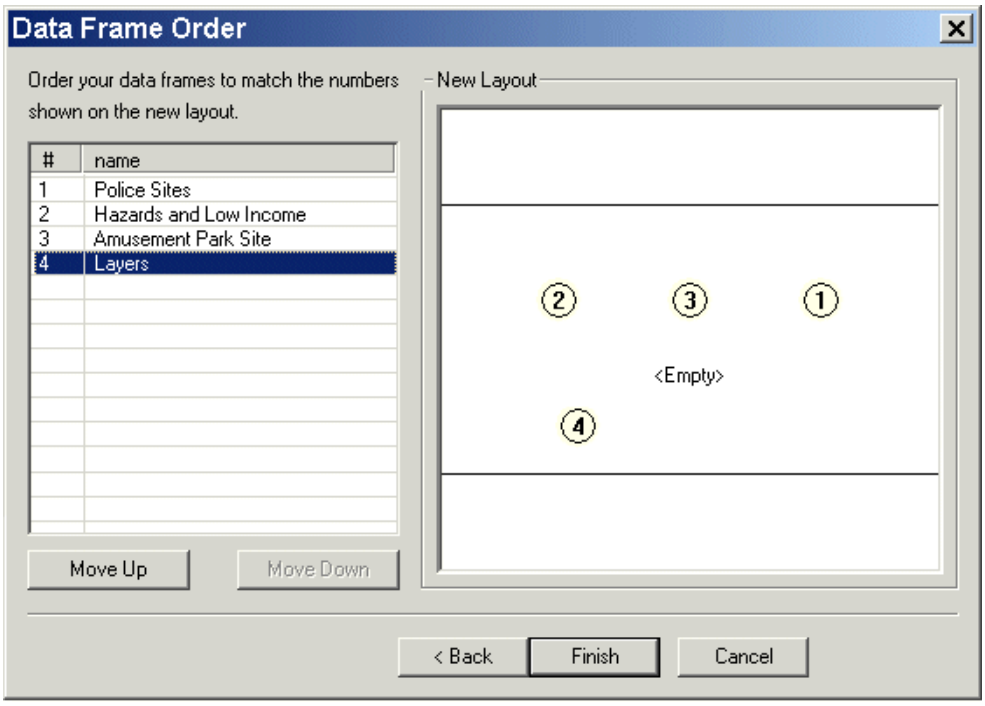
☐ On the *Layout* toolbar, click the *Change Layout* button .

☐ On the *Select Template* dialog, click the *Browse* button.

☐ Navigate to *C:\Student\igis2\MapDocuments*, select *Ex11_FinalLayout.mxt* and click *Open*.

The Data Frame Order dialog will appear.

☐ Select the *Layers* data frame, and use the *Move Down* button to move *Layers* to position 4.



☐ Click *Finish.*

Notice that the chosen template is applied to the layout, and that a scale bar and north arrow are already included. Now you will add a Legend and text to complete the map.

STEP 4: ADD A LEGEND AND MANIPULATE THE PROPERTIES

☐ In the map layout, confirm that the *Layers* data frame is the focus frame. It will be outlined with a dashed gray line.

☐ In the *Main Menu*, click *Insert* > *Legend*. The *Legend Wizard* opens.

By default, your map legend is oriented vertically, but this map calls for a horizontally oriented legend. You change this by adding more columns to your legend.

☐ For the *Set the number of columns in your legend:* click `3`

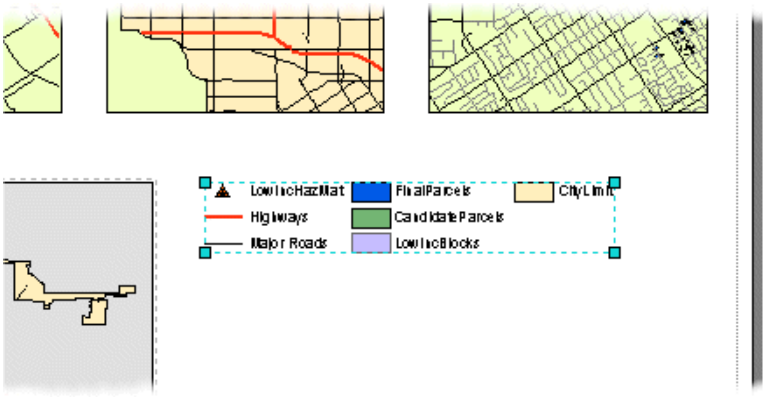
☐ Click *Next.*

☐ In the *Legend Title* text box, delete the text.

☐ Click *Preview.* The legend will be added to your map.

☐ Click *Finish.*

☐ Use the *Select Elements* tool to move the legend box to a location to the right of the Redlands overview data frame.



Upon examination, setting 3 columns results in the Citylimit symbol being drawn in a column by itself. You will move it to the same column as the other polygon symbols.

☐ With the *Legend* box still selected, right-click and click *Properties*.

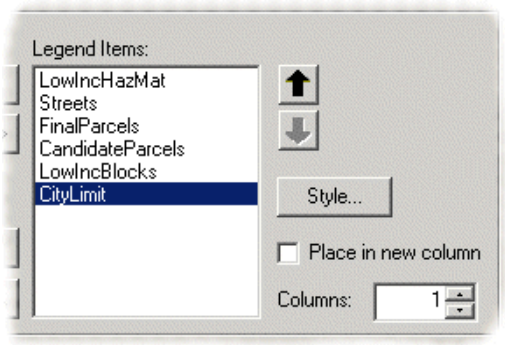
☐ In the *Legend Properties* dialog, click the *Items* tab.

☐ In the *Legend Items* list, select *Citylimit.*

☐ Uncheck *Place in new column.*

☐ Click *OK.*

☐ Move the legend so that the top margin is in line with the top margin of the Redlands overview map.



You have now created a basic legend. If time allows, you can explore more of the legend properties, and perhaps add a border or change the background color.

> **NOTE:** You can manipulate individual legend elements by converting the legend to graphics. However, you will lose the dynamic link between your ArcMap Table of Contents and the legend properties.

Your map is almost complete. Now you will add some text which will effectively communicate to the map viewers what they are looking at.

STEP 5: ADD INFORMATIVE TEXT AND A TITLE TO THE MAP

A map title would be a good place to start.

☐ On the *Drawing* toolbar, click the *New Rectangle Text* tool.

☐ Draw a new text rectangle across the top of the map

☐ Right-click inside the text box, and click *Properties*. Select the *Text* tab if necessary.

☐ In the *Text:* window, type: **`Redlands Enterprise Geographic Information System (REGIS) Pilot Studies`**

☐ Click *Change Symbol.*

☐ Change the text properties to: Times New Roman, bold, font size 20.

☐ Click *OK* to close both dialogs.

Now you will add brief descriptive titles to the larger scale pilot study maps.

☐ On the *Drawing* toolbar, click *New Text.*

☐ In the small text box which is added to your map, type: **`Final Amusement Park Site`**

☐ Click *Enter*.

☐ Right-click on the selected text box and click *Properties*.

☐ Change the text properties to: Arial, font size 14.

☐ Click *OK*.

☐ Move the text box to be centered below the appropriate map.

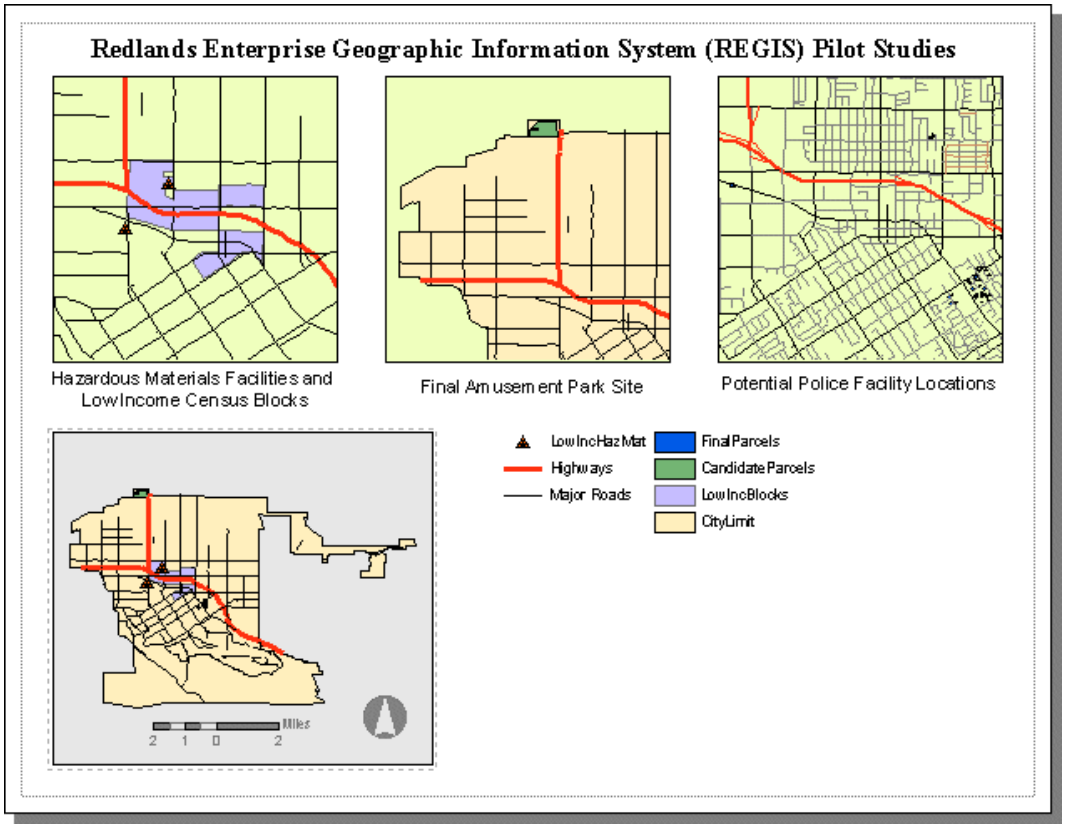
You will use the same text properties for the remaining two pilot study maps. You will save yourself a bit of time by copying and pasting the existing text box, and only typing in the new text.

☐ Select the *Final Amusement Park Site* text box, and click *Ctrl+C*.

☐ Click *Ctrl+V* twice.

☐ Access the properties for each new copied text box to create titles for the two remaining maps, and place them centered beneath their corresponding images. Use names that are descriptive and concise.

Although it is far from finished, your map now contains enough basic elements to be useful. It might look similar to the graphic below depending on what changes you explored beyond the listed steps.



If you have time, you can continue to work on your map using the suggestions supplied in the Challenge steps. Otherwise, you have finished the map. If your class computer has access to a printer, perhaps you want to print a copy as a souvenir of this great course.

☐ Exit *ArcMap* without saving your map, or move on to the Challenge steps.

In this final step of Exercise 11, you completed the final map layout of your REGIS Pilot Study analyses. You created new data frames, and applied a pre-set template and to those data frames. You added a new legend and altered its properties, and you added descriptive text.

CHALLENGE: IMPROVE THE MAP

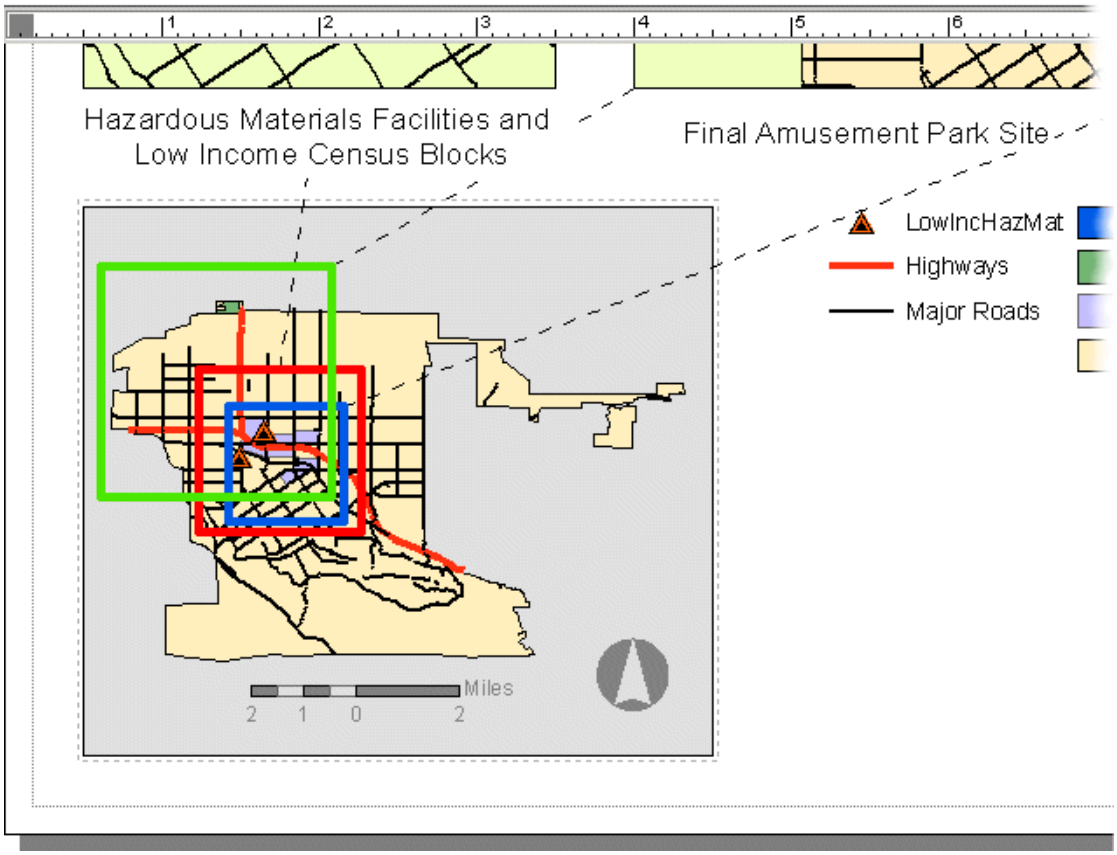
While the map you have produced is functional, it is missing information that would probably be added if this were meant for actual public consumption. Continue working in ArcMap to improve the map according to your own personal taste, or use the suggestions below to provide ideas.

- Make the legend labels larger and more descriptive.
- Add a reference grid.
- Add a label class for the road and highway features.
- Add text which states that not all the maps are displayed at the same scale.

CHALLENGE: ADD EXTENT RECTANGLES

Use the data frame properties of the Layers data frame to add extent rectangles to your map. You may choose to accept the default extent rectangle and leader symbology, but you are encouraged to explore the functionality and change the default settings so that the boxes stand out against the Redlands overview map, and the extent leaders are not too obtrusive on your map.

☐ Your new extent rectangles may look something like this:



EXERCISE END

A

ESRI data license agreement

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