

Mapping where things are

The simplest form of analysis is to show features on a map and let the viewer do the analysis in their mind's eye. It falls on the cartographer to use various colors and symbols and to group the data in a logical manner so that the viewer can clearly see the information being highlighted. More complex methods involve categorizing the data and designing symbology for each category.

Tutorial 1-1

Working with categories

The most basic of maps simply show where things are without complicated analysis. You can enhance these useful maps by symbolizing different categories. By symbolizing categories, you can show both the location and some characteristics of the features.

Learning objectives

- *Work with unique value categories*
- *Determine a display strategy*
- *Add a legend*
- *Set legend parameters*
- *Use visual analysis to see geographic patterns*

Preparation

- *Read through page 29 in Andy Mitchell's The Esri Guide to GIS Analysis, volume 1 (Esri Press, 2001).*

Introduction

The first and simplest type of geographic analysis is visual—that is, view it. You can display data on a map using various colors and symbology that enable the viewer to begin to see geographic patterns. But deciding what aspects of the features to highlight can take some thought.

It may be as important to map where things are not located as it is to map where they are. Visual analysis allows you to see the groupings of features, as well as areas in which features are not grouped. All of this analysis takes place in the viewer's mind, considering that visual analysis does not quantify the results. In other words, display the data using good cartographic principles, and the viewer will determine what, if any, geographic patterns might exist. Viewers do not get an explicit answer. Rather, they can determine one on their own.

You can aid the process by determining the best way to display the data, but the proper method will depend on the audience. If the audience is unfamiliar with the type of data being shown or the area of interest on the map, you may want to include more reference information about the data. You may also want to simplify the way the data is represented or use a subset of the data to make the information more easily understood by a novice audience.

Conversely, if the audience is technically savvy and familiar with the data, you can make the symbology more detailed and specific.

In making the map, you will decide what features to display and how to symbolize them. Sometimes simply using the same symbol to show where features are located is enough. For example, seeing where all the stores are in an area might give you an idea of where the shopping district is. All you really want to know is where the stores are, and not what each type of store is.

A more complex method of displaying the data is to use categories, or symbolize each feature by an attribute value in the data. This method also requires a more complex dataset. Your dataset will need a field to store a value that describes the feature's type or category. A dataset of store locations may also have a field storing the type of store: clothing, convenience, auto repair, supermarket, fast food, and so on.

For other instances, you might want to see only a subset of the data. These cases can still be shown with a single symbol but using only one value of a field. It might be fine to see where all crimes are occurring, but the auto theft task force may want to see only the places where cars have been stolen. The extra data will only confuse the map's message and possibly obscure a geographic pattern.

When making the map, you can use this "type" or "category" field to assign a different symbol to each value. You might symbolize clothing stores with a picture of a clothes hanger or a supermarket with a picture of a shopping cart. This visualization still does not involve any geographic processing of the data; you are merely showing the feature's location and symbolizing it by a type. The analysis is still taking place in the viewer's mind.

Scenario

You are the GIS manager of a city of 60,000 in Texas, and the city planner is asking for a map showing zoning. The target audience is the city council, and each member is very familiar with the zoning categories and the types of projects that may be built in each area. Council members will frequently refer to this map to see in which zoning category a proposed project may fall and what effect that project might have on adjacent property. For example, a proposed concrete mixing plant would only be allowed in an industrial district and would adversely affect residential property if the plant was allowed to be near housing.

Because you will have a technically savvy audience, you can use a lot of categories and not worry about the map being too confusing or hard to read. The city planner asks that you use colors that correspond to a standard convention used for zoning. Later, you will work with setting categories and symbology.

If you have not already downloaded the data for this book, go to the Esri Press online resources at esri.com/esripress-resources. From there, you can download the exercise data, as well as a free trial of ArcGIS.

1-1

1-2

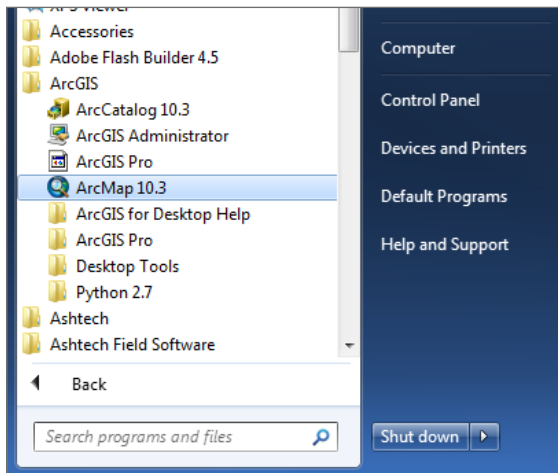
1-3

Data

The first layer is a zoning dataset that contains polygons representing every zoning case ever heard by the city council. An existing field carries a code that represents the zoning category assigned to each area. This code was already set as the “value field” to define the symbology, so you will only deal with how the categories are shown. The city created this data, and a list of the zoning codes and what they mean, called a *data dictionary*, is provided later in the chapter. You may also find similar datasets from other sources that have zoning classifications, and it is important to also get their data dictionaries.

Start ArcMap and open a map document

- 1 On the Windows taskbar, click Start > All Programs > ArcGIS > ArcMap 10.3.x.



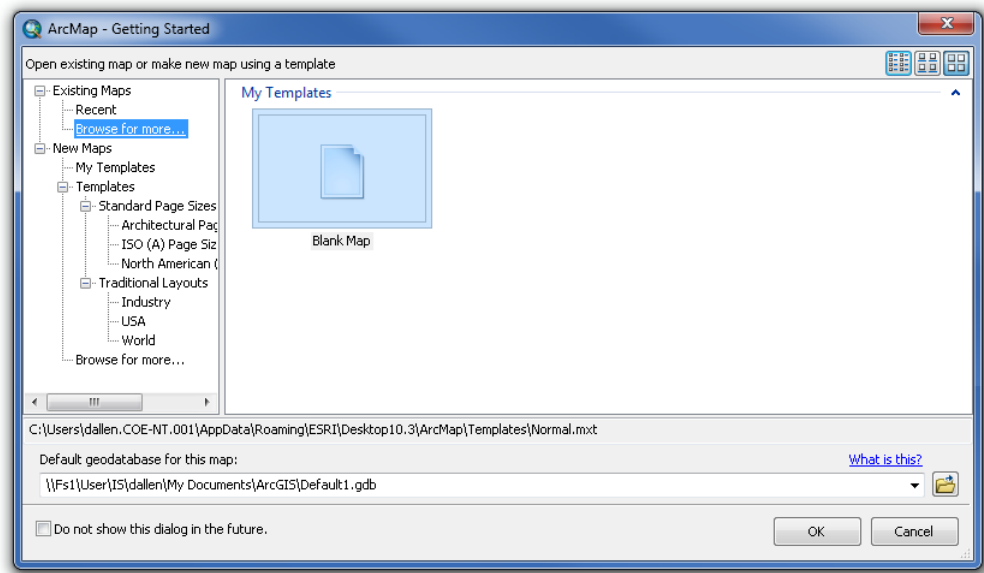
Depending on how ArcGIS and ArcMap have been installed, or which Windows operating system you are using, there may be a slightly different navigation menu to open ArcMap. You may also have an ArcMap icon on your desktop, which will start ArcMap when you double-click it.

- 2
- In the resulting ArcMap window, click the Existing Maps header and then click “Browse for more.”

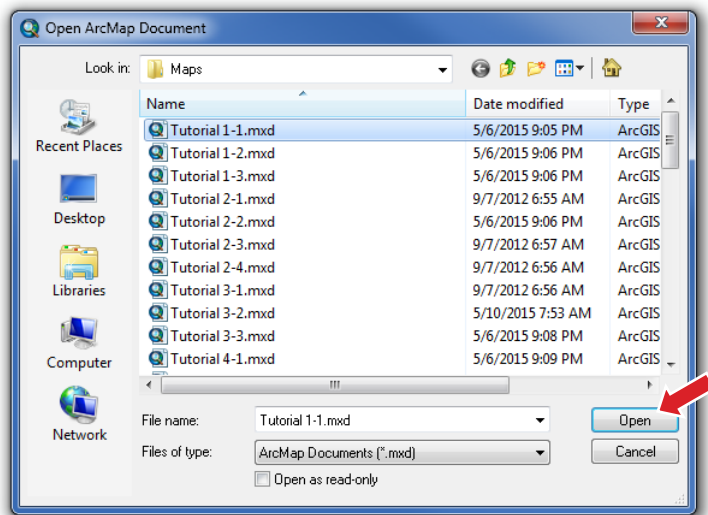
1-1

1-2

1-3

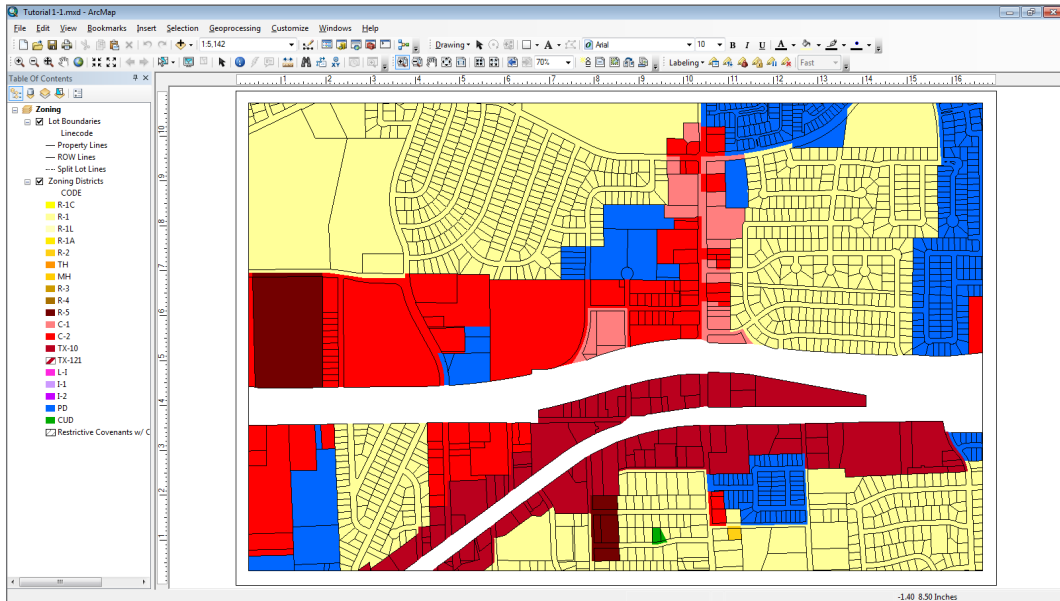


- 3
- Browse to the drive on which the tutorial data has been installed (for example, C:\EsriPress\GIST2\Maps), click Tutorial 1-1.mxd, and then click Open.



This action adds the map document to your Existing Maps list. The list includes your most commonly used maps.

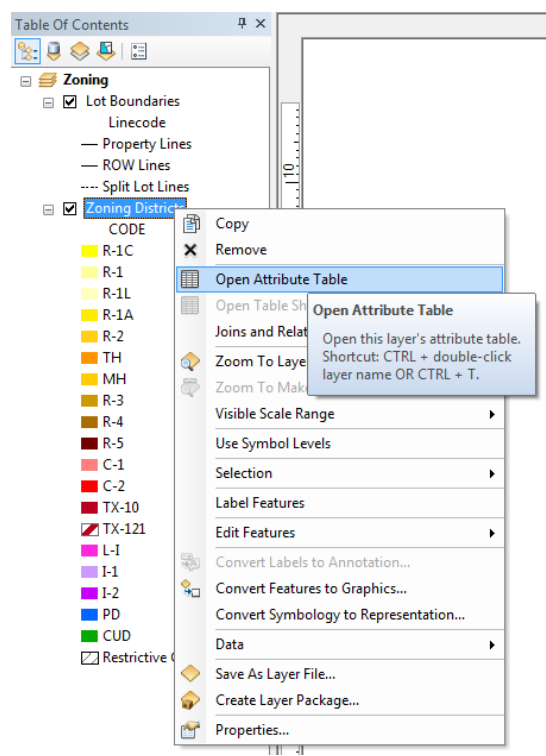
The data shown is zoning categories, each zone in a different color. Note that your toolbar locations may differ from the locations shown. The city planner, for whom you are doing this work, uses this map to visually determine the zoning classification of property.



Open a layer attribute table

1-1
1-2
1-3

- 1 In the table of contents, right-click the Zoning Districts layer and click Open Attribute Table.



The data is shown in a tabular format. The columns are the fields in which the data is stored for this layer, and the rows represent each individual feature in the layer.

Zoning Districts											
OBJECTID *	Shape *	AREA	PERIMETER	CODE	ORDNO	SPECIAL	DISPLAY	CODE2	ACRE	Shape_Length	Shape_Area
44	Polygon	787034.813	4832.484	I-1	0			I-1	18.068	4948.535032	810297.792243
45	Polygon	321591.25	2396.213	R-5	0		YES	R-5	7.383	2367.725868	313835.963925
46	Polygon	94350	1402.351	R-2	0		SM	R-2	2.166	1394.210965	93066.219341
47	Polygon	36494	764.79	R-2	0	SP	NO	R-2	0.838	745.767163	34710.942588
48	Polygon	1048927.5	4519.677	R-1L	1545		YES	R-1L	50.401	4486.306627	1033545.506086
49	Polygon	888936.5	4631.71	C-2	0		YES	C-2	50.401	4595.428226	872040.145182
50	Polygon	142654.688	1689.308	CUD	753		SM	R-2	3.275	1702.75691	144575.237925
51	Polygon	777802.125	3734.871	MH	0		YES	MH	17.856	3712.666575	770627.471658
52	Polygon	1005325.5	4345.54	R-1L	0		SM	R-1L	23.079	4291.724818	995697.968501
53	Polygon	2514783.5	7596.229	C-2	0		YES	C-2	57.731	7588.156186	2522663.096898
54	Polygon	66492.875	1047.754	R-1A	1612		SM	R-1A	599.313	1157.851657	82009.463216
55	Polygon	165030.25	1625.612	R-5	0		YES	R-5	3.789	1617.878456	163566.689062
56	Polygon	1242138.875	10677.555	TX-10	0		YES	TX-10	28.516	10701.508225	1212326.630195
57	Polygon	296698.375	2508.016	PD	1173		YES	C-2	6.811	2532.333658	303067.263314
58	Polygon	12836.25	470.518	PD	1513		SM	C-1	0.295	573.613225	19244.473385
59	Polygon	772995.125	3695.549	TX-10	0		YES	TX-10	17.746	3673.591014	774492.850081

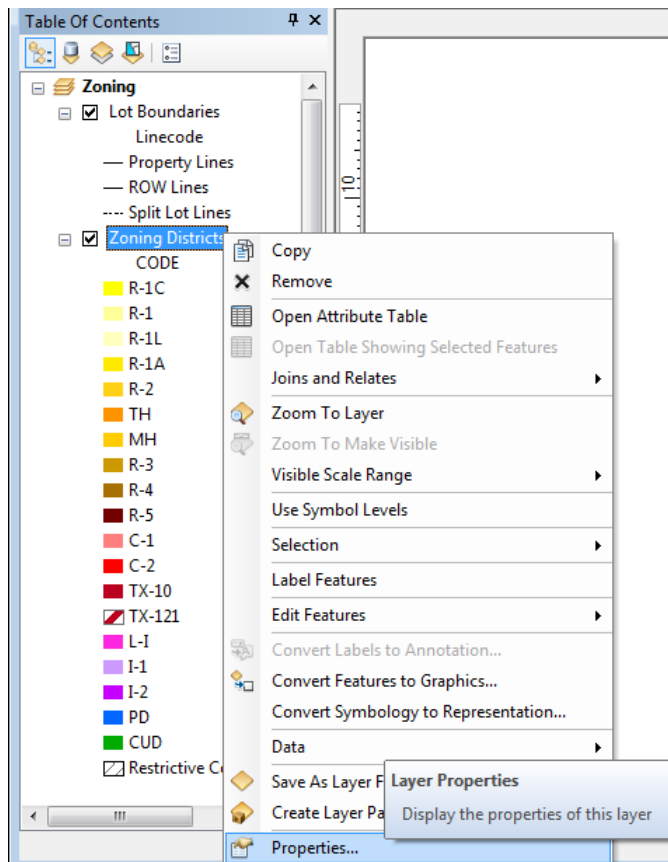
The field CODE contains the zoning category for each parcel, representing various single-family, multifamily, commercial, and industrial uses. Other fields contain the ordinance number (ORDNO) for the zoning case, a display marker, and the acreage.

2 Close the attribute table.

Change a category label

The layer came with the code values displayed for each category. Although these values may be fine for someone who works with these codes every day and recognizes the underlying meaning, someone who is not familiar with the codes will want a more descriptive label. You can change the labels in the symbol properties of the layer.

1 In the table of contents, right-click the Zoning Districts layer and click Properties.

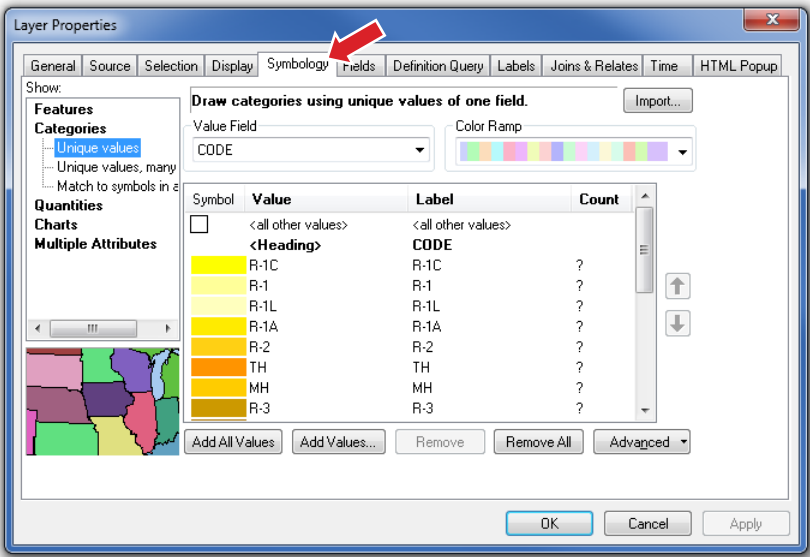


2 Click the Symbology tab.

1-1

1-2

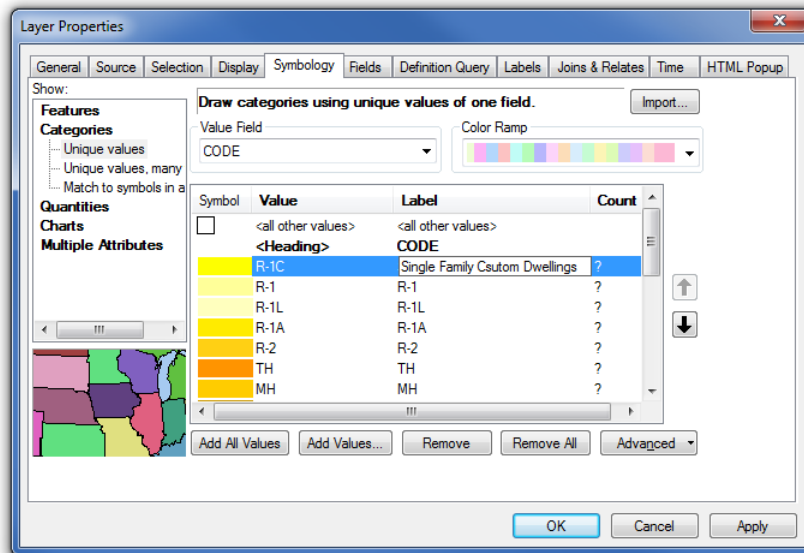
1-3



Note that the Categories selection is set to Unique values, and the Value field is set to CODE. This setting means that each unique value of the field CODE will be represented in the legend.

To a city planner or someone who is experienced with zoning districts, these codes tell the whole story. But for the layperson, these codes can be difficult to interpret. You will change the codes to match the simplified list provided by the city planner.

- 3 Click the R-1C entry under the Label column and type a new description: **Single Family Custom Dwellings**.



- 4 Click OK to close the dialog box.

The text you typed in the Label column is what will be shown in the legend.

YOUR TURN

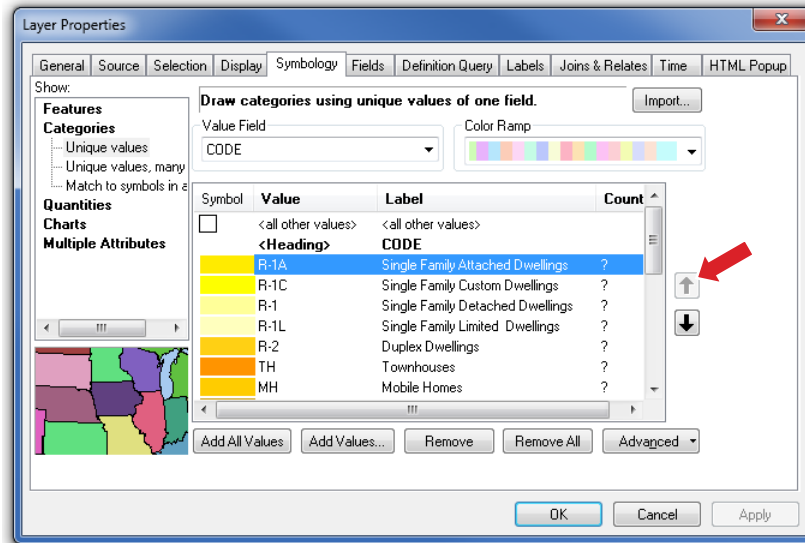
Change all the labels to match the following list. **Note:** you can change the width of the column headers Value and Label by dragging the vertical dividers side to side to reveal the entire category description. When all the descriptions are entered, click Apply, but do not close the Layer Properties dialog box.

R-1	Single Family Detached Dwellings
R-1L	Single Family Limited Dwellings
R-1A	Single Family Attached Dwellings
R-2	Duplex Dwellings
TH	Townhouses
MH	Mobile Homes
R-3	Multi-Family Dwellings 16 units/acre
R-4	Multi-Family Dwellings 20 units/acre
R-5	Multi-Family Dwellings 25 units/acre
C-1	Neighborhood Business District
C-2	Community Business District
TX-10	Texas Hwy 10 Business District
TX-121	Texas Hwy 121 Business District
L-I	Limited Industrial District
I-1	Light Industrial District
I-2	Heavy Industrial District
PD	Planned Development
CUD	Community Unit Development

All the descriptions are in, but they are not in the order that the city planner wants. These labels can be moved to appear in the desired order.

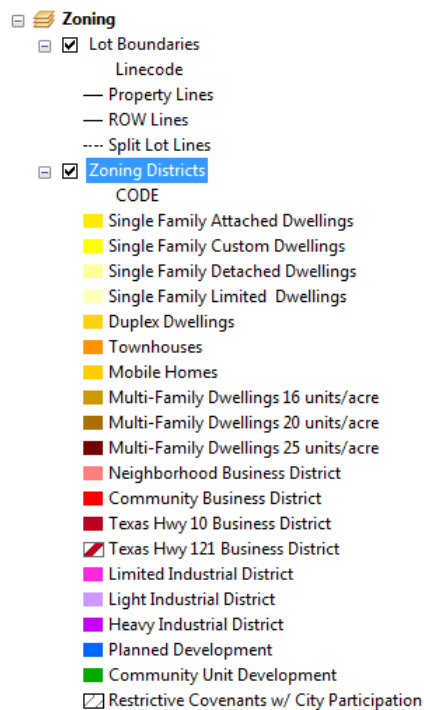
1-1
1-2
1-3

- 5 Highlight the value R-1A and click the Up arrow to move it above R-1C in the list.



- 6 Click OK to close the Layer Properties dialog box.

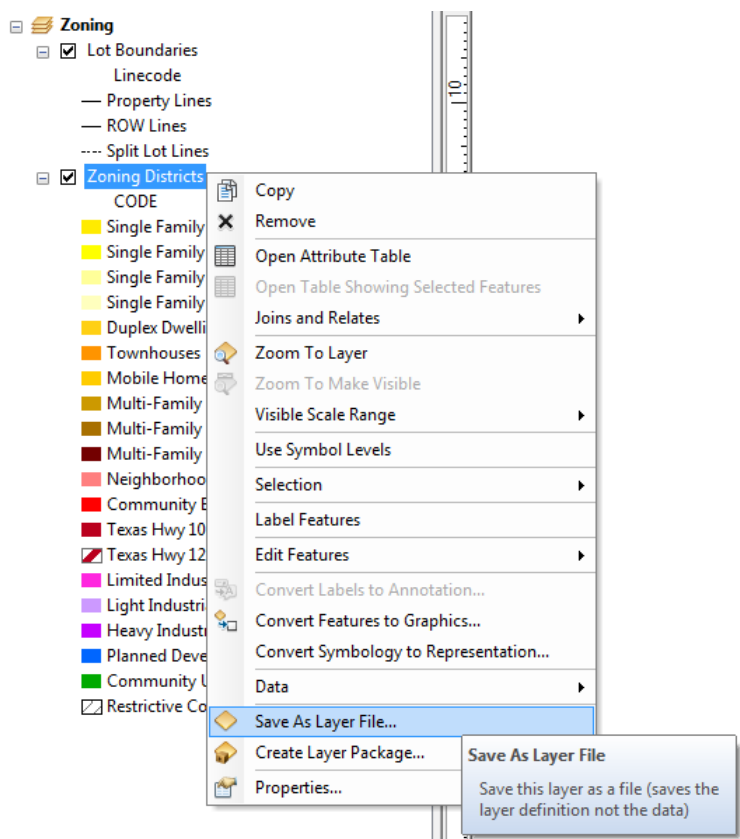
Once you have moved the values in the correct order, your table of contents should look like the graphic.



This zoning layer is used a lot in city maps, so it is a good idea to save all this work for future use. You can save it by creating a layer file (layer file names end in “.lyr”). A layer file saves all the symbology settings for a layer, but it does not save any of the data. A layer file is useful when a dataset such as zoning must be symbolized in several different ways for different audiences, but you do not want to save the dataset several times. If you had to make updates in several files, it would lead to a problem in updating the data and keeping all the files current. With a layer file, you maintain one dataset along with several ways to symbolize the dataset.

1-1
1-2
1-3

7 Right-click the Zoning Districts layer and click Save As Layer File. Save the file as DetailedZoning.lyr in your \GIST2\MyExercises folder.

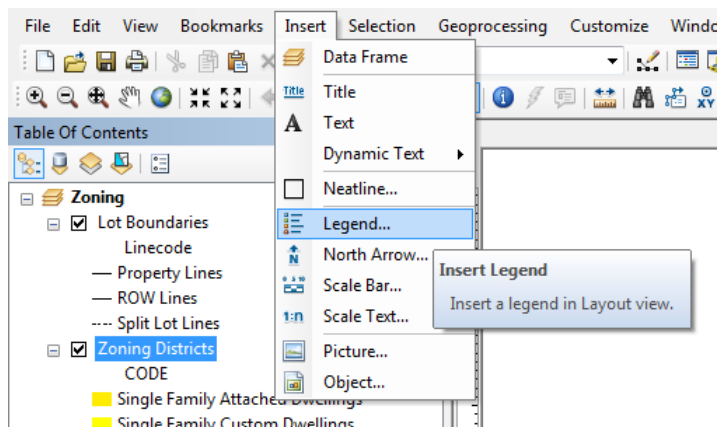


The next time you want to use the zoning data, do not add the feature class or shapefile; add the layer file, and the data will be added and already symbolized.

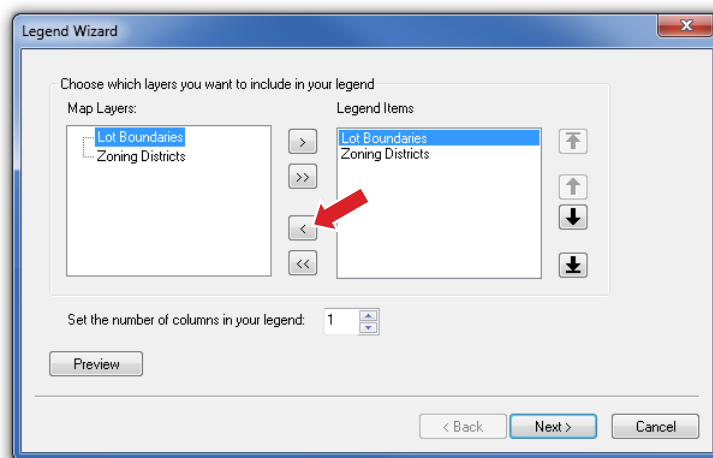
Add a legend to your map layout

Now that you have set everything, you can add a legend to the map layout. In fact, even if everything is not exactly the way you want or if the city planner changes his mind later, any changes you make to the table of contents will automatically be reflected in the legend.

- 1 On the main menu, click the Insert menu and then click Legend.

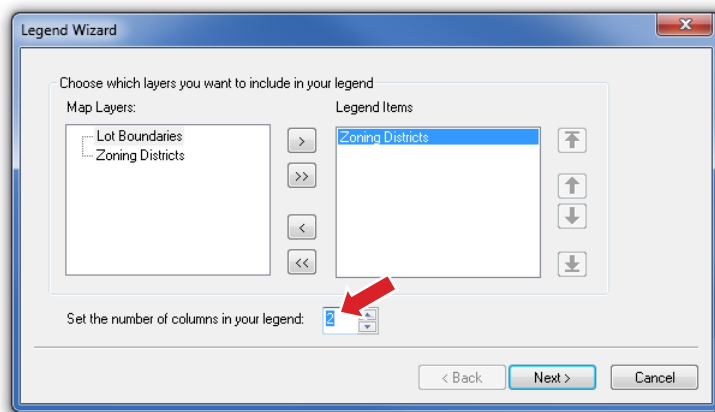


- 2 In the Legend Wizard window, highlight the Lot Boundaries layer in the Legend Items column and click the < button.

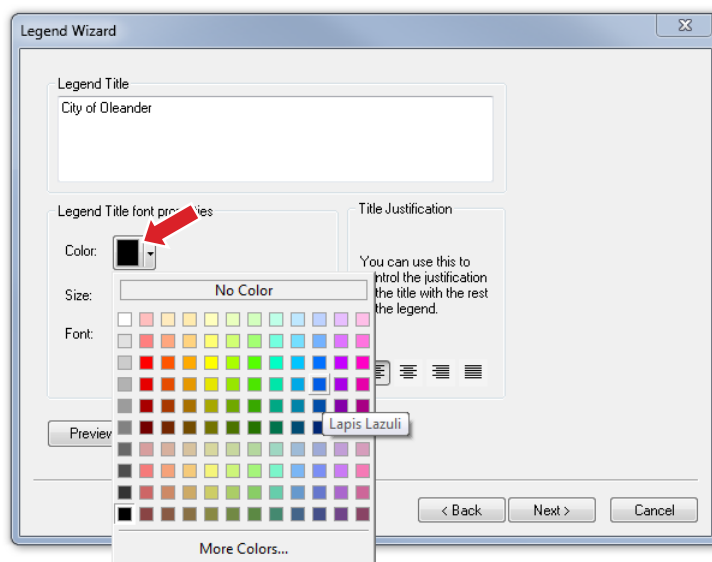


The Lot Boundaries layer is removed from the legend.

- 3** Set the number of columns in the legend to 2 and click Next.



- 4** Change the text Legend Title to **City of Oleander**. Click the Color drop-down arrow and change the font color to Lapis Lazuli. Click Next.

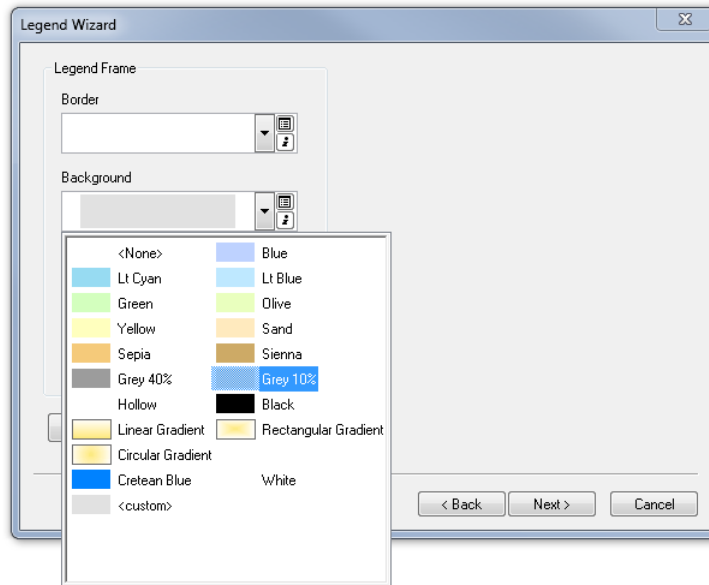


1-1

1-2

1-3


- 5** Click the Background color box and select Grey 10% from the drop-down list. Click Next. Complete the legend with the remaining default values by clicking Next and Finish.



The legend is complete and is added to the map. However, it is slightly too large and not in the right place. You will use the Select Elements tool  to resize and move it.

When a graphic element is selected, cyan boxes appear at the corners of the element. You can change the element by clicking these boxes using the Select Elements tool. Your map contains a specific spot for the legend, so you are going to use page coordinates and a set frame size in the legend's properties dialog box to place the legend.

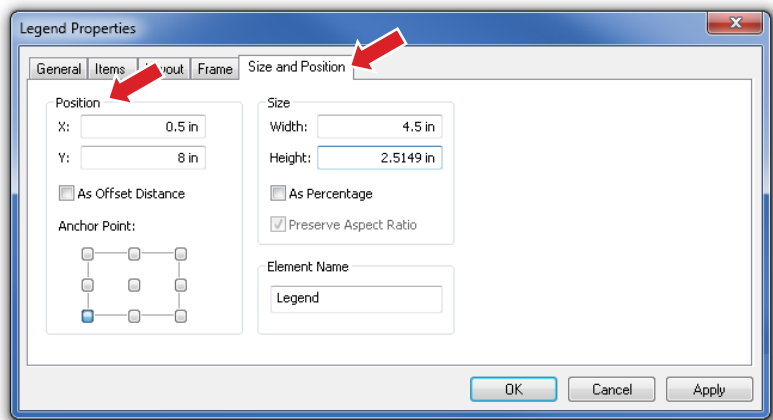
- 6** With the Select Elements tool active, right-click the legend and click Properties. Click the Size and Position tab.

- 7
- Enter the new x- and y-values for Position and the new Width and Height values for Size, as shown in the graphic. Click Apply and then click OK. You may need to click the Zoom Whole Page button  on the Layout toolbar to see the entire map.

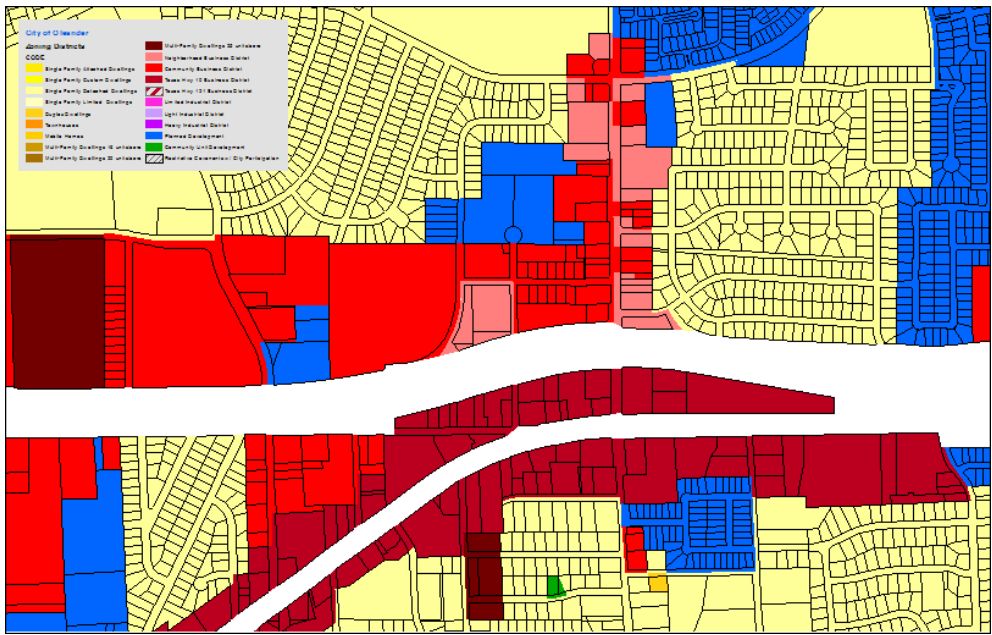
1-1

1-2

1-3



Your completed map should look like the one shown. This type of map, showing “where things are,” allows viewers to recognize and analyze items in their mind’s eye. You are not identifying every feature on the map; you are only giving users a color reference that they can use to identify features. Likewise, you are not pointing out any spatial relationships in the data, but letting viewers perform visual analysis to draw their own conclusions.



- 8
- Save your map document as **Tutorial 1-1.mxd** to the \GIST2\MyExercises folder. If you are not continuing to the exercise, exit ArcMap.

Exercise 1-1

The first tutorial showed how to use categories to help the map viewer determine the zoning for a piece of property. The user looks at the property on the map, notes the color, and then matches that color in the legend to determine the associated zoning code. You also helped the viewer better understand zoning codes by providing a text translation of the otherwise cryptic values.

In this exercise, you will repeat the process using land-use codes, which show how property is being used, as opposed to zoning codes, which show the prescribed use of land. Land-use codes are also cryptic, so you will change the labels to a simple description. You will also add the legend to the map layout, and then resize and move the legend to an appropriate place on the map.

- Continue with the map document you created in this tutorial, or open Tutorial 1-1.mxd from the \GIST2\Maps folder.
- Turn off the Zoning Districts layer.
- Add the layer file LandUseCodes.lyr from the \GIST2\Data folder. **Note:** if you loaded the tutorial data to a location other than the default, you must repair the data path for layer files before adding them to your map. See the instructions in the preface on how to fix broken path links.
- Change the labels for the Land Use values to match the following labels:
 - A1 Single Family Detached
 - A2 Mobile Homes
 - A3 Condominiums
 - A4 Townhouses
 - A5 Single Family Detached Limited
 - AFAC Airport Facilities
 - APR Airport Private Land
 - AROW Airport ROW
 - B1 Multi-Family
 - B2 Duplex

1-1

1-2

1-3

- B3 Triplex
 - B4 Quadruplex
 - B5 High Density Multi-Family
 - CITY City Property
 - CITYV Vacant City Property
 - CITYW City Water Utilities Property
 - CRH Church
 - ESMT Easement
 - F1 Commercial
 - F2 Industrial
 - GOV Government (State or Federal)
 - POS Public Open Space
 - PRK Park
 - PROW Private Right-of-way
 - ROW Right-of-way
 - SCH School
 - UNK Unclassified
 - UTIL Utilities
 - VAC Vacant
- Make any necessary changes to the legend so that it displays all the values.
 - Create a layer file for the new symbology.
 - Save the results as **Exercise 1-1.mxd** to the \GIST2\MyExercises folder.

What to turn in

If you are working in a classroom setting with an instructor, you may be required to submit the maps you created in tutorial 1-1.

Turn in a printed map or screen capture of the following:

Tutorial 1-1.mxd

Exercise 1-1.mxd

Tutorial 1-1 review

You determined that your audience was very familiar with the data being used and decided to make a detailed map of zoning and land use. Next, you checked the attribute table to see which field might contain zoning or land-use data. Since the field existed, you were able to use it to set the symbology.

The codes were rather cryptic, even for your expert audience, so you changed the display labels on the Symbology tab to include both the code and a text description of each category. This notation will help remind the viewer what each code represents.

Finally, you added a legend to the map to display the zoning or land-use codes and make the map complete.

Study questions

1. Select a piece of property on the map. Can you determine the adjacent zoning category?
2. The city council has been asked to approve a dry-cleaning plant in the Highway 10 business district, but members want to make sure that it is near other commercial uses and not residential. Can you find a place where this district has residential zoning next to it? How about commercial zoning next to it?

Other real-world examples

Each street in a centerline feature class may have a field with a code that represents its status in the thoroughfare plan. You can symbolize the streets with different line thicknesses according to the codes: a thick line for Freeways, a medium line for Major Collectors, and a thin line for Residential Streets. A quick look at the map will allow you to determine a fast route based on the amount of traffic a street is designed to handle. You may also use speed limits and get a similar result.

A forester may symbolize harvestable tree stands by their age. A darker symbol might be stands that are ready for harvesting, while a lighter color may be immature trees. A quick view of the map may show where to concentrate logging efforts to minimize the movement of equipment and impact on surrounding areas.

A dataset of all the counties in the United States may have a field that represents the political leaning of each county, whether Democrat, Republican, Green Party, Independent, and so on. A candidate for national office might symbolize the map according to these categories to determine friendly areas for fund-raising, and unfriendly areas for political conversions.

Tutorial 1-2

Controlling which values are displayed

In tutorial 1-1, you worked with all the values of a given category field. These values were specific codes that the experts use, but sometimes either for clarity or ease of use in an analysis project, you will want to display only some of the categories.

Learning objectives

- *Group symbology by category*
- *Arrange columns in a legend*
- *Hide categories*

Preparation

- *Read pages 30–36 in The Esri Guide to GIS Analysis, volume 1.*

Introduction

In tutorial 1-1, your audience was a technically savvy group that was very familiar with the data. Displaying a long list of zoning or land-use codes was appropriate for them because it allowed them to do the detailed visual analysis required. This scenario is not always the case, and often it may be necessary to simplify the display of the data to fit the audience.

There are two ways to simplify the data. One way is to use one of the generalization tools to physically change, or dissolve, the data into a simpler structure by removing vertices in lines and polygons. This method creates a copy of the data in a more simplified form, but it also adds to your data-maintenance chores. You will have to make any edits of the data to both datasets; or perhaps you can delete the simplified data, do your edits, and re-create the simplified dataset.

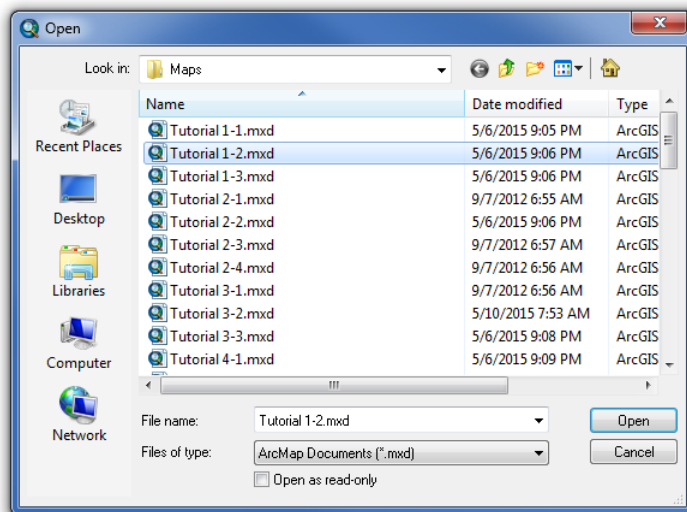
Another method to simplify the data is to control the way it is displayed. By grouping values together, you can create the same look as a dissolved dataset without creating a copy of your dataset. This method works well for visual analysis because all analysis takes place in the viewer's mind based on what they see. For more complex analysis that involves quantifying the results, the dissolve methods are preferred because extra processing may be done to the dissolved dataset that cannot be done to the entire dataset.

Scenario The maps you made in tutorial 1-1 were a success with the city council and the city planner. They have caught the eye of the development director, who will be traveling to a developers conference to promote the city. He wants to show the zoning map to potential developers but wants the data simplified to something easier to grasp in a quick overview of the map. Developers will quickly scan the map looking for the type of zoning that is favorable to their business, and they will only stop to talk details if they see what they like. You will produce the zoning map again, but this time using general categories.

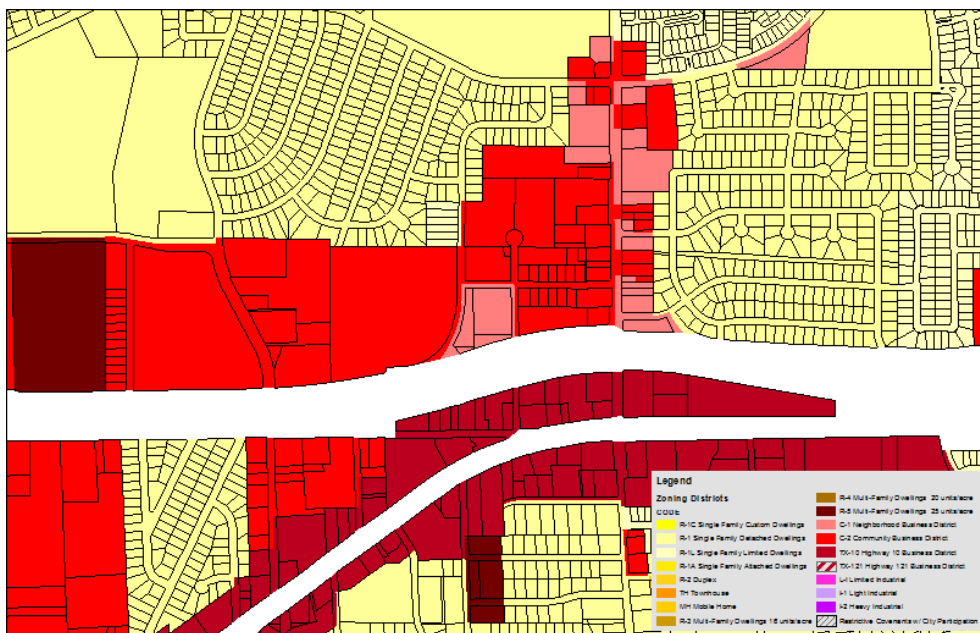
Data You will use the same datasets as in tutorial 1-1. One change has been made in how the data is symbolized. In the previous tutorial, you used a code that included two special zoning districts that demonstrate an “a la carte” zoning style. This zoning style allows developers to define housing density and other special features of their projects to create a custom zoning category before obtaining city council approval. For this tutorial, you will use the “translated zoning,” which will generalize the special zoning districts into the closest categorical zoning classifications. The translated zoning is stored in the field CODE2.

Change category labels

- 1 In ArcMap, open Tutorial 1-2.mxd from the location in which the tutorial data has been installed (for example, C:\EsriPress\GIST2\Maps).



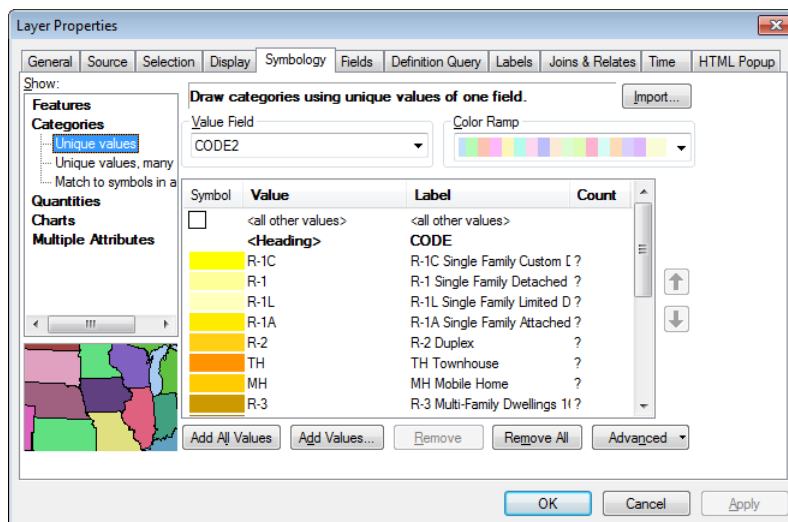
The map looks similar to the one you finished in tutorial 1-1.



Now you will revise the map for the development director and group all the zoning codes into four categories: Single Family Residential, Multi-Family Residential, Commercial, and Industrial. These groupings will make the map suitable for a general audience that can get an overview of the city's zoning at a glance. Rather than using a dissolve function, you will change the symbology of the layer to match the groupings. It is important to note that you are not changing the underlying data in any way, but only changing how it is symbolized.

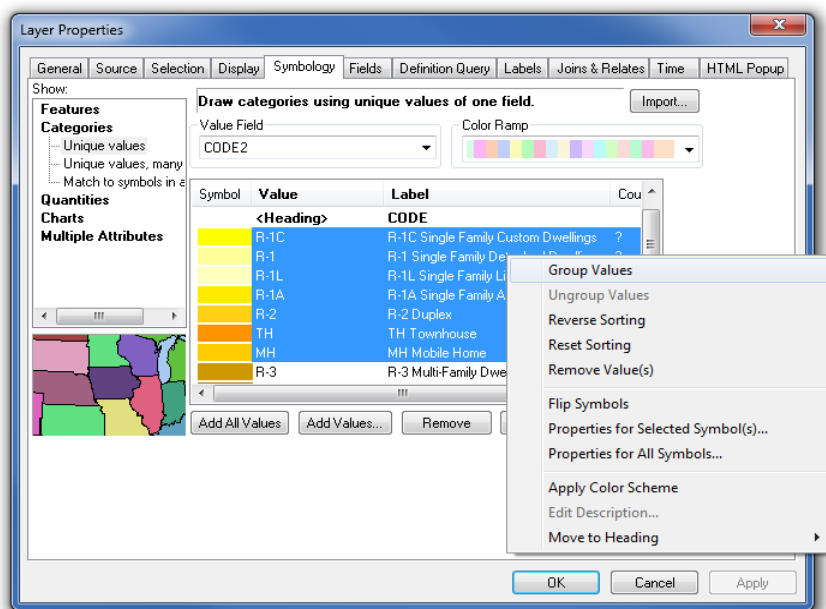
2 In the table of contents, right-click the Zoning Districts layer and click Properties.

3 Click the Symbology tab.



As before, all the values of the field CODE are displayed and symbolized. You want to create a simple category called “Single Family.” This category will include these codes: R-1C, R-1, R-1L, R-1A, R-2, TH, and MH.

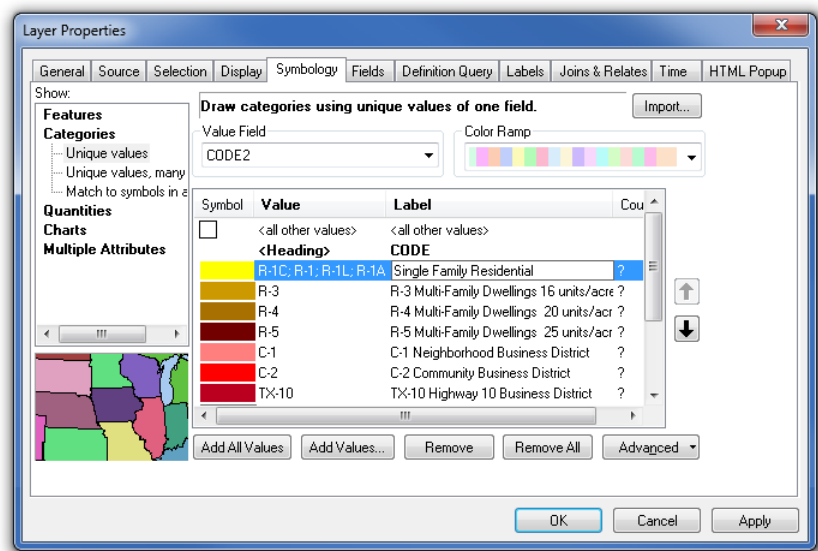
4 Click R-1C. Then press and hold Shift, and click MH. All the single-family zoning categories are highlighted. Right-click anywhere in the highlighted categories and click Group Values.



All the selected values are now shown with a single symbol. The new label strings together all the labels of the grouped values, which is not desirable. Next, you will change the label to a simple description.

1-1
1-2
1-3

- 5 Click the label for the grouped values and type **Single Family Residential**.



- 6 Click Apply and then click OK to close the dialog box.

By default, the color of the first value in the group is used for the combined values. Because single-family residential is typically shown in yellow, you can leave this color alone.

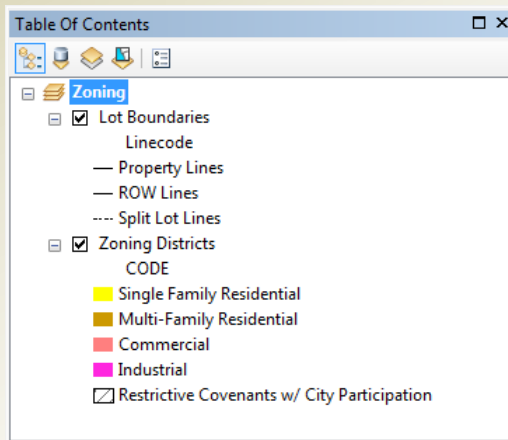
YOUR TURN

As you did with the Single Family Residential, create group symbols for the following code values:

- Groups R-3, R-4, and R-5. Change the label to **Multi-Family Residential**.
- Groups C-1, C-2, TX-10, and TX-121. Change the label to **Commercial**.
- Groups L-I, I-1, and I-2. Change the label to **Industrial**.

Click OK to accept the changes and close the dialog box.

When you are finished, the table of contents should look like the graphic.



Next, you will create a layer file of the new symbology for later use.

- 7** Right-click the **Zoning Districts** layer and click **Save As Layer File**. Save it to the **GIST2 \MyExercises** folder and name it **Grouped Zoning.lyr**.

The legend reflects the changes, but it looks a little strange. You set the legend to display two columns when there were a lot of values to show, but the simplified legend does not require two columns.

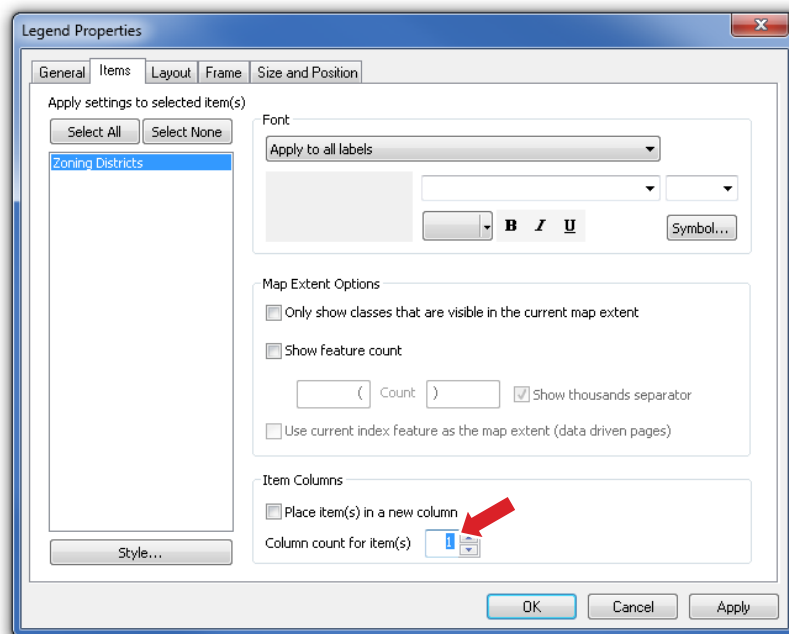
Modify the legend

- 1 In the layout, right-click the legend and click Properties.
- 2 Go to the Items tab and change the number of columns to 1. Click OK.

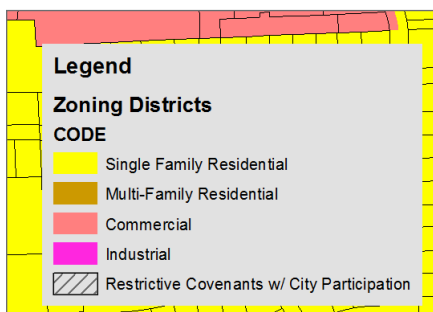
1-1


1-2

1-3



The legend displays the grouped symbology along with your updated labels in a single column. The legend should now be simple enough for the novice audience to understand.



- 3 Look at the map, which now looks different from the more detailed version earlier. If you want to zoom into the layout so you can see the legend better, use the Zoom In button  on the Layout toolbar. Use the Zoom Whole Page button on the Layout toolbar to return the map to the original view.
- 4 Save your map document as **Tutorial 1-2.mxd** to the \GIST2\MyExercises folder. If you are not continuing to the exercise, exit ArcMap.

Exercise 1-2

The tutorial demonstrated how to simplify the look of your map by grouping symbol values.

In this exercise, you will repeat the process using land-use codes. These codes are also cryptic, so you will change the labels to a simple description. You will also add the legend to the map layout, and then resize and move the legend to an appropriate place on the map.

Continue with the map document you created in this tutorial, or open Tutorial 1-2.mxd from the \GIST2\Maps folder.

- Turn off the Zoning Districts layer.
- Add the layer file LandUseCodes.lyr from the \GIST2\Data folder.
- Group some of the land-use values together and update the labels to match the following definitions. For values that are not next to each other in the list, select the first one and press and hold Ctrl while selecting the others.

• A1, A2, A3, A4, A5	Single Family Residential
• B1, B2, B3, B4, B5	Multi-Family Residential
• F1	Commercial
• ESMT, F2, UNK, UTIL	Industrial
• POS, PRK	Parks
• CITY, CITYV, CITYW, GOV	Government
• AROW, PROW, ROW	Right-of-way
• AFAC, APR	Oleander International Airport
• CRH	Church
• SCH	School
• VAC	Vacant
- Make any necessary changes to the legend so that it displays all the values.
- Create a layer file from the new symbology.
- Save the results as **Exercise 1-2.mxd** to the \GIST2\MyExercises folder.

What to turn in

If you are working in a classroom setting with an instructor, you may be required to submit the maps you created in tutorial 1-2.

Turn in a printed map or screen capture of the following:

Tutorial 1-2.mxd

Exercise 1-2.mxd

Tutorial 1-2 review

1-1

1-2

1-3

This time, your intended audience was not familiar with all the nuances of zoning and land use, so you simplified the display of the map. If more analysis steps are required, you can simplify the data. However, because you are only doing visual analysis, grouping the symbology will produce the required map without altering the data.

The simplified legend looks cleaner and clearer than the more complex legend, and you changed how it was displayed. A simple legend with five values is suitable for your audience.

Study questions

1. Look at the map and count how many different zoning categories you can identify. How complex a question can you answer with this level of data?
2. A developer is looking for a commercial corridor in which to locate a business. Can you get a general idea of where the developer should start looking?
3. The city council is reviewing an ordinance to require special fencing between light-industrial and heavy-industrial zones. Is this map suitable for that purpose? Why or why not?

Other real-world examples

Police department data may include up to eight categories of burglaries. Although this amount is great for a detailed study, the map produced for the general public might group all of the burglaries into one category.

Dallas Area Rapid Transit produces detailed maps for each bus route, but when producing a systemwide map, it groups all bus routes into one symbol. Similarly, it groups all train routes into one symbol and all light-rail lines into one symbol. This simplified map reads well on a regional scale, although it may answer only general transit questions and not guide you to a specific bus or train.

Tutorial 1-3

Limiting values to display

Legends are the key to how the map creator wants the viewer to interpret it. Sometimes all the data is shown in a complex form, and sometimes the data is simplified but still shows the entire dataset. It may also be necessary to display only a subset of the data so that the map conveys the desired message.

Learning objectives

- *Add only specific values to the legend*
- *Work with legend properties*
- *Work with definition queries*

Introduction

You have seen how to group many values together to simplify the way data is displayed on a map, but there may be times when you want to keep certain groups of values from ever showing at all. Perhaps you want to show only auto-related crime and disregard all other types of crime, or maybe show only major roads and not show local and residential streets. In this tutorial, you will look at ways to restrict which data is symbolized on your maps.

Scenario The city planner has looked at the maps you produced earlier and was impressed. Now he has another idea for more maps that you can work on. He wants you to take the zoning map but display only the single-family zoning categories to produce an inventory of residential zoning. In this case, you must remove all other types of zoning from the map and display only the requested values.

Data You will use the same datasets as in tutorial 1-1, but this time the datasets will not have a symbology schema already set. You will set the symbology value field to CODE and manually define what values to show.

Set symbol values

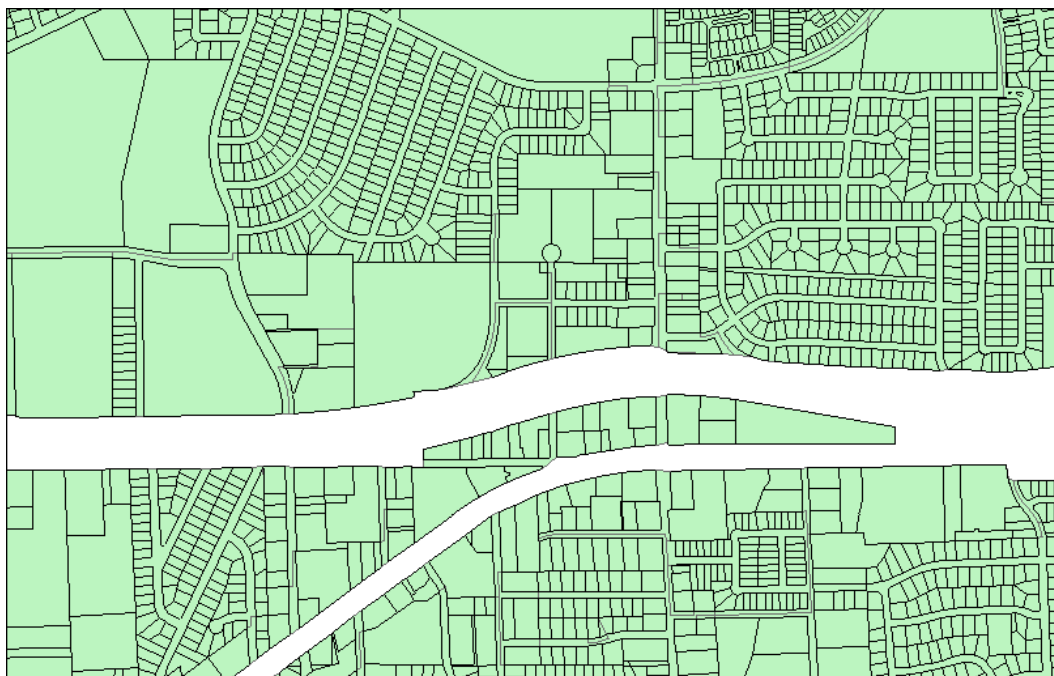
1-1

1-2

1-3

- 1 In ArcMap, open Tutorial 1-3.mxd from the \GIST2\Maps folder.

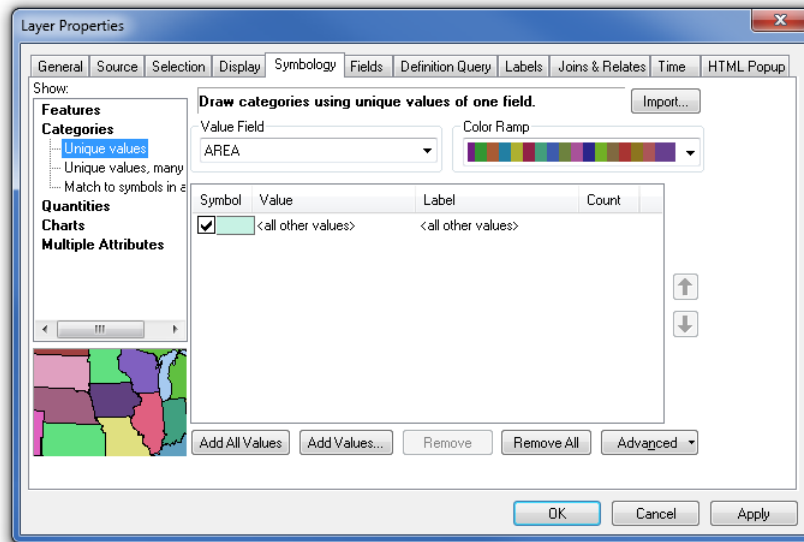
This time, the map has no symbology set. You will set up controls that will display only the data that meets the request that has been made.



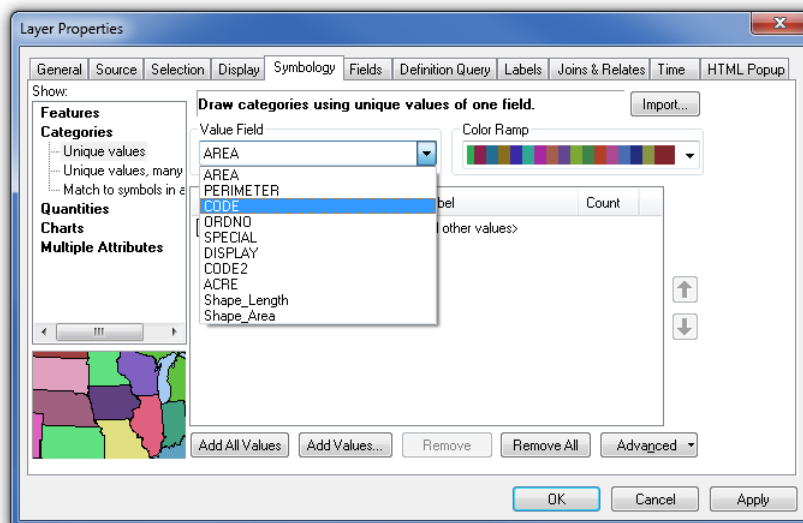
The residential zoning inventory requires that you display only the following values: R-1, R-1A, R-1L, R-2, TH, and MH.

These values represent the single-family zoning types. The first method you will use will add only these values to the symbology editor.

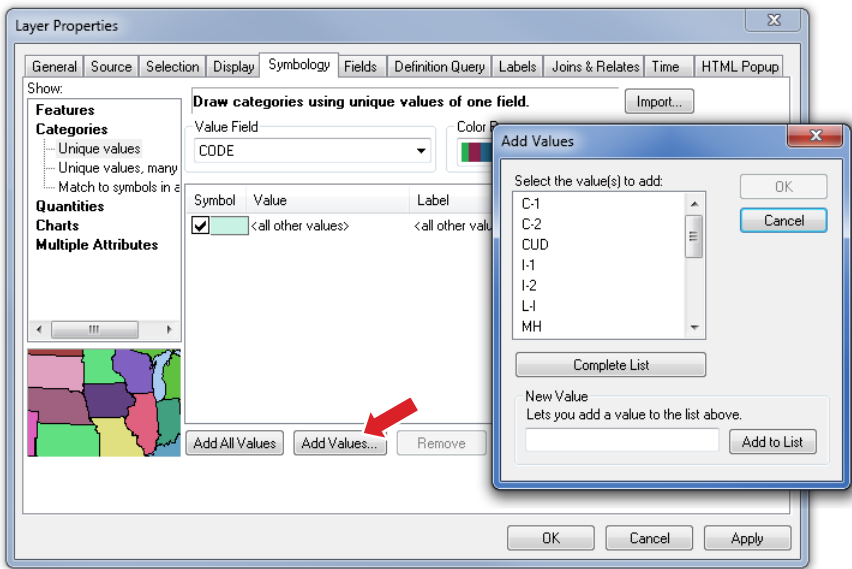
- 2 In the table of contents, right-click the Zoning Districts layer and click Properties.

3 Click the Symbology tab. In the Show box, click Categories and then click Unique values.

You will set the Value field to the attribute field that contains the zoning classifications. You know from tutorial 1-1 that the field is the CODE field.

4 Click the Value Field drop-down list and click CODE.

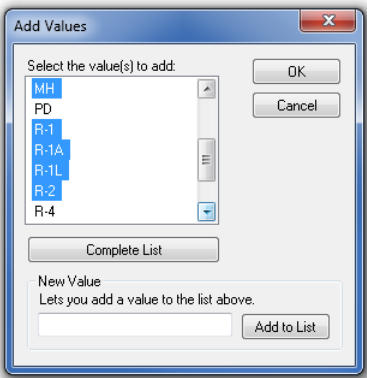
5 Click the Add Values button.



1-1
1-2
1-3

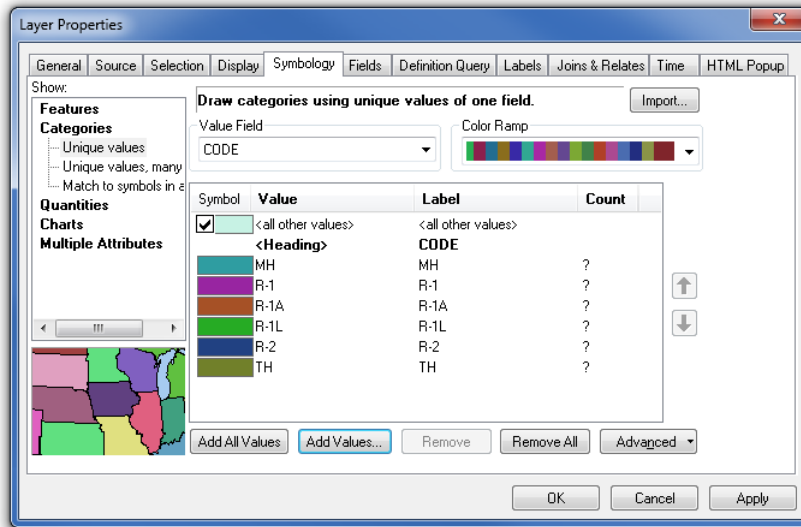
Note: the Add All Values button adds each unique occurrence of the Value field to the legend, while the Add Values button allows you to select specific field values.

6 From the list, highlight the desired single-family residential codes (listed in step 1). Press and hold Ctrl to select multiple values. If you do not see a value, click the Complete List button to refresh the list. When you have selected the right codes, click OK.



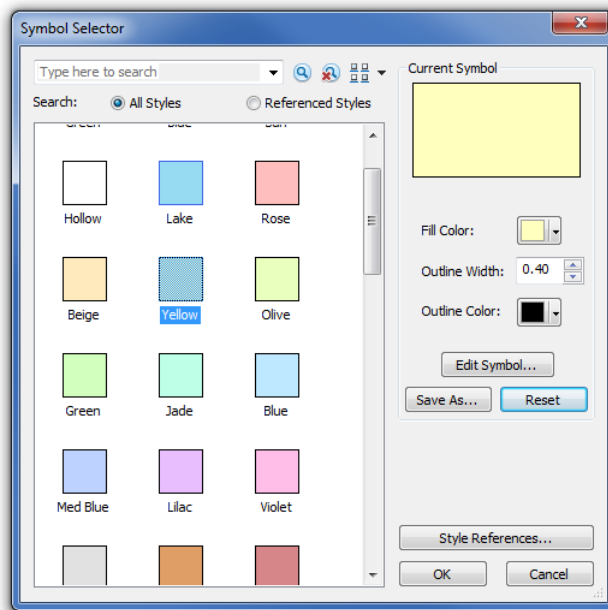
The symbology editor now shows only the selected values. If you missed one, click Add Values again and select it.

- 7** As in the previous tutorials, change the labels to a simple description of the zoning categories. Also, clear the <all other values> option to prevent the values that were not selected from being displayed.



Next, you will deal with the color choices.

- 8** Double-click the color symbol to the left of the MH value. The Symbol Selector opens. Click Yellow and then click OK.



9 Repeat the process and set the other colors as follows:

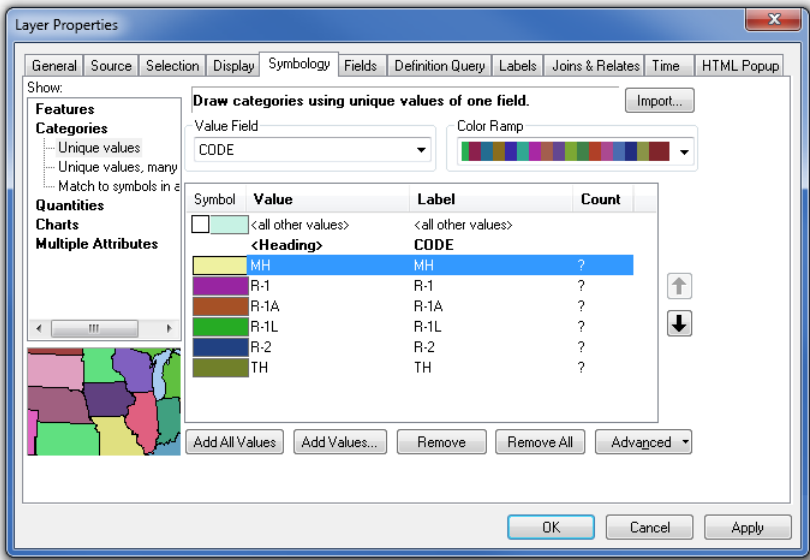
- R-1 Medium Yellow
- R-1A Tan
- R-1L Beige
- R-2 Orange
- TH Lt Orange

1-1

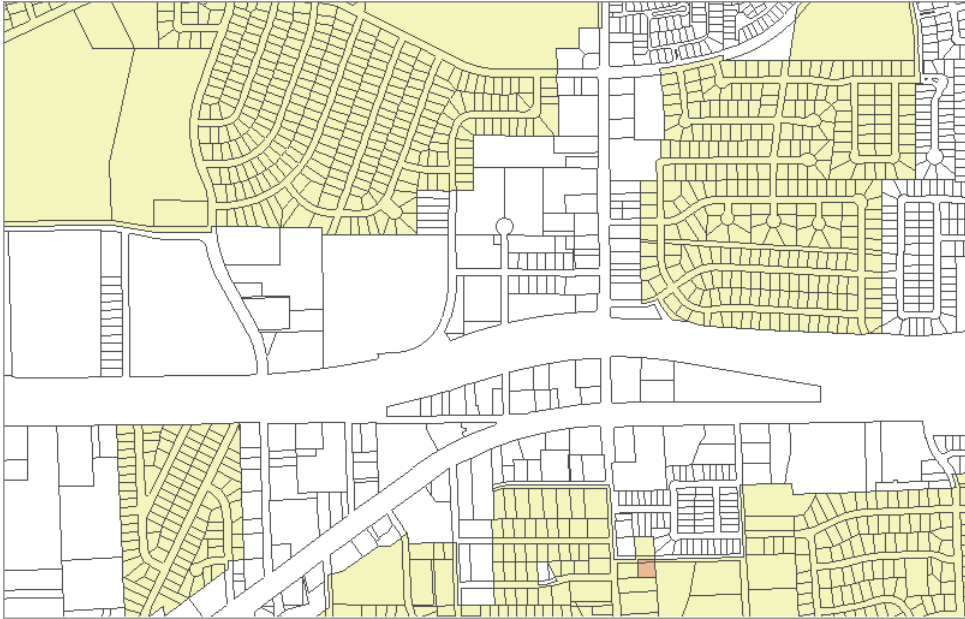
1-2

1-3

10 Verify that your dialog box matches the graphic and then click OK.



The resulting map shows only the specified residential zoning categories in the colors you chose.



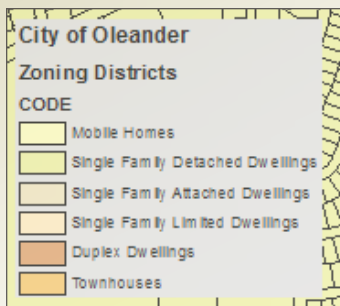
- 11** Create a layer file of the new symbology. Right-click the Zoning Districts layer and click Save As Layer File. Save it to the \GIST2\MyExercises folder and name it **ResidentialZoning.lyr**.

YOUR TURN

Add a single-column legend to this map displaying the values you selected and symbolized. Change the legend title to **City of Oleander**. Two things will be different from legends you have worked with in previous tutorials:

1. The legend background will be transparent, or colorless. Open the legend properties, go to the Frame tab, and set the background to 10% Grey.
2. The gap between the text and the legend box is set to a default value of 10 points. Decrease this gap by setting the background gap for X and Y to 4 points.

Many of the legend parameters are user-definable. Browse the legend properties box and experiment with a few.



You were able to display only the categories the city planner wanted and learned a little about legends in the process. But there is one problem with this method. The city planner may want you to do some calculations or analysis against the data, and your numbers will reflect the entire dataset, not only the displayed items. Values that are not displayed are still in the database and will still be used in calculations. You will look at the attribute table to better understand the problem.

1-1

1-2

1-3

Examine the attribute table

- 1
- In the table of contents, right-click the Zoning Districts layer and click Open Attribute Table.

The attribute table is displayed, and you can see that the CODE column contains values that you do not want shown on the map.

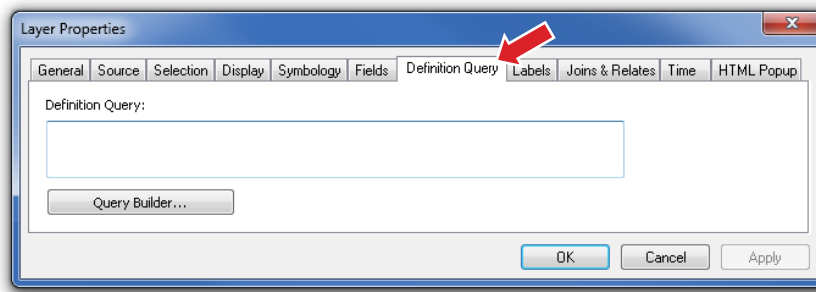
Table												
Zoning Districts												
OBJECTID *	Shape *	AREA	PERIMETER	CODE	ORDNO	SPECIAL	DISPLAY	CODE2	ACRE	Shape_Length	Shape_Area	
1	Polygon	22079.25	600.234	TX-10	0		NO	TX-10	0.507	581.697207	21117.150816	
2	Polygon	139981.938	1492.252	PD	1648		YES	I-2	0	1472.455671	135636.408874	
3	Polygon	394050.563	2878.861	PD	1014		SM	I-1	9.046	2844.533959	382993.567038	
4	Polygon	1055427.5	4192.619	I-2	0		YES	I-2	24.229	4236.170089	1075114.505069	
5	Polygon	117241.625	1370.84	I-1	0	SP	SM	I-1	2.691	1365.771874	116283.064106	
6	Polygon	1728689.5	6940.227	I-1	0		YES	I-1	39.685	7030.636052	1734090.98521	
7	Polygon	394069.188	3409.292	C-2	0		YES	C-2	9.047	3412.871577	390619.026774	
8	Polygon	214473.063	1861.301	R-4	0		YES	R-4	4.923	1849.774471	211739.201546	
9	Polygon	305606.438	2669.028	L-1	0			L-1	7.016	2700.771405	307691.01323	
10	Polygon	283946.938	4168.954	PD	379		NO	R-1A	6.519	4218.482896	287151.532414	
11	Polygon	33434.563	956.73	TH	379		NO	TH	0.768	1009.753944	36508.923669	
12	Polygon	26335	692.575	C-2	0		SM	C-2	0.605	691.937514	26531.757215	
13	Polygon	172593.688	2128.938	R-2	0		SM	R-2	3.962	2130.549204	172256.978087	
14	Polygon	64251.25	1025.05	C-2	1613		SM	C-2	2.246	1045.124789	67637.241277	
15	Polygon	33585.063	746.266	PD	1666		SM	R-1L	2.246	763.506672	34970.947867	
16	Polygon	6921839.5	14283.724	R-1	0		LG	POS	158.904	14287.508289	6893578.324051	

- 2
- Close the Zoning Districts attribute table when you are finished examining it.

You need a way to temporarily ignore all values except the single-family residential codes. Using a definition query is an easy way to do it. Build a query to select only the values you want, and ArcMap will ignore all the other values. It is important to note that the values will not be deleted, only ignored. Removing the definition query will restore all the dataset values.

Build a definition query

- 1 In the table of contents, right-click the Zoning Districts layer and click Properties.
- 2 In the Layer Properties dialog box, click the Definition Query tab and click Query Builder.



You will build a query to define the values you want to see in your map. The format for the query statement will use simple Structured Query Language (SQL) statements composed of a field name from the table; an operator, such as “greater than” (>) or “equals” (=), and a value that will be used to select fields. You can connect statements using AND or OR to select multiple values. When you use AND, the statements on both sides of the connector must be true for a feature to be selected. If you use OR, the statements on either side of the connector can be true for the feature to be selected. Suppose you wanted only the values of R-1 and R-2. Would the following equation be correct?

`CODE = 'R-1' AND CODE = 'R-2'`

For a feature to be selected, both statements must be true. Because a single feature cannot be both R-1 and R-2, no features will be selected. Now try the same statement using OR, in which either of the statements can be true for a feature to be selected.

`CODE = 'R-1' OR CODE = 'R-2'`

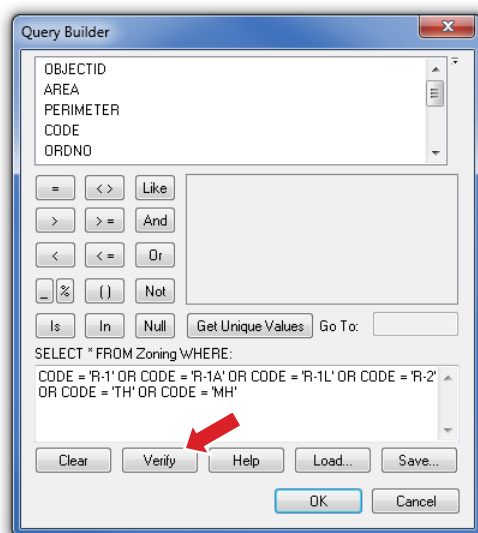
A feature with a value of R-1 will be selected, because at least one of the statements is true, and the same with features containing the value of R-2. A feature with a value of I-1 will not be selected because neither of the statements is true.

Your definition query must use OR as a connector and select the following values for the field CODE: R-1, R-1A, R-1L, R-2, TH, and MH.

The definition query you will build will look like this equation:

`CODE = 'R-1' OR CODE = 'R-1A' OR CODE = 'R-1L' OR CODE = 'R-2'
OR CODE = 'TH' OR CODE = 'MH'`

- 3** In the fields box of the Query Builder window, double-click CODE to add it to the expression box at the bottom. Click the equals button (=). Click Get Unique Values and then double-click the value of 'R-1'.
- 4** To string the next selection onto the query, click the Or button.
- 5** Continue to build the query. Double-click CODE, click the equals button, and then double-click the value of 'R-1A'.
- 6** Continue until you have built the entire query, as shown in the graphic. Click the Verify button and let ArcMap validate your query. If there are errors, go back over the query and check each entry. When the query is successfully verified, click OK to close the Verify dialog box. Click OK to close the Query Builder and OK again to close the Layer Properties dialog box.



Next, you will take a look at the attribute table of the Zoning Districts layer and see the results of the definition query.

Examine the attribute table again

- 1 In the table of contents, right-click the Zoning Districts layer and click Open Attribute Table.

OBJECTID *	Shape *	AREA	PERIMETER	CODE	ORDNO	SPECIAL	DISPLAY	CODE2	ACRE	Shape_Length	Shape_Area
180	Polygon	880873.063	3979.246	R-1	0		YES	R-1	20.222	4030.728232	888954.798642
198	Polygon	90767.188	1281.335	R-2	0		NO	R-2	2.084	1285.060319	88278.703149
201	Polygon	365170.25	2704.639	R-1L	1457		SM	R-1L	8.383	2701.560431	369881.824996
217	Polygon	584766.063	3678.179	R-1L	1584		NO	R-1L	30.998	3772.973956	598232.203708
221	Polygon	832592.375	4053.444	R-1L	1449		SM	R-1L	30.998	4076.96243	842175.144159
225	Polygon	520014	3764.233	R-1L	0		NO	R-1L	30.998	3835.362993	529302.635671
230	Polygon	28140.813	775.566	R-1L	1627		YES	R-1L	1.872	791.733015	26262.385372
233	Polygon	202158.188	2587.641	R-1L	1610		YES	R-1L	1.872	2620.541602	198608.182183
247	Polygon	516775.313	3117.935	R-1	0		SM	R-1	11.864	3209.581862	535364.772428
261	Polygon	154916.25	1689.74	TH	0		SM	TH	3.556	1655.864795	150317.378765
263	Polygon	19414.688	572.404	R-1A	0		SM	R-1A	0.446	560.948818	18658.843571
264	Polygon	297635.813	2601.249	R-1	0		YES	R-1	6.833	2583.421366	296660.016775
265	Polygon	68765072	107792.391	R-1	0		NO	R-1	1590.55	74688.542698	57847172.352166
266	Polygon	305050.688	3069.015	R-1	0		SM	R-1	7.003	1870.590428	122750.806832
271	Polygon	<Null>	<Null>	R-1L	1706	<Null>	<Null>	R-1L	<Null>	1150.210716	69162.694514
272	Polygon	109649.313	1420.972	R-1	0		SM	R-1	2.517	867.532899	40165.269007

(0 out of 56 Selected)

Notice now that In the CODE column, all the values you specified are on the list. Remember that the definition query did not delete any data. The values that the definition query did select are only ignored. The process can be reversed simply by removing the definition query.

- 2 Close the attribute table and save your map document as **Tutorial 1-3.mxd** to the **\GIST2\MyExercises** folder. If you are not continuing to the exercise, exit ArcMap.

Exercise 1-3

1-1

1-2

1-3

The tutorial demonstrated how to add only certain field values to your symbology editor, and how to build a definition query to restrict the dataset you are working with.

In this exercise, you will repeat the process using land-use codes. Add only the values that are necessary and build a definition query to restrict the dataset to the given list.

- Continue with the map document you created in this tutorial, or open Tutorial 1-3.mxd from the \GIST2\Maps folder.
- Turn off the Zoning Districts layer.
- Add the dataset LandUse.lyr from the \GIST2\Data folder. Turn on the layer.
- In the symbology editor, set the Value field to UseCode and add only the following values. Change the labels to the correct description.
 - A1 Single Family Detached
 - A2 Mobile Homes
 - A3 Condominiums
 - A4 Townhouses
 - A5 Single Family Detached Limited
- Set the colors as necessary and create a layer file of the new symbology.
- Set a definition query to restrict the dataset to only the specified values.
- Add a legend and make any necessary changes to the legend so that it displays all the desired values.
- Save the results as **Exercise 1-3.mxd** to the \GIST2\MyExercises folder.

What to turn in

If you are working in a classroom setting with an instructor, you may be required to submit the maps you created in tutorial 1-3.

Turn in a printed map or screen capture of the following:

Tutorial 1-3.mxd

Exercise 1-3.mxd

Tutorial 1-3 review

The city planner gave you the added task of restricting the dataset to only a specific set of values. You were able to control the display on the map by adding only the values on the list to the symbology editor, and thus to the legend.

A problem with this method is that if you later do any summations or calculations, they will be performed on the entire dataset. One way to solve this problem is to use a definition query. You built a query to select only the features of interest. Always remember that a definition query does not delete data, but merely causes it to be ignored until the definition query is removed.

A query statement must contain, in this order, a field name, an operator, and then a value. You can string these statements together using AND or OR. Using AND means that *both* sides of the equation must be true to select a feature. Using OR means that *either* side of an equation can be true to select a feature.

Study questions

1. What extra properties does the legend have?
2. What query will select the zoning values of I-1 and I-2?
3. What query will select the zoning value of R-1 and acreage greater than 50?

Other real-world examples

It is common to want to work with a subset of your data, without having to make a copy.

A city may have within its boundaries many private water wells, categorized by the aquifer they tap. You may want to restrict your data to a single aquifer to calculate the water removal rate from that water source.

The public works department is responsible for repaving the asphalt and concrete streets in the city. You may want to restrict your data to show only the asphalt streets to give it a total linear mileage of streets paved with this material.

You may have a dataset of all fire department responses in a month and want to do analysis on only the arsons. A definition query on the cause of the fire will accomplish this task.