SD2005 Labs

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Preface

This is a Quarto book.

To learn more about Quarto books visit https://quarto.org/docs/books.

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1 Introduction

This is a book created from markdown and executable code.

See Knuth (1984) for additional discussion of literate programming.

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2 Summary

In summary, this book has no content whatsoever.

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[1] 2
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Lab No 1: Getting Started with ArcGIS Online

This tutorial is inspired from ArcGIS Online Learning resources available at https://learn.arcgis.com/en/projects/get-started-with-arcgis-online/

Mapping Census Data for Emergency Planning

By the end of this lab, students will be able to: - Navigate and use the ArcGIS Online interface - Add and configure data layers from ArcGIS Living Atlas - Style demographic data using appropriate symbology - Filter data to focus on specific geographic areas - Apply visual effects to emphasize important data patterns - Create a professional web map for emergency planning purposes

Background

In this lab, you will create a web map to identify areas that may need additional evacuation assistance during emergencies. You will work with census data to identify households with limited vehicle access, which is crucial information for emergency planning and resource allocation.

Estimated time of completion: 45 Minutes

Part 1: Begin a Map

Step 1: Access ArcGIS Online

1. Sign in to ArcGISOnline, using your University Credentials.

2. On the ribbon, click the **Map** tab

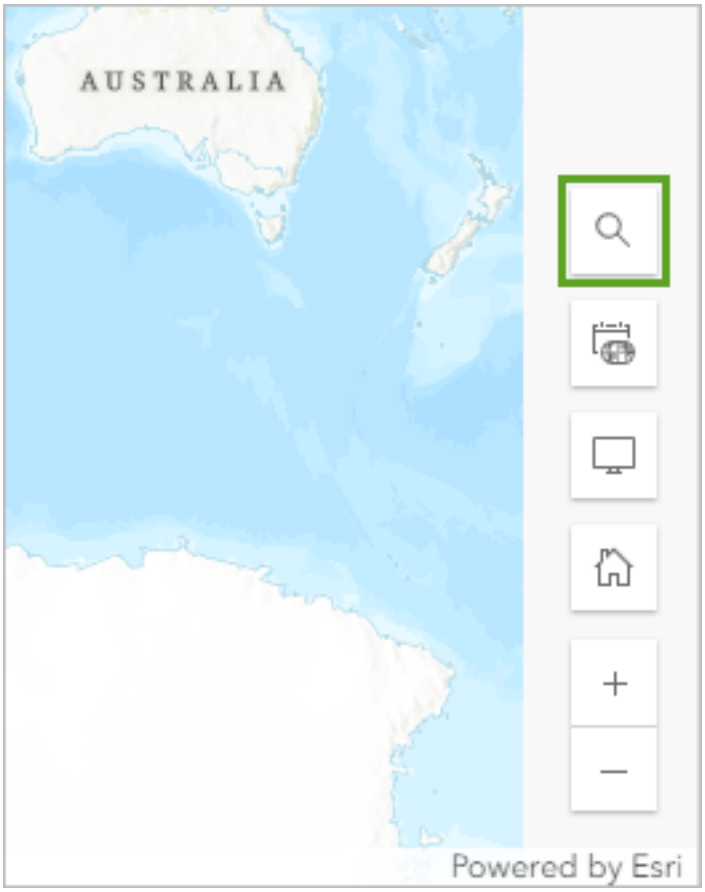
A default web map appears. Your map's appearance varies based on your account or organizational settings and your browser window size. It may show the United States, the world, or another extent.

The only layer on the map is the basemap, which provides geographic context such as water bodies and political boundaries. The default basemap is **Topographic**, but your map may have a different basemap depending on your organization's settings.

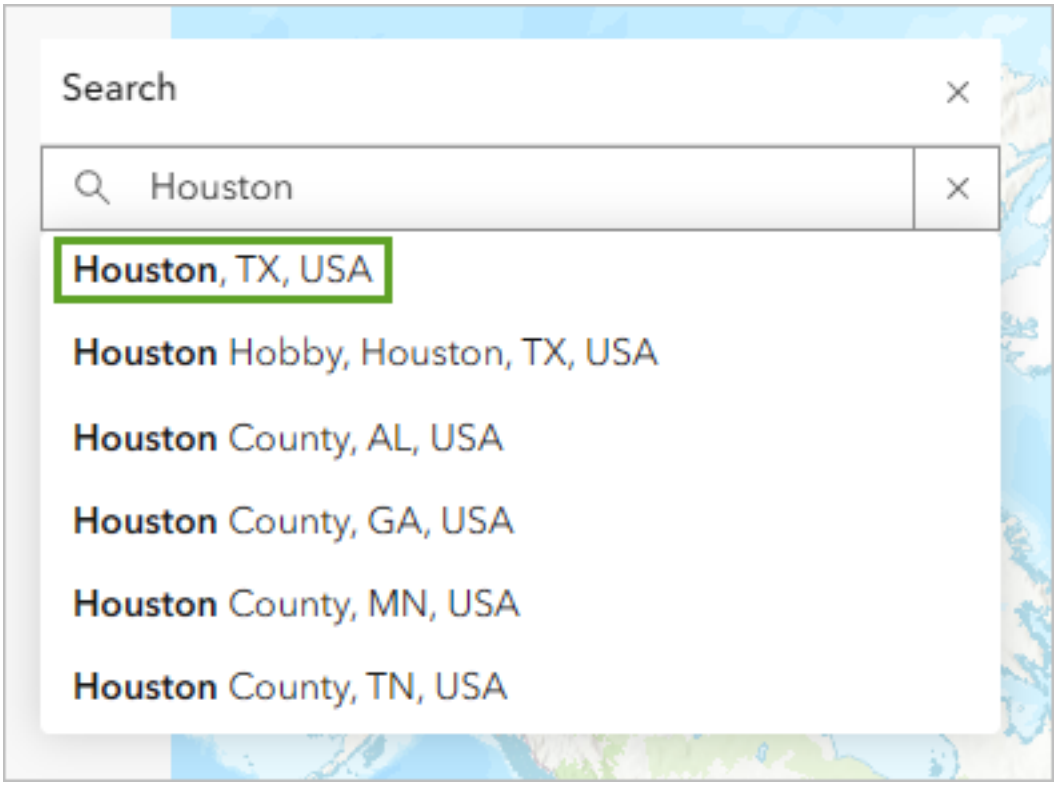
On either side of the map are the toolbars: - **Contents (dark) toolbar:** Allows you to manage and view map contents - **Settings (light) toolbar:** Provides tools and options for configuring and interacting with map layers - **Layers pane:** Lists the data you add to the map

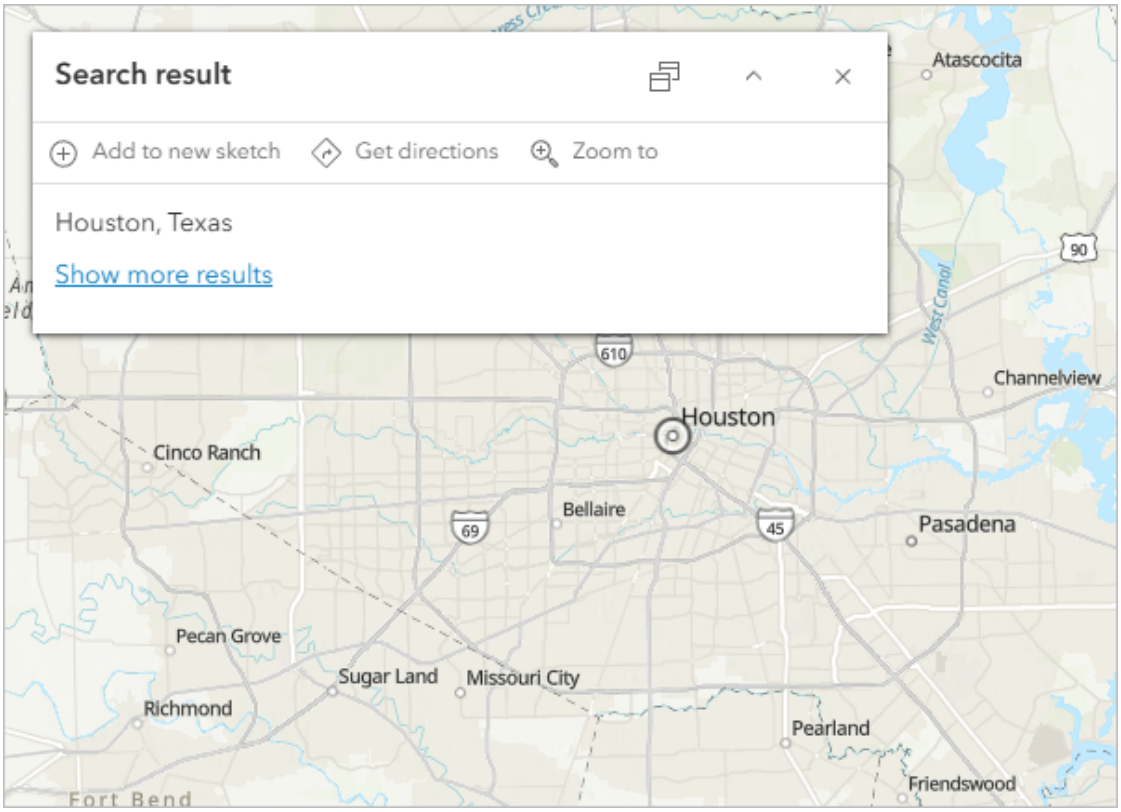
Step 2: Navigate to Your Area of Interest

1. On the map, at the bottom corner, click the **Search** button



2. In the search box, type `Houston` and choose **Houston, TX, USA** from the list of suggested locations


Search
Houston
Houston, TX, USA
Houston Hobby, Houston, TX, USA
Houston County, AL, USA
Houston County, GA, USA
Houston County, MN, USA
Houston County, TN, USA



3. Close the **Search** result window when the map zooms to your location

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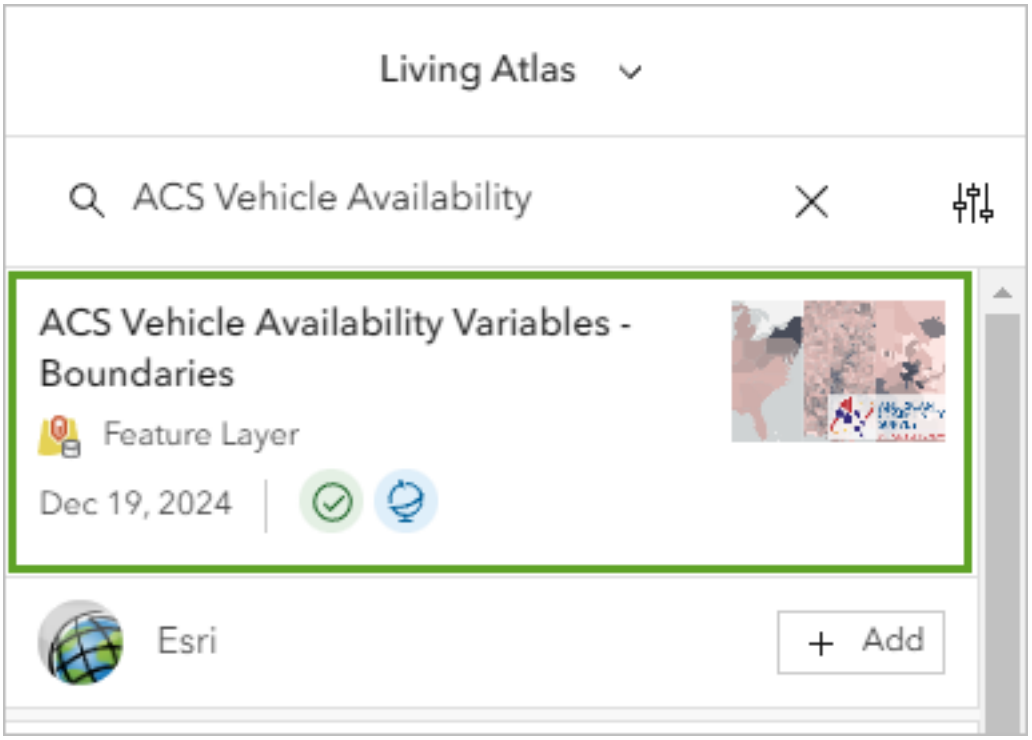
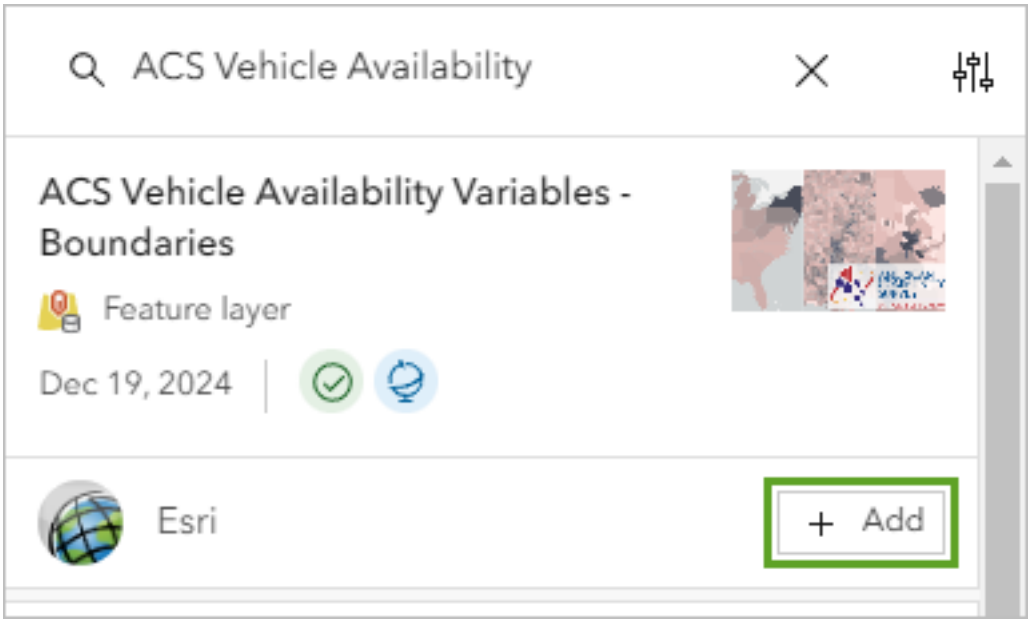
Part 2: Add a Layer

Layers contain geographic data that can be displayed on your map. To determine areas that may need evacuation assistance, you'll add a layer containing demographic data by census tract.

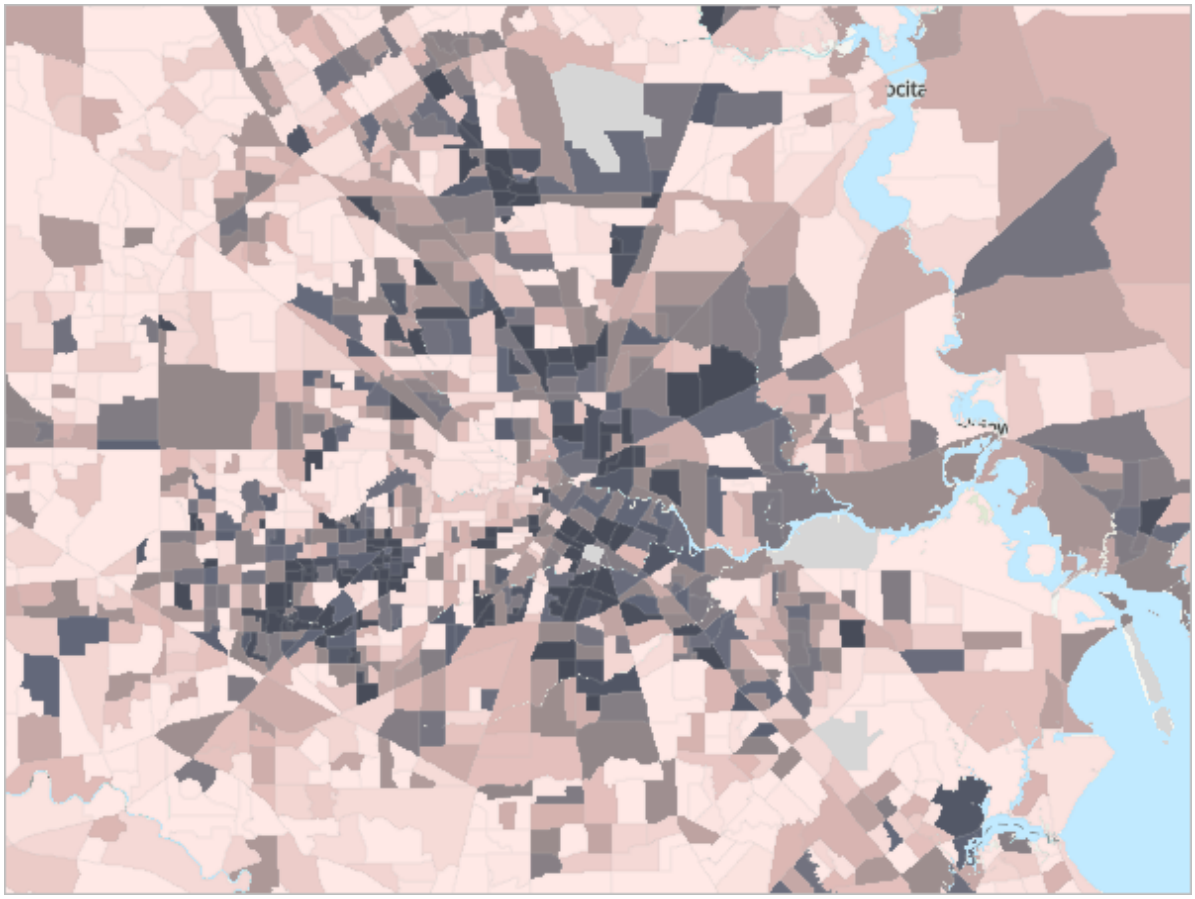
1. In the **Layers pane**, click **Add**
2. In the **Add layer pane**, click **My content** and choose **Living Atlas**
3. In the search box, type or paste `ACS Vehicle Availability`
4. Click the **ACS Vehicle Availability Variables - Boundaries** result



5. In the item pane, expand the **Description** section and read about the layer
6. Close the item pane
7. For the **ACS Vehicle Availability Variables - Boundaries** layer, click **Add**



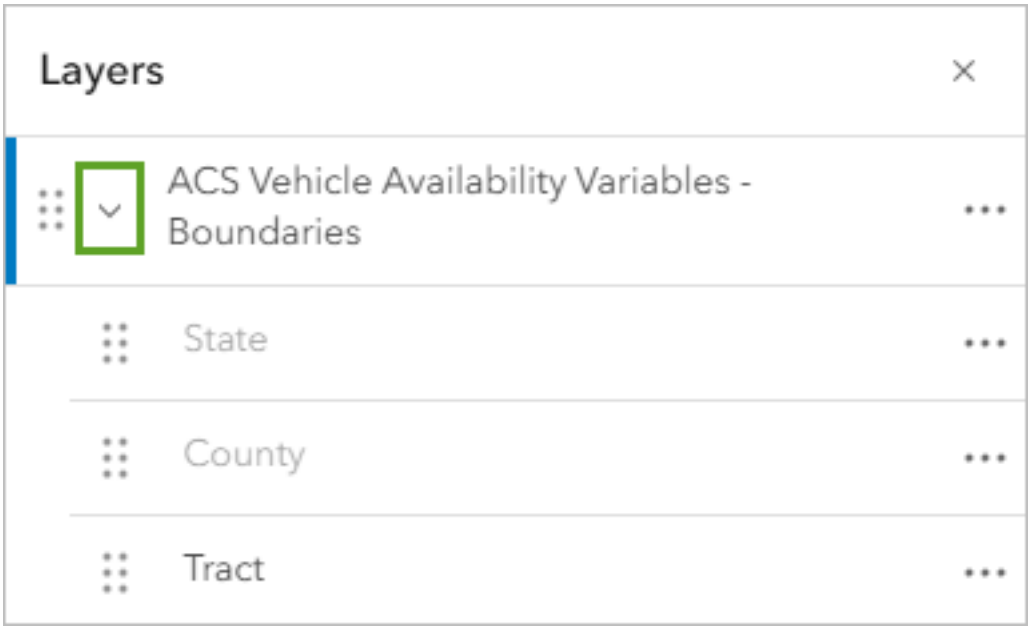
The layer is added to the map, styled to show the percentage of households with no vehicle available in each census tract. Darker areas have higher percentages of households without vehicle access.



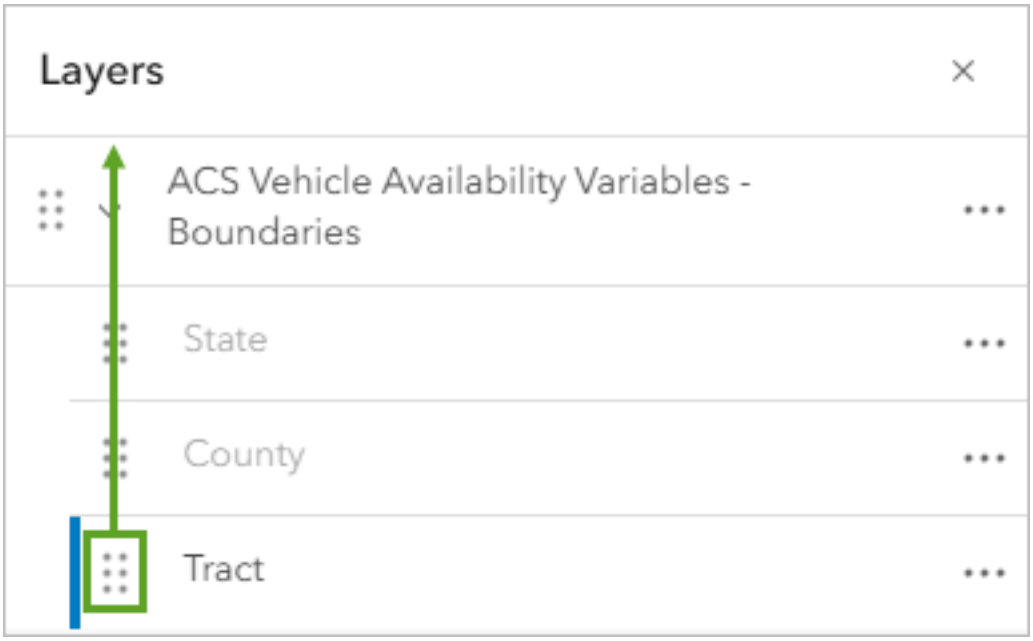
Step 1: Manage Layer Groups

1. At the top of the Add layer pane, click the **Back** button

2. In the **Layers pane**, expand the **ACS Vehicle Availability Variables - Boundaries** group



3. Drag the ==**Tract**== layer above the group

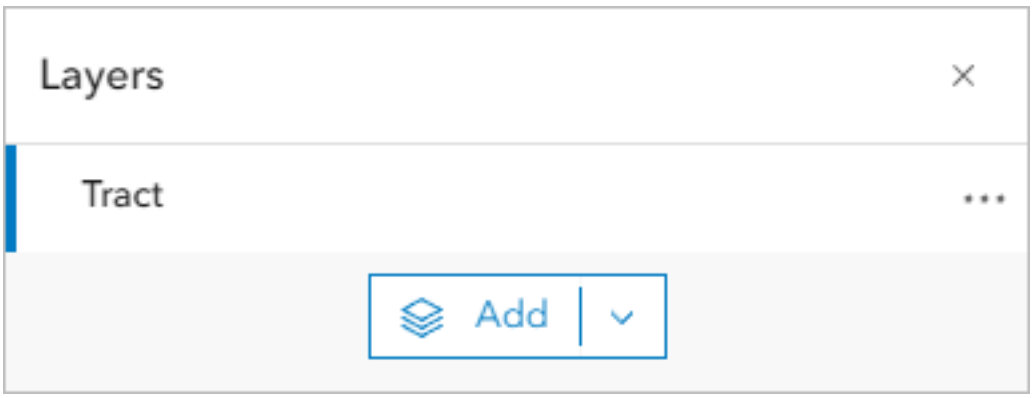


4. For the group, click the **Options** button and choose **Remove**

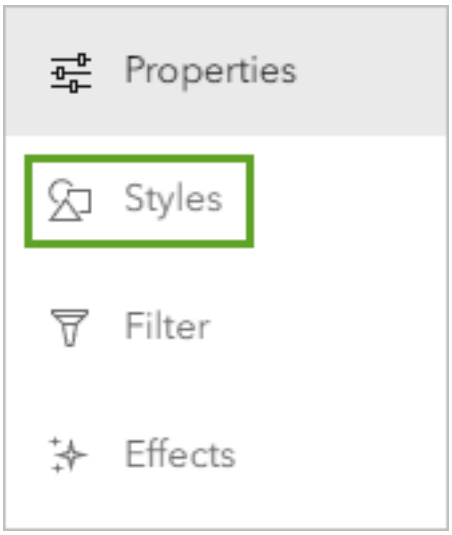
Part 3: Style Demographic Data

Step 1: Select Styling Options

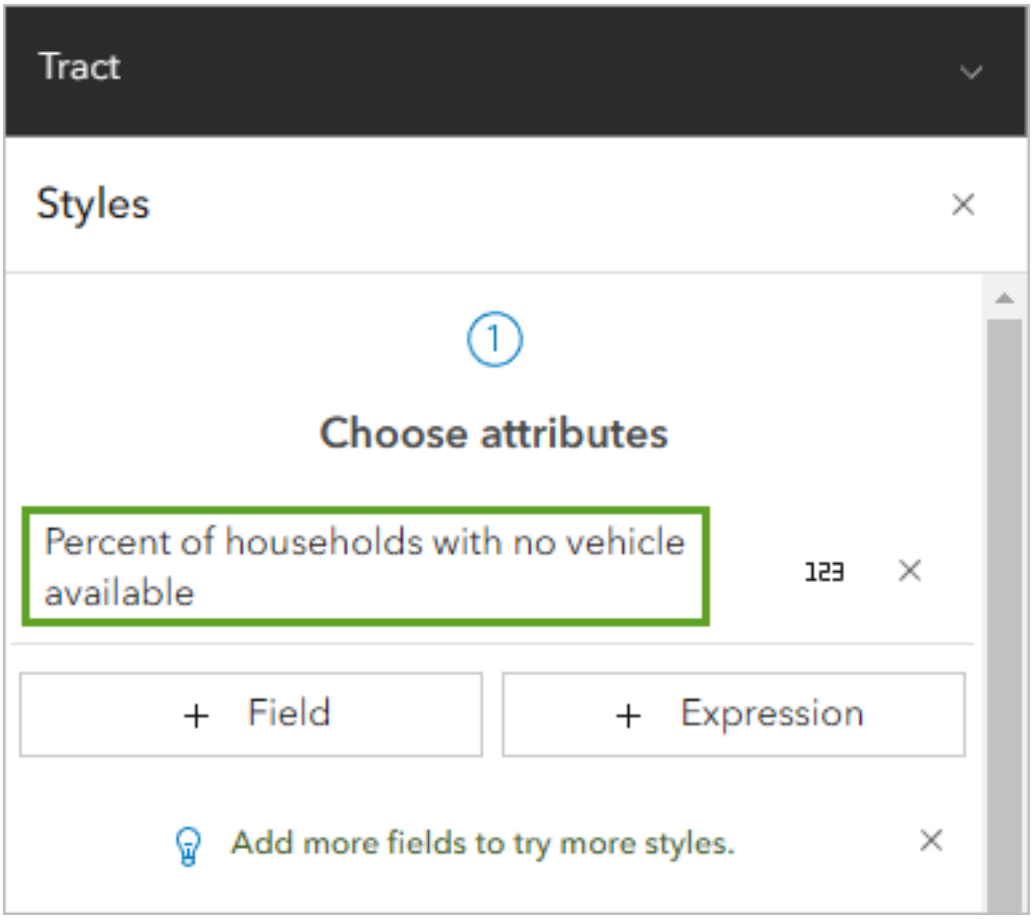
1. In the **Layers pane**, click the **Tract** layer to select it



2. On the **Settings toolbar**, click the **Styles** button



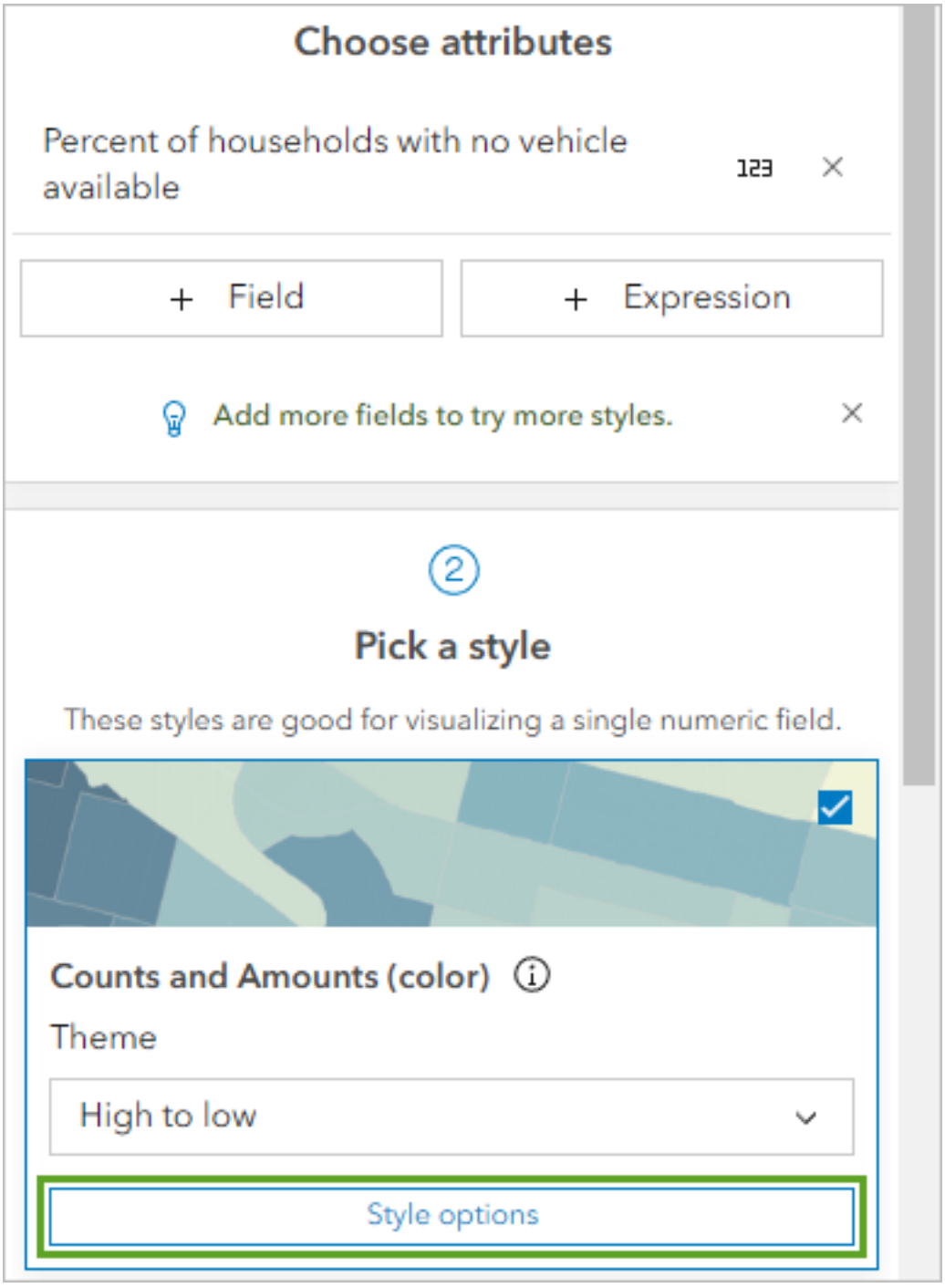
3. In the **Styles pane**, ensure **==Percent of households with no vehicle available==** is selected



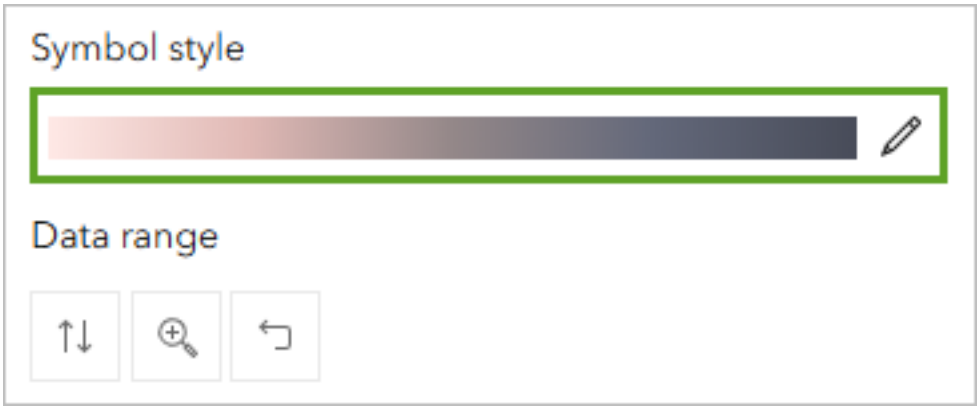
The list of available styles is determined by the data type. In this case, the options are for numeric data. The map shows the **Counts and Amounts (color)** style. The colors are based on the **High to low** theme. This style symbolizes each census tract with a different color based on the percentage of households without a vehicle. Census tracts with the lowest values have a light color, while those with the highest values have a dark color.

Step 2: Customize Symbol Style

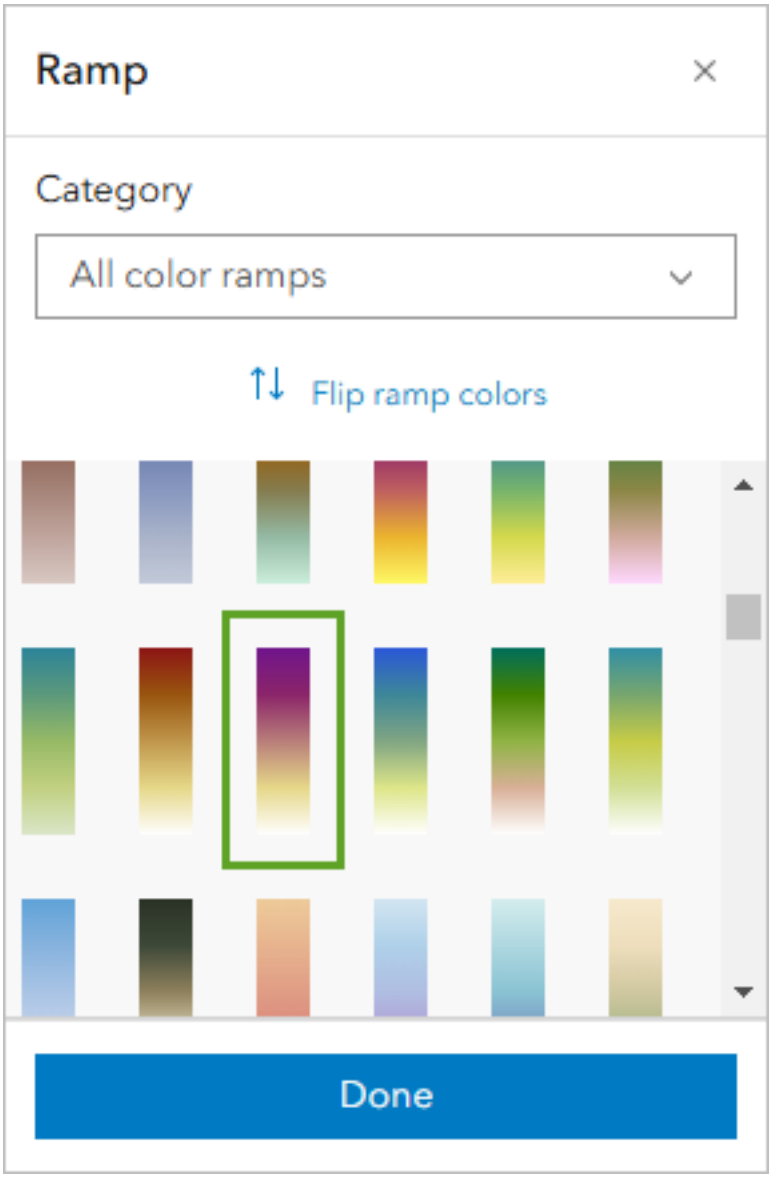
1. For **Pick a style**, on the **Counts and Amounts (color)** card, click **Style options**



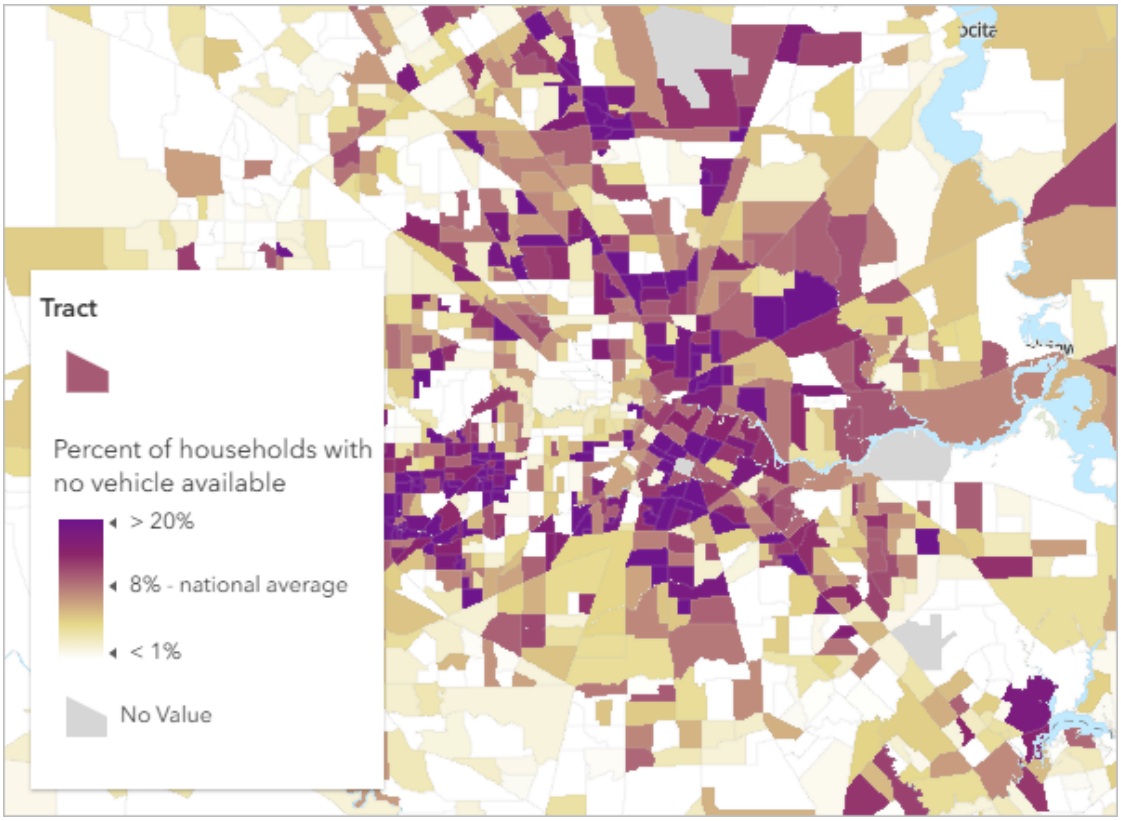
2. For **Symbol style**, click the color ramp



3. In the **Symbol style** window, for **Colors**, click the color ramp
4. In the **Ramp** window, choose **Purple 18**



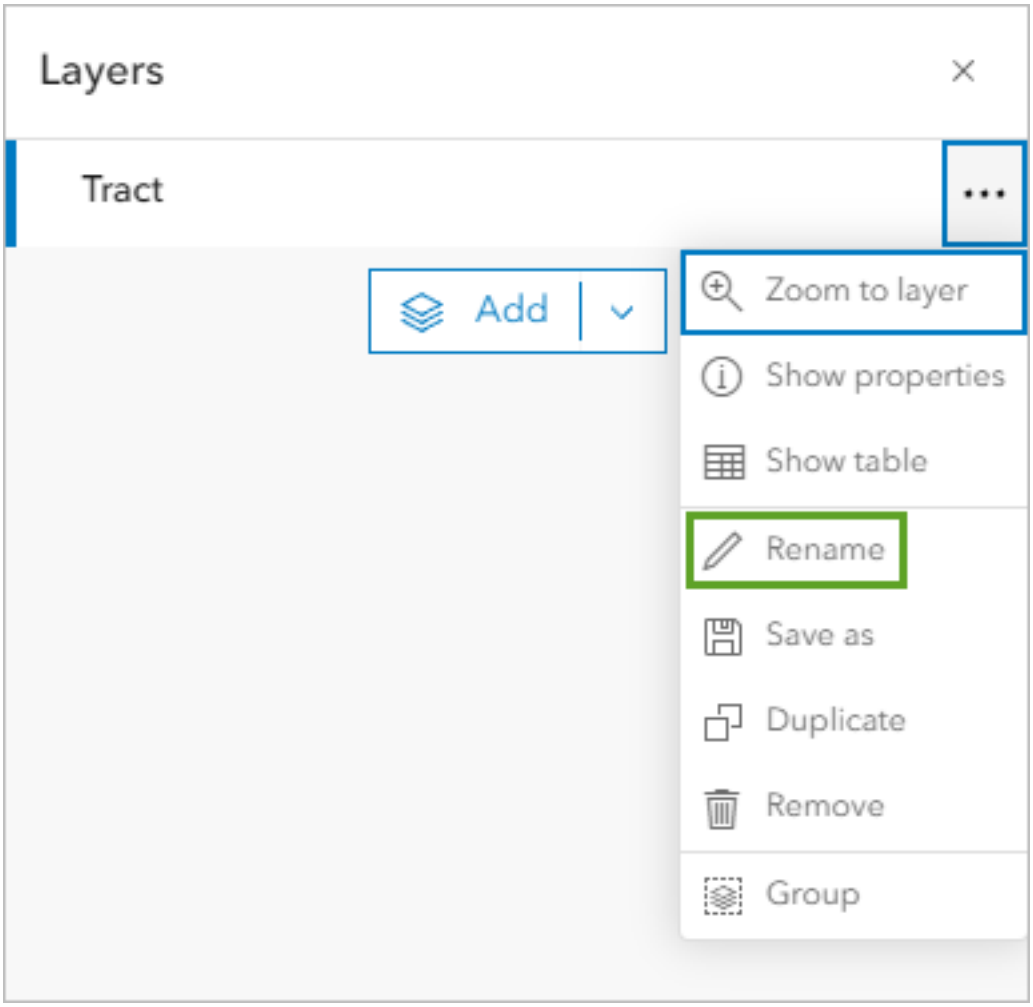
The new color ramp is applied to the map. Census tracts with high percentages are displayed in dark purple while low percentages are white.



5. If needed, click **Flip ramp colors** so high percentages show in dark purple
6. Click **Done** to close all style windows

Step 3: Rename the Layer

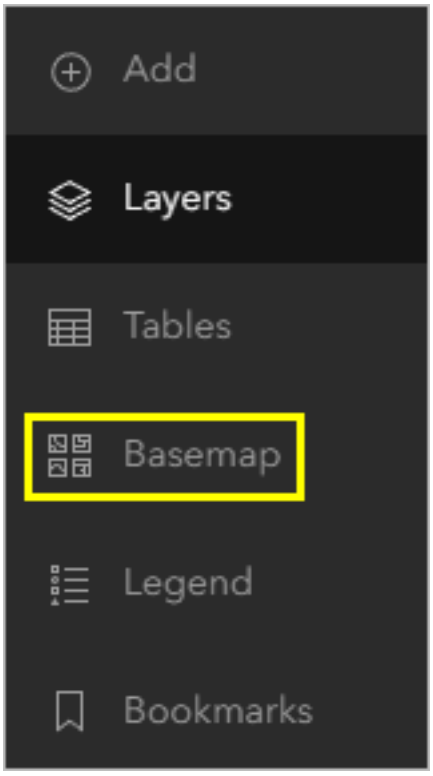
1. In the **Layers pane**, for the layer, click the **Options** button and choose **Rename**



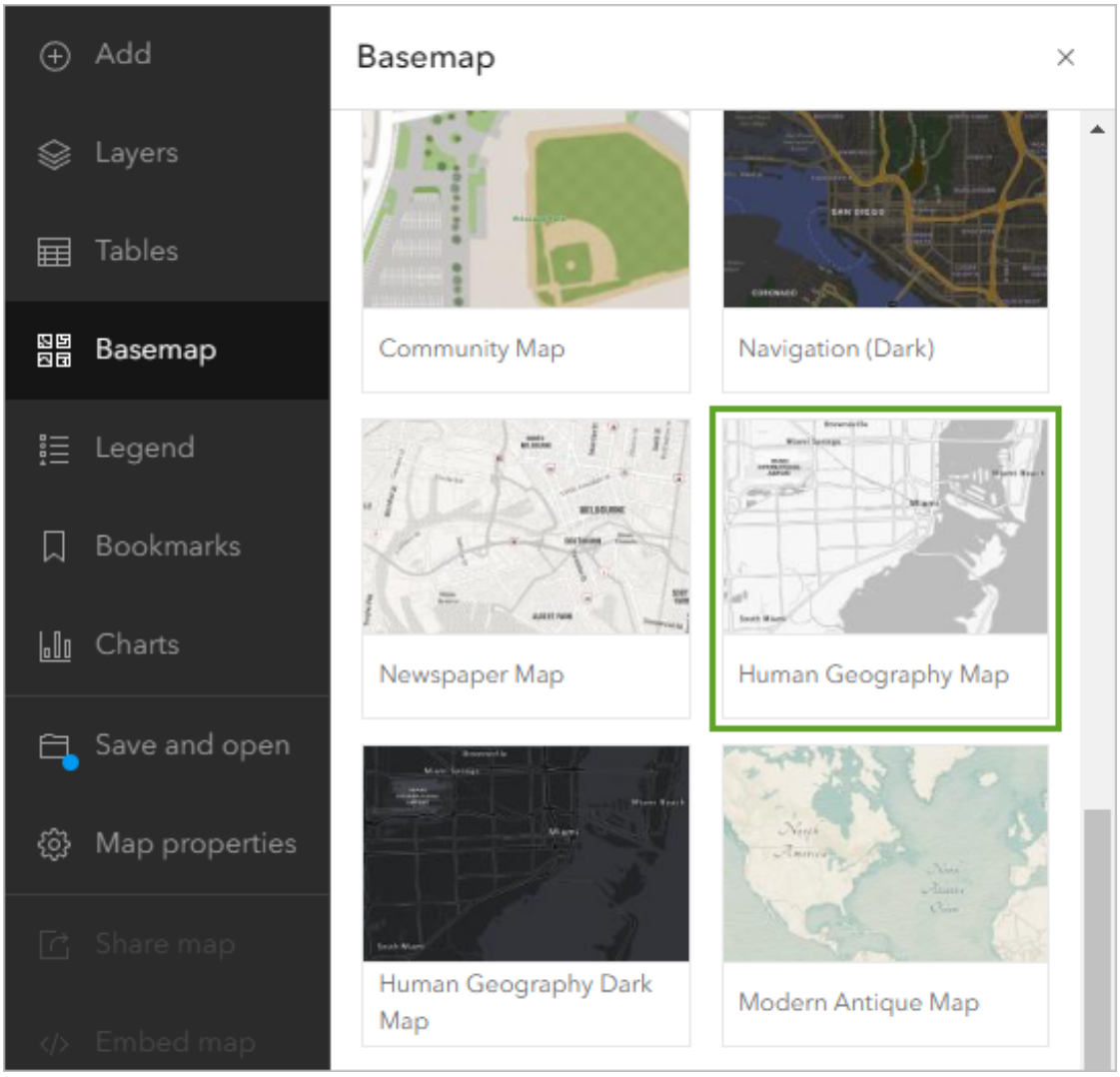
2. For **Title**, type **Percent of Households with No Vehicle Access**
3. Click **OK**

Part 4: Change the Basemap

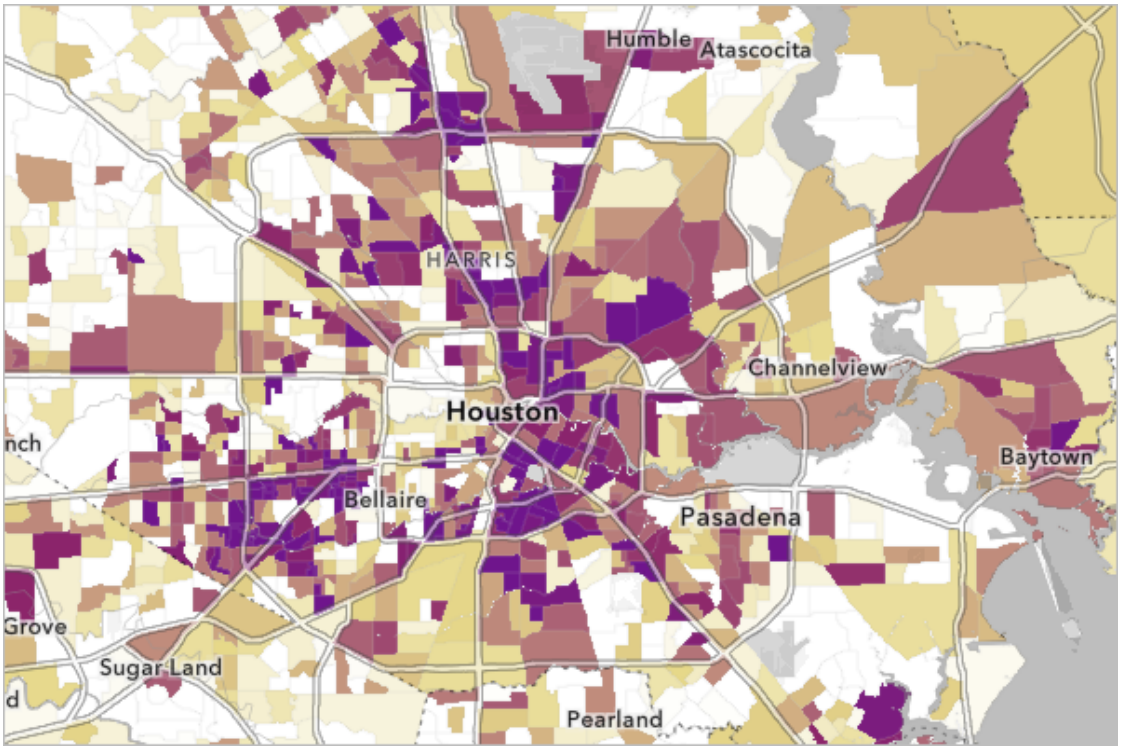
1. On the **Contents toolbar**, click **Basemap**



2. In the **Basemap pane**, find and choose **Human Geography Map**



3. On the **Contents toolbar**, click **Layers** to return to the Layers pane

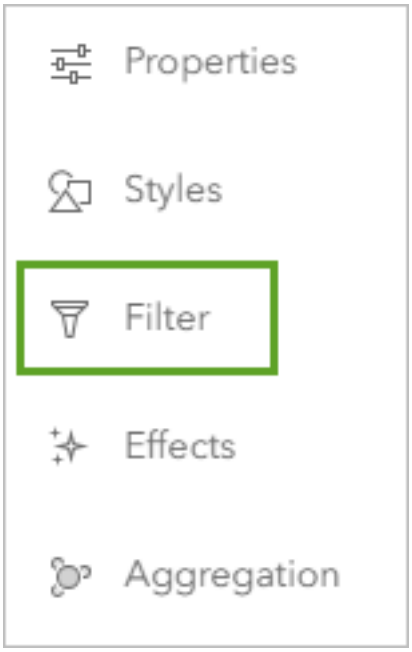


The new basemap shows labels and contextual information over the census data.

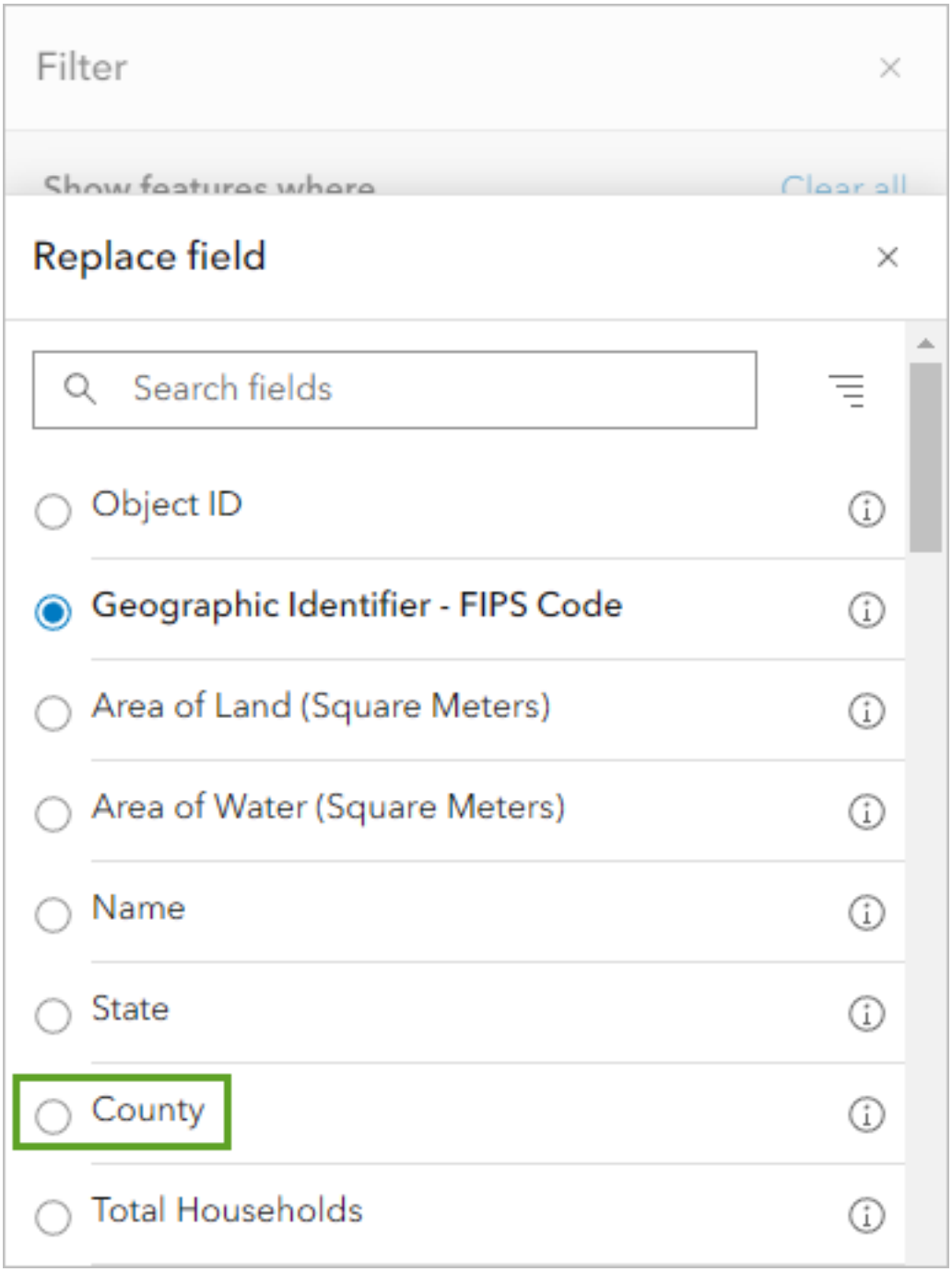
Part 5: Filter the Map

Step 1: Create a Geographic Filter

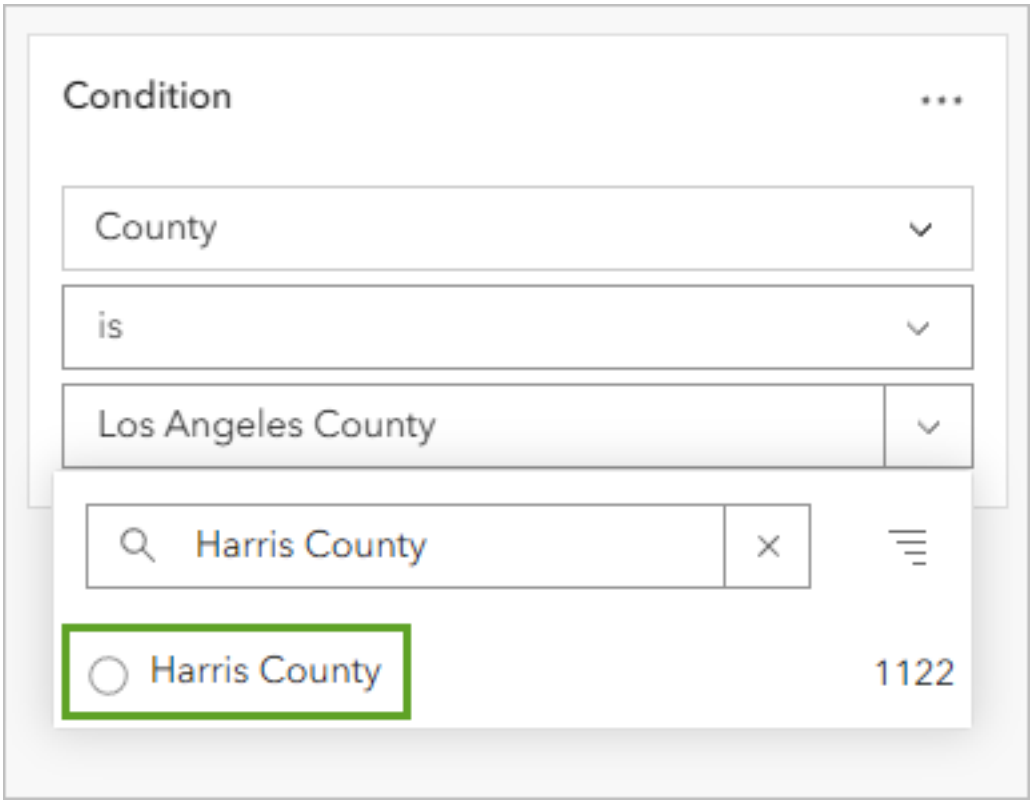
1. Ensure the **Percent of Households with No Vehicle Access** layer is selected
2. In the **Settings pane**, click **Filter**



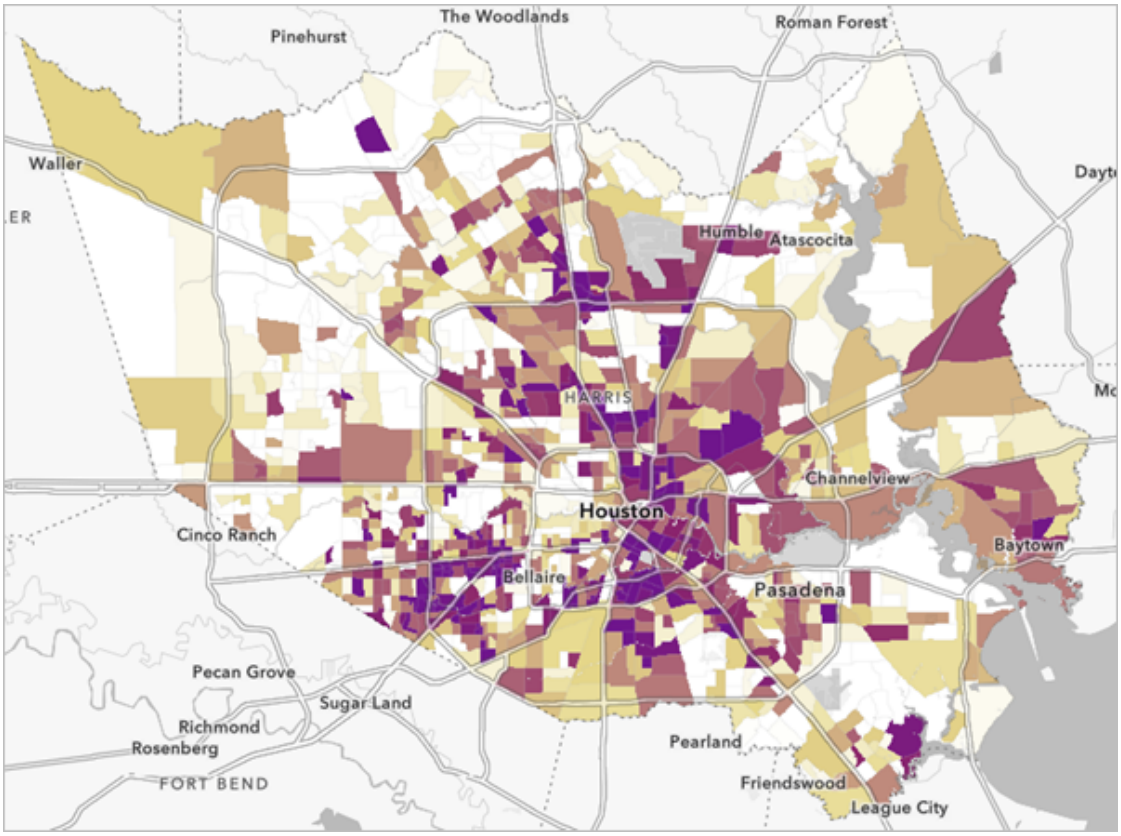
3. In the **Filter pane**, click **Add new**
4. Under **Condition**, click the first box and choose **==County==**



5. Leave the operator as **is**
6. For the third box, click the drop-down arrow, type **==Harris County==** and select it

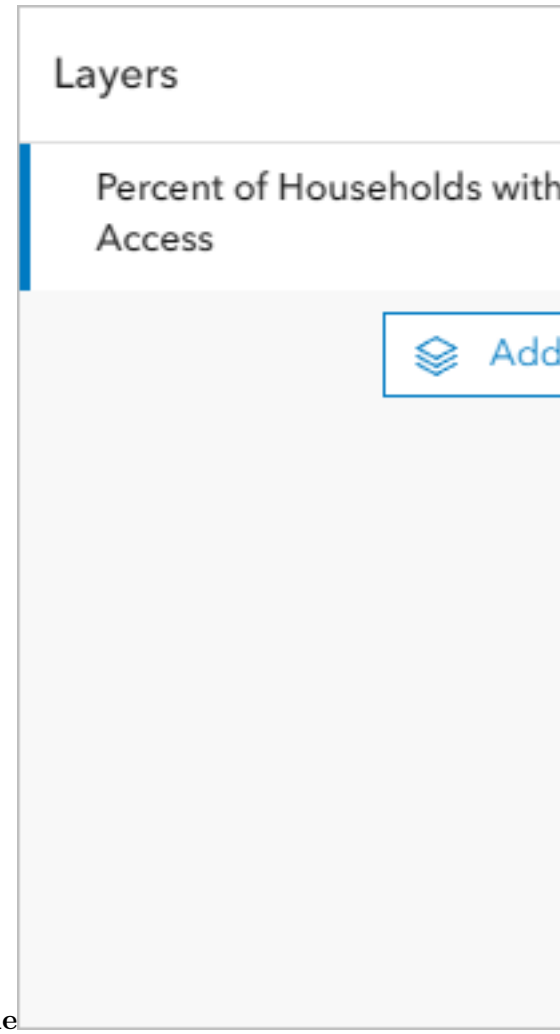


7. Click **Save** to apply the filter


The Woodlands
Pinehurst
Roman Forest
Waller
Humble
Atascocita
HARRIS
Channelview
Houston
Cinco Ranch
Baytown
Bellaire
Pasadena
Pecan Grove
Sugar Land
Richmond
Rosenberg
Pearland
FORT BEND
Friendswood
League City

Part 6: Emphasize the Top Tracts

Step 1: Examine the Attribute Table

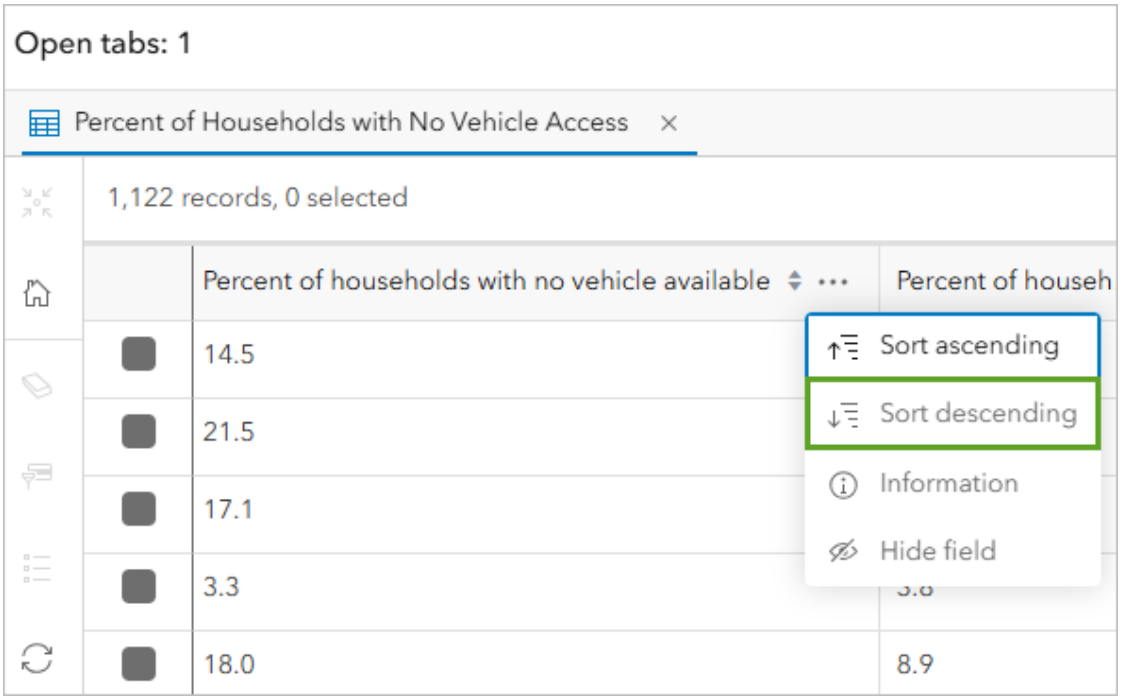


1. For the layer, click the **Options** button and choose **Show table**

   The layer's attribute table appears. The attribute table is a way of viewing all of the attributes that exist for each feature. Each row in the table represents a feature (in this case, a census tract area). The columns, or fields, provide information about the census tract features, such as the **County** attribute that you used to filter the data earlier.

   The top of the table indicates that there are 1,122 census tracts in Harris County.

2. Scroll right to find the **==Percent of households with no vehicle available==** column

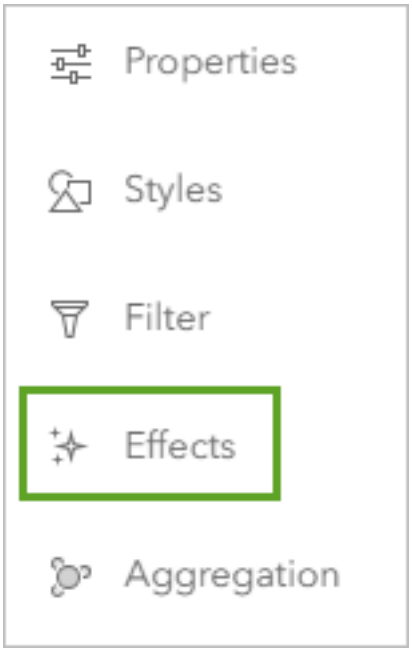


The table is sorted so that the **Percent of households with no vehicle available** field shows tracts in order of highest to lowest values. The highest value is 48.9 percent.

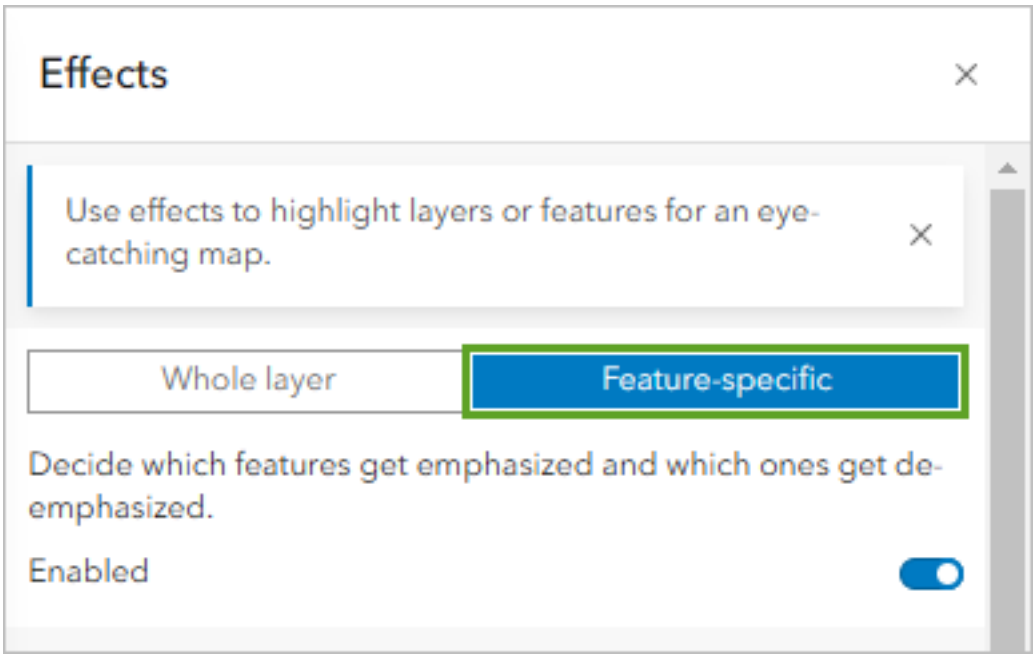
3. Click the **Menu** button for this column and choose **Sort descending**
4. Identify the 10 highest values in the table
5. Close the table

Step 2: Apply Visual Effects

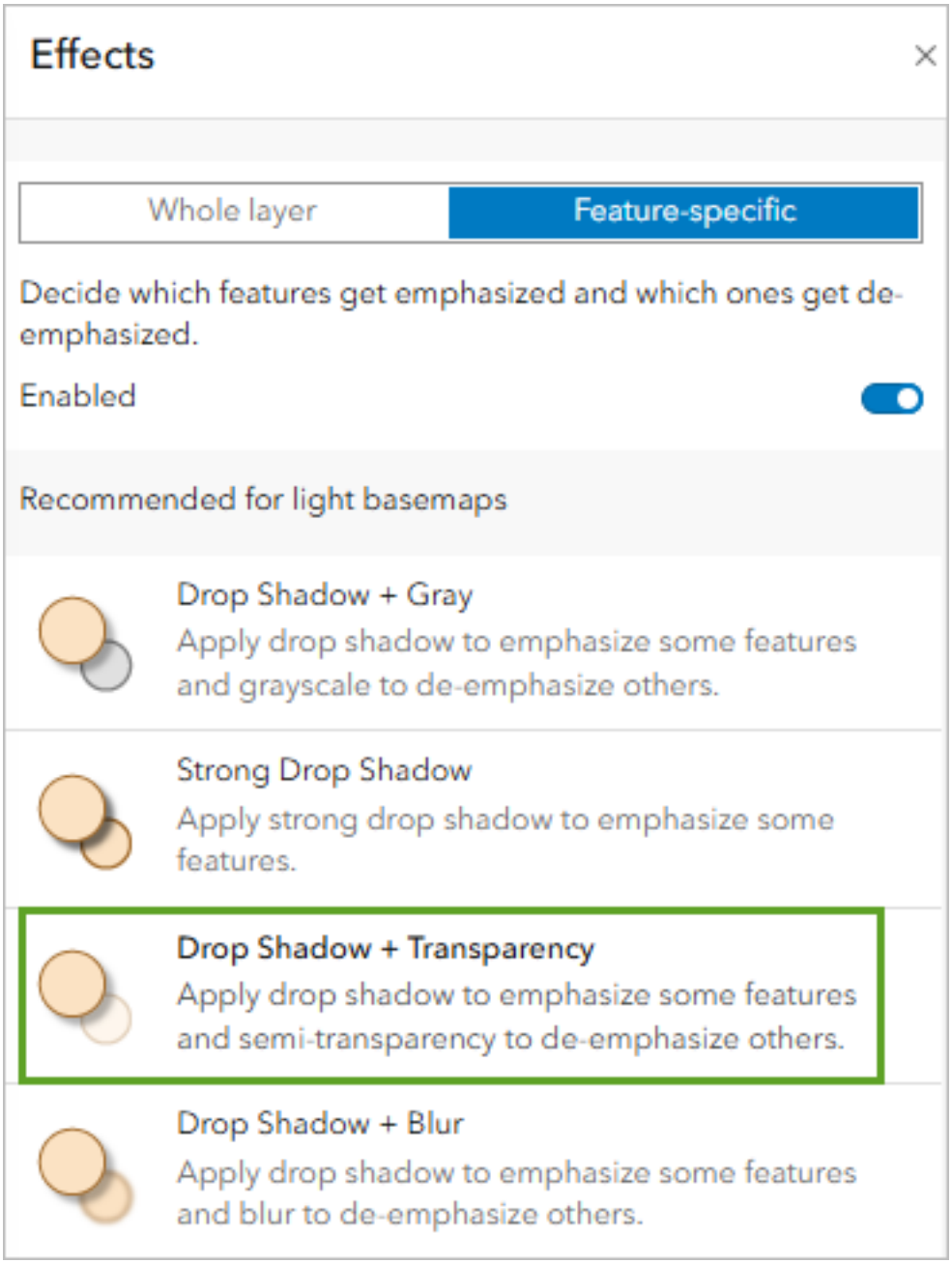
1. In the **Settings pane**, click the **Effects** button



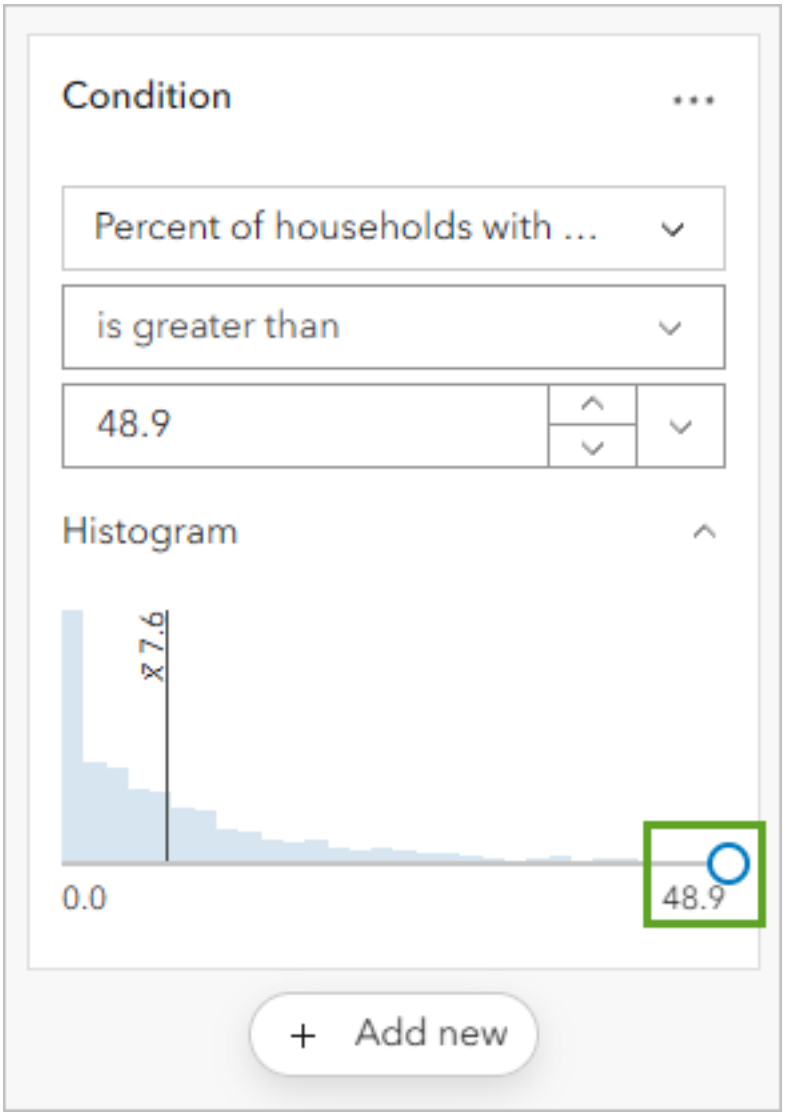
2. In the **Effects pane**, click **Feature-specific**



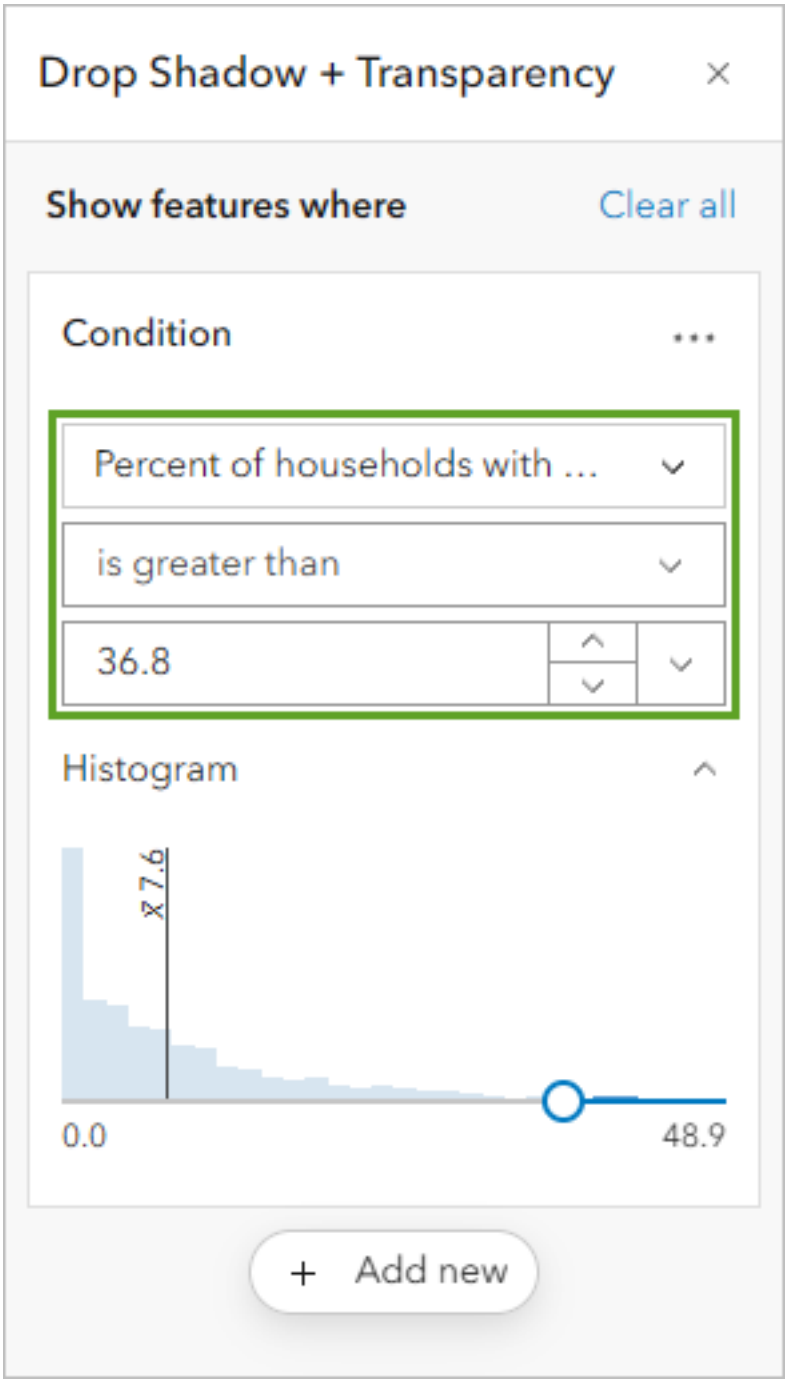
3. Click the **Drop Shadow + Transparency** effect

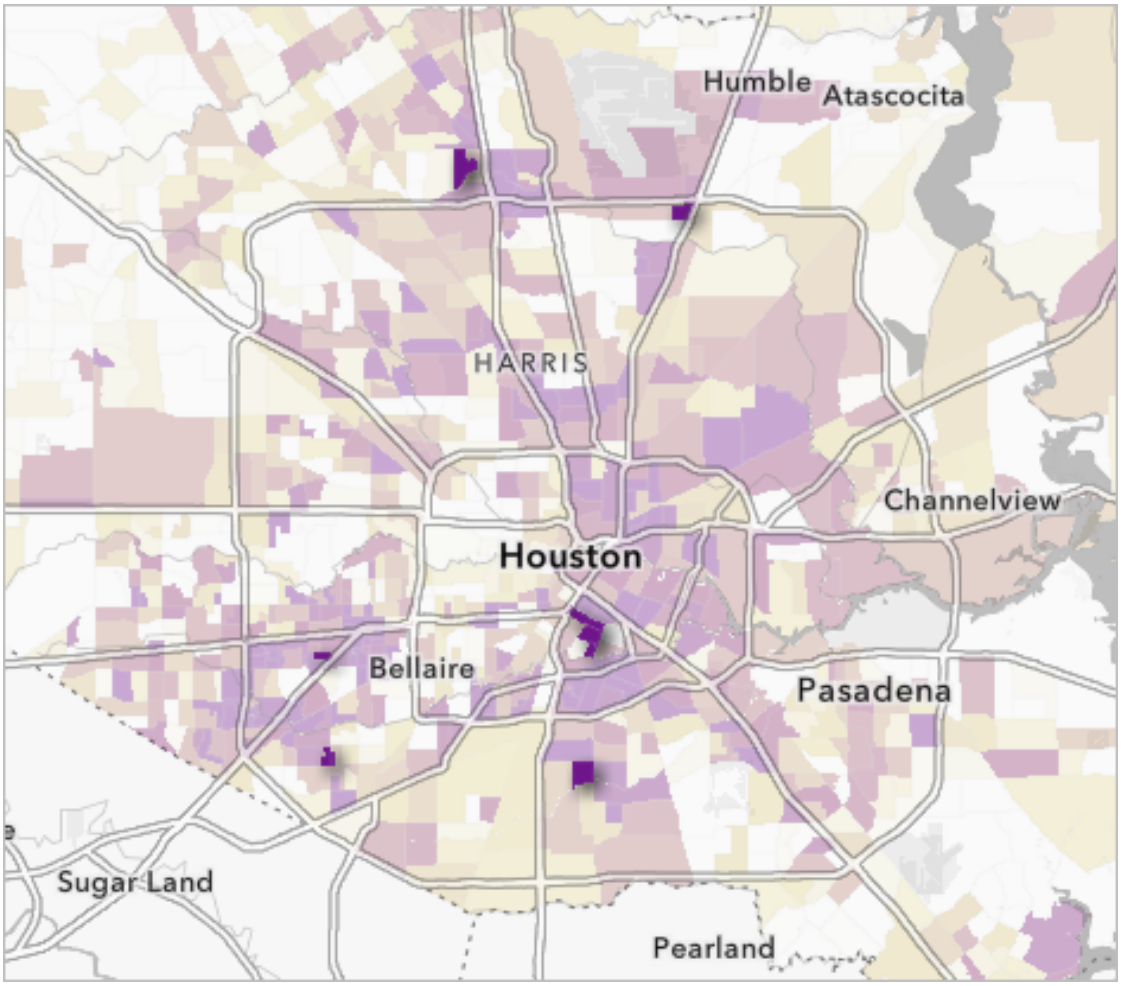


4. In the **Drop Shadow + Transparency** pane, drag the histogram slider to the **48.9** label. This will adjust the histogram slider to emphasize the top 10 tracts



5. Modify the logical expression to highlight areas above your identified threshold. Change the logical expression to read **Percent of households with no vehicle available is greater than 36.8**.


Drop Shadow + Transparency
Show features where
Clear all
Condition
Percent of households with ...
is greater than
36.8
Histogram
x̄ 7.6
0.0
48.9
+ Add new



6. Close the effects windows

Part 7: Final Documentation and Submission

Step 1: Save Your Map

1. On the **Contents toolbar**, click **Save and open** and choose **Save as**
2. For **Title**, type: **==Census tracts in Houston with low vehicle access==**
3. For **Tags**, add the following (press Enter after each):

- **==Hurricanes==**
- **==Evacuation Assistance==**
- **==Houston==**

4. For **Summary**, type: **==This map shows census tracts in Houston, Texas, that have many households without access to a vehicle. These areas may need to be considered for evacuation assistance in case of a hurricane or other natural disaster.==**

The map is saved. It now appears in your account's content. You can access your content by clicking the options button next to the map's name and choosing **Content**. For now, you'll set the sharing permissions.

By default, your content is private and only visible to you and your organization's administrator. You can share content to different groups of viewers depending on the level of privacy you want to maintain and the content's audience and purpose. For example, if you choose to share it with your organization, only users with accounts in the same organization as you can access your content. For this tutorial, you've created a public information map and you want it to be available to everyone, so you'll share it publicly.

1. Click **Save**

Step 2: Submission Requirements

IMPORTANT: Instead of sharing your map publicly, you must provide descriptions of your completed work.

Take a screenshot that includes: - Your complete computer screen - The ArcGIS Online map you created - The system date and time visible (usually in the taskbar/menu bar) - All relevant map elements (legend, layers panel, styled data)

1. Ensure your map displays all required elements: - Properly filtered census data - Appropriate styling with color scheme - basemap - Applied effects highlighting top areas - Descriptive layer name.
2. Take a full-screen screenshot showing:
    - Your completed map
    - Current date and time from your system
    - ArcGIS Online interface with your map title visible
3. The date-time stamp allows the marker to validate when the work was completed

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Additional Resources

- ACS Vehicle Availability Variables - Boundaries data is from the American Community Survey.
- Topographic map sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS User Community
- Human Geography Map sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, OpenStreetMap contributors, and the GIS User Community

To extend your learning with ArcGIS Online: - Create interactive apps from web maps - Learn advanced styling techniques - Explore spatial analysis tools - Access the ArcGIS tutorial gallery for more exercises

- To learn how to transform your web map into an interactive app, check out the tutorial Create an app.
- To learn useful tips and tricks for web maps, check out the series Common skills for working with data in ArcGIS Online.
- To learn about performing spatial analysis, check out the series Perform analysis in Map Viewer.
- To learn more advanced techniques for styling your map, check out the series Cartographic creations with web maps.

3 Lab No 2: Create a Map Lab

Objective: Add a data layer to a new map and start visualizing patterns

3.1 Download and Examine the Data

First, you will download a .csv file that contains general information about public high schools in Detroit, Michigan.

1. Download the DetroitSchoolCharacteristics.csv file to your computer and open it in Microsoft Excel or another spreadsheet program like Google Sheets.

You will see a table with columns of longitude, latitude, school name, total students eligible for free and reduced meal plans, and race and ethnicity data. This data comes from the National Center for Education Statistics' (NCES) Education Demographic and Geographic Estimate (EDGE) program.

It's hard to visualize where these schools are located or any patterns in the information from the table alone. Making a map is a better way to understand your data than viewing it as a table, so that's your next task.

> **Note:** You can find data about public schools across the United States in the Public School Characteristics - Current layer.

2. Close the .csv file.

3.2 Create a Map Layer

Layers are the way geographic data is organized and combined to create maps. For example, a map may consist of a roads layer, a lakes layer, and buildings layer. These layers are also the basis for geographic analysis to aid in decision making. You will create a map layer by adding your .csv file to an empty map.

1. Sign in to your ArcGIS organizational account or into ArcGIS Enterprise using a named user account.

Note: If you don't have an organizational account, see options for software access.

2. On the ribbon, click the **Map** tab.
3. In Map Viewer, in the Layers pane, click the arrow next to the **Add** button and click **Add layer from file**.

The Add Layer window appears.

4. Drag the DetroitSchoolCharacteristics.csv file to the Add Layer window.

   Tip: Alternatively, click **Your device** and browse to the .csv file.

5. For **How would you like to add this file**, choose **Create a hosted feature layer and add it to the map**. Click **Next**.

A list of fields appears. Map layers consist of spatial and tabular information. The table will contain the same columns—also called fields or attributes—as the .csv file. On this page, you can choose which fields from the .csv file you want to include, provide display names, and data type information.

The software automatically detected the fields and produced default display name and data types. This page is an opportunity for you to review that the automatic assignments are accurate.

In this example, you will choose to include all the fields, so you won't adjust the check boxes.

Display name sets a nickname or shortened name of the field name that is more readily understandable to others. Field names cannot include spaces or numbers, so sometimes you may want these in the display name. Setting Display name allows you to provide meaningful names without changing the Field name text.

Type describes the data you will store in the field: - **Date**—Date and time. - **Double**—Numbers with decimal places. - **Integer**—Whole numbers from -2,147,483,648 to 2,147,483,647 (long integer). - **Big Integer**—Whole numbers between -(2^53) and 2^53. - **String**—Any sequence of characters. The default length is 256 characters.

You will accept all the default settings and continue.

6. Click **Next**.

The Location settings page appears. Spatial information for the layer will be derived from the Latitude and Longitude columns in the .csv file.

> **Note:** If your table contains the names or addresses of locations (like Paris or 15 Central St. Bethlehem, PA) instead of latitude and longitude fields, try this tutorial about geocoding data: Convert a list of historic places into a map.

7. Click **Next**.
8. For **Title**, type "Detroit high schools" followed by your name or initials (for example "Detroit high school (Your name)").

   Note: You cannot create two layers in an ArcGIS organization with the same name. Adding your initials to a layer name ensures that other people in your organization can also complete this tutorial. Once a layer has been created, you can rename it in the map to remove your initials, which will not affect the name of the underlying data layer.

9. Click **Create and add to map**.

The new layer appears on the map. The map displays the locations of the schools listed in the .csv file. Each school is considered a feature in the layer. You have access to the descriptive information, or attributes, by viewing pop-ups for features on the map.

10. On the map, click any circle.

A pop-up window appears with information about the school from the layer's table.

11. Close the pop-up.

Before you continue, you will save the map.

12. In the Contents pane, click **Save and open** and click **Save as**.
13. In the Save map window, enter the following:

    - For **Title**, type "Public high schools in Detroit".
    - For **Summary**, type "Map of public high schools and student body race and ethnicity data in Detroit, Michigan".

14. Click **Save**.

3.3 Change the Basemap and Layer Style

Maps in ArcGIS Online consist of layers. You added the Detroit high schools layer, but the map also has a basemap layer by default. Next, you'll change the basemap layer and the style of the feature layer.

1. On the Contents (dark) toolbar, click **Basemap**.

The Basemap pane appears. The Topographic basemap is selected. This basemap looks good but is better suited for a reference map. You'll choose a more minimally designed basemap so it does not distract from the school data.

2. In the Basemap pane, click **Light Gray Canvas**. Close the Basemap pane.

   Note: You may see different basemaps depending on the configuration of your organization. If the Light Gray Canvas basemap is not available, skip to the next step without changing the basemap.

Next, you'll configure the high school layer's symbols so they are sized based on the number of students at each school eligible for free and reduced meal plan programs.

3. On the Settings (light) toolbar, click **Styles**.

   Note: If the Settings toolbar is unavailable, on the Contents toolbar, click **Layers**. In the Layers pane, click **Detroit high schools** to select the layer.

The Styles pane appears. Currently, the style is based on the data's location only. You'll configure the symbols to convey both location and one of the data's attributes.

4. In the Styles pane, click the **Field** button.

You will choose to style the map by the number of students at each high school who are eligible for free and reduced price meal (FRPM).

Eligibility for FRPM is set by U.S. Department of Agriculture Child Nutrition Programs and is based on Federal poverty guidelines issued by the Department of Health and Human Services. The number or percent of students eligible for FRPM is often used as an equity indicator to understand the needs of school-aged children.

5. On the Select fields menu, choose **Total of free lunch and reduced-price lunch eligible** and click **Add**.

The options under Pick a style update to reflect choices that are suitable for the Total of free lunch and reduced price lunch eligible field. **Counts and Amounts (size)** is selected and the map updates to reflect this style. This style reveals some new patterns in the data. The larger the circle, the more students are eligible for FRPM at the school.

6. On the **Counts and Amounts (Size)** card, click **Style options**.
7. In the Counts and Amounts (size) pane, for **Symbol style**, click the current symbol.

The Symbol style window appears. You'll adjust the symbol's properties so circles can be seen even when they are overlapping.

8. Set **Fill transparency** to 25. Set **Outline transparency** to 0.

The symbols on the map update. It is now easier to see overlapping circles.

9. In the Symbol style window, for **Fill color**, click the current color. In the Select color window, for #, type **0070FF** and press Enter.

The color of the map symbols changes to blue.

10. Click **Done** in the Select color window, the Style options pane, and the Styles pane.

The map shows the number of students at each high school who are eligible for FRPM programs. The schools with more students who are eligible for FRPM programs are represented by larger circles. Schools represented with smaller circles have fewer students who are eligible for FRPM programs.

11. On the Contents pane, click **Save and open** and click **Save** to save your map.

3.4 Configure Pop-ups and View a Table

The pop-up that you viewed earlier displayed all the attributes for the features, which may be unnecessary for your map. You can configure pop-ups to show only those attributes that are important to your map. In this example, you want to show only the name of the school and the number of students eligible for FRPM programs.

1. In the Layers pane, ensure that the **Detroit high schools** layer is selected.
2. On the Settings toolbar, click **Pop-ups**.

The Pop-ups pane appears and a sample pop-up appears on the map. The pop-up's title contains the name of the layer and the name of the school. This title is unnecessary for your map, so you'll remove it.

3. In the Pop-ups pane, click **Title**. Erase the text in the box.

The title text disappears from the sample pop-up. You'll replace the list of fields with a sentence that includes the relevant information.

4. Next to **Fields list**, click the **Options** button. Click **Delete**.
5. Click **Add content** and click **Text**.
6. In the text editing window, type **{**. In the menu that appears, scroll almost to the bottom and click **School name**.

The School_name field was one of the fields in the .csv file you used to create the feature layer. By setting the dynamic text to this field, the pop-up that displays for each school point will display the corresponding School_name field.

7. After **{School_name}**, type **enrolled {Total_elementary_secondary_stud} students during the 2019-2020 school year.**

You can add fields by typing their names inside of curly brackets or by choosing them from the list that appears when you type a curly bracket.

8. Press Enter to start a new paragraph. Type **{Total_of_free_lunch_and_reduced} of those students were eligible for the free and reduced meal plan program.**
9. Use the **Bold** button on the toolbar to add bold formatting to **{School_name}**, **{Total_elementary_secondary_stud}**, and **{Total_of_free_lunch_and_reduced}**.
10. Click **OK**.

The preview pop-up replaces the field names with the attribute values of one of the features.

All the fields still exist in the data table, but they don't display in the pop-up. You can modify the contents of the pop-up at any time. You can still see all the attributes by showing the table.

11. In the Layers pane, next to **Detroit high schools**, click the **Options** button. Click **Show table**.

The layer's table appears below the map.

12. Review the data in the table. Close the table when you are finished.
13. Close the Pop-ups pane.
14. Save the map.

3.5 Style the Layer in Another Way

Your goal is to identify which schools would most benefit from more after-school programs. You have styled the school data by the number of students eligible for FRPM. But there are other aspects of equity that are also important to consider. Due to historic and present-day practices, race and ethnicity can play a critical role in how many resources and opportunities students have at their schools. Practices like segregation in schools and neighborhoods have widened inequities in resource allocation to schools.

Next, you will style the schools to show the race and ethnicity of the student body. First, you will rename the layer you had previously styled to show FRPM eligibility.

1. In the Layers pane, for the **Detroit high schools** layer, click the **Options** button and click **Rename**.
2. For **Title**, type **Students FRPM eligible** and click **OK**.

Next, you will make a copy of the layer.

3. For the **Students FRPM eligible** layer, click the **Options** button and click **Duplicate**.
4. Rename the copied layer to be **Race and ethnicity data**.
5. Next to **Students FRPM eligible**, click the **Visibility** button to hide the layer on the map.

Next, you will style the Race and ethnicity data layer with race and ethnicity attributes.

6. Ensure that the **Race and ethnicity data** layer is selected in the Layers pane. In the Styles pane, remove the **Total FRPM eligible** attribute.
7. Click the **Field** button.
8. In the Add fields window, check the following fields:

    - All students - American Indian/Alaska Native
    - All students - Asian
    - All Students - Black or African American
    - All Students - Native Hawai'ian or Other Pacific Islander
    - All Students - Hispanic
    - All Students - Two or More Races
    - All Students - White

9. Click **Add**.
10. Under **Pick a style**, click the **Charts and Size** style.

The layer style updates.

The map now shows pie charts of the student body's race and ethnicity categories. The sizes of the pie charts represent the number of students at the schools.

11. Save the map.

3.6 Update the Item Details

Your map now tells a story about the locations and some socioeconomic attributes of public high schools. For example, the school with the largest number of students eligible for FRPM programs is Western International High School in southwest Detroit. Many of the schools have a high percentage of students who identify as Black or African American. In southwest Detroit, there are more schools with higher percentages of Hispanic or Latino students.

By saving your map, you also created a corresponding item page that contains information, actions, options, and settings for the map.

1. On the Contents toolbar, click **Map properties**. In the Map Properties pane, click **Item details**.

Your map's item page opens in a new browser tab. The item details are missing important attribution and descriptive information that you will fill in before you share the map. For example, you must give credit to the data providers.

2. Scroll to the bottom of the page. Next to **Credits (Attribution)**, click **Edit**.
3. Type **National Center for Education Statistics' (NCES) Education Demographic and Geographic Estimates (EDGE)**. Click **Save**.
4. Close the item page's tab.

3.7 Submit Your Work

To demonstrate completion of this lab, take a screenshot that includes your entire computer screen showing your completed map. Ensure that the date and time are visible on your screen (either in the system taskbar or by opening the system clock). This screenshot will allow the instructor to validate that you have successfully completed the mapping exercise.

Submit your screenshot through the designated course submission portal.

3.8 What's Next?

You have created a web map with a .csv file of school location and demographic data. Now that you have the data mapped, you have more ideas for how to share and explore potential after-school program needs in your city.

You can create a web app to display your map data in an interactive way so viewers can explore the data without editing the map. There are many ways you can use your web map to visualize data, understand problems, determine informed solutions, and discover what else is possible.

You can find more tutorials in the tutorial gallery.

References

Knuth, Donald E. 1984. “Literate Programming.” *Comput. J.* 27 (2): 97–111. https://doi.org/10.1093/comjnl/27.2.97.