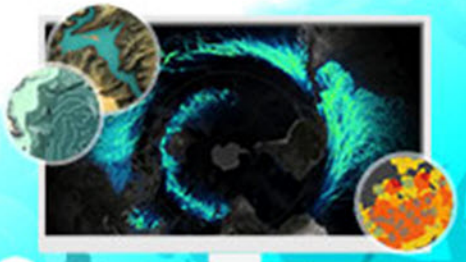
Exercise

Make a Map

Section 1 Exercise 3

04/2018

esri
THE SCIENCE OF WHERE™



Make a Map

Instructions

Use this guide and ArcGIS Pro to reproduce the results of the exercise on your own.

Note: The version of ArcGIS Pro that you are using for this course may produce slightly different results from the screen shots that you see in the course materials.

Time to complete

Approximately 65-70 minutes.

Software requirements

ArcGIS Pro 2.1

Introduction

A map is a graphic—either static or dynamic—that conveys a geographical story. In other words, a map is a *visual* thing that *communicates spatial* things. All three aspects—visual, spatial, and communication—are vital to the success of your map.

Sometimes, the story is about intangible or invisible phenomena. Sometimes, it's about how something changed over time. And sometimes, it is just a detailed accounting of the reality of a place.

The spatial component of your map is the data that you use to tell the story. Making sure that your data is relevant and authoritative is vital to ensuring that your map is credible.

The visuals are the symbols, symbology methods, text, and layout elements that you choose to support your story. It is through these elements that you tell your story.

And the communication is *how* you tell that story. This is the most nebulous part of the process, but it is what can make the difference between an ordinary map and a compelling one. The design choices set the tone and clarity of your map and dictate how the map communicates.

What will you learn?

This course will teach you the balance between the art and science aspects of mapmaking. To begin, this exercise teaches you the mechanics of making a map in ArcGIS Pro. You'll get comfortable with ArcGIS Pro and learn how to create a project to store your work.

In this exercise, you'll make a small-format reference map of the U.S. state of Massachusetts to print.

Step 1: Download the exercise files

In this step, you will download the exercise files.

a. Open a new web browser tab or window.

b. Go to https://bit.ly/2Hdq3ik, and download the exercise ZIP file.

c. Extract the files to a folder on your local computer, saving them to a location that you will remember.

Step 2: Open an ArcGIS Pro project, sign in, and add data to a new map

You will start by opening a project package from the data that you downloaded, and then you will sign in to ArcGIS Pro.

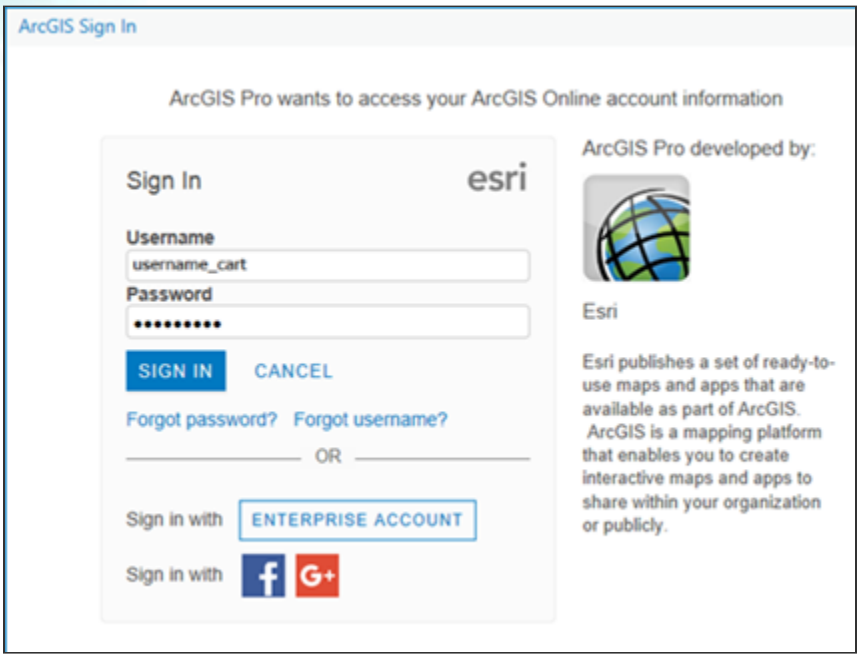
a. From File Explorer, browse to the location where you saved your data, and double-click the Sec1Ex3_MakeAMap_InitialState.ppkx file to open the exercise project in ArcGIS Pro.

You will use the contents of the exercise project package to make your map.

First, you will sign in to ArcGIS Pro.

b. In the top-right corner of the app, click Not Signed In and then choose Sign In.

c. Sign in to ArcGIS Pro using your ArcGIS account credentials (the same set of credentials that you used to sign in to ArcGIS Online; the username includes _cart).



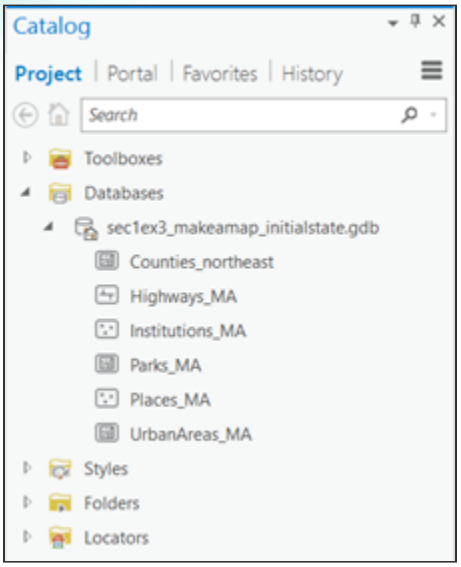
You will use the Catalog pane to access a database containing the data for the Make A Map project. The Catalog pane provides an inventory of items in your project and the commands to manage them.

d. If necessary, open the Catalog pane:

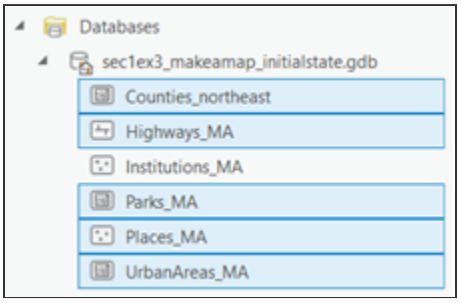
1. On the ribbon, click the View tab.
2. In the Windows group, click Catalog Pane.

Note: If you would like to dock the Catalog pane next to your map, right-click the pane title, and from the pop-up, choose Dock.

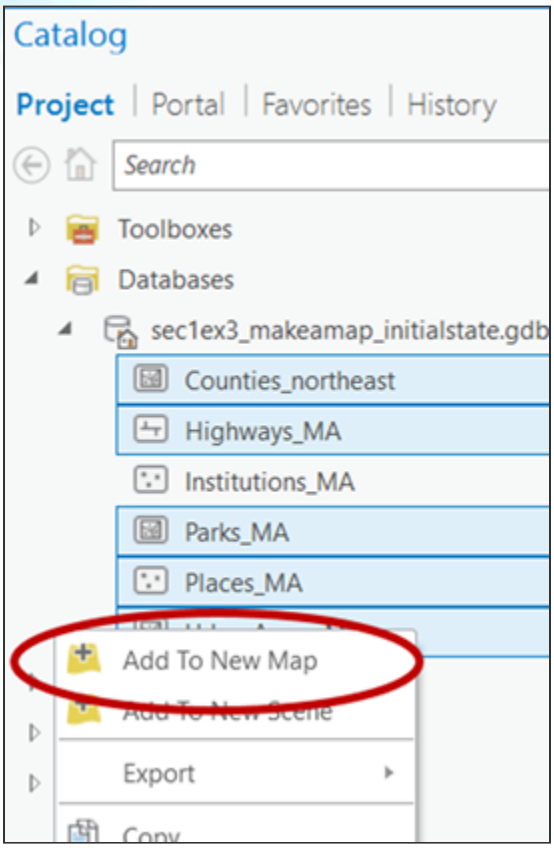
e. In the Catalog pane, expand Databases and expand the Sec1Ex3_MakeAMap_initialstate project database.



f Press the Ctrl key on your keyboard and click each feature class in the project geodatabase except the Institutions_MA feature class to select them.

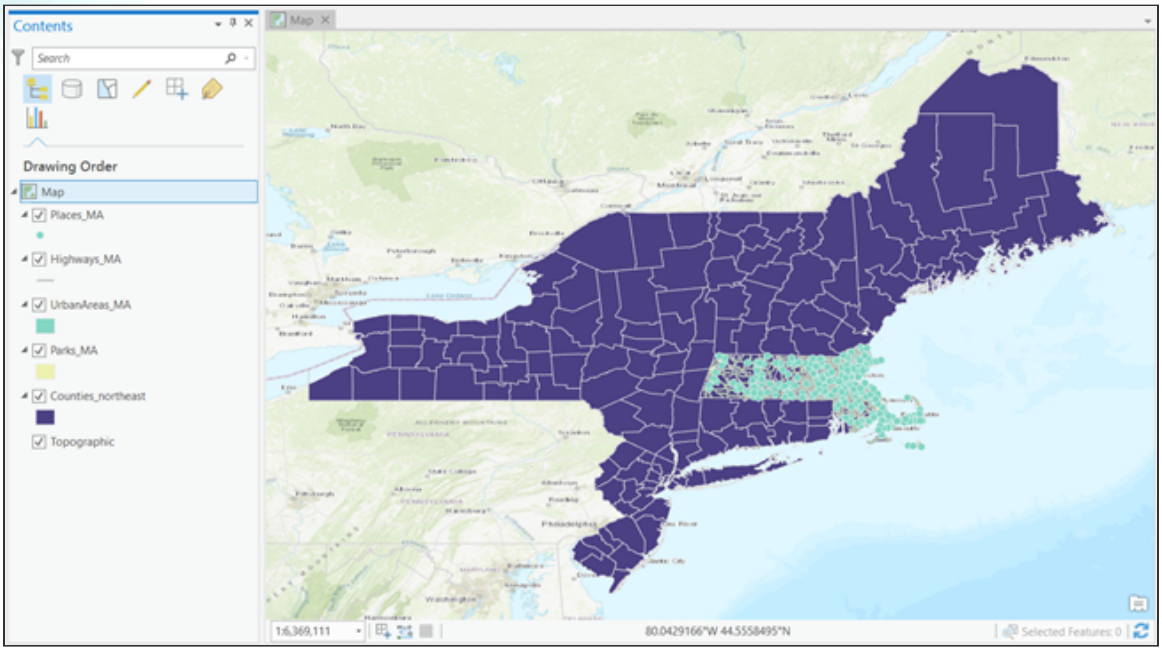


g Right-click the selection and choose Add To New Map.



Note: Optionally, you can choose to work with the Institutions_MA feature class at the end of the exercise in one of the stretch goals.

A new map is created with a basemap that provides a background of geographical context. The map is zoomed to the extent of the data layers in the northeastern part of the United States.



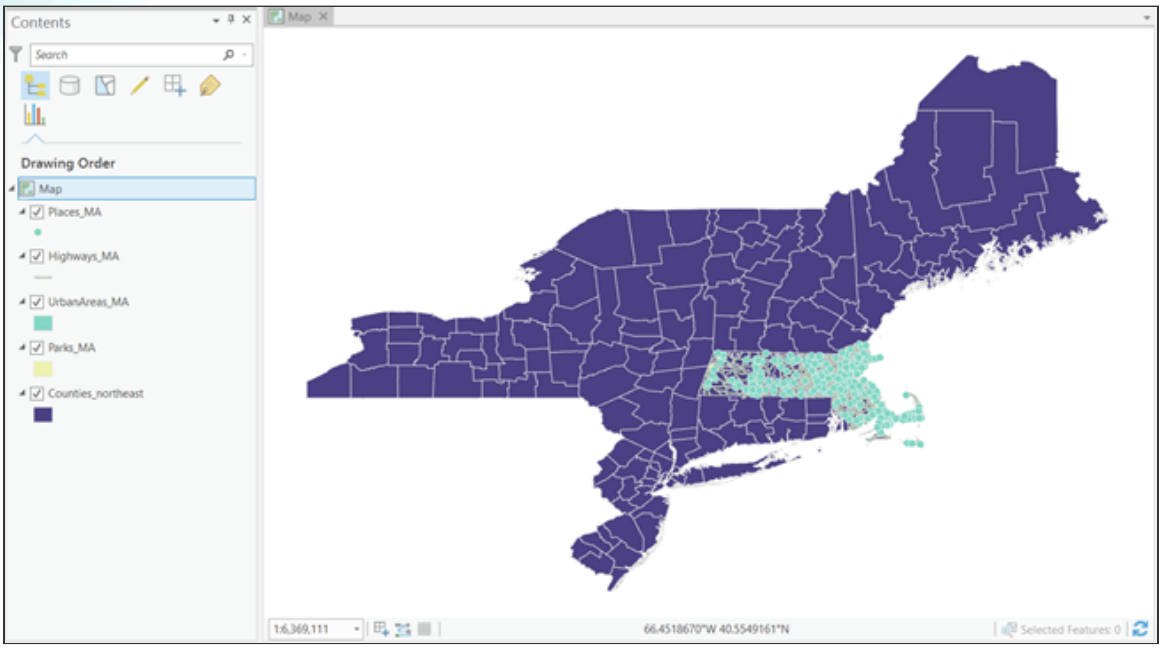
Note: ArcGIS Pro randomly assigns colors, so the colors in your map may differ.

h Close the Catalog pane.

The left side of the ArcGIS Pro window displays the Contents pane, which lists the layers contained in the current map. In the Contents pane, you can manage the display of layers, symbology, and other layer properties.

Using the check boxes next to the layer names in the Contents pane, you control which layers are drawn in the map or scene at any given time. You can remove the World Topographic basemap because it is not needed in the general reference map that you will make.

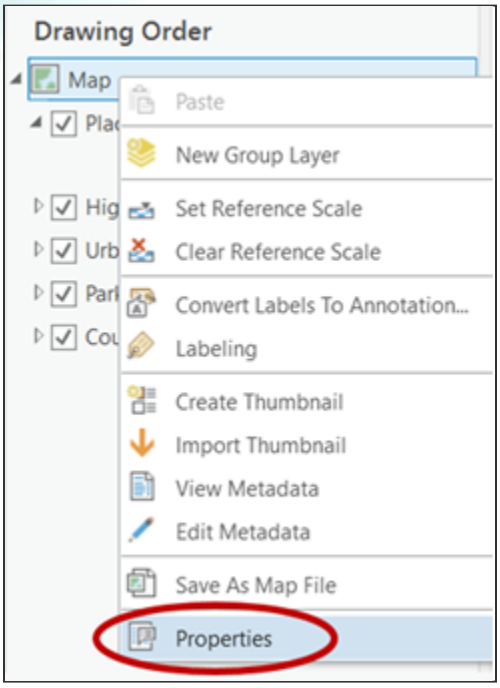
i In the Contents pane, right-click the Topographic basemap layer and choose Remove.



Step 3: Set the map properties

Next, you'll set some properties to make your map better.

a. In the Contents pane, right-click Map and choose Properties to open the Map Properties dialog box.



Note: You can also double-click Map to open its properties.

On the General tab, in the Name field, you can see that the map is currently named Map.

b. In the Name field, type **Massachusetts** as the new name for the map.

c. Click the Metadata tab.

It's good practice to include metadata for your map. When someone else goes to use your map in the future, the metadata provides context and understanding of what the map is for and where the data came from. You can learn more about metadata in ArcGIS Pro here (https://bit.ly/2HtXwFC).

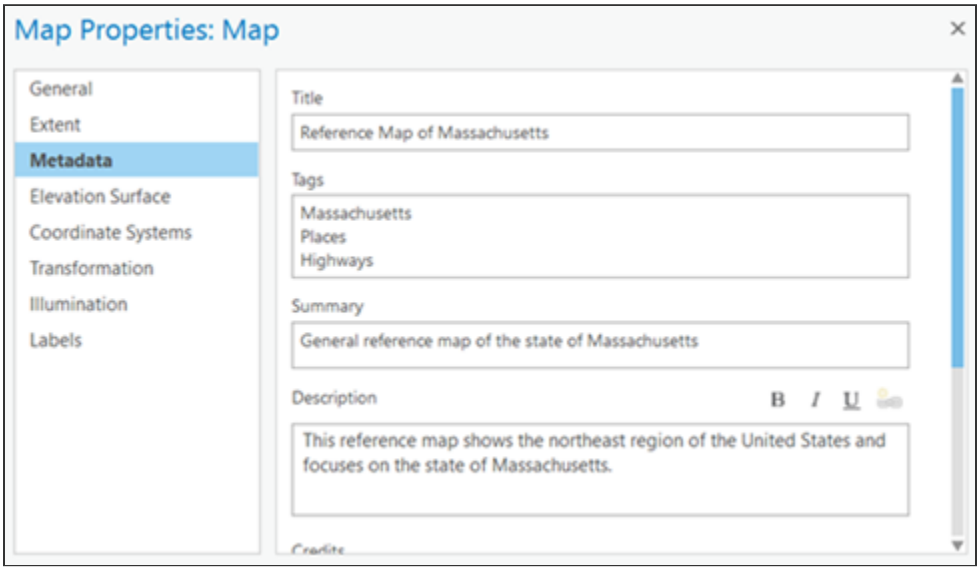
d. On the Metadata tab, type a title for your map, such as **Reference Map of Massachusetts**.

e. Add some descriptive tags, such as **Massachusetts**, **Places**, **Highways**, and any others that you'd like.

f. Type a summary for the map, such as **General reference map of the state of Massachusetts**.

g. Finally, type a description for your map, such as **This reference map shows the northeast region of the United States and focuses on the state of Massachusetts**.

You can use the Summary and Description shown in the following graphic, or you can write your own.



h. After providing the metadata, click the Coordinate Systems tab on the left side of the dialog box.

Maps and scenes use coordinate systems (https://bit.ly/2qih20s) to locate and display data correctly on the earth's surface and relative to one another. A coordinate system is a reference framework that defines the position of features in either two- or three-dimensional space.

In a GIS map, you work with geographic data through layers. Layers are collections of geographic data, such as features or imagery.

Currently, all layers in your map are unprojected in the WGS 1984 geographic coordinate system. Unprojected coordinate systems apply the geographic coordinates of the (nearly) spherical globe to the page or screen on a rectangle. This is why the states look a bit stretched. A projected coordinate system applies a mathematical adjustment to the coordinates to project their image onto the page or screen.

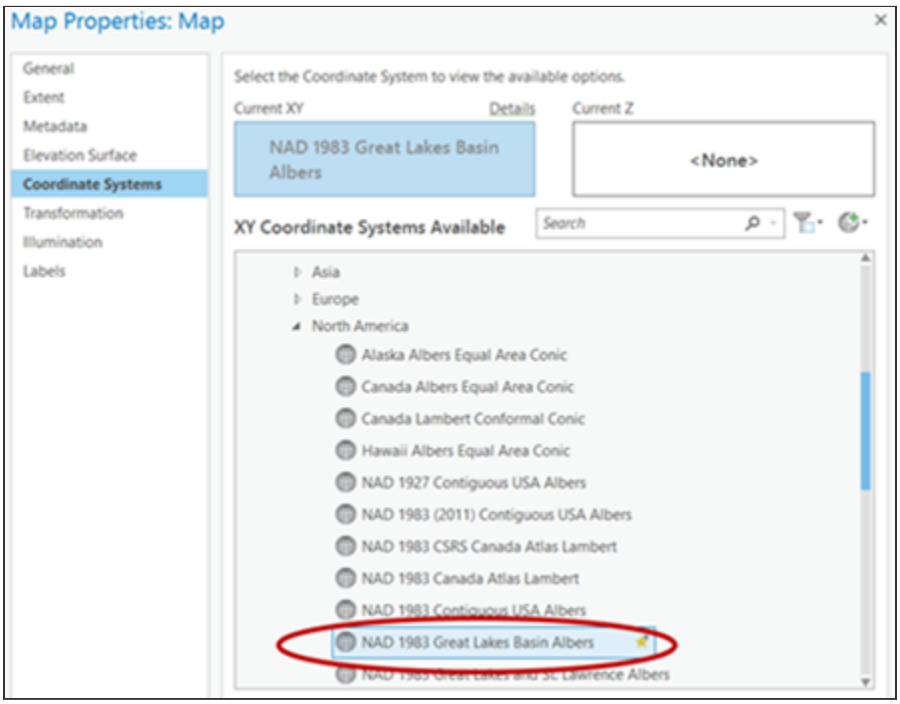
Projected coordinate systems all have limitations, but you can choose and manage the specific limitations to meet the needs of your map.

You will change the coordinate system for your map to an Albers projection (https://bit.ly/2qnA4RZ). Albers is an equal-area projection, which keeps the size of areas on the map true to their size relative to the globe. This comes at the price of minor scale and shape distortions. The Great Lakes Basin Albers projection is designed to minimize distortions specifically in the Great Lakes Basin area of North America. You'll learn more about coordinate systems in Section 2 Exercise 1 - *Working with Map Projections*.

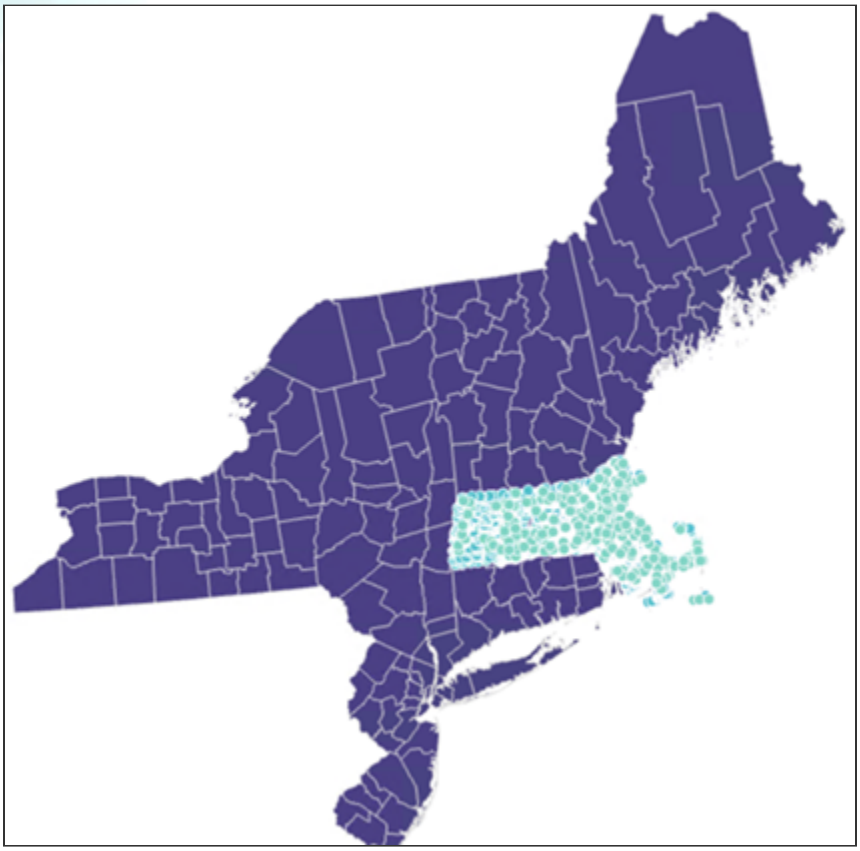
i On the Coordinate Systems tab, scroll down the list of coordinate systems and find and expand the Projected Coordinate System section.

j Expand the Continental section and the North America section.

k Click the NAD 1983 Great Lakes Basin Albers projection to select it.



l Click OK to apply the coordinate system and close the Map Properties dialog box.



Because the Albers equal-area projection minimizes distortion, it is well-suited for areas of interest that trend east-west, like Massachusetts. You will notice that Massachusetts no longer looks "stretched."

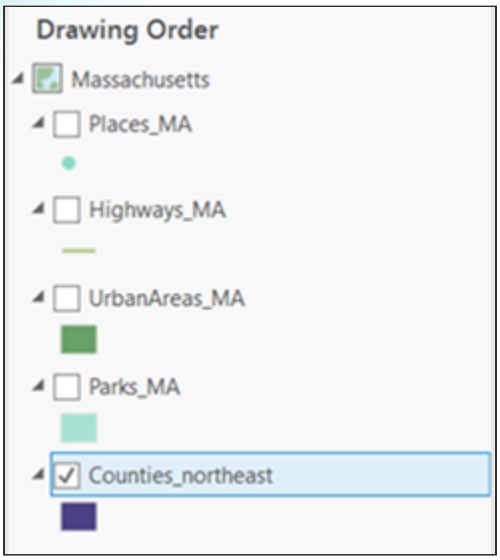
Step 4: Symbolize a layer

The data was added to the map with areal (polygon) features like counties and parks at the bottom of the Contents pane list so that they draw first, below other features. The linear (line) features like highways and railways draw above them. Finally, single-dimension point features draw on top. You can reorder layers in any way.

a. In the Contents pane, if necessary, move the Counties_northeast layer to the bottom of the layer list, below all other features in the list.

Note: To move a layer, click and drag it to a new location in the Contents pane.

b. Press Alt and click the check box to the left of the Counties_northeast layer.



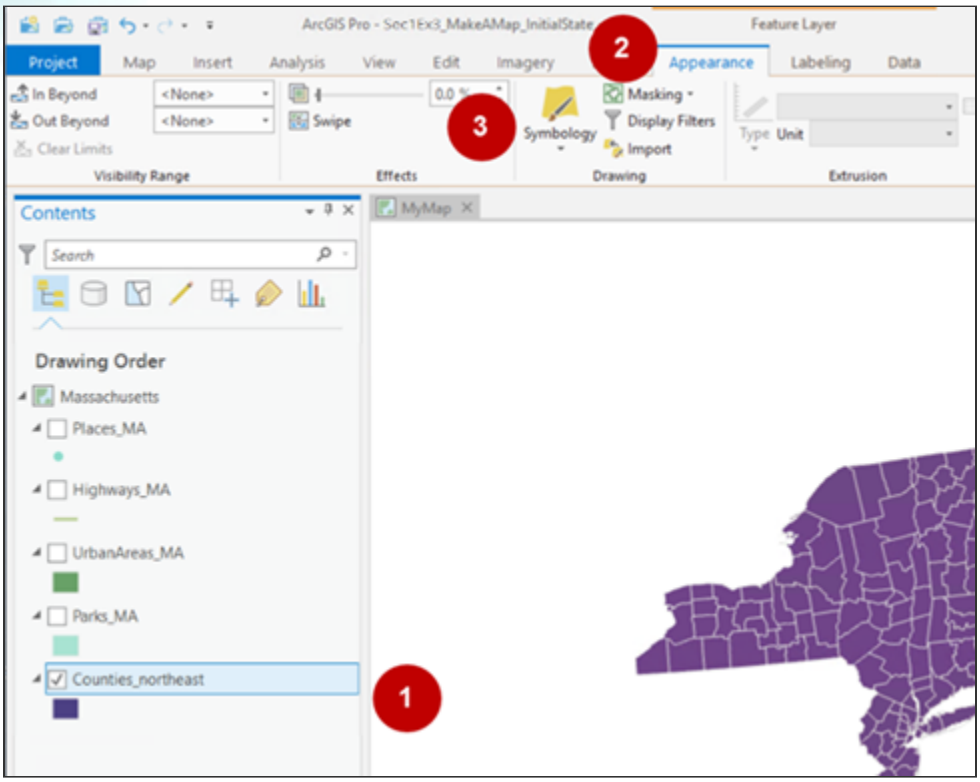
All the other layers turn off.

You want your reference map to showcase the state of Massachusetts. You can use symbology (https://bit.ly/2GTDRhi) to highlight Massachusetts and make it the focus of your reference map.

c. In the Contents pane, click the name of the Counties_northeast layer to select it. It will be highlighted with a blue box.

d. From the ribbon, on the Feature Layer tab, click the Appearance tab.

e. In the Drawing group, click Symbology to open the Symbology pane.



f In the Symbology pane, click the Symbology drop-down list at the top of the pane.

Various options for symbolizing your layer appear. You can symbolize feature layers in different ways depending on the type of data that you're showing. Learn more about symbolizing feature layers here (https://bit.ly/2JzHWZz).

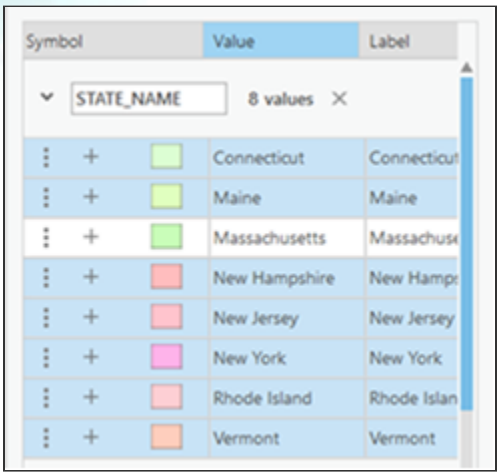
Because you want to showcase one feature in the map (the state of Massachusetts), you will use unique-value symbology.

g Choose Unique Values.

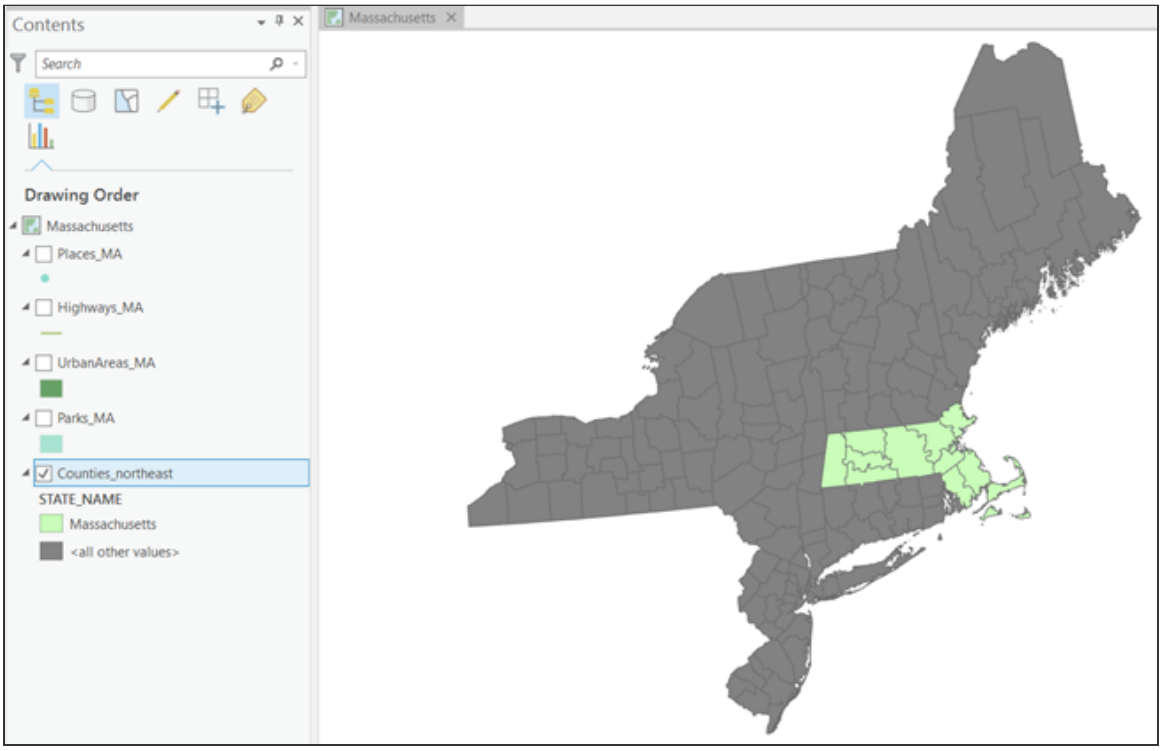
Each state in the map has a unique value—its name. You will use that information to apply a different symbol to Massachusetts.

h For the Value Field, from the Field 1 drop-down list, choose STATE_NAME.

i Press Ctrl, and in the grid at the bottom of the Symbology pane, click each state name except Massachusetts.



j. Right-click anywhere on the selected states and choose Remove.

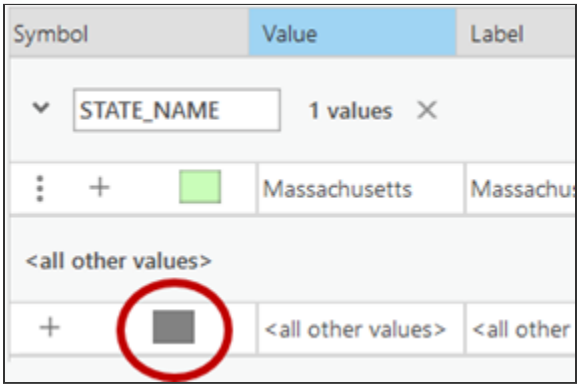


Massachusetts is now highlighted with a unique symbol to distinguish it from the other states, which are all drawn with the symbol defined for "all other values".

Step 5: Create a custom color

First you will modify the symbology of the states surrounding Massachusetts.

a. In the Symbology pane, next to All Other Values, click the Format Symbol color patch.



The Format Polygon Symbol pane opens. You will use the Format Symbol mode of the Symbology pane to change symbols as they are applied to features. This mode of the pane has two primary tabs: Gallery and Properties.

The Gallery tab gives you access to a gallery of existing symbols, where you can pick an existing symbol.

The Properties tab gives you access to all the properties of the current symbol. This tab gives you complete control over the symbol's appearance.

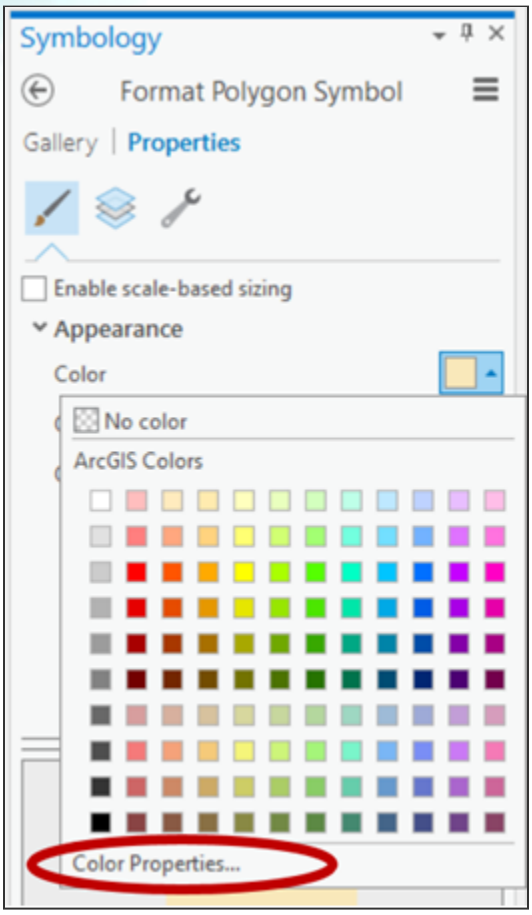
b. Click the Properties tab.

The Properties tab contains three secondary tabs. The first is the Symbol tab , which contains the basic high-level properties of the symbol. You will modify the selected symbol and create a custom color.

c. Click the Symbol tab, if necessary.

d. Expand the Appearance section and, for Color, click the down arrow to open the color palette.

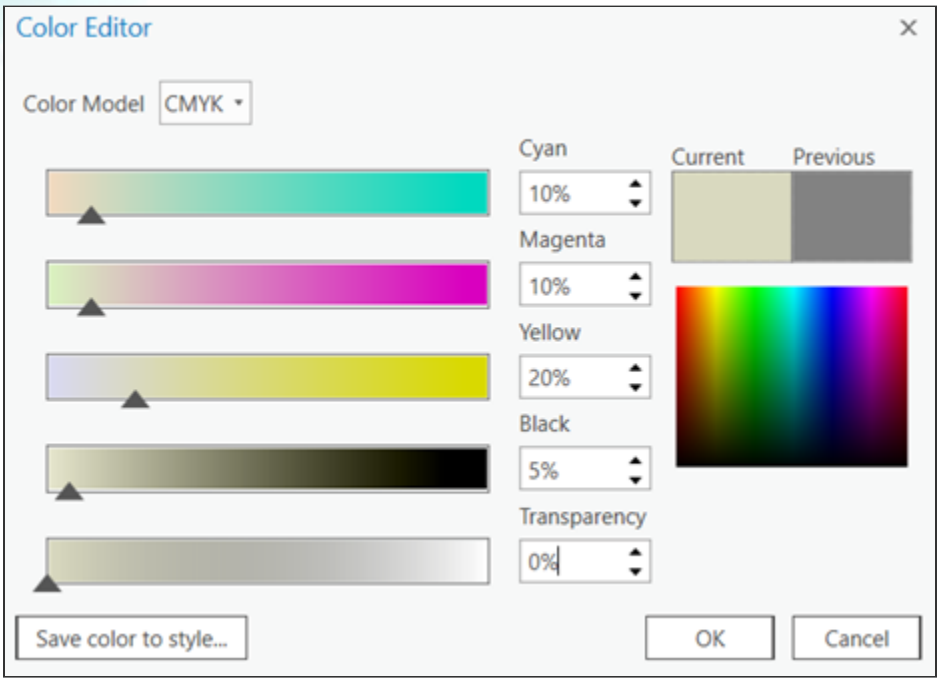
e. You could choose a color from the color palette, but for this exercise, click Color Properties to open the Color Editor.



Because you are making a map for hard-copy printing, you will change the color model to CMYK. CMYK is a subtractive color model that relates to subtractive output. Printing colored ink, usually in **C**yan, **M**agenta, **Y**ellow, or blac**K**, *subtracts* from the white light reflected from the page. This contrasts with an additive color model like RGB, where **R**ed, **G**reen, and **B**lue light from within your monitor *add* together to change your dark monitor to bright white.

f Set the Color Model to CMYK with the following values:

- Cyan = **10%**
- Magenta = **10%**
- Yellow = **20%**
- Black = **5%**

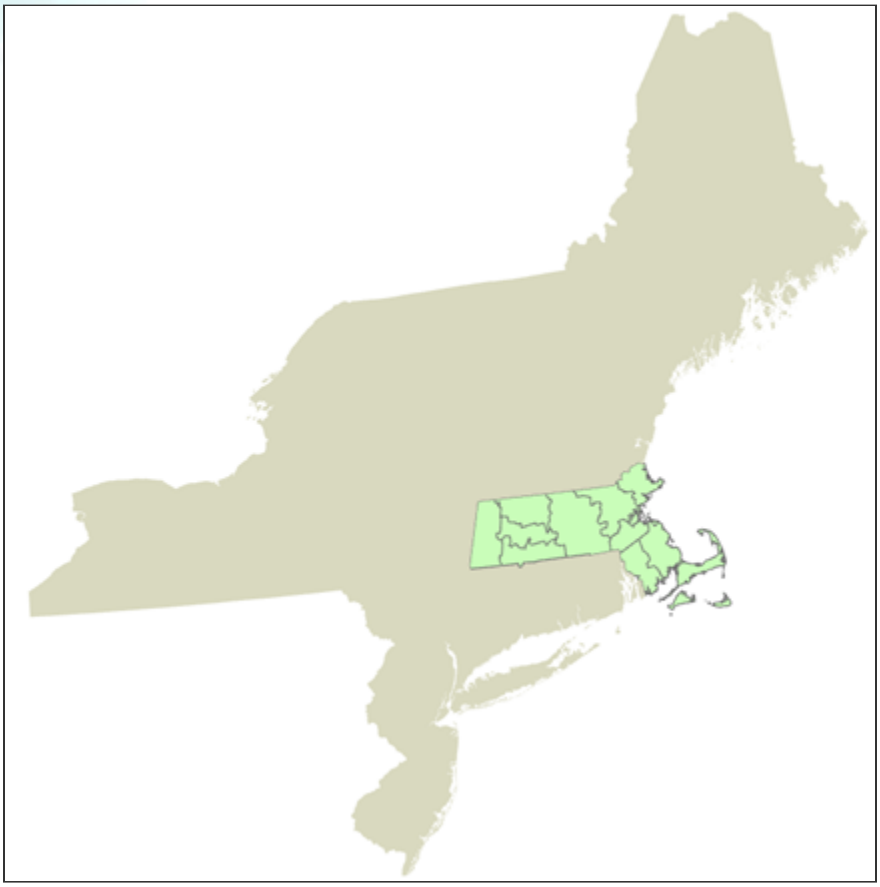


g. Click Save Color To Style and name your custom color **States**.

h. Click OK twice to close the open dialog boxes.

i. In the Format Polygon Symbol pane, if necessary, for Outline Color, choose No Color and set Outline Width to 0 pt.

j. At the bottom of the pane, click Apply.



All the states except Massachusetts now appear in a solid color with no county lines visible.

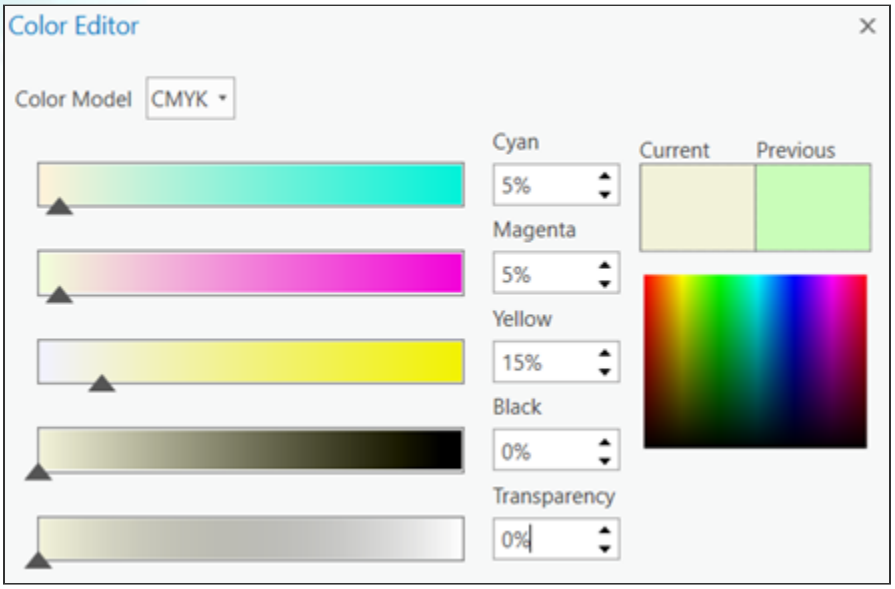
Now you will create another custom color style for the symbol used for Massachusetts.

k. At the top of the Format Polygon Symbol pane, click the Back arrow to return to the Symbology pane.

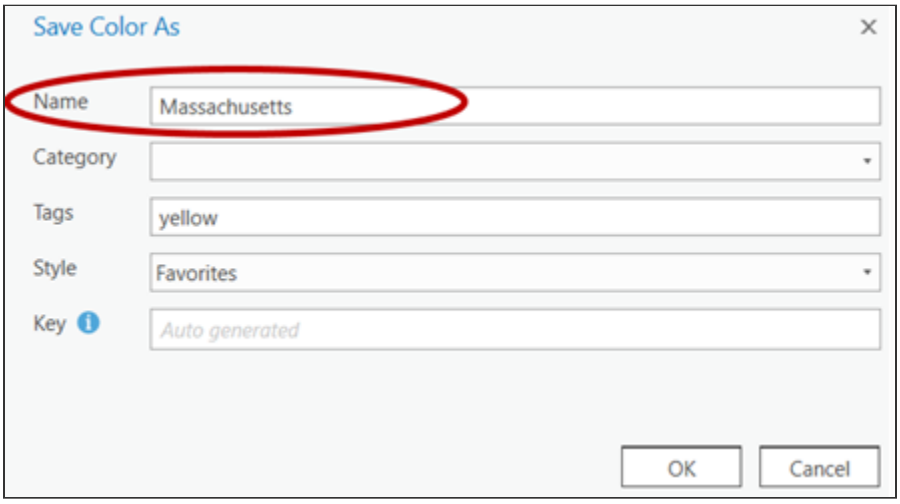
l. In the grid at the bottom, click the symbol for Massachusetts to open the Format Polygon Symbol pane.

m. Using the same steps, remove the outline and set the symbol color of the fill to CMYK with the following values:

- Cyan = **5%**
- Magenta = **5%**
- Yellow = **15%**
- Black = **0%**

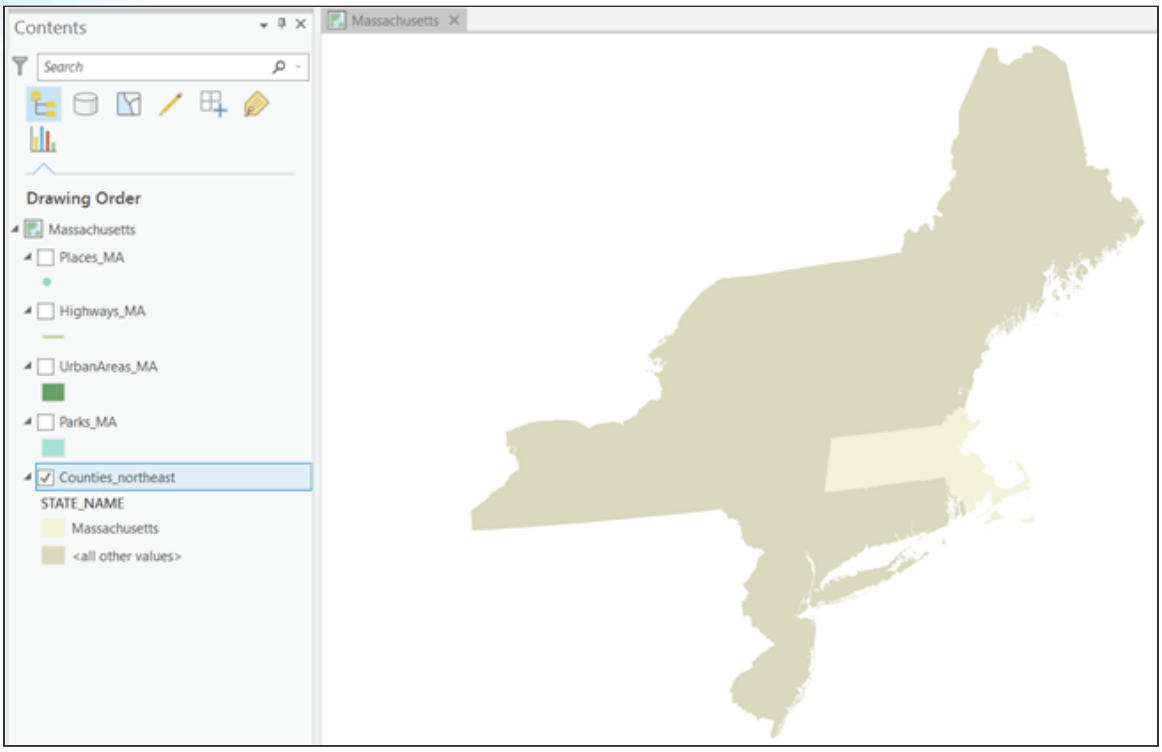


n. Save this color to your Favorites style and name it **Massachusetts**.



o. Click OK twice to return to the Format Polygon Symbol pane.

p. Change the Outline Color to No Color, and change the Outline Width to 0, and then click Apply.



The map display updates with the new symbols.

Using light colors for background information better supports the more detailed features that will appear on the background. You can use related colors to indicate related things. The two colors used in your current map are similar, but a brighter version is used to make Massachusetts the focal point.

As you work, it's a good idea to periodically save your map.

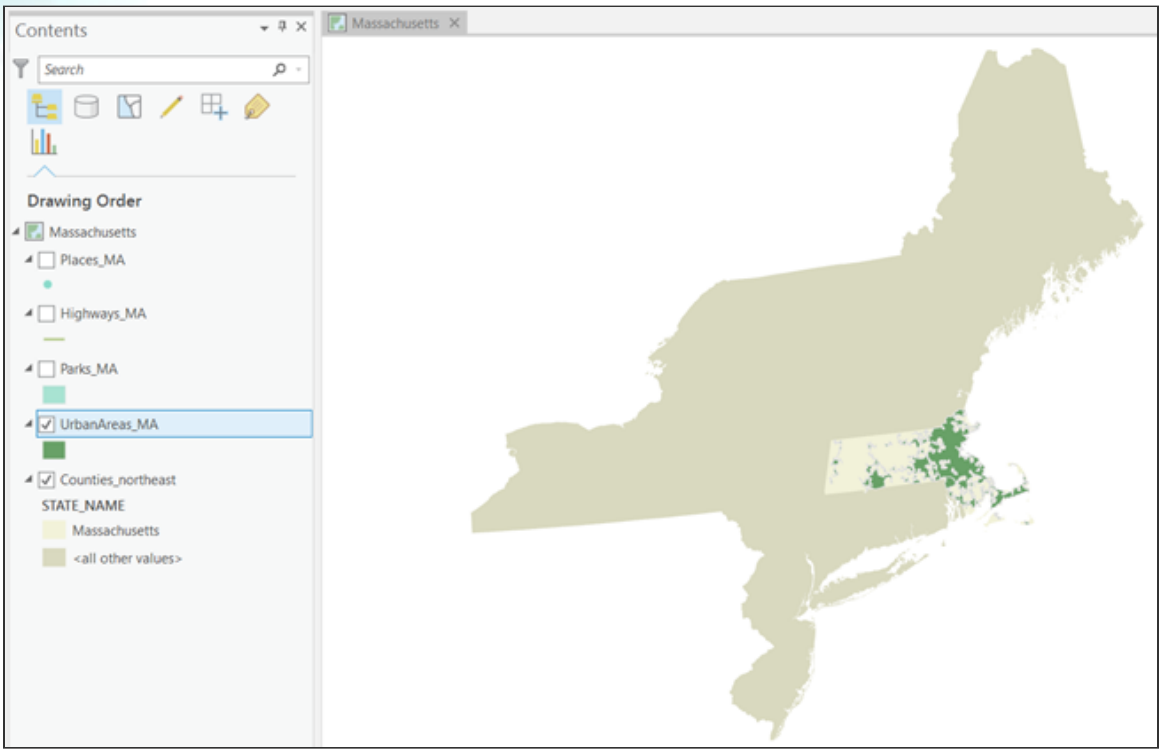
q. On the ArcGIS Pro ribbon, click the Project tab, and then click Save As.

r. Browse to your Sec1Ex3_MakeAMap folder on your computer, and save your map as **Sec1Ex3_MyMassachusettsMap_<yourfirstandlastname>**.

Step 6: Use transparency to set visual hierarchy

Visual hierarchy is the presentation of features on a map in a way that implies relative importance, usually achieved with visual contrast. In this step, you will use transparency to set visual hierarchy.

a. In the Contents pane, if necessary, click and drag the UrbanAreas_MA layer down so that it is the second layer from the bottom, and then turn it on.

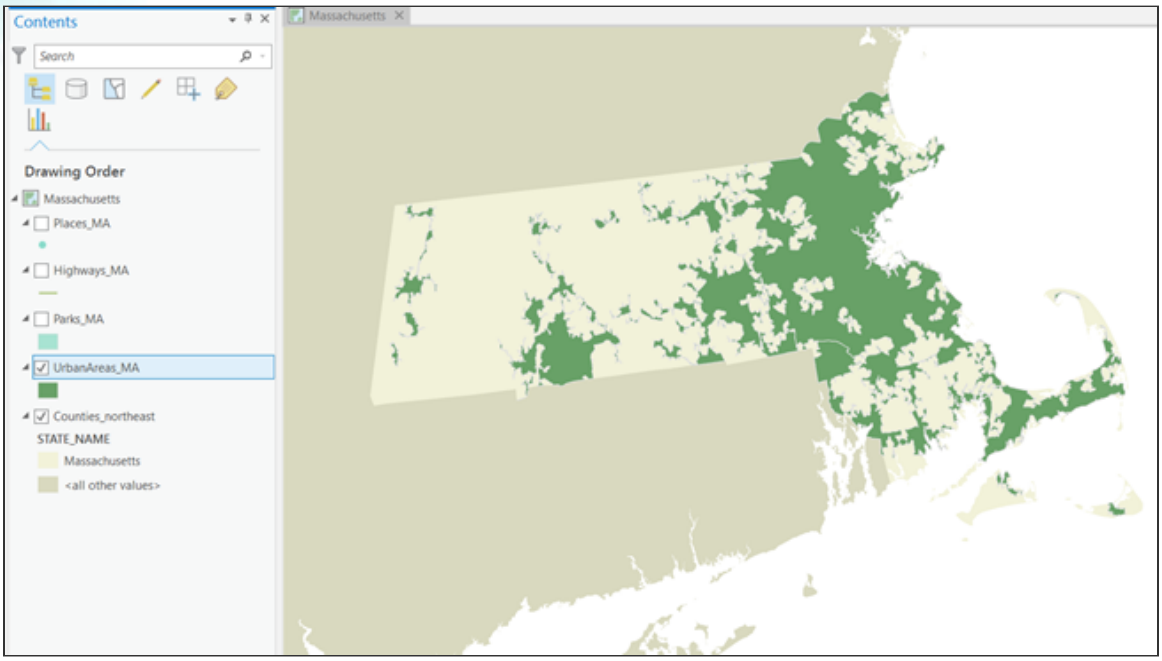


Because you are now focusing on the various layers for the state of Massachusetts, you can zoom in closer to better see the features.

When you work with maps and scenes in ArcGIS Pro, you need to zoom in and out and move around. Learn more about navigation here (https://bit.ly/2Jy0aLb).

You can use your mouse to zoom in, or use the navigation tools on the Map tab in the Navigate group. For this exercise, you will zoom to the layer.

b In the Contents pane, right-click UrbanAreas_MA and choose Zoom To Layer.

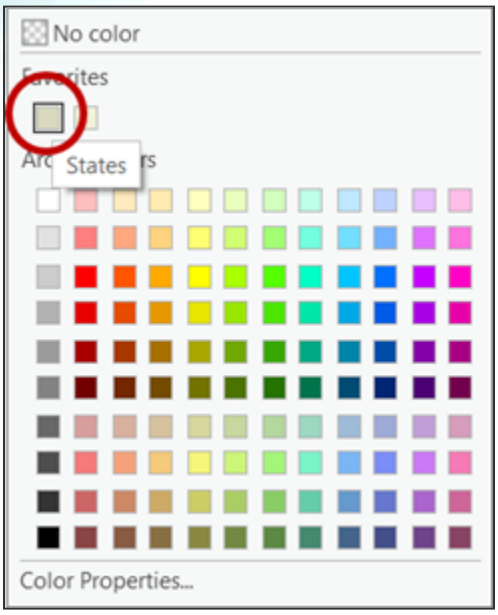


This time, as a shortcut, you will set the color for the layer directly from the Contents pane.

c. If necessary, in the Contents pane, to the left of the UrbanAreas_MA layer, click the down arrow to expand the layer so that its symbol appears below the layer name.

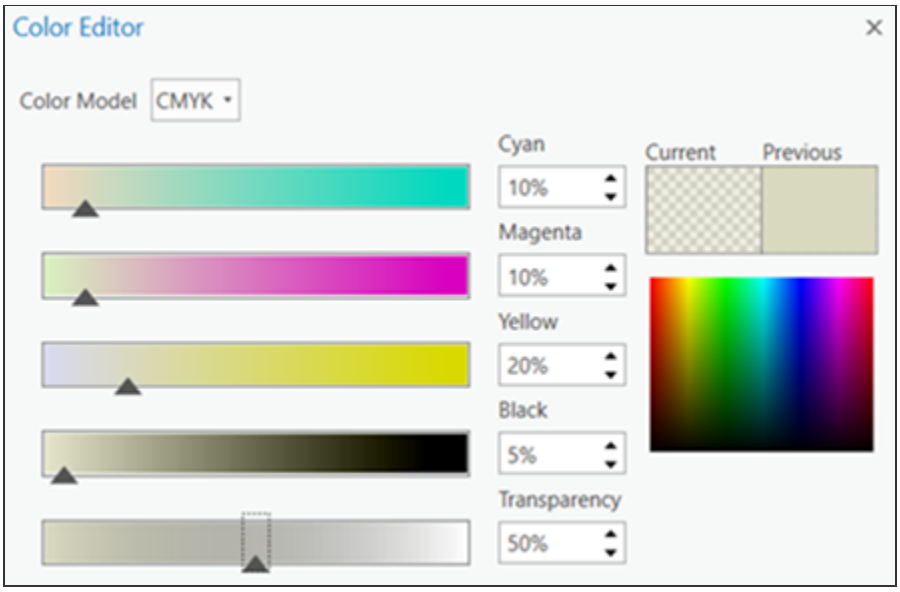
d. Right-click the symbol, and in the Favorites section, pick the States color that you previously saved.

Hint: Point to the color patches to see the names.



e Right-click the symbol again and choose Color Properties to open the Color Editor.

f Make this color **50%** transparent to lighten it.



g Click OK to apply your change and close the Color Editor

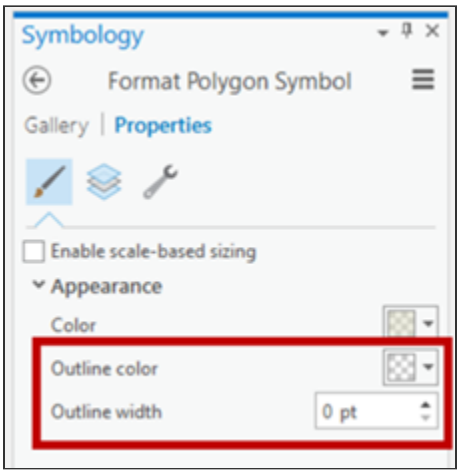
Any color used anywhere in ArcGIS Pro can have transparency. By using an existing color in the map as a starting point, it is easier to find colors that will work harmoniously in your map. Now the urban areas are subtly implied with a darker fill but still won't overpower or interfere with features that appear above them.

If there is an outline on the urban areas symbol, you will turn it off. The edges of urban areas are already implied by the color change, and they are in reality subjective features.

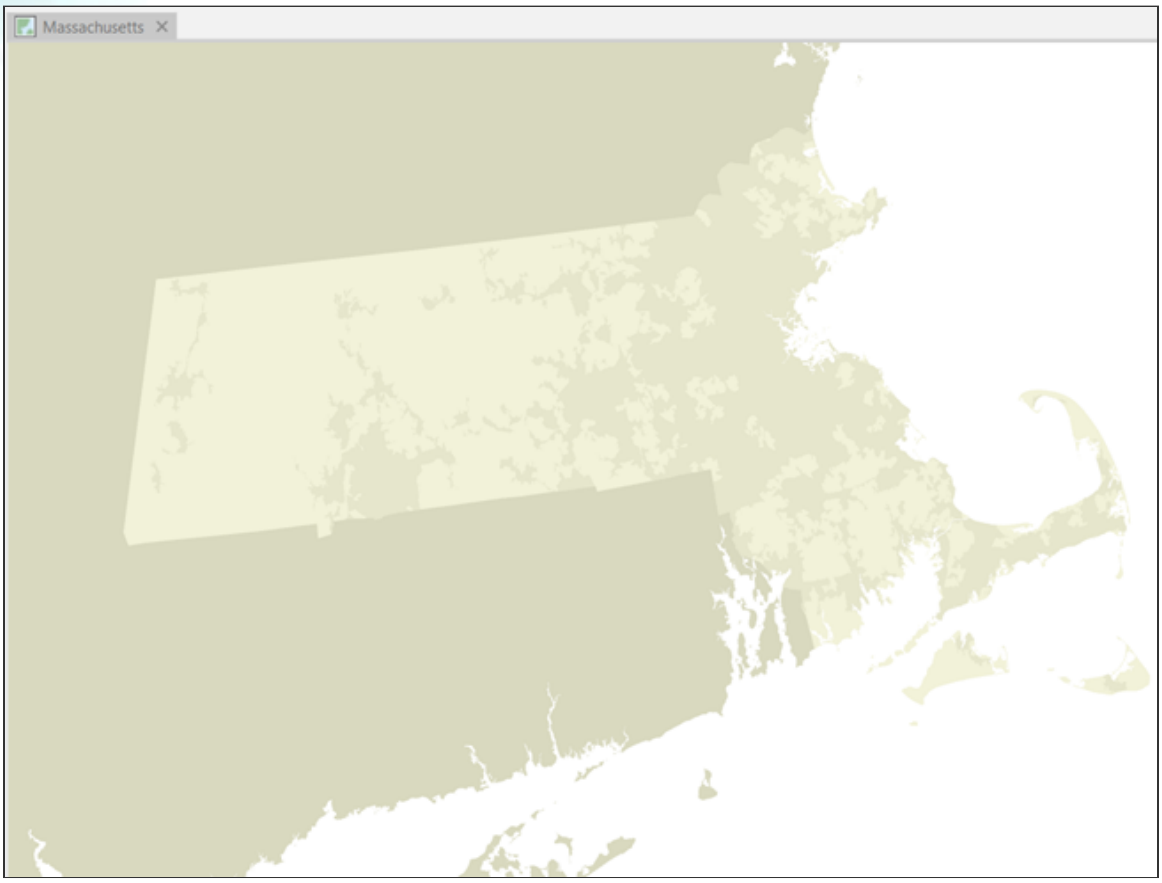
h. In the Contents pane, click the UrbanAreas_MA layer symbol to open the Format Polygon Symbol pane.

i. On the Properties tab, click the Symbol tab , if necessary.

j. In the Appearance section, set the Outline Color to No Color and set the Outline Width to 0 pt to remove outlines from the urban areas.



k. Click Apply to update the symbol.



l Save your map.

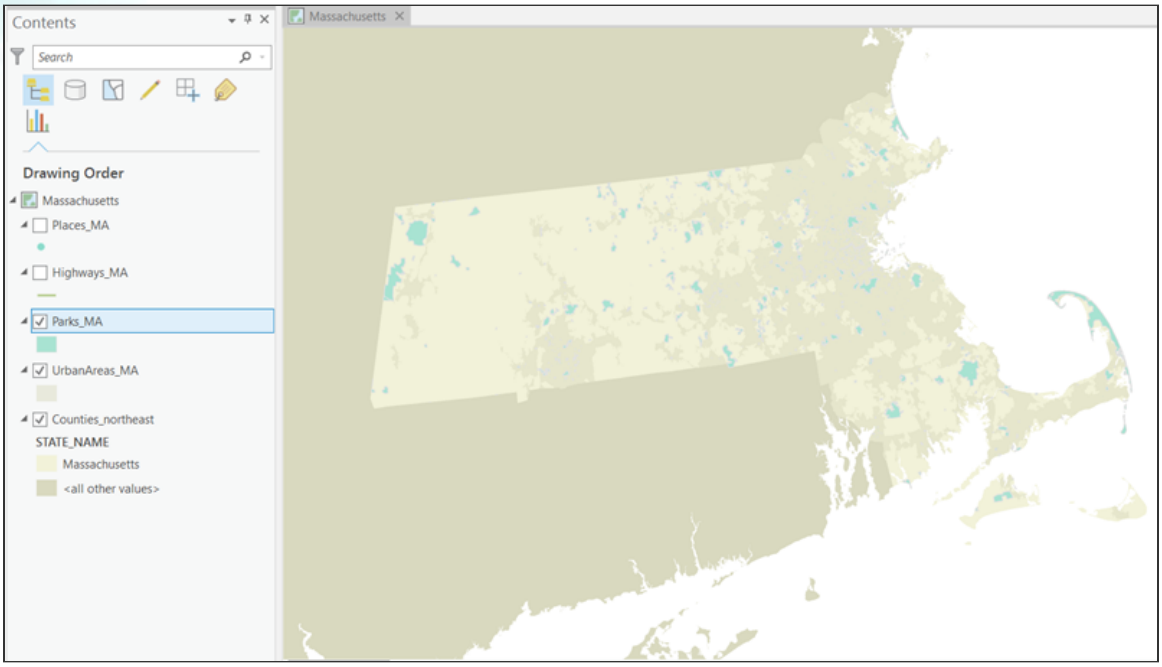
Hint: On the ribbon, click the Project tab and choose Save.

Step 7: Use data attributes to differentiate public lands

In your map, the Parks_MA layer contains area features of different types, such as national parks, state parks, and so on. You can symbolize them to differentiate between the types of parks.

a In the Contents pane, make sure that the Parks_MA layer appears just above the UrbanAreas_MA layer, and then turn it on and ensure that it is selected.

Hint: A layer is turned on when a checkmark appears to the left of the layer name in the Contents pane. A layer is selected when a blue highlight box appears around the layer name in the Contents pane.

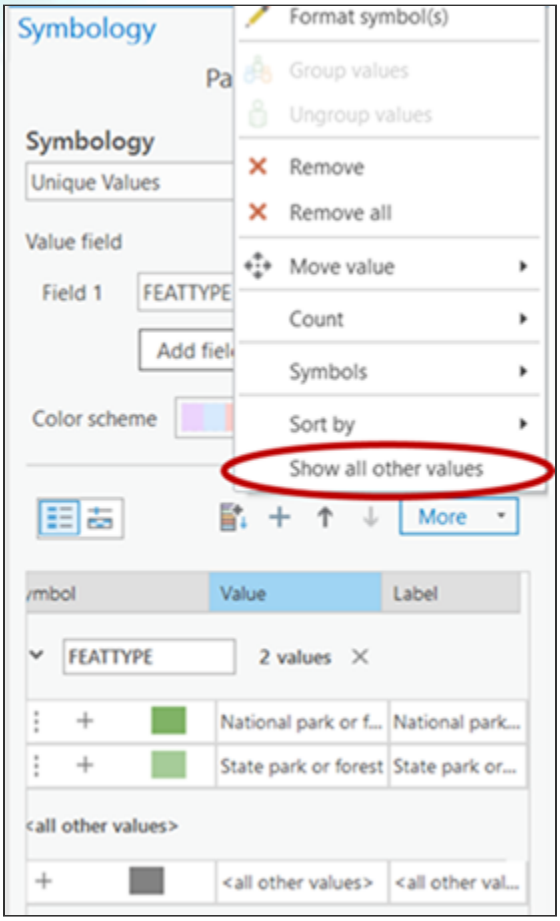


b **Challenge:** Use what you have learned so far to draw the Parks_MA layer with the following information:

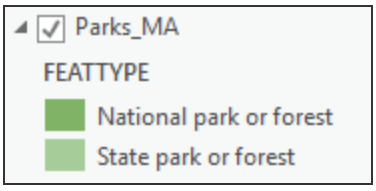
- Use Unique Values and the FEATTYPE attribute value for each type of park.
- Make National Park Or Forest CMYK **40 20 50 10** with no outline, and save the color to your favorites as **National**.
- Make State Parks Or Forest CMYK **30 15 35 5** with no outline, and save the color to your favorites as **State**.
- Do not include Local Park or Regional Park.

Note: For the complete set of steps for this challenge, go to the end of this exercise and review the Solution: Step 7b Challenge section.

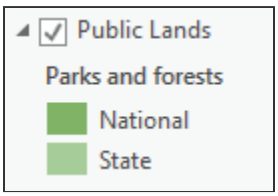
c To also remove symbology for All Other Values, in the Symbology pane, click the More drop-down list and uncheck Show All Other Values.



In the Contents pane, the Parks_MA layer legend should look like the following graphic when you are done.

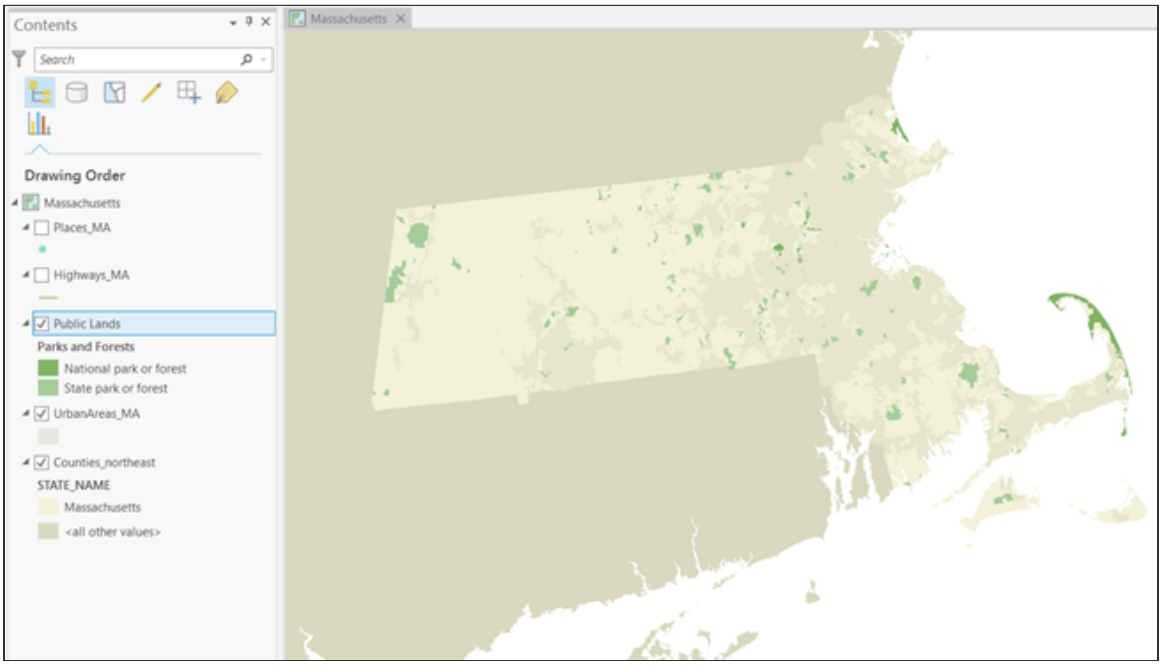


d **Challenge:** Update the layer to appear like the following graphic in the Contents pane.



Note: For the complete set of steps for this challenge, go to the end of this exercise and review the Solution: Step 7d Challenge section.

If you complete the challenges, your map should look like the following graphic.



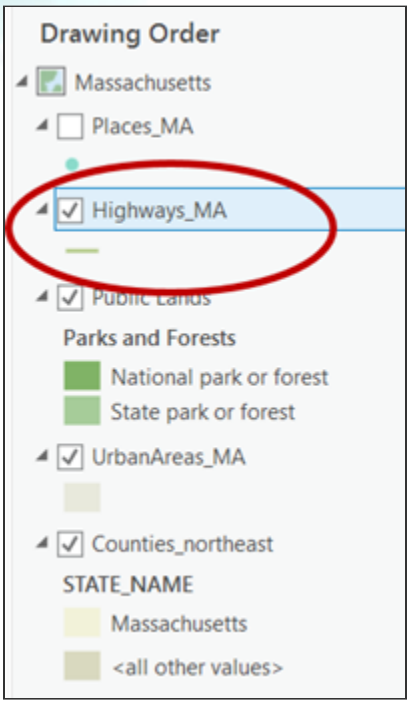
Now you will look at the line features in the map.

Step 8: Use the symbol gallery to symbolize line features

In the Contents pane, the next layer from the bottom of the list should be Highways_MA. This layer contains line features representing the different types of highways in the state.

a. If necessary, drag the Highways_MA layer immediately above the Parks_MA layer (or Public Lands layer if you renamed it in the last step).

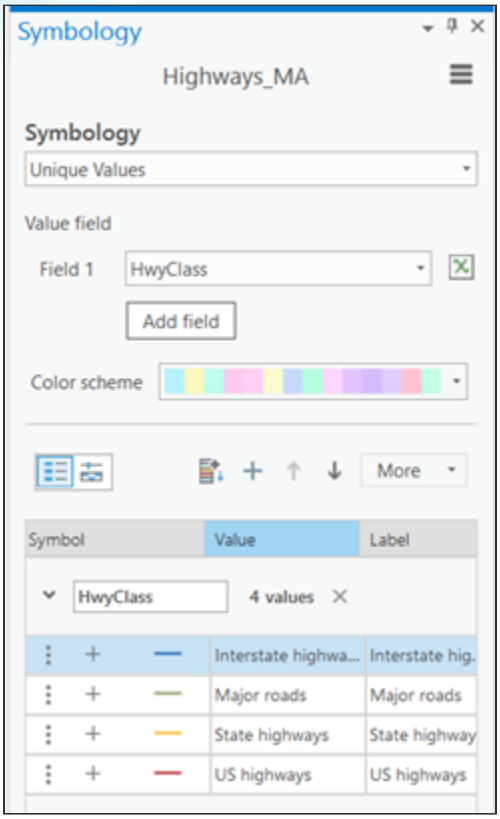
b. Turn on the Highways_MA layer, and, if necessary, expand its contents.



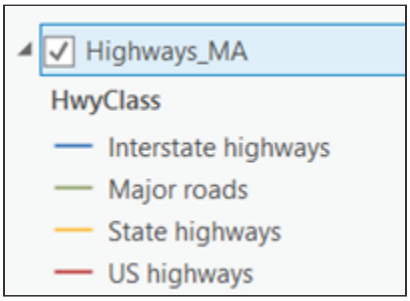
All highway and road features are currently using the same line symbol. There is nothing to visually distinguish an interstate highway from a major road.

c. Using the HwyClass field in the Symbology pane, use what you have learned to symbolize this layer and differentiate the four different highway types.

Note: There is no reason to show <all other values>.



Now each highway type symbol is a different colored line.



Note: ArcGIS Pro randomly assigns colors to the line features, so your results may not exactly match the graphic.

To streamline the process of modifying symbols, you can use symbols available in the symbol gallery. The gallery shows symbols of the current type (in this case, line symbols) that are contained in the project styles.

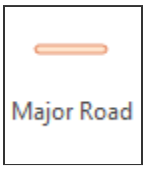
You can browse the ready-made symbols in the symbol gallery to find a suitable symbol, or you can search for one by typing a search term. You will choose existing symbols from a gallery for each of the highway types and modify them.

d. Either in the Contents pane or in the Symbology pane, click the symbol for Interstate Highways.

e. In the Format Line Symbol pane, click the Gallery tab, and then click the first symbol called Highway.

The new symbol is applied to all Interstate Highway features. Looking at the map, it's now more obvious where those features are located within the state.

f. Similarly, symbolize both the State Highways and the US Highways with the same Major Road symbol.

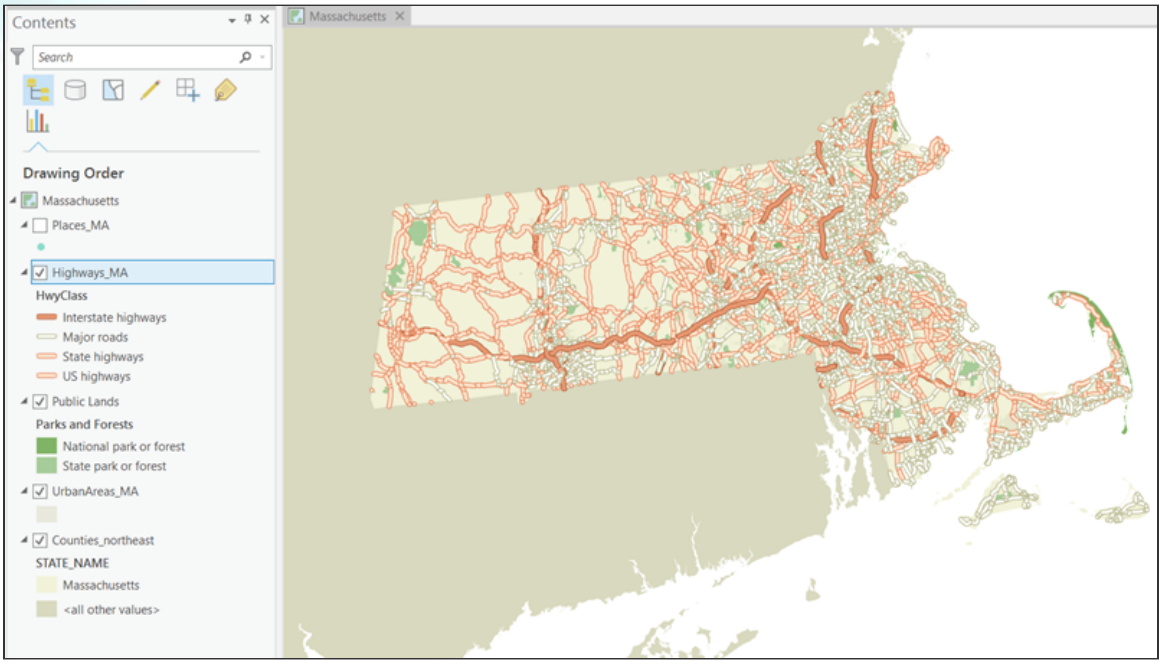


Hint: At the top of the Format Line Symbol pane, click the Back arrow and then select the symbol that you want to format. Another option is to select the symbol that you want to format from the Contents pane.

g. Finally, symbolize the Major Roads with the Minor Road symbol.

h. After symbolizing the highways, save your map.

The roads and highways are now classified, but if you zoom in and out, you can see that several improvements can be made.

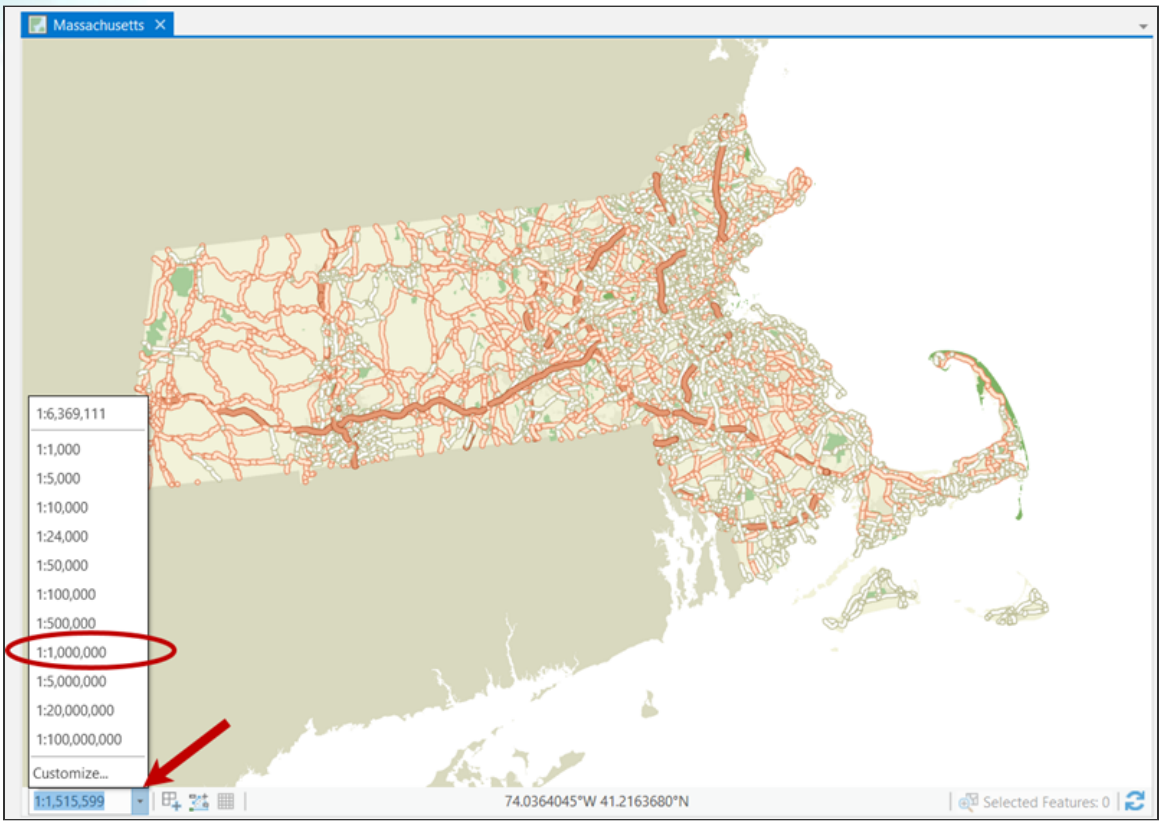


Depending on how far you are zoomed in, the roads and highways may look overly thick or too thin. This is because the map doesn't have a reference scale set.

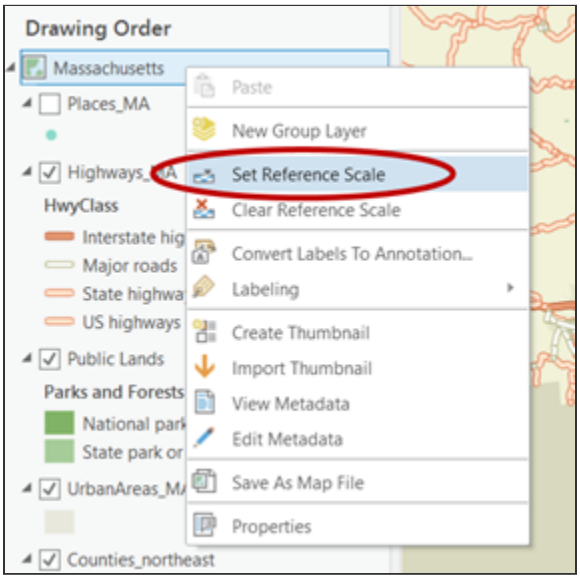
Step 9: Set the map reference scale

A map reference scale (https://bit.ly/2GNG7GC) establishes the scale at which symbols are true to their set size. When a reference scale is set, symbols remain a constant size in relation to geography, regardless of the view scale. Without a reference scale, the symbols remain a constant size in relation to the screen, regardless of the view scale. Because you are making a hard-copy map for output, you will set the reference scale to the output scale of the final map.

a. Below the map view, use the map scale control to set the view scale to 1:1,000,000.

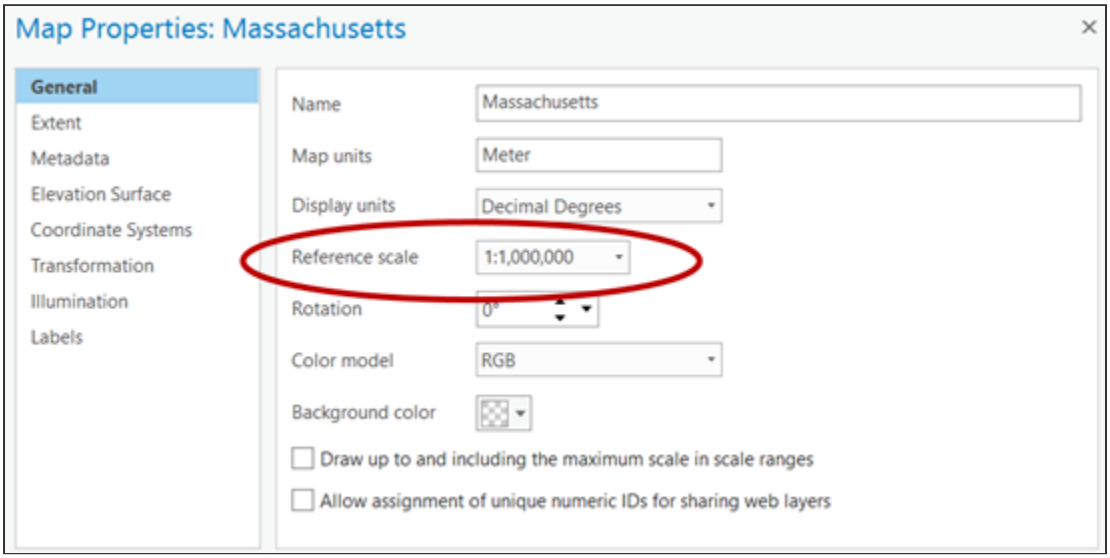


b In the Contents pane, at the top of the list, right-click Massachusetts and choose Set Reference Scale.



c Zoom in and out again to see the difference.

Note: You can see and modify the reference scale from the Map Properties dialog box on the General tab.



But, now the symbols seem excessively wide in relation to the rest of the map. The rounded ends overlap the edges of the state and look out of place.

Step 10: Modify a gallery symbol

You can improve the appearance of the symbols by modifying them.

a. In the Contents pane, click the symbol for Interstate Highways.

b. In the Format Line Symbol pane, click the Properties tab and click the Symbol tab.

The composite line symbol is 4.2 points wide. Composite symbols are made up of more than one symbol layer. In this case, two stroke symbol layers make up the line symbol.

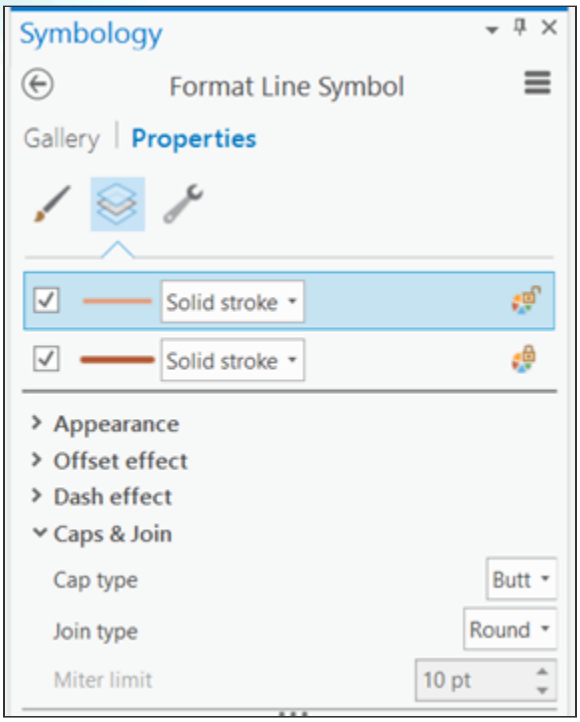
c. Change the Line Width to **2.8 pt**, and then click Apply.

d. Click the Layers tab .

From this tab, you can adjust the two strokes that make up the composite line symbol independently.

e. Click the first stroke symbol layer to highlight it, if necessary.

f. Expand the Caps & Join section, and then change the Cap Type to Butt.



g At the bottom of the pane, zoom in on the preview of the symbol to see the difference.

Hint: Click in the preview box and use your mouse wheel to zoom in on the line symbol. You can also click and drag the symbol left or right to see its ends.

h Highlight the other stroke and set its Cap Type to Butt.

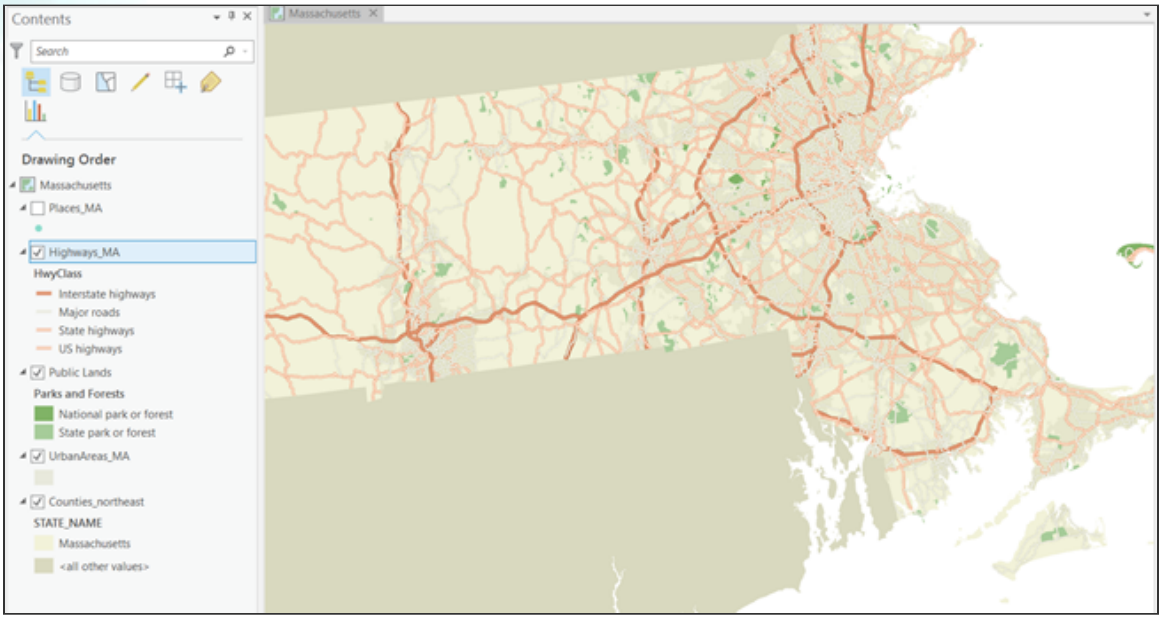
i Click Apply.

j Similarly, set the symbol size for the remaining classes as follows:

Class	Line Width	Cap Type
Major Roads	1.4 pt	Butt
State Highways	2 pt	Butt
US Highways	2 pt	Butt

Hint: Be sure to set the Cap Type for both strokes for each class.

k When you are finished, your map should look like the following graphic.



The weights of the line symbols and their appearance along the state boundary are improved, but they are not ordered correctly, and each segment is drawing independently. Ideally, the road segments should look visually connected, and the smaller roads should draw below the larger ones.

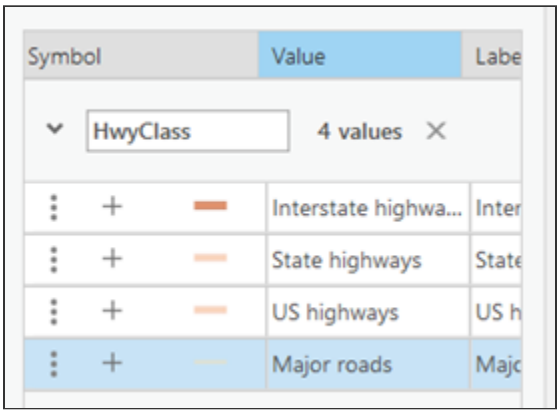
l. Return to the Symbology pane for the Highways_MA layer.

Hint: If the Format Symbol pane is open, click the Back arrow to get to the Symbology pane.

In the grid of highway classes, the classes are listed alphabetically.

m. In the grid, click and drag the Major Roads class to the bottom of the list.

Hint: Drag it by the three vertical dots on the side.



This update will make a more sensible order in the Contents pane but does not affect the order in which the symbols draw on the map. To control that, you'll use symbol layer drawing.

Step 11: Use symbol layer drawing

As you've learned, the order in which features draw in a map—how they overlap each other—is dictated by the order of the layers in the Contents pane. But, for layers with more than one symbol class, like the Highways_MA layer in this map that has four symbol classes, you need to use symbol layer drawing to adjust the drawing order of the symbol classes within the layer.

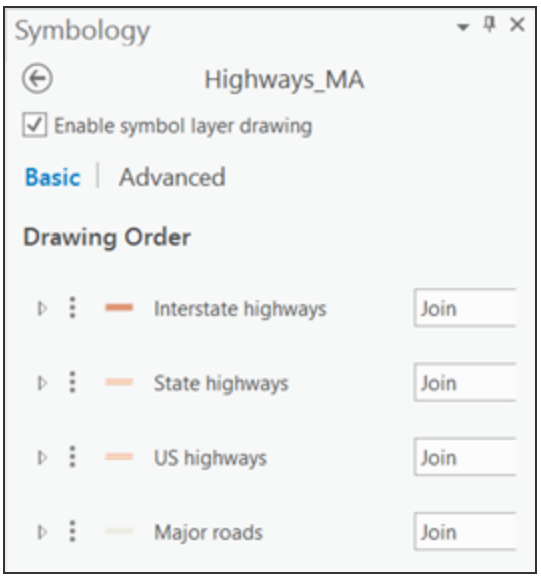
Symbol layer drawing (https://bit.ly/2JzIy1j) specifies the drawing order of symbols on maps.

a. At the top of the Symbology pane, click the menu button and choose Symbol Layer Drawing.

b. Check the Enable Symbol Layer Drawing check box.

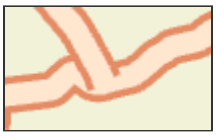
Each symbol class is now set to Join, meaning that the lower symbol layers (in this case, wider and darker) in each symbol draw first, with the upper (narrower and lighter) drawing above, for each symbol class, implying a sense of connectivity. Each symbol class draws independently in the order specified in the Drawing Order list.

c. If the Major Roads group is not at the bottom of the list, click and drag it to the bottom.

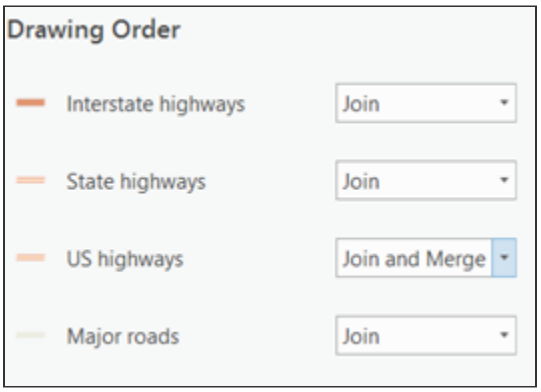


Because you are not differentiating between the State Highways system and the US Highways systems in this map—they are drawn with the same symbol—you must ensure that they look

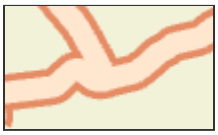
visually connected, too. You can do this by *merging* the two symbol classes. Merged symbol classes draw all of their bottom symbol layers first from both symbol classes, followed by all of the top symbol layers from both symbol classes. In other words, the two symbol classes are treated as one from a drawing order perspective. Currently, they appear separated, as shown in the following graphic.



d. Change the drawing setting of US Highways to **Join And Merge**.



This merges the current symbol class (US Highways) with the one immediately above it in the drawing order (State Highways).



Now the wider, darker stroke symbol layers of both symbol classes draw below the narrower, lighter stroke symbol layers of both symbol classes.

Step 12: Label point features on the map

A label is a piece of text on the map that is dynamically placed and whose text string is derived from one or more feature attributes.

Labeling adds descriptive text to features in a map or scene. It is a fast way to add text to your map because it lets you avoid having to add text for each feature manually. This can be useful if your data is expected to change or you are creating maps at different scales.

ArcGIS Pro uses the Maplex Label Engine, which gives you access to label placement properties for additional control over your labels. You will learn more about labeling in Section 4 Exercise 1 - *Labeling a Map*.

Note: ArcGIS Pro has two labeling engines: the Standard Label Engine (https://bit.ly/2JCzSar and the Maplex Label Engine (https://bit.ly/2qnFf4t.

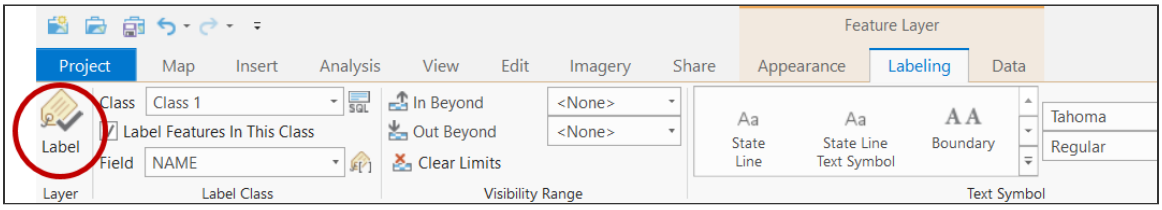
Because the urban areas are shown as darker polygons, indicating where the built-up areas of population are, you don't necessarily need to show dots or other point symbols for the cities. Sometimes, it's beneficial to use features for labeling but not show the features themselves. In this case, you will use the Places_MA point features to place the city names without a point symbol.

The Places_MA points layer appears at the top of the list of layers in the Contents pane, which means that these features will draw on top of all other layers in the map. Currently, the features in this layer are symbolized with a small colored point symbol. You will add labels to these features.

a. In the Contents pane, turn on the Places_MA layer and ensure that it is selected.

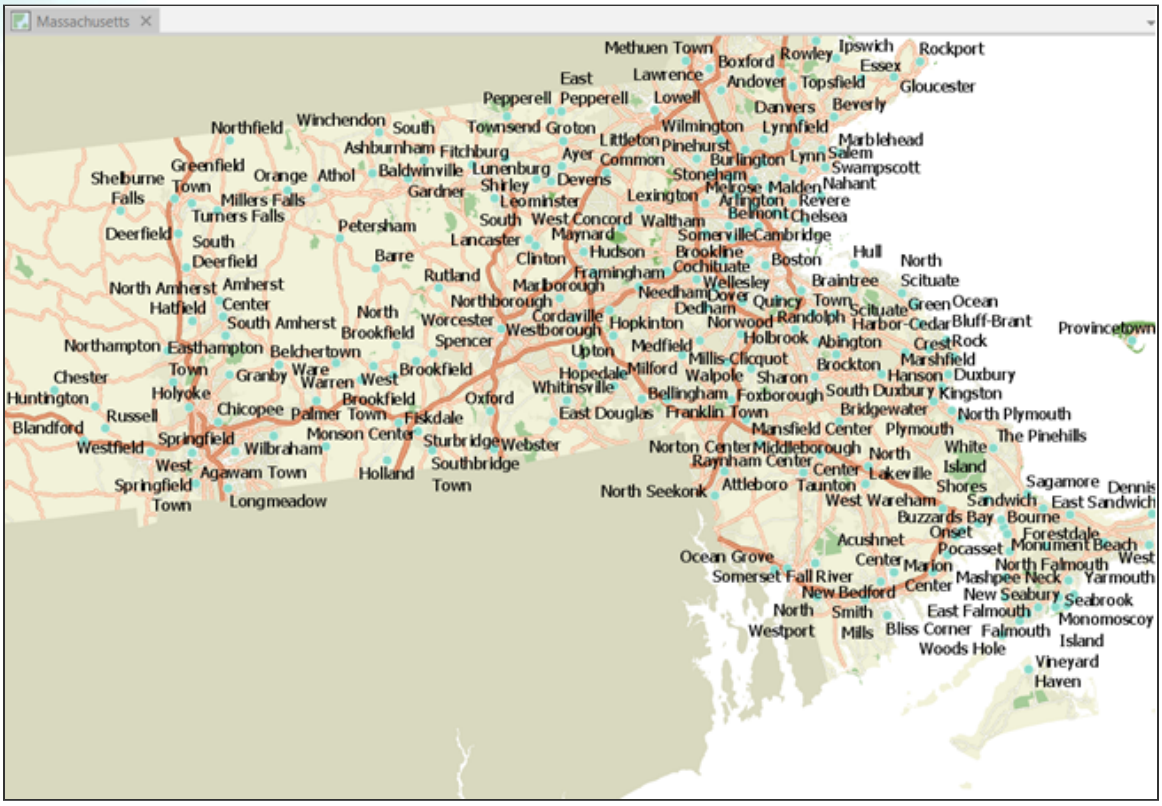
b. On the ribbon, under Feature Layer, click the Labeling tab.

c. In the Layer group, click Label.



The Label button turns labels on and off. When labels are turned on, the button is blue and labels appear for each of the point features in the layer.

There are 244 features in this layer, which creates a lot of labels! Perhaps there are too many for a map of the whole state. It would be better to label just the larger cities.



You will open the Places_MA layer attribute table to better understand the data.

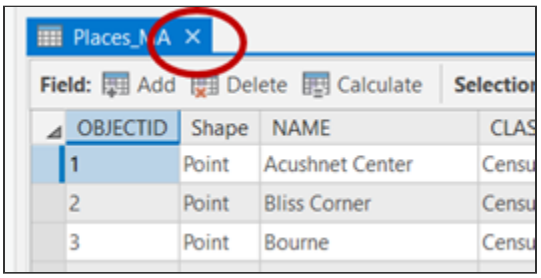
d In the Contents pane, right-click the Places_MA layer and choose Attribute Table.

The attribute table lists the attributes and data associated with the points in the layer.

e Scroll through the records in the attribute table and examine the available information.

Note that you have population information and classification. There is a mix of incorporated cities and census-designated places, which are just a concentration of people. For your map, you will only show cities with at least 15,000 people.

f Close the attribute table.



You can set a definition query (https://bit.ly/2GNROBc) to identify the cities that meet this criteria.

g. In the Contents pane, right-click the Places_MA layer and choose Properties.

Note: In the Contents pane, you can also double-click the layer name to open the Layer Properties dialog box.

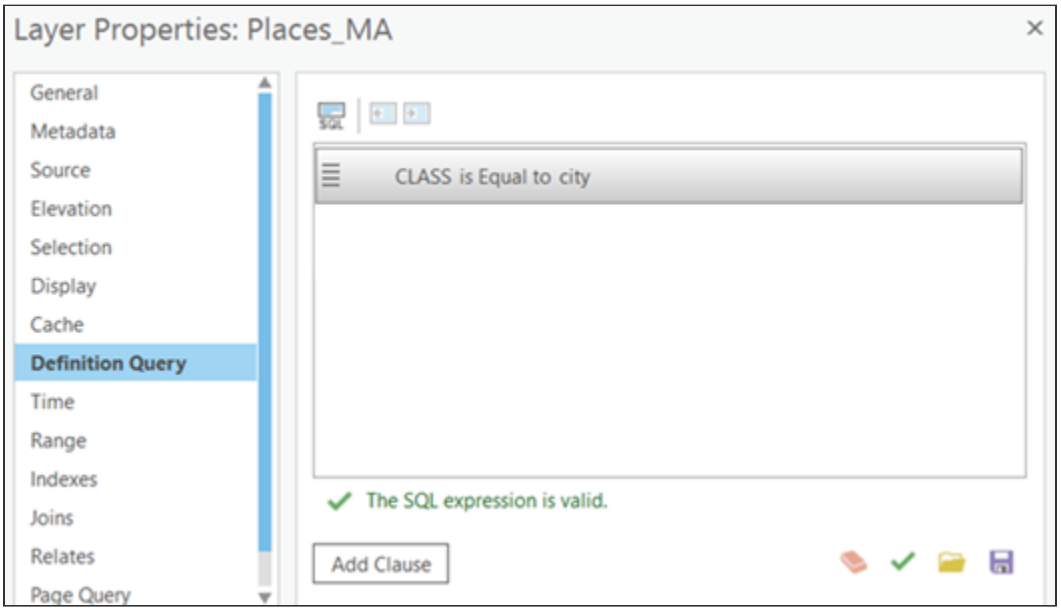
h. In the Layer Properties dialog box, on the Definition Query tab, click Add Clause.

You will add two clauses—one where the class is equal to City and one where the 2015 population is greater than or equal to 15,000 people.

i. Set the first field to CLASS.

j. Set the operator to Is Equal To, if necessary, and set the third field to City.

k. Click Add.



l. Click Add Clause to add another clause.

m. Set the operator to And, if necessary.

This field is a Boolean operator (https://bit.ly/2GQPANB) that is used to combine the two clauses so that the result is only features that meet both criteria.

n. Set the second field to POP2015.

This field contains the 2015 population.

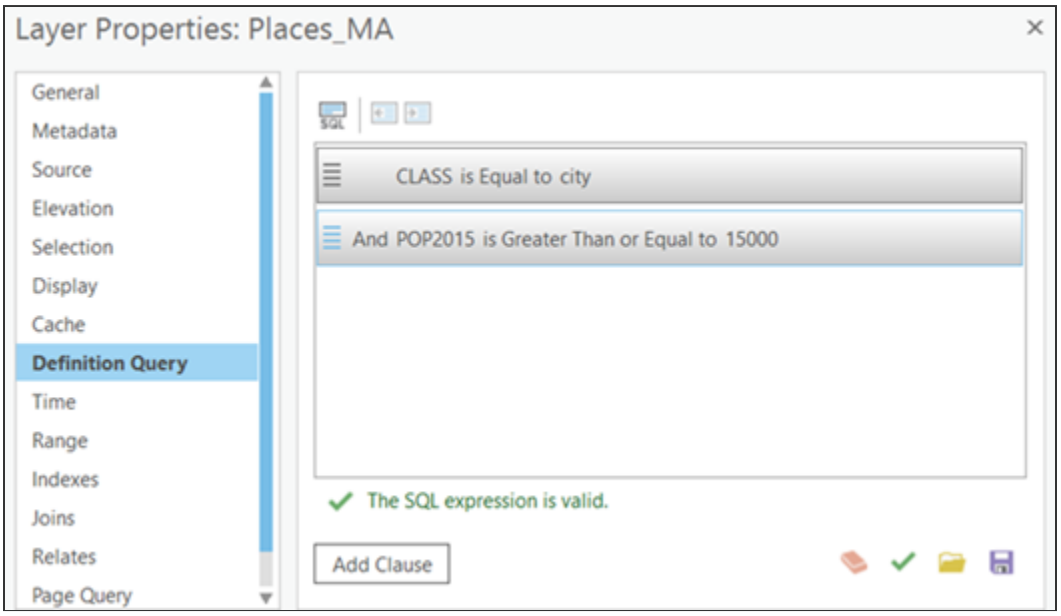
o Set the operator to Is Greater Than Or Equal To.

p In the last field, type a value of **15000**, and then click Add.

Hint: If you receive an error that your SQL expression has invalid syntax, make sure that there is no comma in the value that you typed.

q Click the green check mark to verify that your query expression is valid.

The definition query should look like the following graphic.

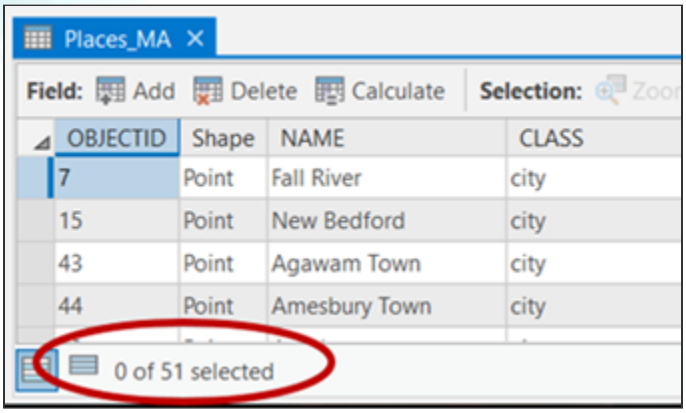


r Click OK to run the query.

The map display updates, and fewer place labels appear on the map.

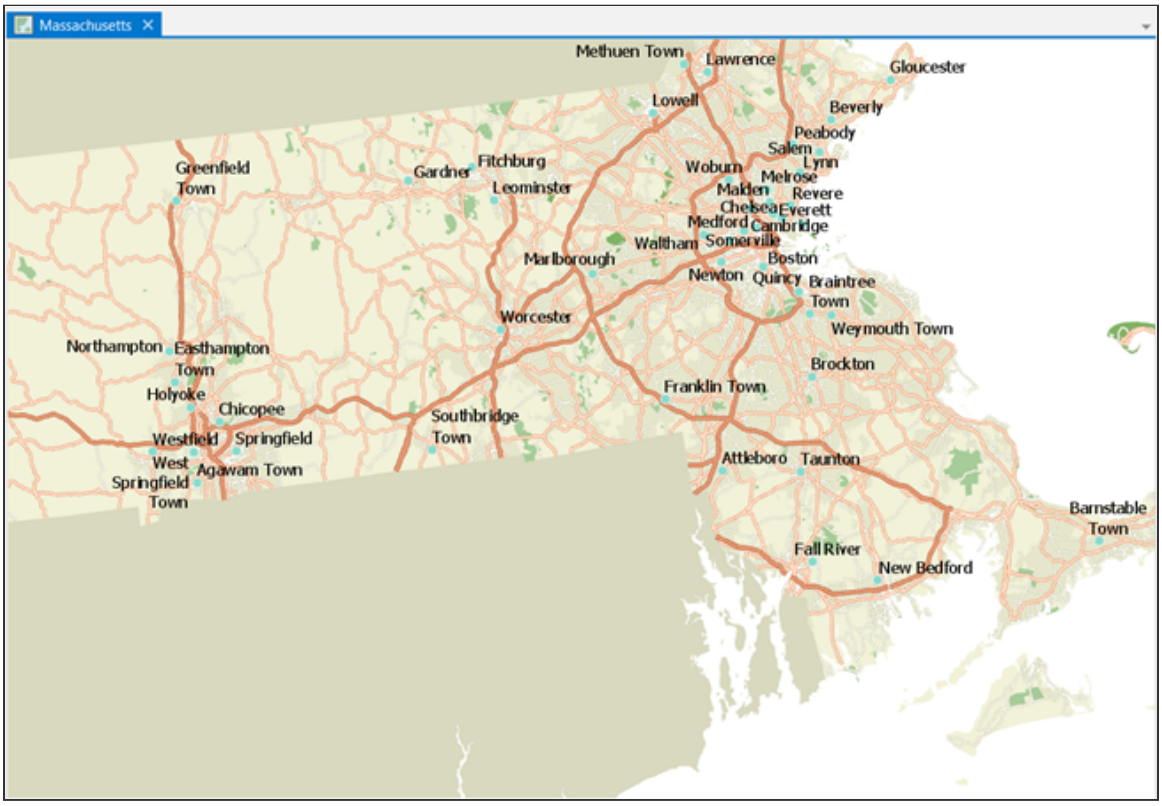
s Open the attribute table for the Places_MA layer again.

You should see only 51 cities listed in the attribute table.



Note: You can also see how many records are selected without opening the attribute table. If you right-click the layer name, point to Selection, and choose Select All, the number of selected features will appear in the bottom-right corner of the map.

t Close the attribute table.

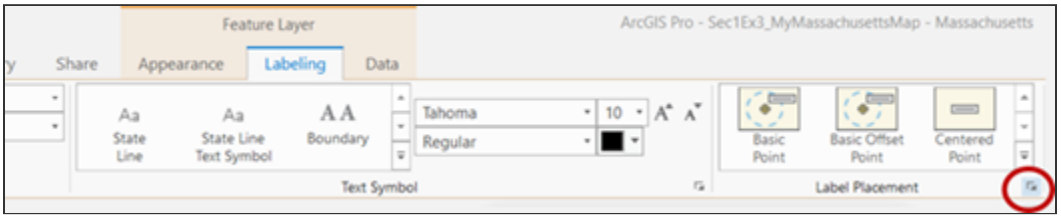


Step 13: Set label placement properties

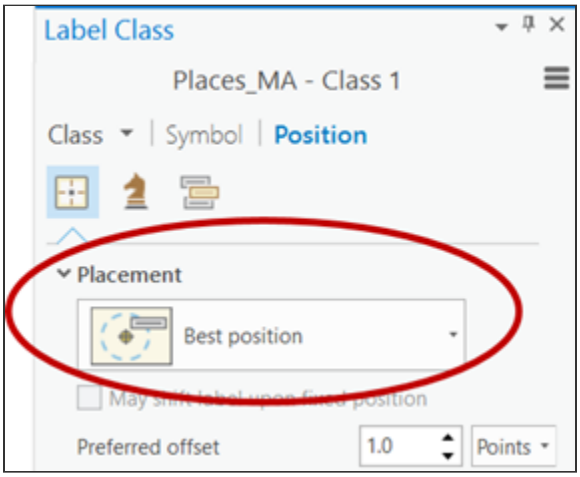
The map has fewer points now and labels and looks less cluttered. However, the placement of the labels is, in some cases, not ideal. You have control over the placement of labels for the point features using label placement.

a. In the Contents pane, confirm that the Places_MA layer is selected.

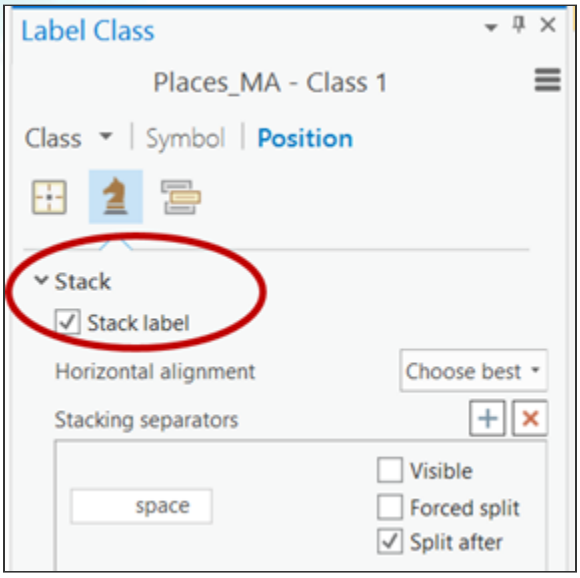
b. From the Labeling tab, in the Label Placement group, click the expander to open the Label Class pane.



c. On the Position tab, expand the Placement section, and confirm that Best Position is selected.



d. Click the Fitting Strategy tab , expand the Stack section, and confirm that the Stack Label check box is checked.



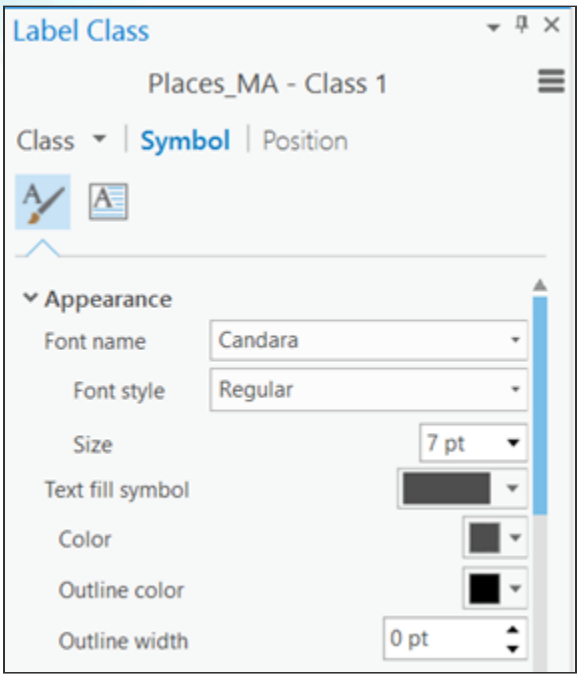
e. Click the Symbol tab and expand the Appearance section.

f. Set the following values:

- Font = Candara Regular, 7 pt
- Color = Gray 70%

Hint: Pause your pointer over the color choices in the color palette to view color names.

Using dark gray for text instead of full black is an effective way to tone down the contrast and noise of a map. Be aware, however, that if your labels are small and you don't have control over how your map readers may print your map, text will remain crisper and clearer if 100% black is used.



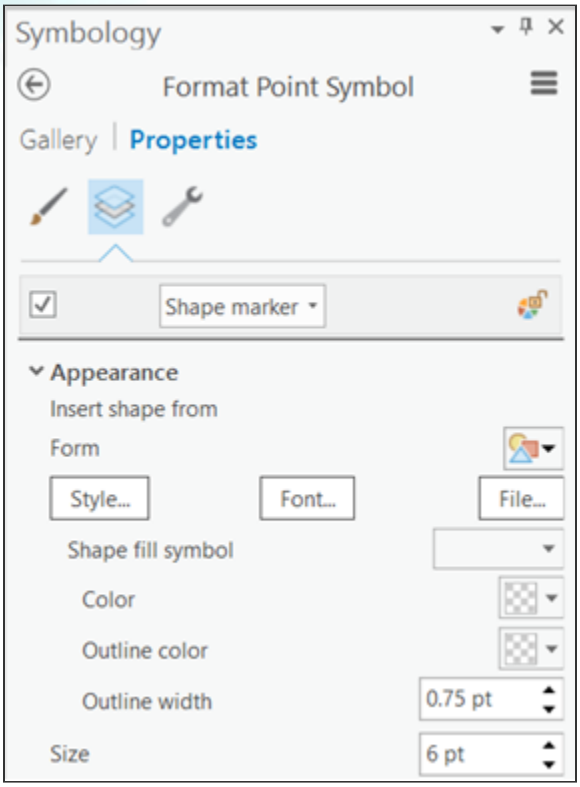
g. Click Apply, and then close the Label Class pane.

The map display updates again, and there is a noticeable improvement in the size and position of the labels. Because there is no need to include the point symbols in the map, you will remove the city dots.

h. On the Symbology pane, click the small dot symbol to open the Format Point Symbol pane.

i. On the Properties tab, click the Layers tab, if necessary, and in the Appearance section, set the following parameters:

- Color = No Color
- Outline Color = No Color

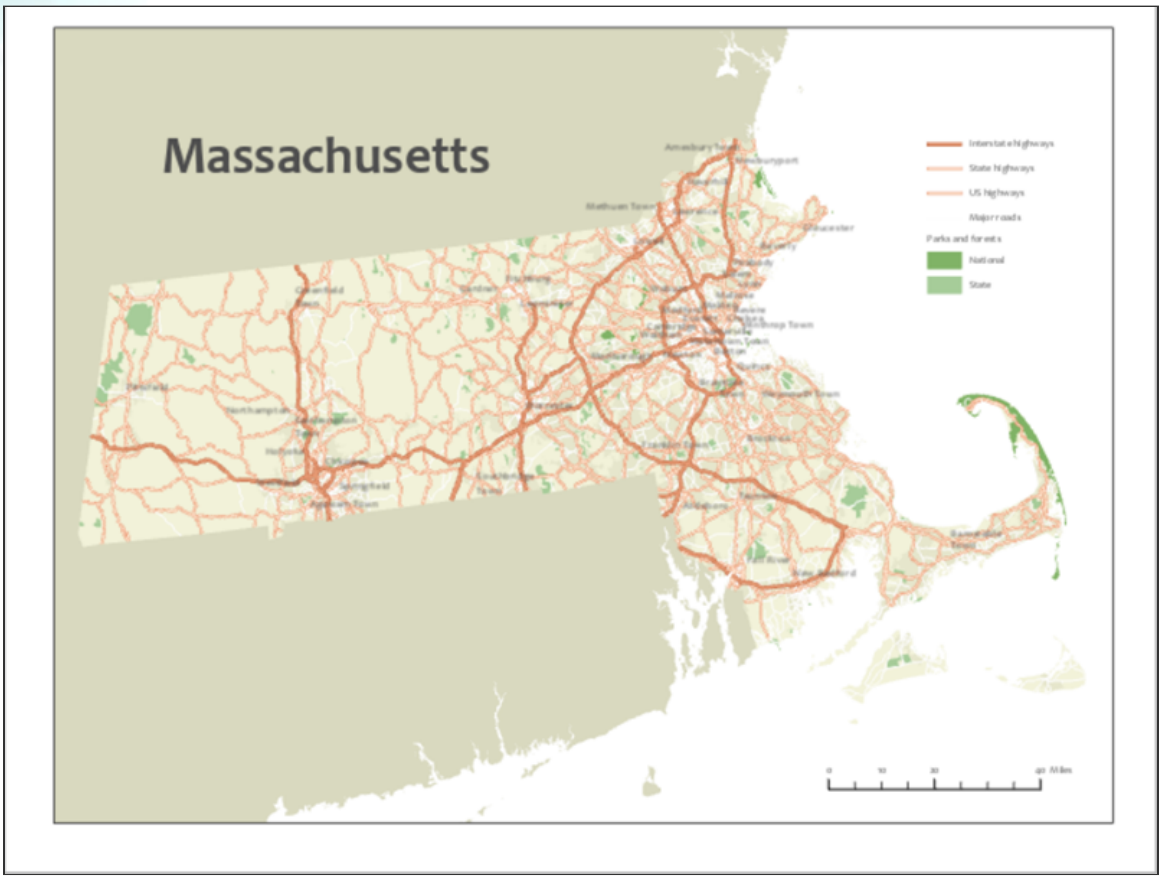


j Click Apply, and then save the project.

Your goal with this exercise was to create a printable map. Now that you've enhanced the map by adjusting the drawing order of features and applied different cartographic techniques to better communicate the map's purpose, it's time to prepare the map for printing.

Step 14: Make a layout

A page layout is a collection of map elements organized on a virtual page designed for map printing. You will create a layout for your map of Massachusetts that includes a legend, scale bar, and title.

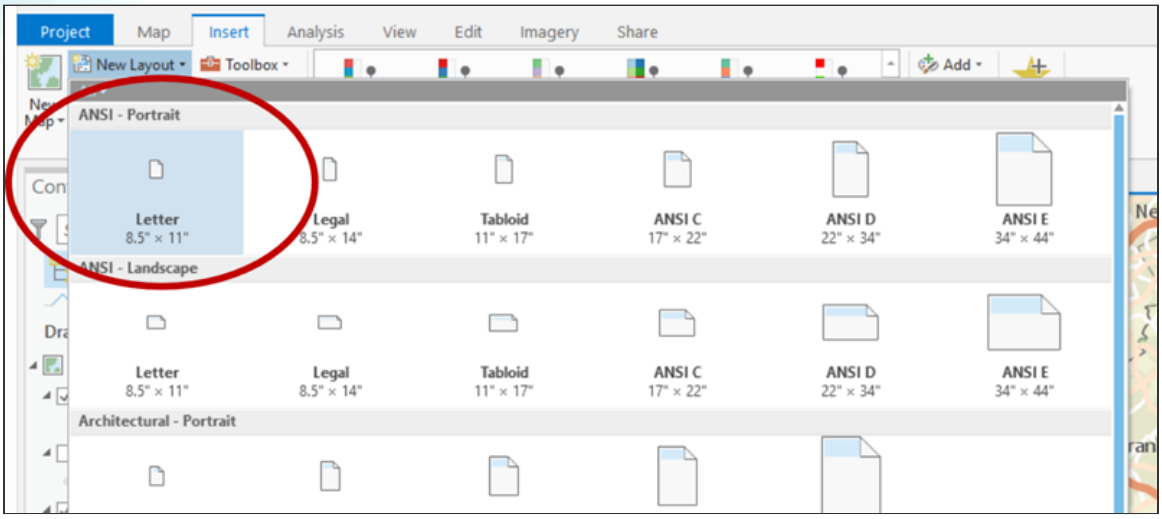


Note: Learn more about layouts in ArcGIS Pro here (https://bit.ly/2HcT7ZH). You will also learn more about map layouts in Section 2 Exercise 2 - Exploring Data Classification.

First, you will create the layout (https://bit.ly/2Hrn6uO).

a. From the Insert tab, in the Project group, click New Layout.

b. From the drop-down list, in the ANSI - Portrait section, choose Letter (8.5" x 11").



In your map of Massachusetts, the state appears longer horizontally than vertically, so you will set that orientation for your layout next.

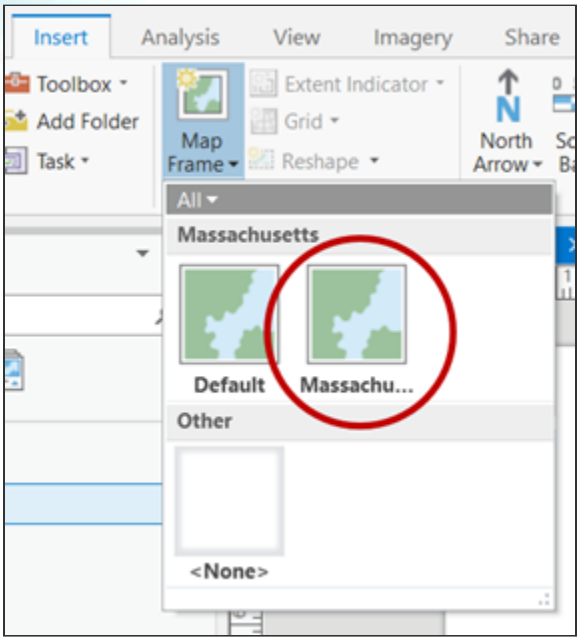
c. In the Contents pane, double-click Layout to open the Layout Properties dialog box.

d. On the Page Setup tab, in the Orientation section, choose Landscape and click OK to close the Layout Properties dialog box.

Next, you will add a map frame, which is a page layout element used to display the contents of a map on a layout.

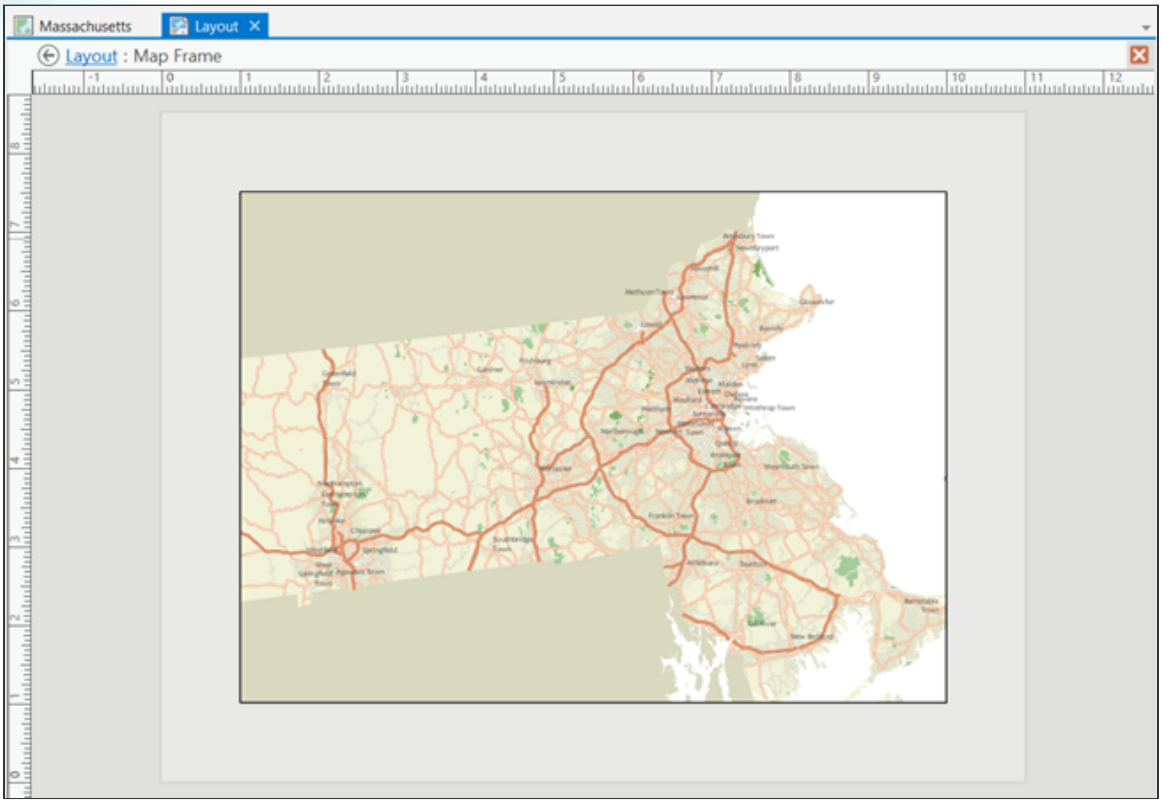
e. From the Insert tab, in the Map Frames group, click the Map Frame down arrow and select your Massachusetts map.

Hint: Remember, your map is named Massachusetts.



A layout tab appears in the map view, and your map is displayed. By default, the map frame is centered on the page. Optionally, you can increase the size of the map frame on the page by clicking and dragging the handles on the rectangle, leaving a little less than half an inch as a margin all around.

f In the Contents pane, right-click Map Frame and choose Activate to activate the map frame so that you can navigate and interact with the map.



g. At the bottom of the map, in the map scale control box, type **1,250,000**, if necessary, and then press Enter.

h. From the Layout tab, in the Map group, click Close Activation.

i. Use the handles of the map frame to enlarge it on the page so that all of Massachusetts is shown in the frame. Be sure to keep a reasonable margin (about half an inch) between the edge of the map frame and the edge of the page. If necessary, re-activate the map frame and pan the map to re-center it within the frame after you have resized it.

Step 15: Add a legend and scale bar

Map surrounds (https://bit.ly/2qjWXGY) are specific types of supporting elements associated with a map, such as a legend, a scale bar, a title, and information about the map author.

A legend tells the map reader the meaning of the symbols used to represent features on the map.

a. On the Insert tab, in the Map Surrounds group, click Legend.

Your pointer symbol will change.

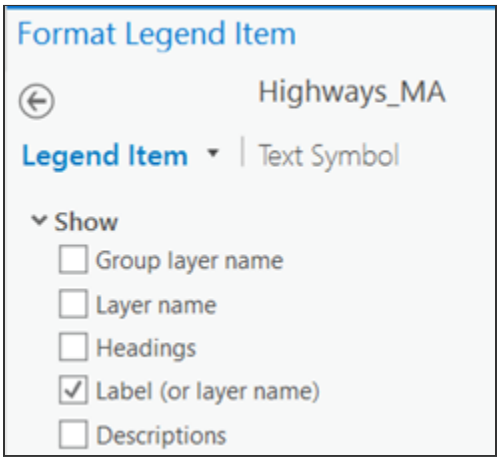
b. In the upper-right corner of the layout's white space, click and drag a rectangle.

Your map legend is added to the layout. Your legend includes all the layers from your map, so you can remove unnecessary layers.

c. In the Contents pane, expand Legend and uncheck Places_MA, UrbanAreas_MA, and Counties_northeast to remove these items from the legend display.

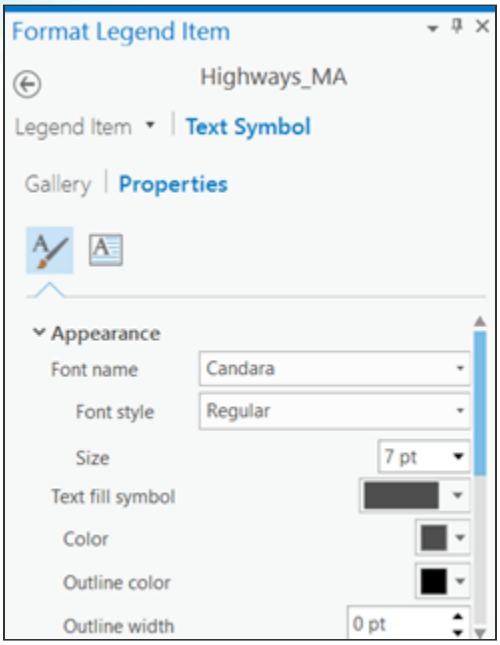
d. In the Contents pane, under Legend, select and then right-click Highways_MA and choose Properties.

e. In the Format Legend Item pane, in the Show section, uncheck everything except Label (Or Layer Name).



f. From the Text Symbol tab, click the Properties secondary tab, expand the Appearance section, and set the font as follows:

- Font name = Candara Regular
- Size = 7 pt
- Color = Gray 70%

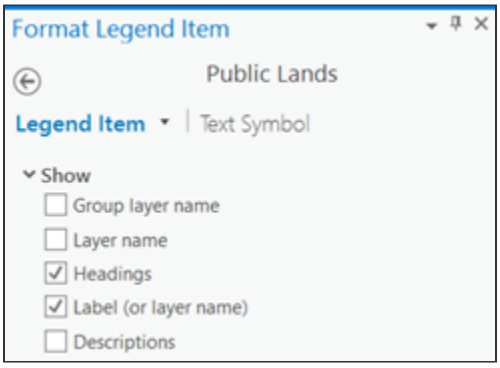


g. Click Apply.

h. In the Contents pane, select Parks_MA (or, if you renamed it, Public Lands).

i. In the Format Legend Item pane, click the Legend Item tab.

j. In the Show section, uncheck everything except Headings and Label (Or Layer Name).



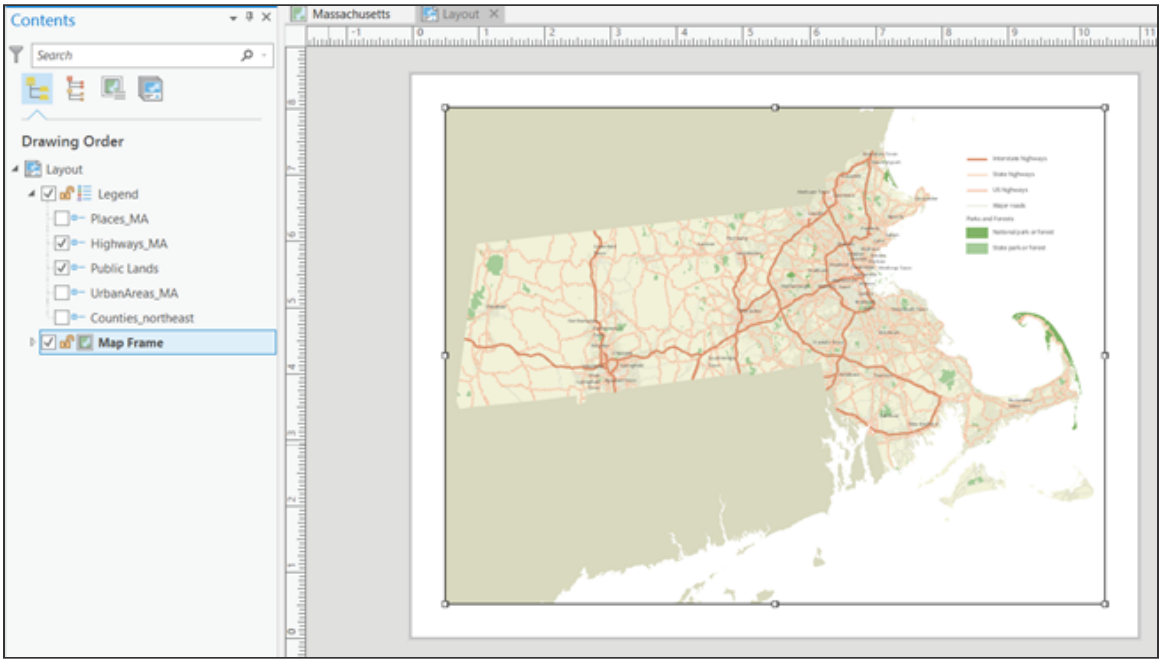
k. From the Text Symbol tab, click Properties, if necessary, and then expand the Appearance section and set the font as follows:

- Font name = Candara Regular
- Size = 7 pt
- Color = Gray 70%

l. Click Apply.

m. Use the handles to resize the legend as necessary.

n. Click and drag the legend to place it near the upper-right corner of the page, roughly top-justified with the northernmost part of the state and roughly right-justified with the easternmost part of the state.

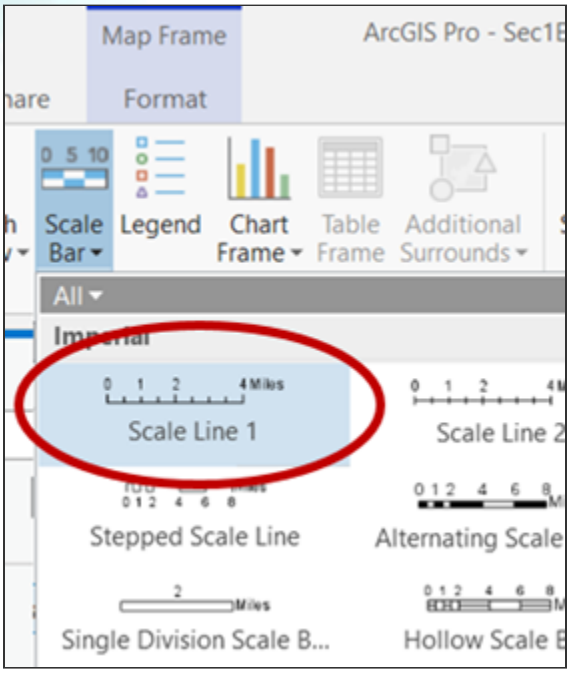


Note: Be sure to expand your legend so that the Highways and Public Lands (Parks And Forests) information is visible.

Scale bars (https://bit.ly/2HbVzQ8) provide a visual indication on the map of the size of features and the distance between features on the map.

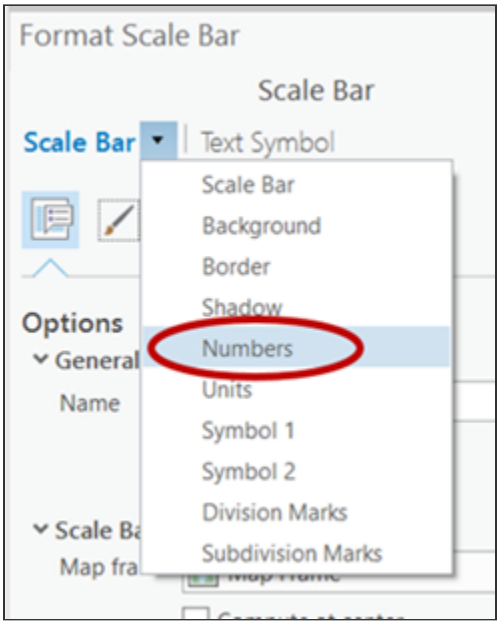
o. From the Insert tab, in the Map Surrounds group, click the Scale Bar down arrow.

p. In the Imperial section, choose Scale Line 1.



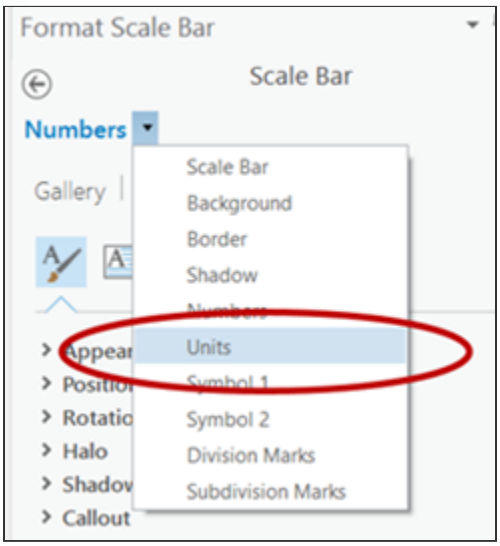
q In the map, right-click the scale bar and choose Properties.

r At the top of the Format Scale Bar pane, click the Scale Bar down arrow and choose Numbers.



s On the Properties tab, expand the Appearance section, set the font to Candara Regular, 7 pt, Gray 70%, and then click Apply.

t. At the top of the Format Scale Bar pane, click the Numbers down arrow and choose Units.

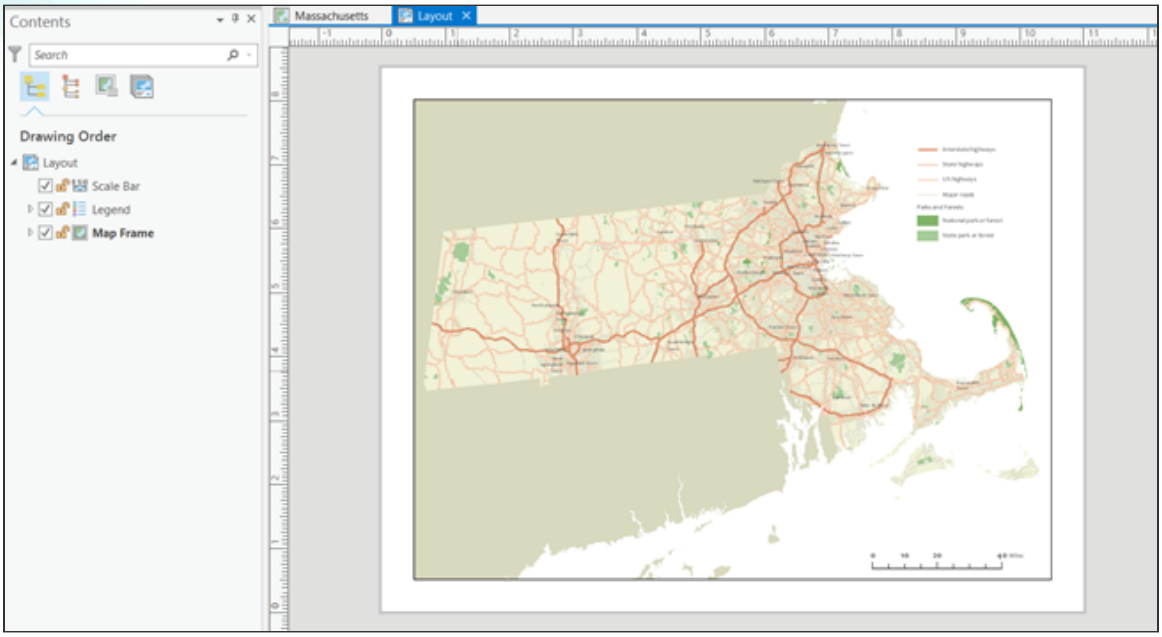


u. Set the font to Candara Regular, 7 pt, Gray 70%, and then click Apply.

v. Follow the same steps to change the color of Division Marks and Subdivision Marks to Gray 70%.

w. Resize the whole scale bar on the page by clicking and dragging the handles until the scale bar is about 2.5 inches wide and shows a distance of 40 miles.

x. Reposition the scale bar to the lower-right corner of the page, roughly right-justified with the easternmost portion of the state.



y. Close the Format Map Frame pane.

Step 16: Add text elements to the map surround

Text elements can be added to the map surround to provide additional information for the map reader.

First, you will add a title to the map surround.

a. On the Insert tab, in the Text group, click Text.

b. Click near the upper-left corner of the map, and type **Massachusetts** as the title for your map.

c. In the Contents pane, right-click the Text element and choose Properties.

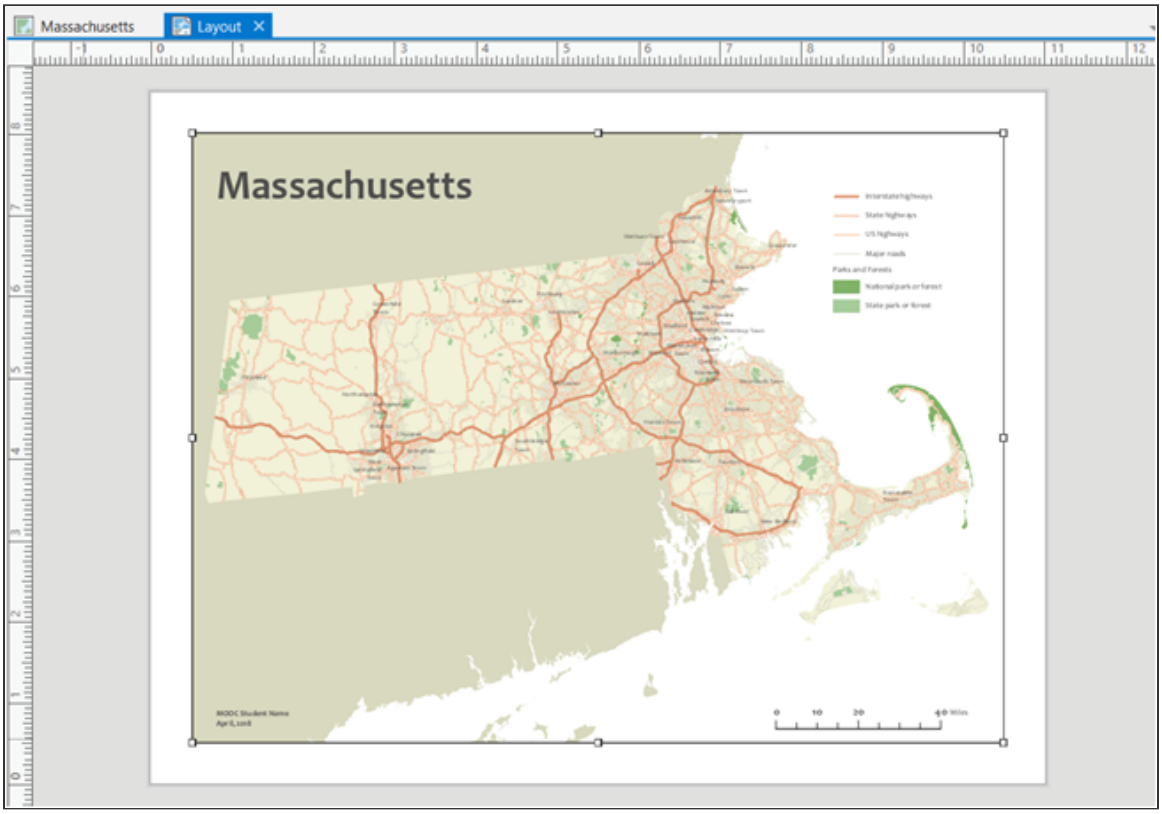
d. In the Format Text pane, on the Text Symbol tab, click the Properties tab and then expand the Appearance section.

e. Set the font to Candara Bold, 36 pt, Gray 70%, and then click Apply.

f. If necessary, click and drag the text frame to move it, above the state.

To finish your map, you will add your name and the date.

g Repeat the previous steps to add your name and the date to the lower-left corner of the map in Candara Bold, 7 pt, Gray 70%.



h Save the project.

Step 17: Export or print your map

When you are finished with your map layout, you can export it to share with others or print it.

a From the Share tab, in the Export group, click Layout.

b Browse to the location of your project file, name the layout **Map of Massachusetts**, ensure that it will be saved as a PDF, and click Export.

c If you are connected to a printer and want to print your map layout, from the Share tab, in the Print group, click Layout.

d When you are finished, save your project and exit ArcGIS Pro.

Conclusion

Congratulations! If you're new to ArcGIS Pro, you've made your first map. You have explored much of the ArcGIS Pro user interface, including the ribbon, the Catalog pane, the Contents pane, and detailed property panes for symbology, labeling, and legend elements. You've worked with a map, layers, and a layout within a project.

You've learned how to symbolize and label layers; some basic symbol editing and label placement techniques; and how to work with color. You went beyond the defaults by setting a map projection and a reference scale and establishing symbol layer drawing.

You will become familiar with the many areas of the app that you worked with as you go deeper into the properties and settings in the upcoming exercises in the course.

Stretch Goals

Throughout this course, you will see exercise stretch goals. These goals include ways that you can continue or enhance the work that you completed during the exercise.

If you would like to continue working with the map that you just made, here are some ideas:

- **Give it a different look.** Maps are graphic communication. Give your map a different style and message by using a different color palette, different symbols, different fonts, or a different layout arrangement.
- **Adjust the map scale.** What would you change if you were making a map of the Boston area in Massachusetts? Think about the reference scale, symbol sizes, and labeling choices. Would you be able to add additional data?
- **Add additional data.** The project database includes a layer of institutional buildings (Institutions_MA) that is not used in the main exercise. How would you show these buildings (with clarity) on a larger-scale map?

Use the Lesson Forum to post your questions, observations, and map examples.

Solution: Step 7b Challenge

In the Step 7b Challenge, you were instructed to draw the Parks_MA layer as follows:

- Use Unique Values and the FEATTYPE attribute value for each type of park.
- Make National Park Or Forest CMYK **40 20 50 10** with no outline, and save it to your favorites as **National**.
- Make State Parks Or Forest CMYK **30 15 35 5** with no outline, and save it to your favorites as **State**.
- Do not include Local Park or Regional Park.

The complete set of actions to accomplish this step is as follows:

a. In the Symbology pane, for Symbology field, from the drop-down list, choose Unique Values.

b. For the Value Field, from the Field 1 drop-down list, select FEATTYPE.

Next, you will change the appearance for national parks and forests.

c. At the bottom of the pane, in the grid, click the color patch for National Park Or Forest.

d. In the Format Polygon Symbol pane, on the Properties tab, click the Symbol tab, if necessary.

e. In the Appearance section, click the Color drop-down list and choose Color Properties.

f. In the Color Editor, set the Color Model to CMYK.

g. Set the color values as follows:

- Cyan = **40%**
- Magenta = **20%**
- Yellow = **50%**
- Black = **10%**

h. Click Save Color To Style, and save the style as **National**.

i. Click OK twice to return to the Format Polygon Symbol pane.

j. Set the Outline Color to No Color and the Outline Width to 0.

k. Click Apply.

l. At the top of the Format Polygon Symbol pane, click the Back arrow.

Now you will change the appearance for state parks and forests.

m. In the grid at the bottom of the Symbology pane, click the color patch for State Park Or Forest.

n. In the Format Polygon Symbol pane, in the Appearance section, click the Color drop-down list and choose Color Properties.

o. In the Color Editor, set the Color Model to CMYK.

p. Set the color values as follows:

- Cyan = **30%**
- Magenta = **15%**
- Yellow = **35%**
- Black = **5%**

q. Click Save Color To Style, and save the style as **State**.

r. Click OK twice to return to the Format Polygon Symbol pane.

s. Set the Outline Color to No Color and the Outline Width to 0.

t. Click Apply.

u. At the top of the Format Polygon Symbol pane, click the Back arrow.

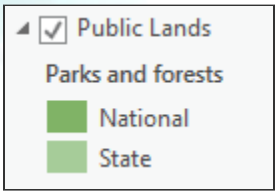
Finally, you will remove local and regional parks.

v. At the bottom of the Symbology pane, in the grid, right-click Local Park and choose Remove.

w. Using the same method, remove the Regional Park symbol.

Solution: Step 7d Challenge

In the Step 7d Challenge, you were challenged to update the Parks_MA layer to appear like the following graphic in the Contents pane.



The complete set of actions to accomplish this step is as follows:

a. In the Contents pane, double-click the Parks_MA layer to open the Layer Properties dialog box.

b. From the General tab, update the Name to **Public Lands**, and then click OK to close the dialog box.

c. At the bottom of the Symbology pane, in the field at the top of the grid, change the value from FEATTYPE to **Parks and Forests**, and then press Enter.