Make Better Maps for Transportation Planning and Communication

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My gracious advisor who kept me focused on my goals—even as I switched topics three times.

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Mom, Dad, Sara, Rosie, thank you for supporting my grad school journey and future career!

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You guys keep me sane. Love ya.

Table of Contents

Why do good maps matter?

Planning requires good communication, maps included.

Planning requires communication. Communication between professionals and the public, communication between engineers and designers, communication between city departments. Mapping is one of our most powerful tools to communicate, but we often miss the mark. "[P]lanners could be much more effective in communicating their ideas to others if they avoided a small number of common map-making pitfalls" (Kent & Klosterman, 2000).

Maps are a powerful tool, but can easily overwhelm the viewer.

"We all know the power of maps to deliver information in ways that other media can't, but we can also add a lot of noise to the message. The best data doesn't mean anything if your audience can't digest it." (Wayne 2020). Nowadays, there is no shortage of data. Most professionals can throw data into their mapping software of choice and start playing around with it. This modern information sharing is powerful, but it is easy to forget how to communicate this data effectively.

Maps must be clear, or people will not hear your analysis.

When was the last time you stared at a confusing graphic for more than a minute? If the information you are trying to express is not clear, people will click away from your map. They will not get to understand your analysis. Maps must be clear, since "information will be received from the map quickly or not at all" (Kent & Klosterman, 2000)

At the end of the day, we are planning for the public!

"If the maps a planner produces cannot be understood by a nonprofessional, it is time to go back to the drawing board" (Kent & Klosterman, 2000).

How to Use this Guide

This guide has three sections: Foundations, Illustrations, and ArcGIS Pro Settings.

Foundations - Page 6
This section combines the most essential information in one place. There are some descriptions provided, but most of the information is distilled into tables. Use it as a quick reference.

Illustrations - Page 14
This section uses five examples to demonstrate how good/bad mapmaking can change the way people interpret a map. These are examples of maps that transportation planners might make. Use these examples to inspire and improve your own mapmaking. You can find details on how I made these maps in the "ArcGIS Pro Settings" section.

ArcGIS Pro Settings - Page 32
This section lists out the exact symbology for each layer of a map. Every map in the "illustrations" section has a corresponding page in this section. Use this information to duplicate my map styles.

Quick Start

"I want to…"

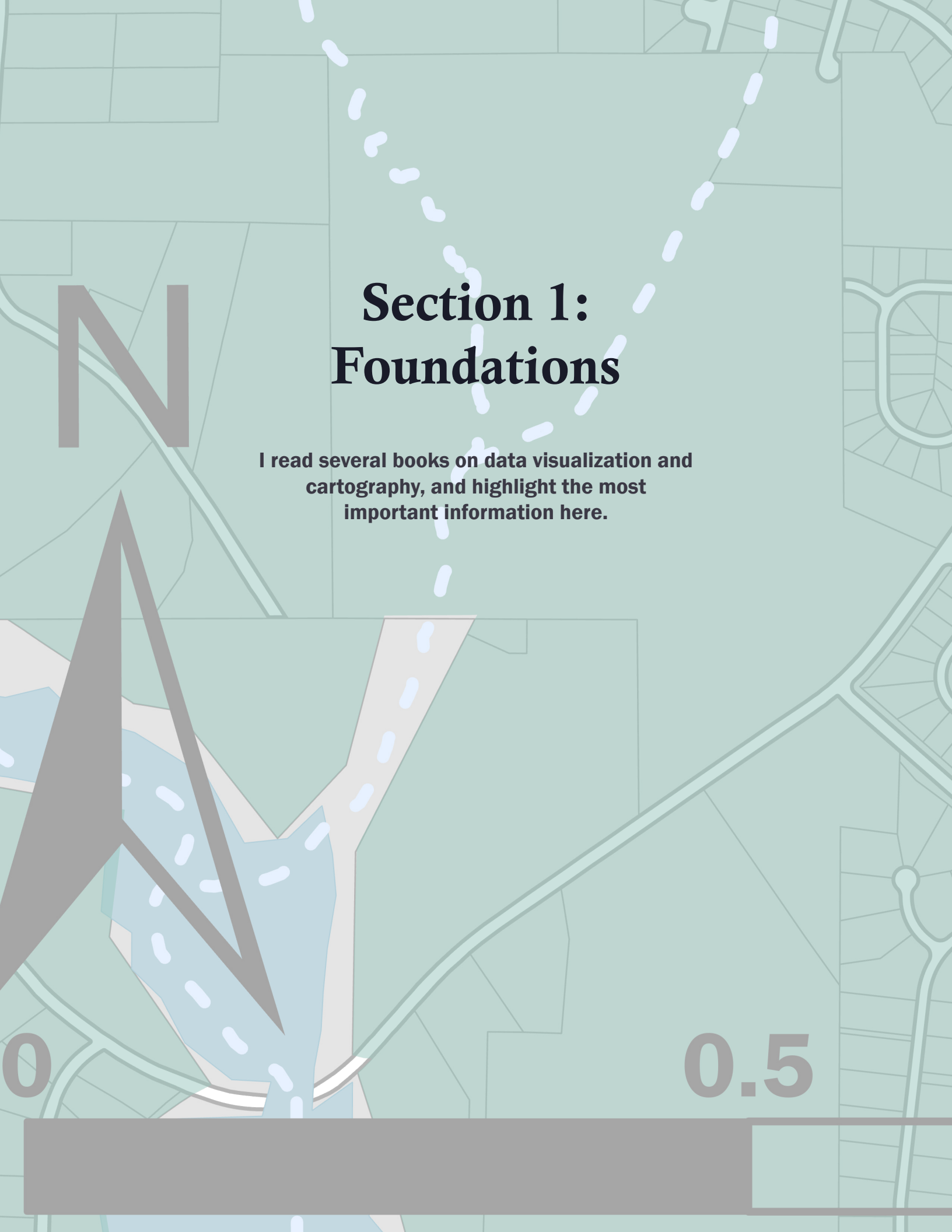
"…make my maps easier to understand"
Start with "Choose Your Data Symbols Well" (pages 10-13), and
"Illustration 1: Remove Distractions" (pages 16-17).

"…make my maps colorblind-friendly"
Start with "Illustration 3: Keep Your Map Straightfoward" (pages 24-25), and
"Illustration 5: Use Color Gradients Carefully" (pages 30-31)

"…represent data accurately"
Start with "Choose Your Data Symbols Well" (pages 10-13), and
"Illustration 2: Pay Attention to Data" (pages 20-23)

"…map a study corridor"
Start with "Illustration 1: Remove Distractions" (pages 16-17), and
"Illustration 3: Keep Your Map Straightfoward" (pages 24-25)

"…learn a few ArcGIS Pro tricks"
Start with "Illustration 2: Pay Attention to Data" (pages 20-23), and
"How to Add a Masking Layer" (pages 34-35)



Section 1: Foundations

I read several books on data visualization and cartography, and highlight the most important information here.


1
Miles

To Map or Not to Map?

Know the purpose of the map and its intended audience before collecting data and making your map (Slocum, 2005, p. 5). Throwing data into mapping software and seeing what happens is completely backwards.

Ask Yourself:

What information am I trying to express?

What question are you trying to answer? What takeaway do you want the audience to receive? Questions like these will help you keep the focus on the right thing. Write down the basic idea you want your audience to take away, and use it to inform the rest of your process.

Is a map the best way to represent this information?

Even if your data needs to be analyzed in a mapping software, a map may not be the best way to represent the information. What are the key takeaways you want to share? Could these takeaways be clearer if the data was shown in a table?

If it is simpler to show your data in a different way, don't make a map.

What is my data distribution? How should I represent it?

Before playing around with symbology, look at the raw data. Take the time to understand how your data is distributed. Is it a normal distribution? Skewed one way or the other? Uniform?

Research the ways this type of data is typically shown. Determine if the data needs to be normalized before you analyze it. Taking this step will make sure your maps are not misleading.

Is my audience the general public, or a technical committee? Does that change my strategy?

The answer may be no!

Sometimes, a professional will require a map with more specific labels and symbology. For example, a zoning administrator may need to know the exact zoning designation of a piece of property. On the other hand, even professionals will appreciate a map that is simple and jargon-free.

Think through why the audience will be looking at your map. For example: do you need to label the exact elevation, or is a high-to-low scale satisfactory?

If your audience is the general public, follow the plain language guidelines set by the federal government. https://www.plainlanguage.gov/guidelines/audience/. Be simple and direct in your legend, description, and labels.

Checklist of Map Elements

Element	Details/Sources
North Arrow 	The north arrow should not be distracting but should be present. To make a north arrow less distracting, make it grey instead of black and somewhat small on your map.
Representation of Scale  **1 inch represents 1 mile** 	**Option 1: Scale Bar** "Graphic scales are particularly safe form maps that might be reduced or enlarged for publication or by users" (Monmonier, 2018). **Option 2: Verbal Scale** (ie: 1 inch represents 1 mile or similar) Do not say "equals", since it "not only robs the user of a subtle reminder that the map is mearly a symbolic model but also falsely suggests that the mapped image is reality" (Monmonier, 2018, p. 7). **Option 3: Dots or a grid** Using a grid (or grid of dots) is useful if the map user will need to be actively measuring distance. They can do this without a ruler if you provide the grid (John Nelson Maps, 2022).
Title/Caption	Explain what the map is representing.
Legend and Labels	If an item is labeled, it likely does not need to be in the legend. Consider removing the title of your legend to improve hierarchy (i.e.: It is self-explanatory what your legend is. It does not need to title itself "Legend").
Data Description	It is important to describe how the data was generated, especially with complex maps. Including a data description can also allow you to remove the source text from your map.

Choose Your Data Symbols Well

Symbology changes depending on the type of data.

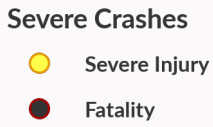
To keep your map understandable, it is important to choose the right symbology for your data.

Using the wrong sort of symbology can be confusing at best, and misleading at worst. The two major pieces to consider is the data type (categorical, numeric, etc) and the way the data is stored (point data, polygon data, raster, etc).

Useful Symbology by Data Type

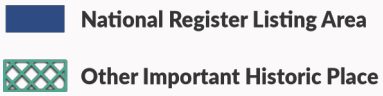
	Point	Line	Polygon	Raster
Categorical (Nominal)	Shapes	Patterns	Color *(hue)* Patterns	Color *(hue)*
Ordered Categories (Ordinal)	Shapes Value Saturation	Value Saturation Patterns	Value Saturation Hatching	Value Saturation
Numeric	Value Saturation Size *(proportional symbols)*	Size *(line width)*	Value Saturation	Value Saturation

Symbology Examples

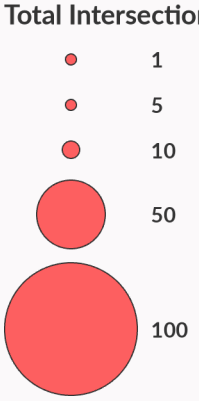


Categorical point data, symbolized by color.

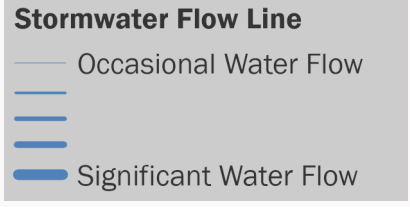
Categorical line data, symbolized by color and pattern



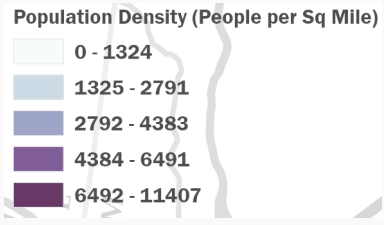
Categorical polygon data, symbolized by color and pattern



Numeric point data, symbolized by size



Numeric line data, symbolized by size



Numeric polygon data, symbolized by value and saturation

Value and Saturation are appropriate for ordered data.

Value is the lightness or darkness of a color.

Saturation is the intensity of a color.

Value and saturation can both be changed in a way that creates an understandable order. Light-to-dark is a color pattern we can understand. Grey-to-color is another color pattern we can understand. Therefore, value and saturation are both useful when the data itself has a logical ordering.

Value and Saturation will be understandable if the map is printed in greyscale.

Avoid "opaque white and solid black" because they ought to be reserved for missing data (Monmonier 2018, p. 160).

Color is appropriate for unordered data.

Color or hue is the dominant wavelength.

Hue (the color itself) should be used carefully. "Hue differences usually fail at portraying differences in percentages, rates, median values, and other intensity measures because spectral hues have no logical ordering in the mind's eye" (Monmonier 2018, p. 65). Therefore, hue should be reserved for categorical data.

Hue/color can be used alongside value or saturation for aesthetic purposes. If this is done, the color must still move from light to dark (Monmonier 2018, p. 66). Set your computer color filter to greyscale to check. If you can see the change in intensity in greyscale, the color you have added will not be distracting. See "Illustration 5: Terrain Visualization" for more information.

Color does not have an order that is easy to understand. Use color to represent unordered categories. (Categorical data)

Color is not a useful way to distinguish ordered categories.

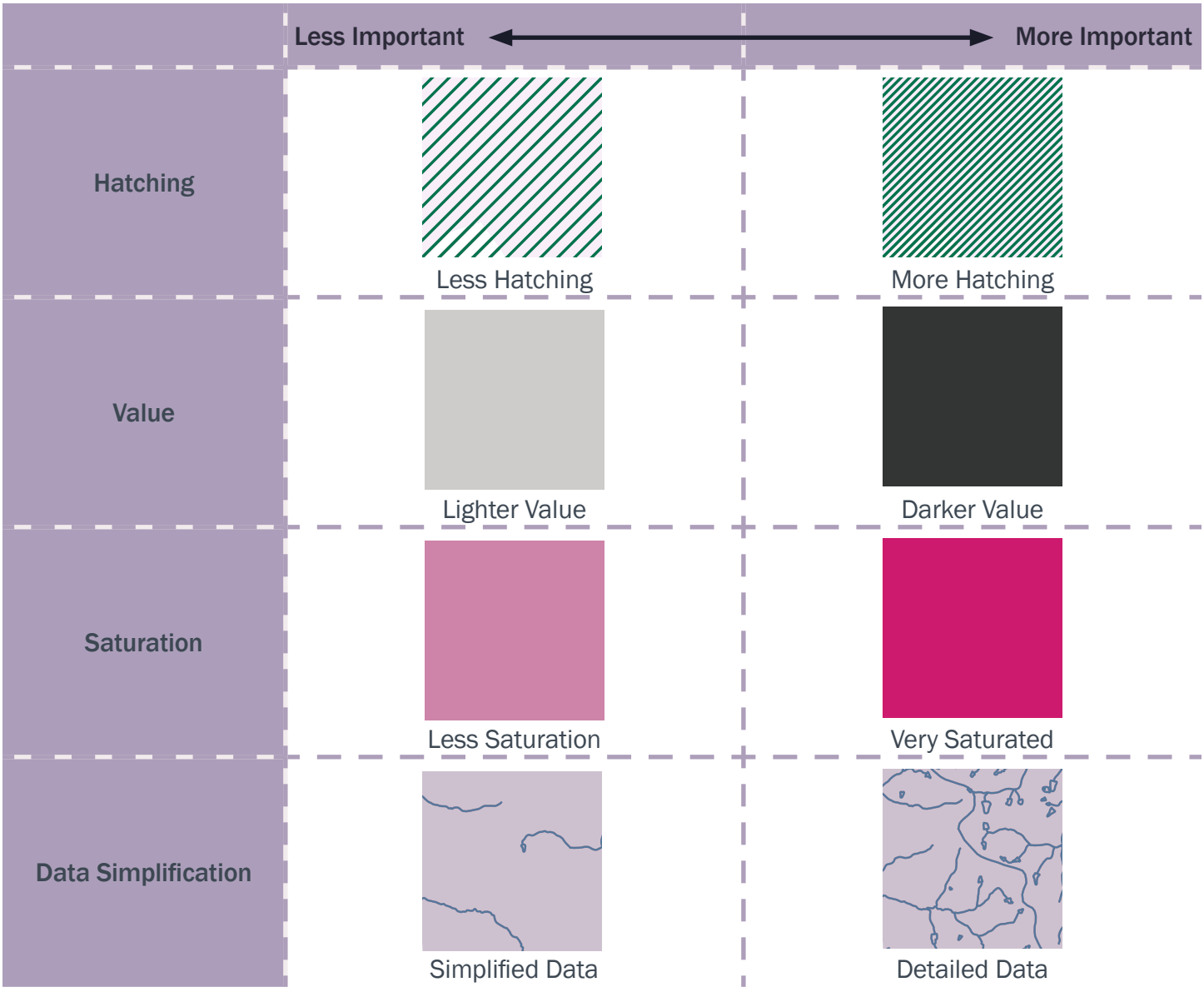
Data representation changes depending on the features you want to emphasize.

Why is it important to think about which data to emphasize? “Features selected to support the specific theme for the map usually require more prominent symbols than background features, chosen to provide a geographic frame of reference” (Monmonier, 2018, p. 28).

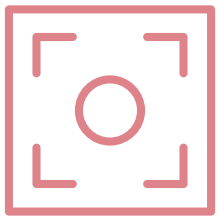
Think through an order of importance (hierarchy) for your data. The main “point” of your map should be obvious without needing to explain it. Allow the background information to fall away.

Establish importance (hierarchy) of map elements using symbols, color, and shading.

A Sampling of Hierarchy Strategies



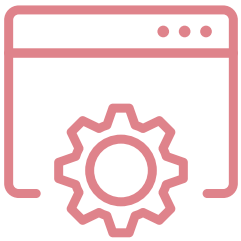
Test your hierarchy.



Zoom out or take several steps away from your computer.

When you can't see the details, do the right map elements still "jump out" at you?

If you have made an effective map, you should not need detail to understand your basic message. The details may enhance your story, but the gist should be clear without them.



Turn on your computer's greyscale color filter.

Without color, is the map still interpretable? Are the right things still clear?

Looking at your map without color is a great way to tell if you have a good balance of lights and darks. Ideally, the most important items should be the darkest, and they should still be obviously important even in greyscale.

This is also a great way to check if your map is colorblind-friendly.

Show your map to a friend. The less experience they have in your field the better.

Can they understand your map?

You may be including jargon or too much detail in your maps. The best way to avoid this is to show your map to other people. Show your map to a friend—there will be at least one thing that they find confusing. Note their questions, and edit your map to make those things more clear.

Make sure a non-professional reviews your map before you share it with the public. It is easy to forget how much of our job is an echo chamber.

Section 2: Illustrations

In this section, you will find examples of maps transportation planners use.

Each one includes explanations that connect back to the foundations listed in section 1.

Maps without citation are my own work.

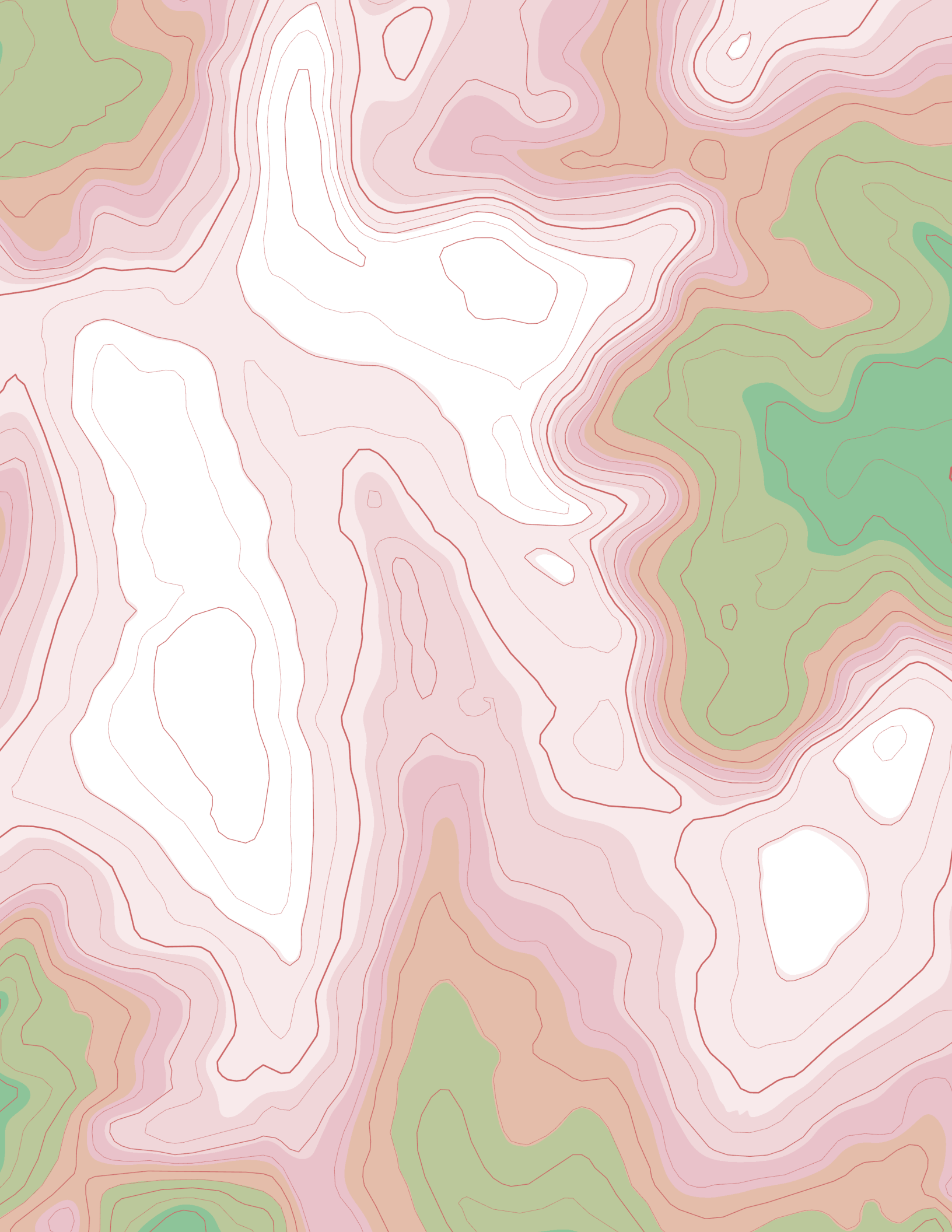
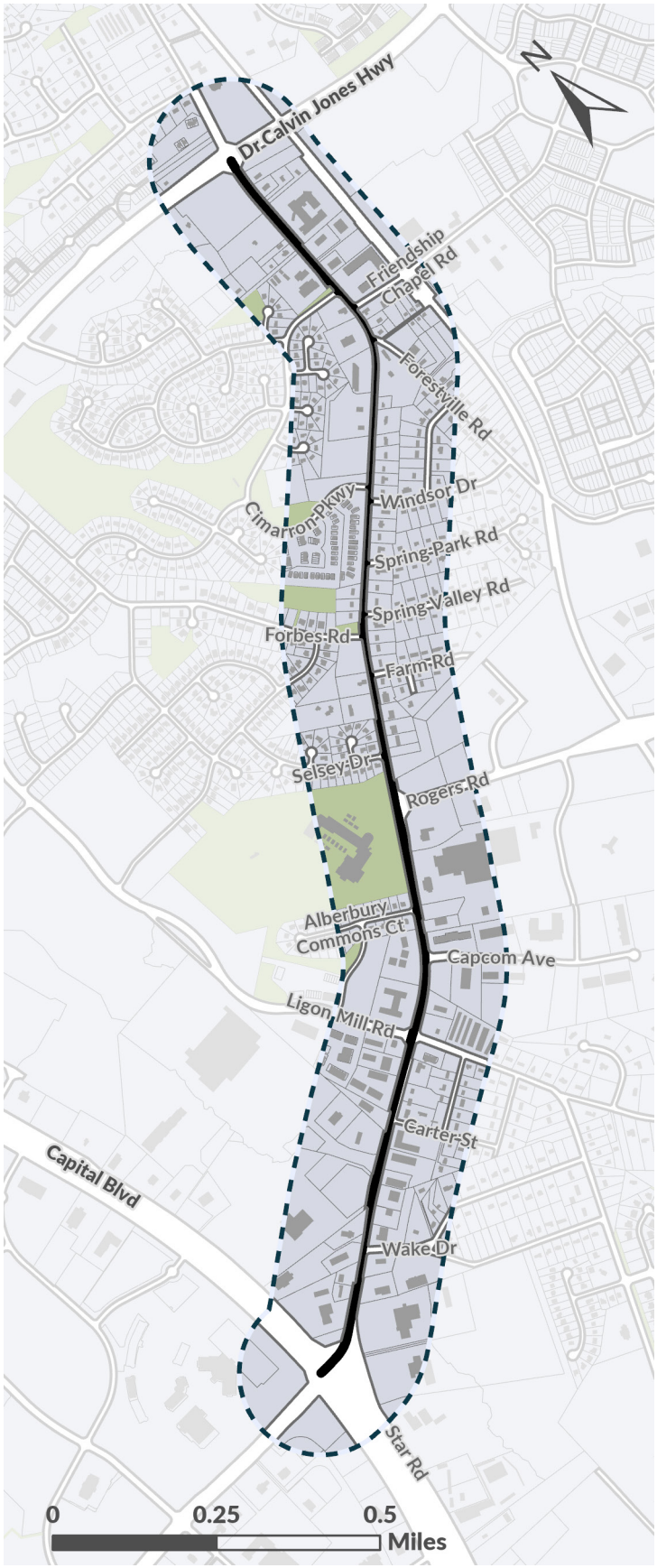


Illustration 1: Remove Distractions



Focused storytelling keeps this map clear.

The purpose of this map is to introduce a viewer to the study area. This requires enough background information to help the viewer orient themselves, but too much information might confuse the viewer.

I used several strategies to keep this map focused. They are outlined on this page.

Background features are light and unsaturated.

Parcels, open space, and building footprints are the three data sets that I chose to be the background of this map. Their colors are all unsaturated, allowing them to fade back.

Use only necessary labels.

Labeling can quickly get out of hand. To make sure the viewer would not be confused by a busy map, I only included road labels for the roads that had an intersection with the study corridor.

To do this, I used the “Select Features by Location” feature to select only roads that touched the main corridor. Then, I used the “Make Layer From Selected Features” menu option to separate out these roads.

https://pro.arcgis.com/en/pro-app/3.1/help/mapping/navigation/select-features-by-location.htm

https://pro.arcgis.com/en/pro-app/3.1/help/mapping/layer-properties/selection-layers.htm

◀ *S Main Street Surrounding Features*
Wake Forest, North Carolina

Block outlines are thicker than property outlines because they are more important.

The individual property lines are drawn with a very thin line, while the larger block outlines have a slightly thicker outline. This helps emphasize the shape of the roads and blocks, giving the user a good frame of reference.

To do this, I duplicated the parcel layer and increased the outline width on the layer underneath. More details are on pages 36-37.

Major roads are labeled with a darker text because they are more important.

The smaller roads are labeled with a lighter shade of grey. The lighter shade helps them "blend" into the map. Compare this with the darker grey used to label major roads. In the photo to the right, the major road is Dr Calvin Jones Hwy.

Since these roads are major landmarks, they deserve more emphasis. Darker labels emphasize these roads.

The areas further away from the corridor are covered by a white overlay to keep the focus on the corridor of study.

A white overlay hides the features outside of the study area. They do not disappear completely, since we need them to orient ourselves, but they are de-emphasized. A transparent white overlay can take down the saturation of the color, keeping the viewer's focus in the right areas.

See "How to Add a Masking Layer" (pages 34-35) for information on replicating this effect.

Default basemaps are distracting.

Default basemaps can be visually "busy". They often include a lot of labels and landmark features. While these can be useful, a basemap is impossible to edit.

The basemap colors this road red. This is very dark and overemphasizes the importance of this road, taking away from the data we are interested in.

Yellow background does not match project color scheme. It is impossible to change this color on a default basemap.

The data we are interested in gets "lost" in all the other bright colors, shading, and labels

Using a basemap requires credit. These credits can be distracting and hard to place.

Bicycle Crash

Pedestrian Crash

Multi-Use Path

Proposed Multi-Use Path

S Main Street Bike/Ped Features on a default basemap

Creating your own "basemap" allows you to have more control of your map's story.

By choosing some data to be your "background", you can create your own basemap. This gives you full control over the look of your map. You can then select what landmarks and labels are essential to your story.

In this example, parcel data (blue with grey outline) and parks data (green) make up the basemap. The colors are light and unsaturated, which allows them to fade into a background.

For an ongoing project, this background can be set up once and used throughout.

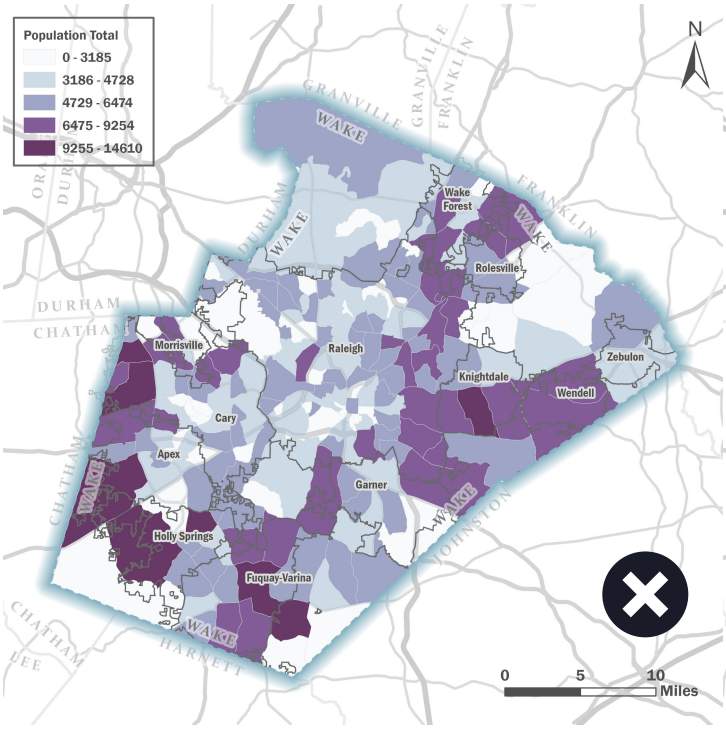
Bicycle Crash
Pedestrian Crash
Multi-Use Path
Proposed Multi-Use Path

◀ *S Main Street Bike/Ped Features on a custom basemap*

Illustration 2: Pay Attention to Data

Using the wrong representation of your data makes your map misleading.

Only mapping population total misses the context. This is misleading.

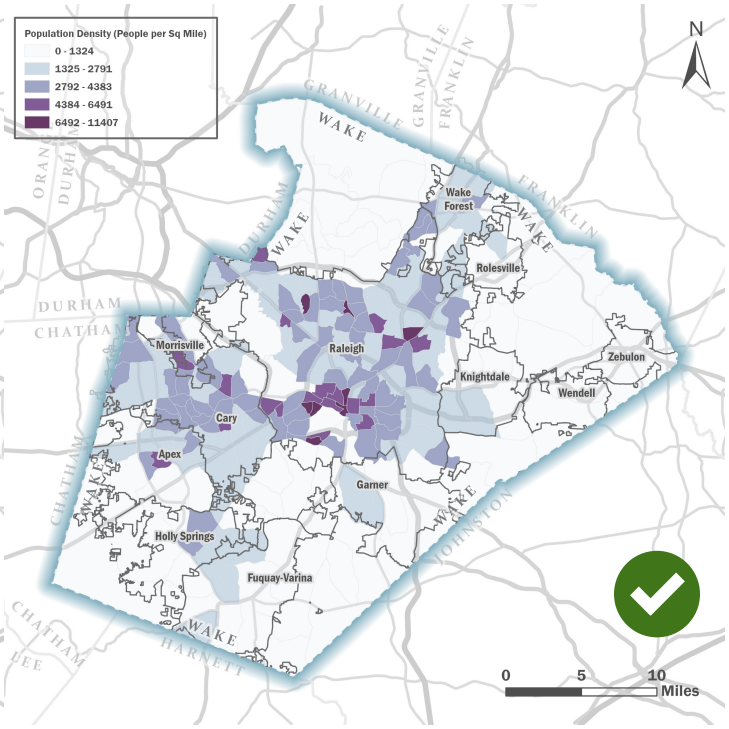


▲ *Population by Census Tract in Wake County, NC*

Unless we are trying to visualize population totals (perhaps to balance population of congressional districts), this map is not helpful.

The downtown census blocks are small, so this map makes it seem like there are no people living downtown.

Showing population density takes the land area into account. This is more accurate.



▲ *Population Density by Census Tract in Wake County, NC*

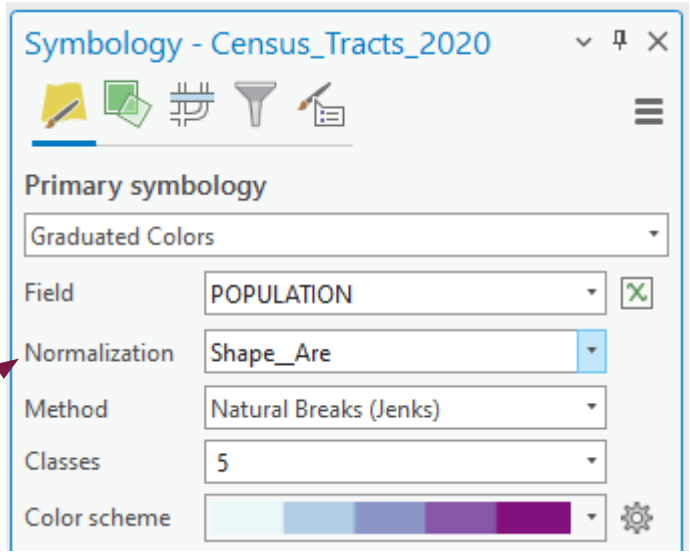
In most cases of transportation planning, we need to visualize population intensity. We want to know where people are, which requires mapping density.

This map properly shows the downtown population.

Normalizing data is easy!

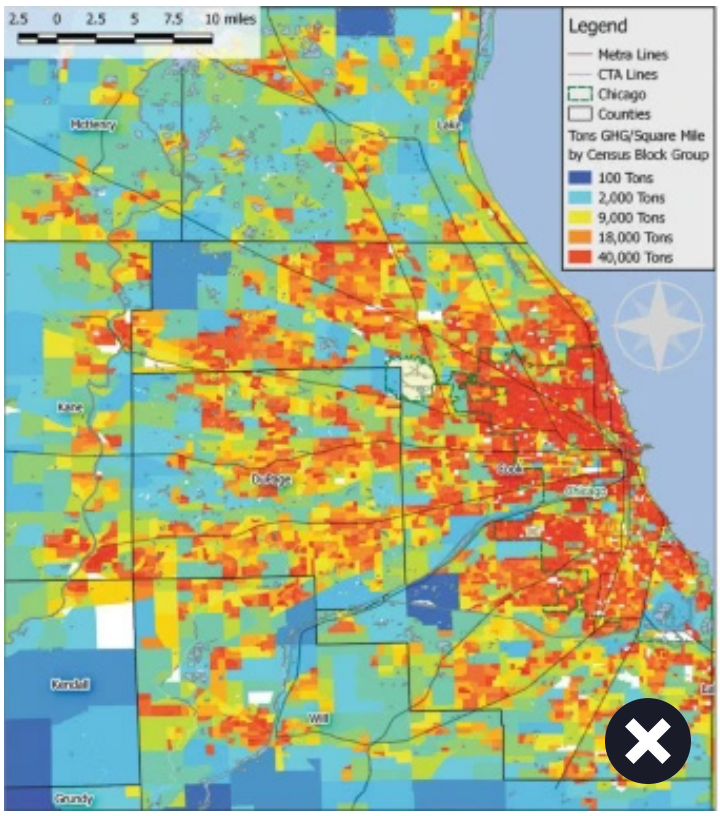
Representing your data correctly only requires one step. It does not require calculating a new field or editing your data.

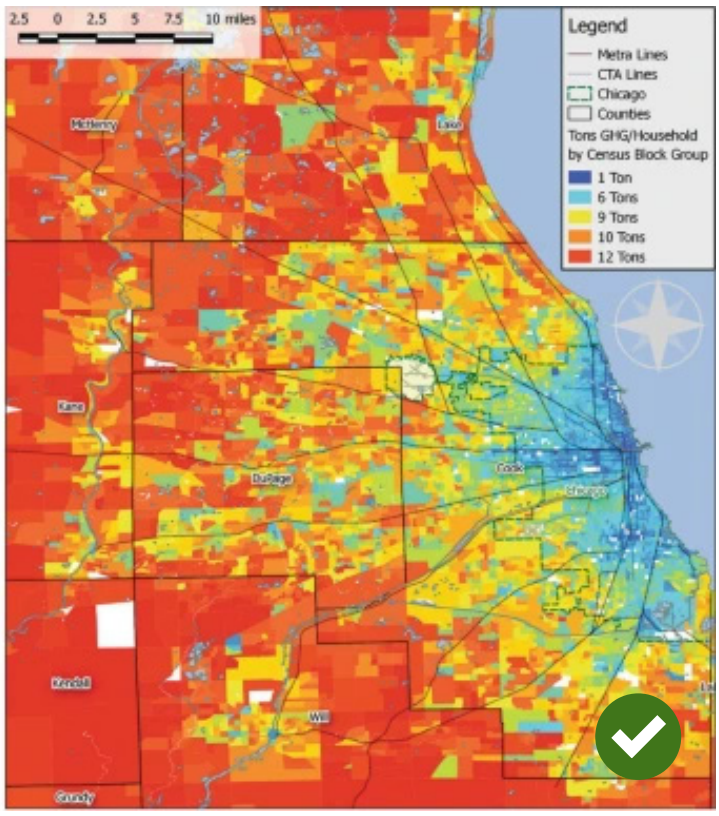
Use the “normalization” option to represent density instead of totals.



Mapping total carbon emissions implies that cities are top polluters. This is misleading.

Including population reveals that each household emits less carbon in cities.



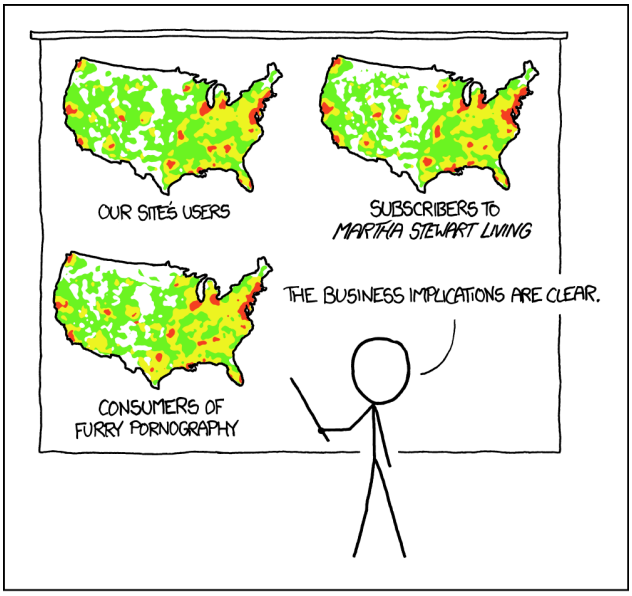


▲ *Greenhouse emissions per block group and per household. Map by Peter Haas, Center For Neighborhood Technology. Speck (2018).*

Another example is carbon emissions maps. Mapping total carbon emissions makes it look like the suburbs are great for the environment! But does carbon emission per square mile matter (per census block group, left map), or carbon emissions ***per household*** (right map)?

Carbon emissions are higher in places where there are more people. The map on the left shows total carbon emissions, but this ends up being a population density map. Looking at total carbon emissions instead of carbon emissions per household paints the wrong picture.

Using the wrong representation of your data makes your map misleading (Monmonier, 2018). At best, it confuses you. At worst, it leads to bad policy.



PET PEEVE #208:
GEOGRAPHIC PROFILE MAPS WHICH ARE BASICALLY JUST POPULATION MAPS

▲ *This error is so common that infamous internet creator xkcd jokes about it*

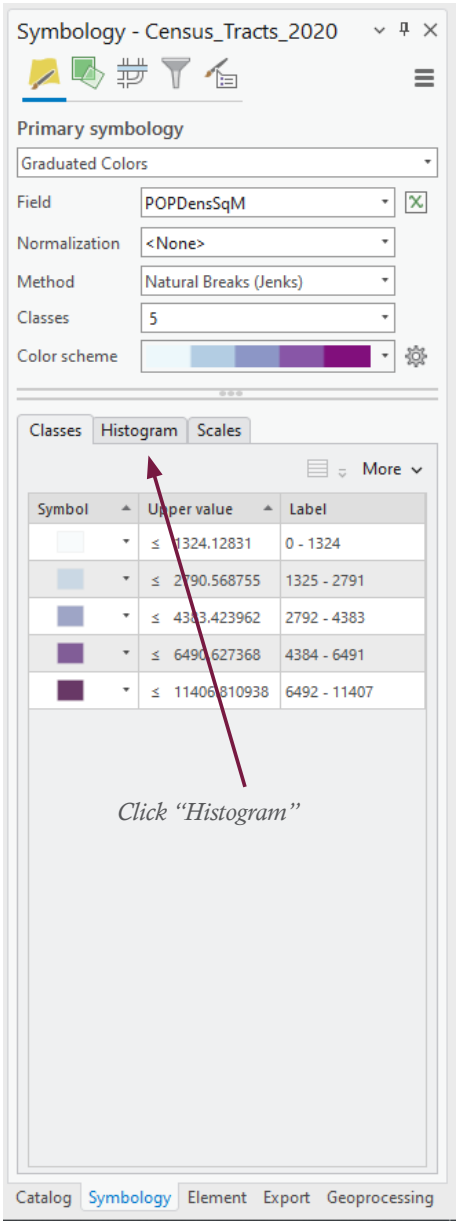
https://xkcd.com/1138

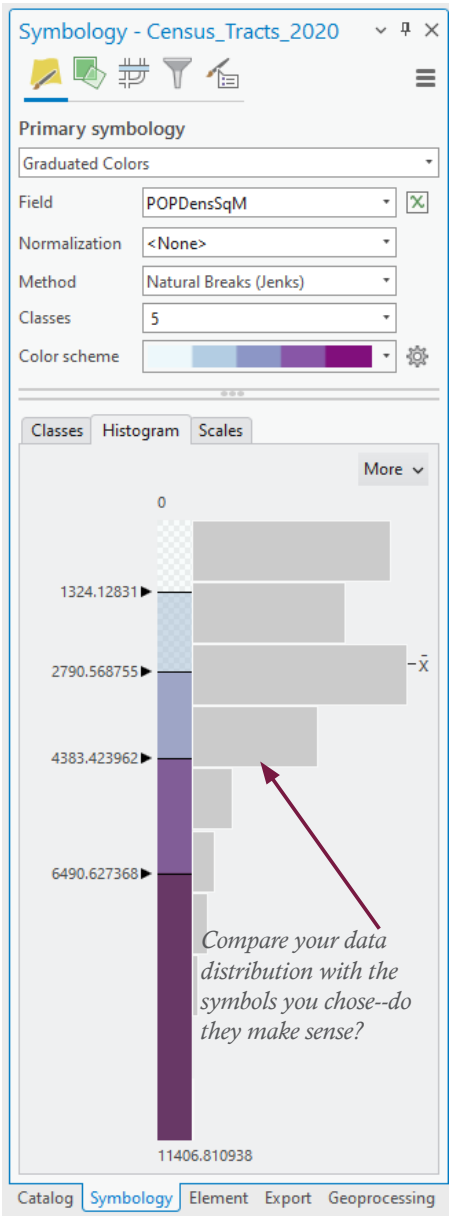
Understand your data distribution so your breaks are set up well.

It is almost too easy to make maps. Our modern software lets you to click through different ways of representing data, but does not tell you how to choose the right one. There is no way to stop you from just finding the method that looks the best—as in, the method that supports your point even if it misrepresents the data. I have created my fair share of misleading maps this way.

The way you split up your data into groups can change the story your map will tell. Make sure the groups you are using make sense for your data distribution. Are you splitting a major group in half? Are you grouping outliers with the main data? You should be aware of your choices and how they change your map.

In ArcGIS Pro, you can easily check your data distribution by viewing a "histogram". A histogram shows you where your data falls in "buckets" along a number line.



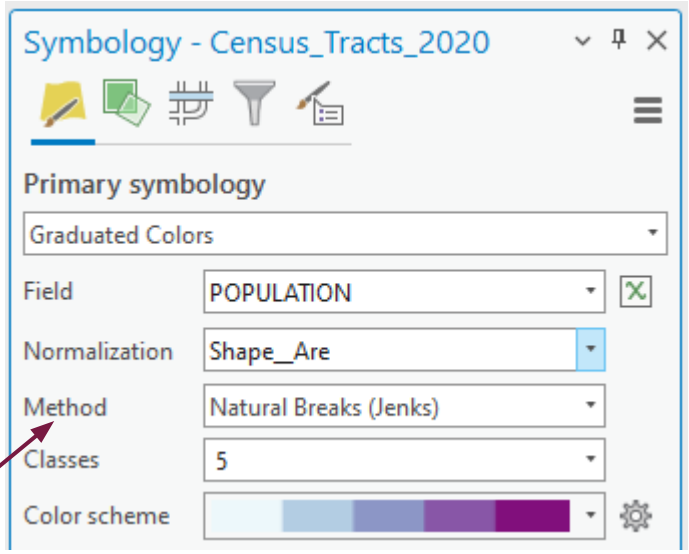


Know the difference between data classification methods.

Some ways of sorting your data are better for comparison, while others are better for statistical analysis.

Take the time to understand the different ways to classify your data, and then use one that is appropriate to your project.

I have summarized the data classification guide from ESRI below.



Change your data classification method here

Data Classification Methods

Manual Interval
Define your own data breaks, using your best judgment and understanding of your data.

Defined Interval
Define the interval first, and the software will determine how many classes are necessary.

Equal Interval
Best applied to data that has a familiar range, such as temperature or percentages. This method sets the class breaks equally far apart.

Quantile
Each class contains the same number of data points. This style can be misleading because the class breaks may not follow the natural data progression.

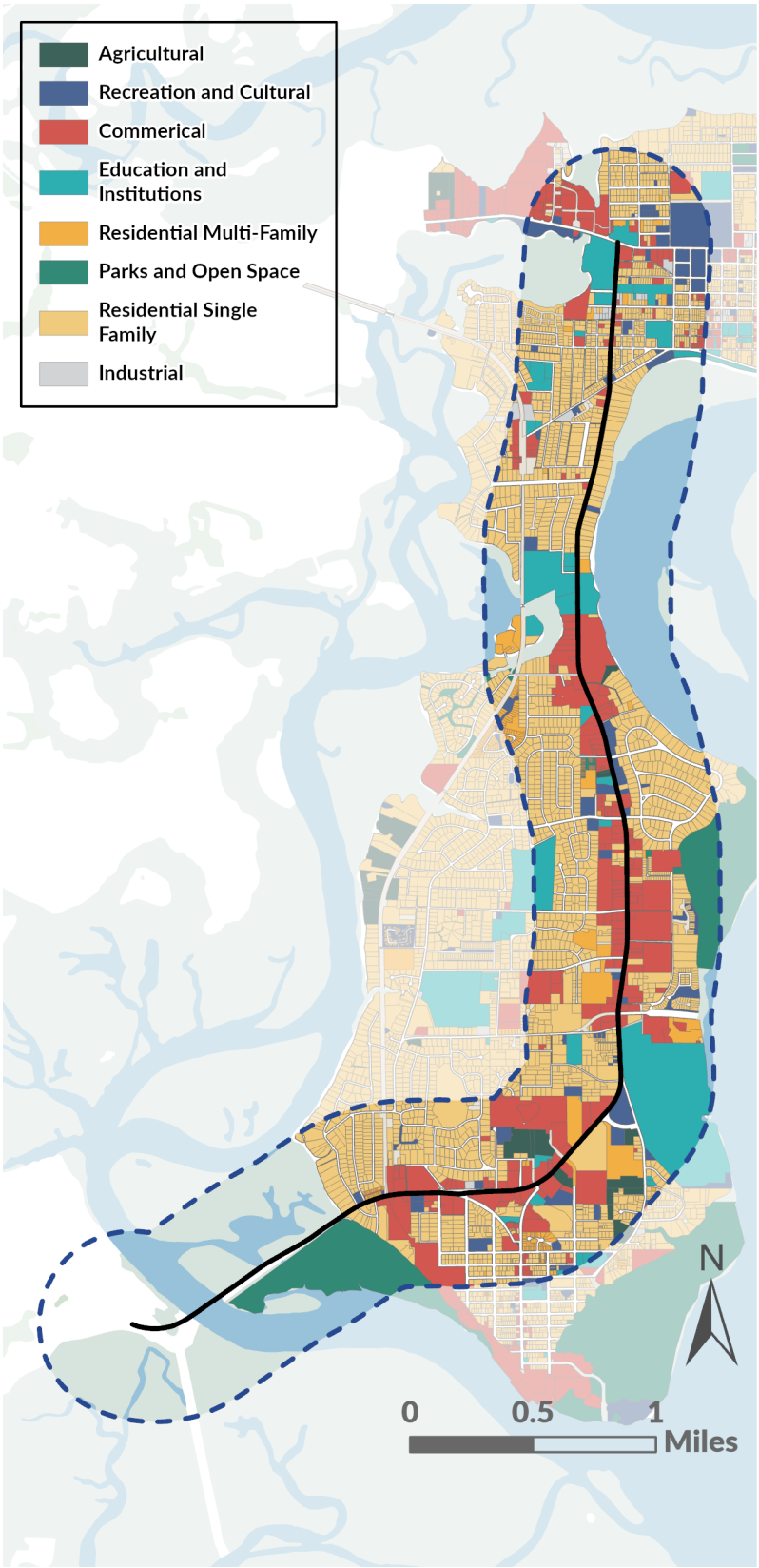
Natural Breaks (Jenks)
Data grouped to approximate the way the data "naturally" falls. This is data specific and is not useful for comparing two different maps with different data.

Geometrical Interval
A compromise between equal interval, natural breaks, and quantile methods.

Standard Deviation
Demonstrates how far away your data is from the mean. Most useful for data that follows a normal distribution.

ESRI, "Data Classification Methods"

Illustration 3: Keep Your Map Straightforward



▲ *Land Use along Ribaut Road in Beaufort County, SC*

Fewer categories makes interpretation easier

The human mind maxes out the number of unique categories they can remember around 7 (Dastrup). For transportation planning, we don't need to know the details of the zoning code. A single symbol can represent a group of similar features, making a map more helpful (Monmonier, 2018, p. 37). There were more than 8 zoning categories, but I consolidated them to make a map that is easier to understand.

Colors are traditional and expected

Parks are green. Industrial is gray. These items are symbolized in ways that evoke the feature they represent. This reduces the amount of effort it takes to remember the category when you are looking between the legend and map.

Colors are contrasting

To keep the focus on the study corridor, the basemap is kept simple. The water (river, coast) is a major landmark, and provides context without needing labels. As we approach the area of interest, more detail is included. The streets in this map are not from a streets data source. The parcel data leaves gaps where the roadways are. This gives it a clean look that blends well with the land use information we are actually looking for.

Visual hierarchy tells a story

The main item we are interested in for this map is a category (land use). A grayscale representation would imply low/high intensity, which is not useful for this map. Land use maps also ought to use similar colors to represent similar features, and "radically different" hues to represent radically different features" (Monmonier, 2018, p. 65). This is done here. Single family and multi-family housing is represented with two different shades of orange.

Critique:
This map is not colorblind-friendly

This map relies heavily on color. It would not make sense to use value or saturation to represent the data, so making a colorblind-friendly version requires creative thinking. To make this map better, I could outline different zones and provide different patterns on top of the color, or provide point symbols on top of the color information.

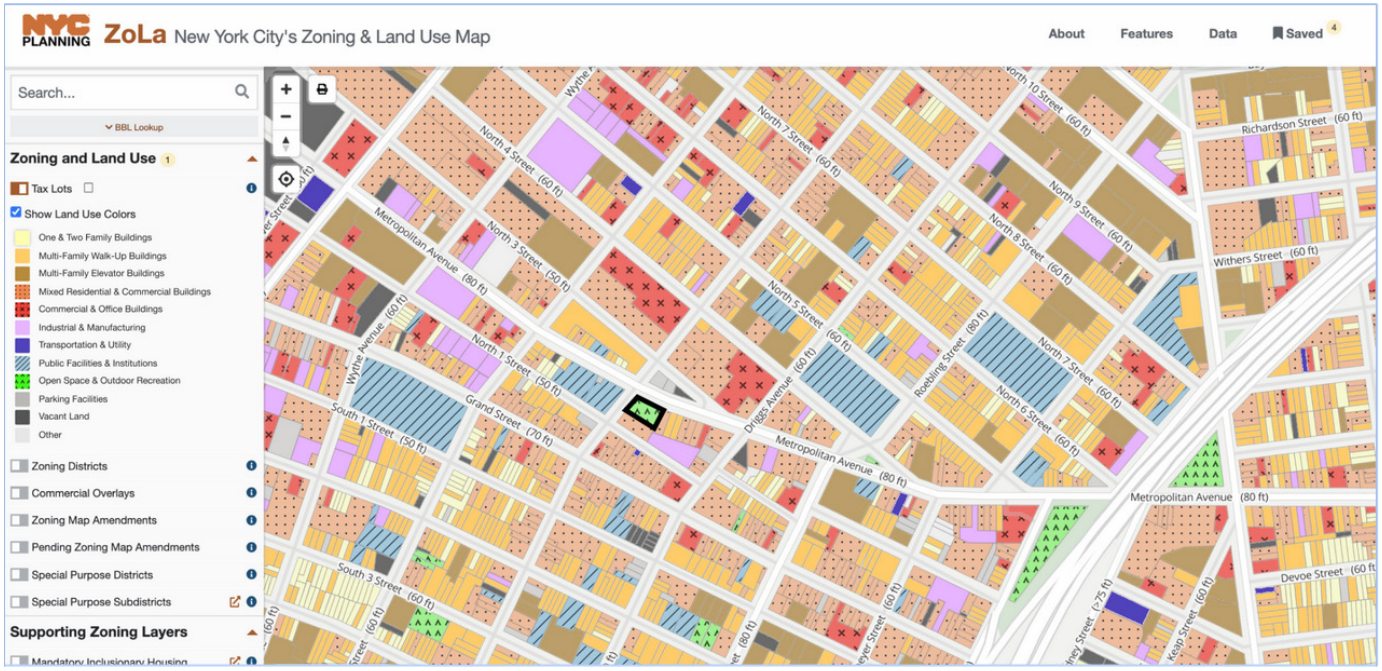
Colorblind-Friendly Option:
Make it intractable

One way to make a land-use map colorblind friendly is to make it intractable (Zhang, 2022). Users can toggle the category they are interested in on/off, allowing them to only see one piece of information at a time.

Colorblind-Friendly Option:
Add texture to the color symbols

Below is an example from New York City's interactive zoning map. This version has a "high contrast mode" that can be toggled on/off. In this mode, texture is added to the color information. You can see this texture as dots, hatches, crosses, and more.

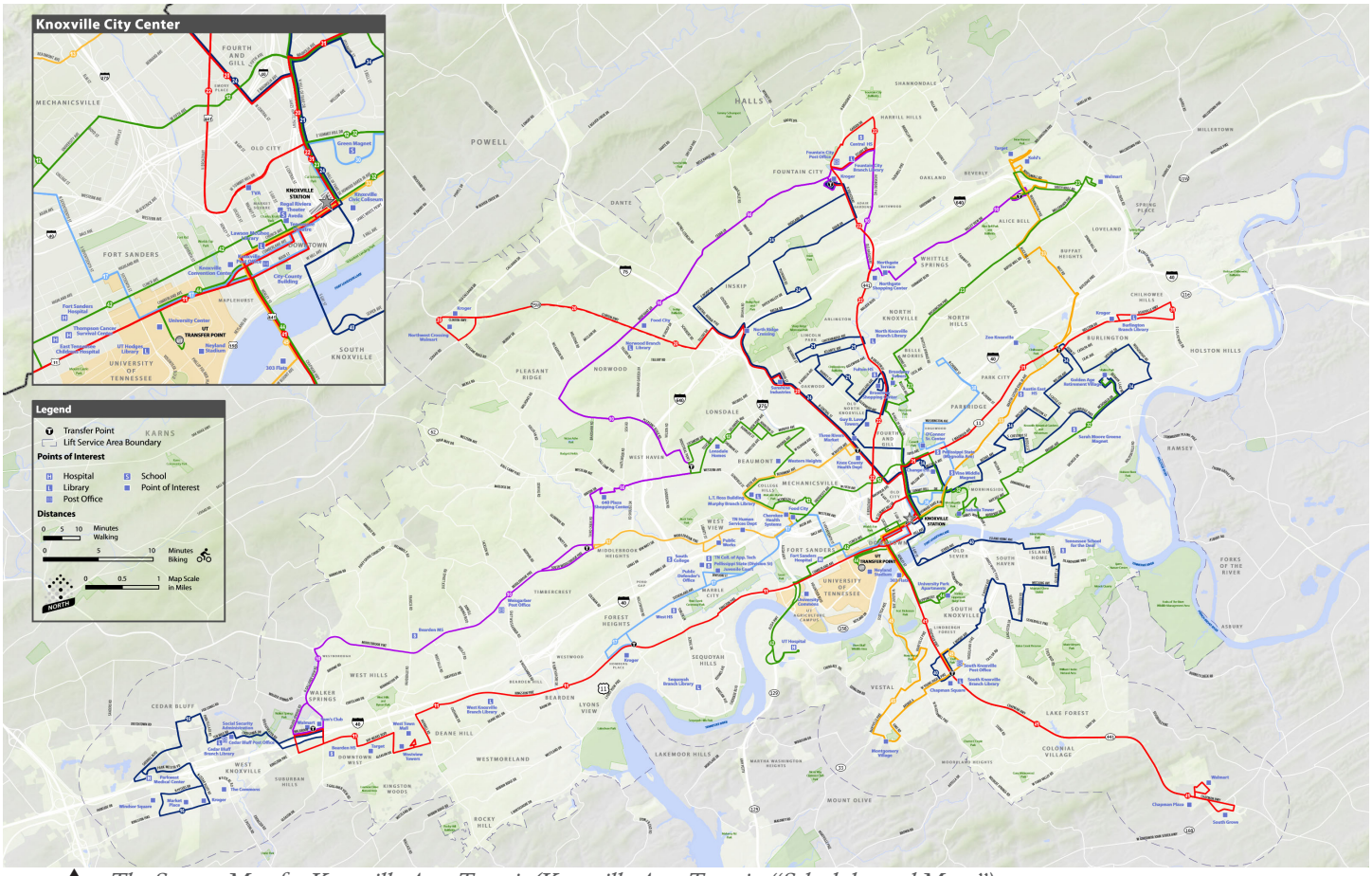
Texture is an unordered category, also appropriate for representing land use. Including both color and texture improves this map and makes it accessible.



▲ *NYC's online zoning map in high-contrast mode (Zhang, 2022)*

Illustration 4: Map The Important Stuff

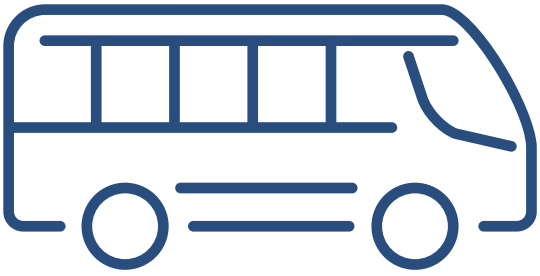
Most transit maps forget to include information on route frequency and reliability.



▲ *The System Map for Knoxville Area Transit (Knoxville Area Transit, "Schedules and Maps")*

This map does a great job of showing "where" transit runs, but not "when". That misses half the picture for transit. Unlike your car, busses are not availible all-day every day. Busses do not run on your schedule—they run on a schedule decided by the city.

Are there some busses that run more frequently? Which routes run on the weekends? Will I have to check the bus schedule before traveling? None of these questions are answered.



▲ *Roadways in Durham, NC*

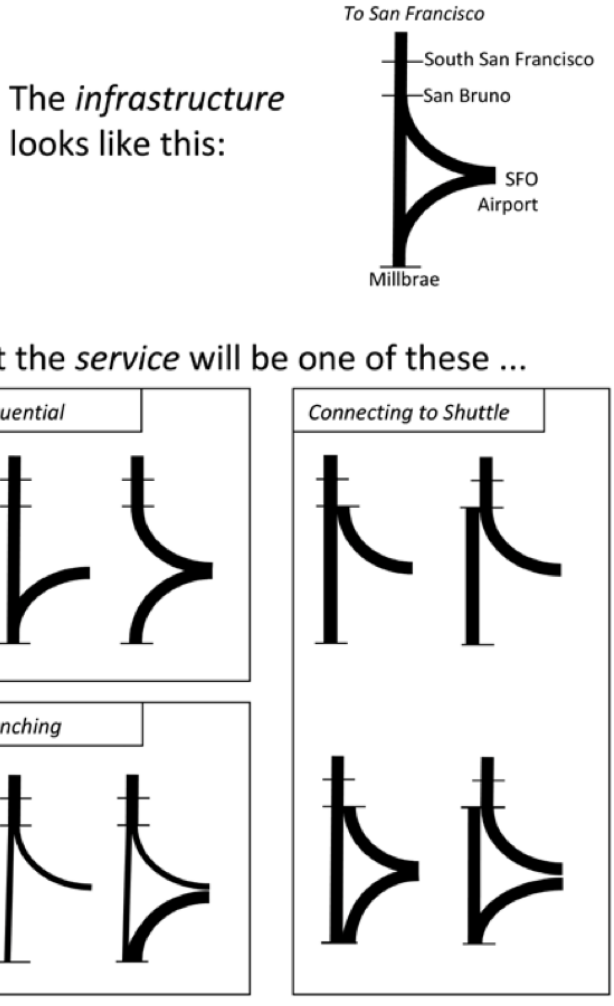
Imagine if our roadway maps drew all roads the same.

This only includes information about where the roads go. There is no information to indicate which roads might be more important, or which roads allow you to drive faster.

Roadway maps typically use width to demonstrate hierarchy. Faster roads (highways) are represented with thicker lines. Transit maps rarely get the same treatment, although they ought to (Walker, 2011).

This kind of map is obviously hard to use, so why do transit route networks get this treatment?

Transit maps easily missrepresent the actual experience of using transit



▲ *Walker 2011, p. 95*

Route branching can create maps that do not represent the experience of the transit user. Even though transit routes may cross each other, this does not always represent the experience of the rider.

"[B]e suspicious whenever [you] see a branch drawn as though one line can effortlessly divide into two equal lines, because this always means one of three things:

- Points beyond the branching point have less frequent service.
- One of the branches operates as a shuttle, requiring a connection.
- [...] The train itself comes apart, with some cars proceeding along one branch and some along the other." (Walker 2011, p. 96).

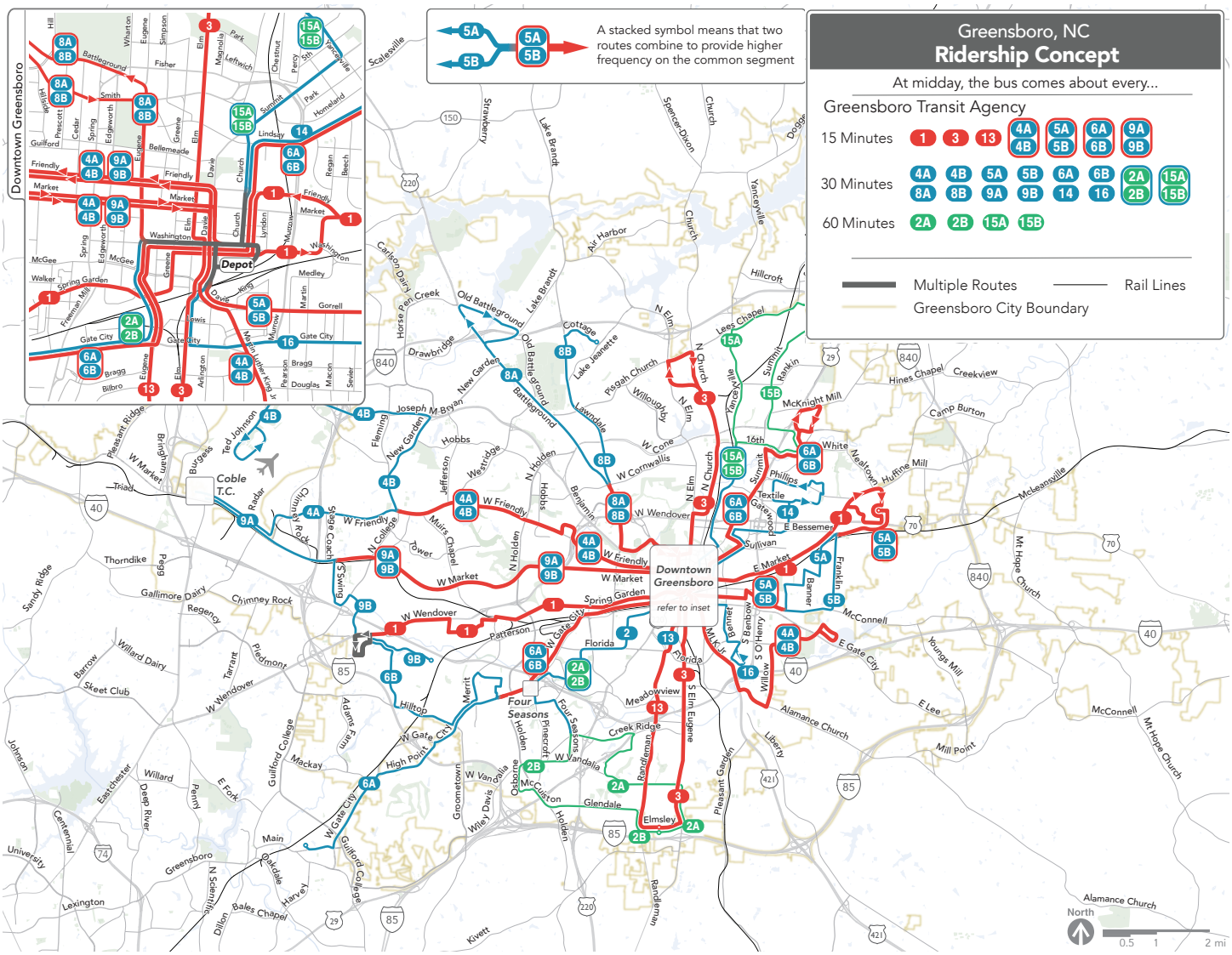
Include information on route importance in your transit maps.

▲ *Bus Frequency in Knoxville, TN*

In this example, I stacked each transit route on top of each other and calculated the frequency of bus service on each segment. This allowed me to change the line weight depending on how frequently the busses ran in certain places.

More frequent bus service indicates a more important route, so I represented these places with a thicker line and a darker shade of purple.

This map is not perfect. Due to the way the data was organized, I could not easily include the route names. Despite this, it was a useful exercise to imagine what information our transit maps could put first.



▲ *A proposed bus system expansion in Greensboro, NC (GOBORO - Greensboro's Long Range Transit Plan | Greensboro, NC)*

This is another example of a transit map that shows frequency in an easy-to-interpret way. This one uses "stacked" labels to show where two routes overlap to get higher-frequency service.

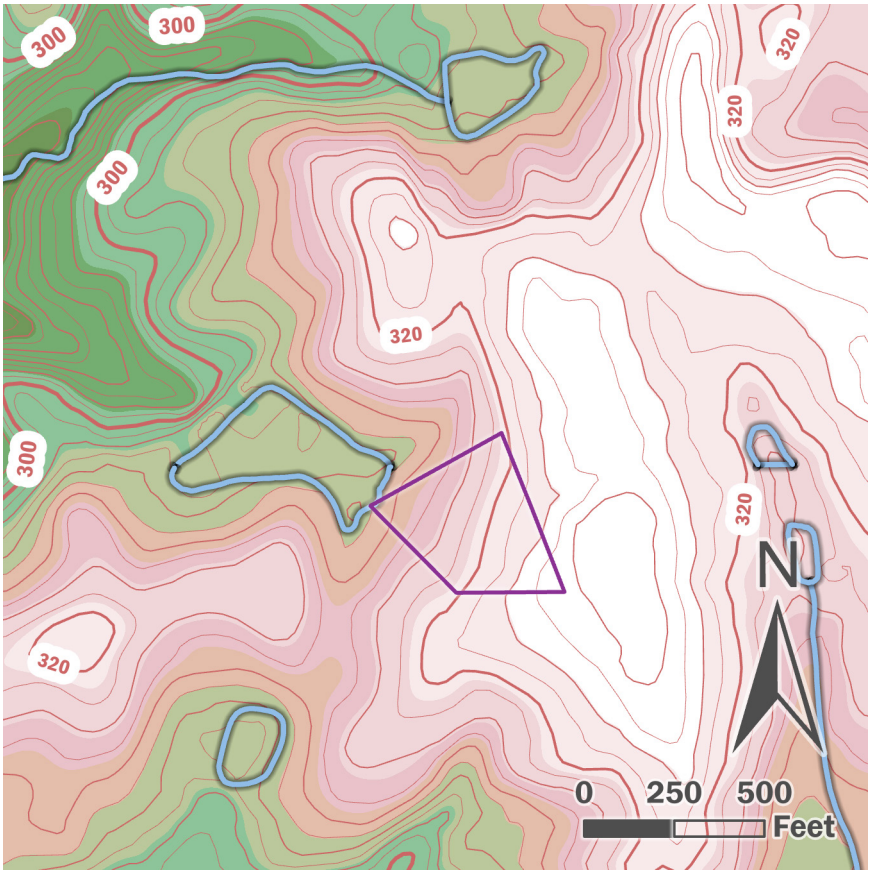
This map also uses color saturation and line thickness to reinforce the importance of high-freqency service. The routes in red "jump out" the most, since they are the most important routes.

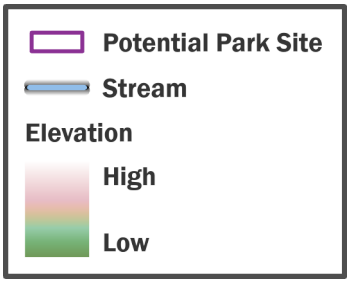
Collect Data that Lends Itself to this Style

Ideally, transit data would be collected in segments that would include a frequency value. This is not the case with most transit data, which is sorted by route. This makes it very difficult to show places with overlapping routes as higher frequency than places served by only one route.

Transit routes could be segmented by stop. Each segment could include information on which routes use this segment, and how frequently they run. This would make it much easier to create these kinds of maps.

Illustration 5: Use Color Gradients Carefully





Compare the full-color map (left) with the greyscale version (right).

Notice how the elevation is still understandable when viewed without color.

This is because the symbology relies on shades of dark to light. Color is only there to enhance this existing scale.

Value (brightness/darkness) is the main symbol for elevation.

Elevation has an order. Lower numbers represent lower elevation, while higher numbers represent higher elevation.

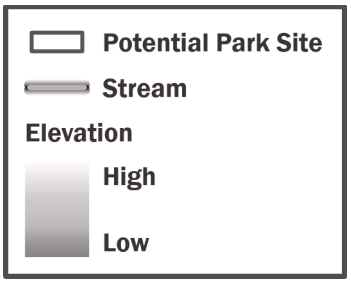
Value has a natural order of dark to light. Therefore, it is an appropriate way to show elevation on this map.

Color hue (pink/green/white in this case) is only included for visual interest. These colors do not take away from the dark to light order.

Value helps imply the features it is representing.

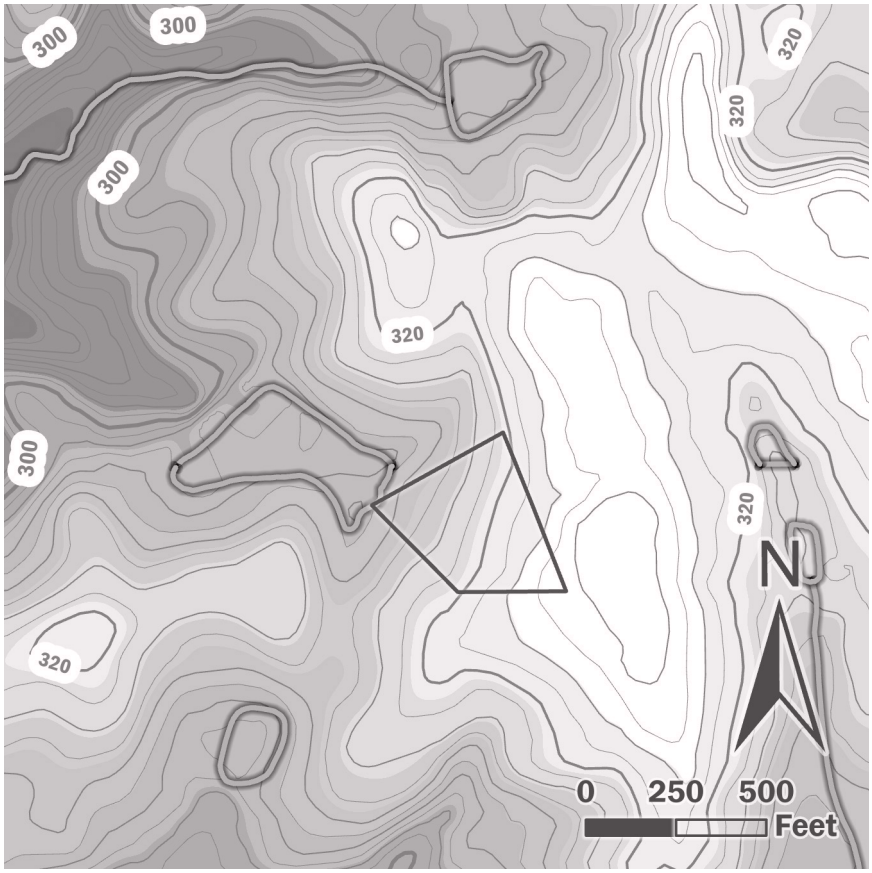
The lowest elevations are represented with a darker shade. This makes intuitive sense because in real life, shadows are cast into deep places. The peaks of hills will get most of the sunshine, brightening them.

By setting the lower elevations in a darker color and high elevations in a higher color, the map user has an easier time understanding the map.

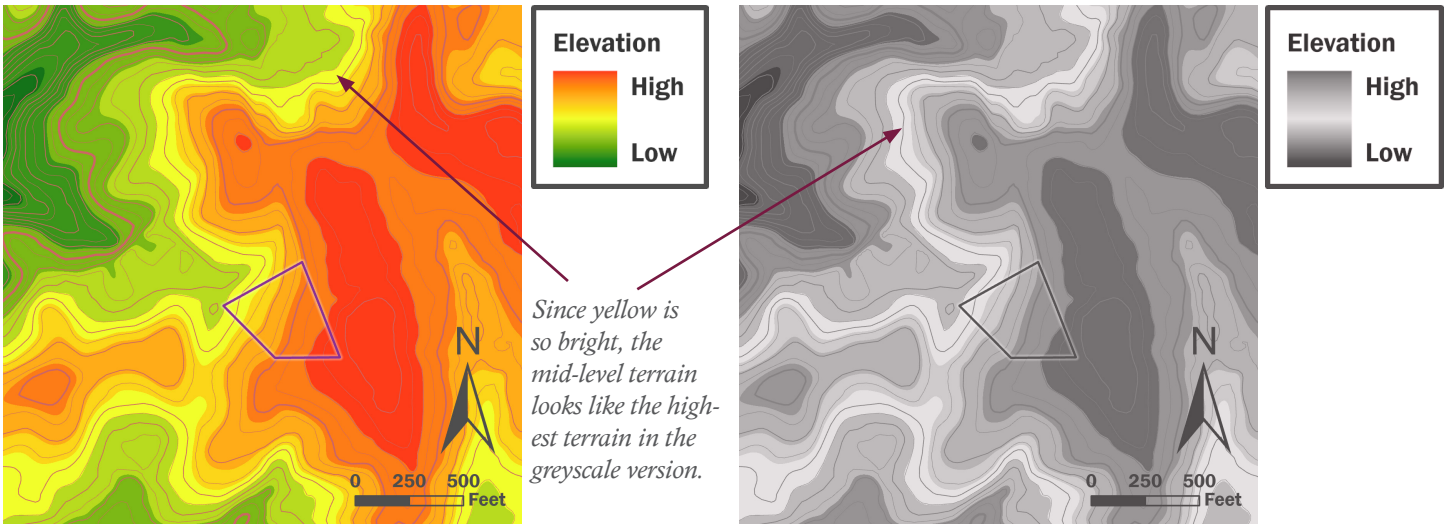


Using a dark-to-light color scheme makes this map colorblind-friendly.

Traditional terrain maps use a red-yellow-green color scheme. The problem with this color scheme is that the reds and greens (on opposite ends of the spectrum) can blend together for people who are red-green colorblind. This is one of the most common types of color blindness.



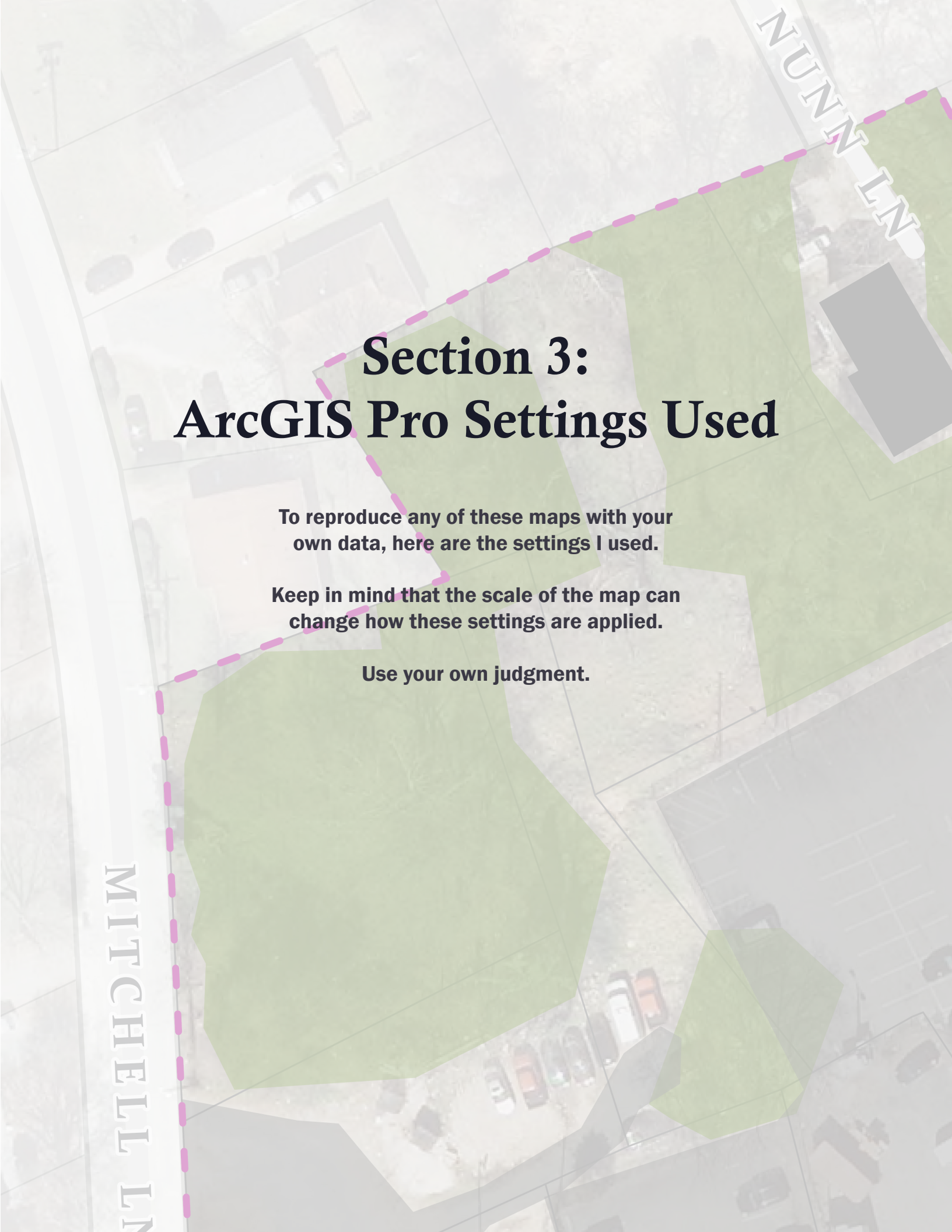
A green/yellow/red color scheme is confusing when the color is removed.



The green/yellow/red color scheme creates a conflicting picture. Since yellow has a very light value (i.e.: it is not a very dark color) it makes the middle of the scale stand out. Without color, it is impossible to tell the difference between the low terrain (darkest green) and the high terrain (darkest red).

4% of the population is colorblind—approximately 1 in 20 people (Mandal 2023).

Red-green colorblindness is a very common type of colorblindness. This map would be difficult for someone who is colorblind to interpret.



Section 3: ArcGIS Pro Settings Used

To reproduce any of these maps with your own data, here are the settings I used.

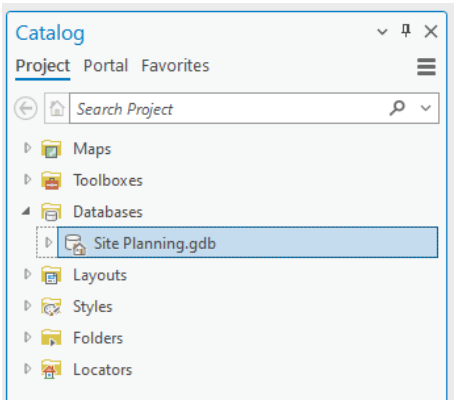
Keep in mind that the scale of the map can change how these settings are applied.

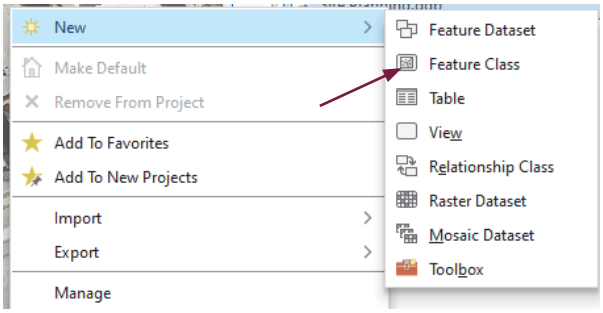
Use your own judgment.


Site Boundary
Tree Cover
Parking Lot, Road, Asphalt Impervious
Building Footprint Impervious
Property Line
AMITY CT

How To Add a Masking Layer

1. Create a new polygon feature class



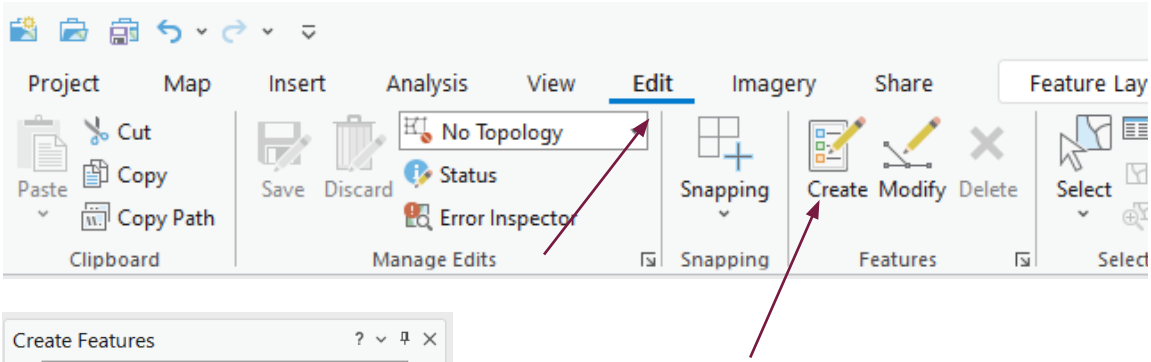


In the catalog pane, **right click** on the geodatabase you want this layer to be stored in.

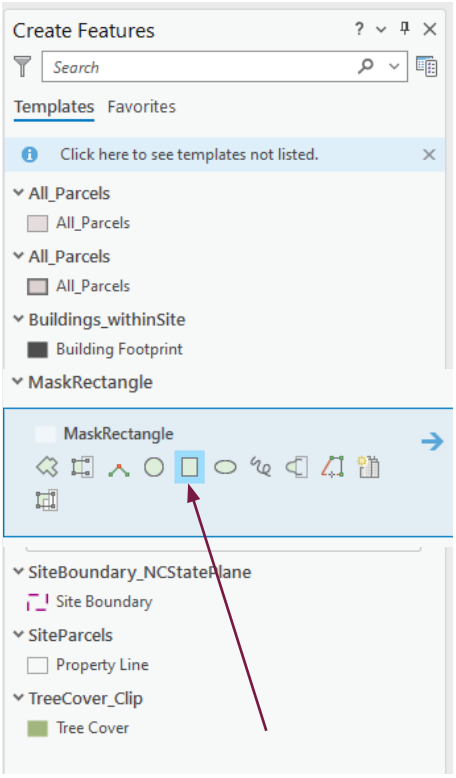
Select “new” and “feature class”.

All the options can be left as default.

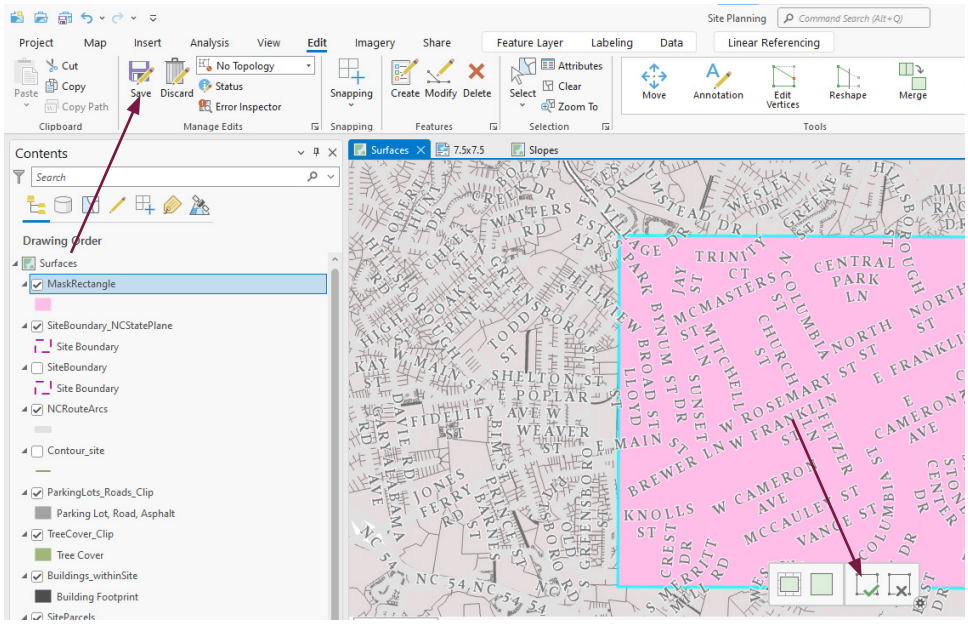
2. Draw a large rectangle



Under the “Edit” tab, select “create”.

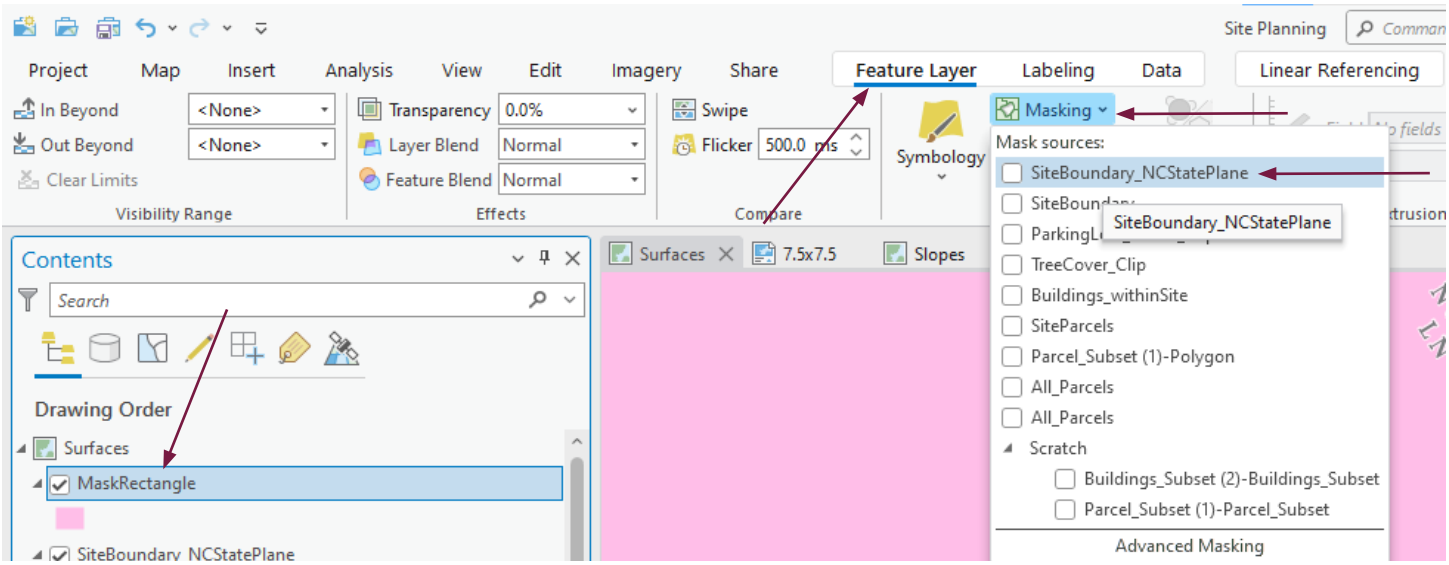


Chose the masking layer and select the rectangle.



When you finish drawing the rectangle, select the green checkmark to finish your edits. Make sure to save as well!

3. Use feature layer masking settings to apply the mask



Select your layer in the contents pane.

Click on “Feature Layer” and then “Masking”.

Select your mask source--i.e.: Where the data should peek through. This must be a polygon to work.

You should be left with something like this--a colorful rectangle with data peaking through.

If this is not the case, make sure your masking layer is drawing on top of the rest of your data.

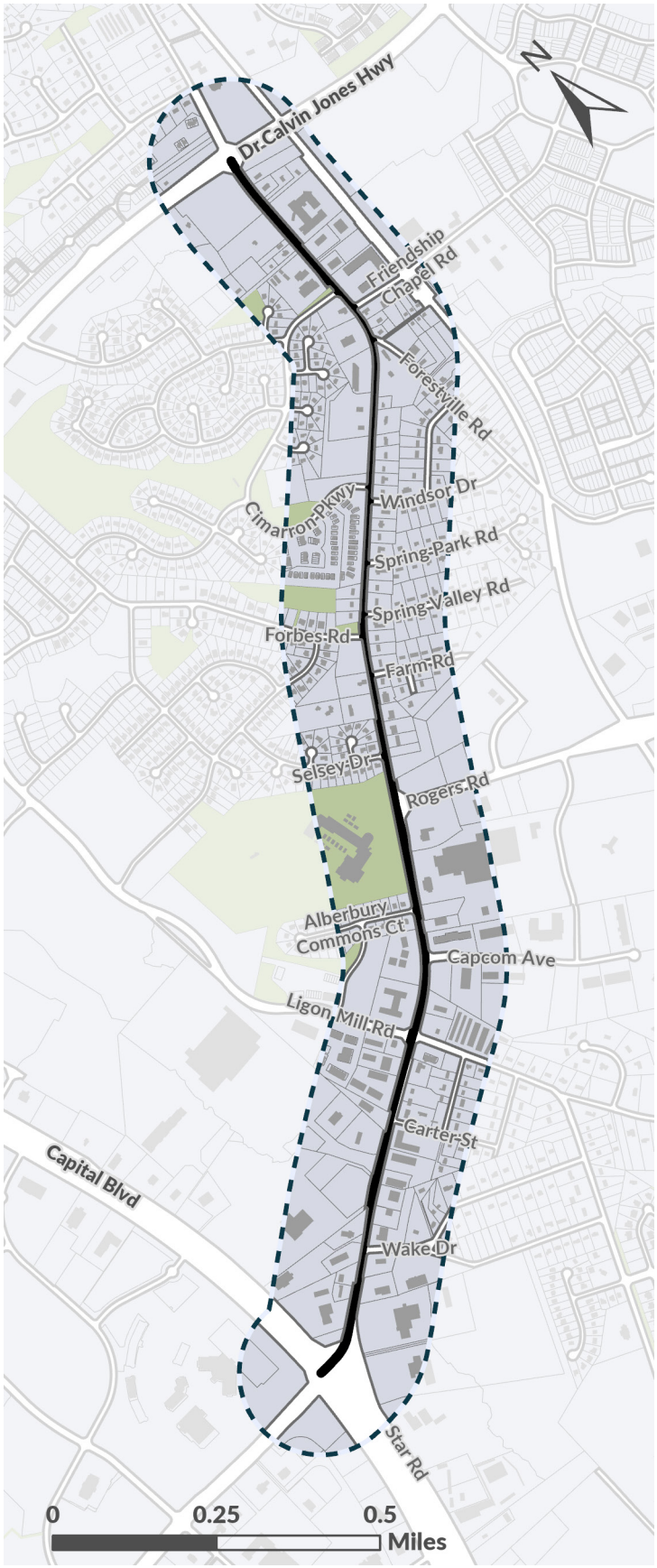
2. Edit the mask layer symbology to be white and semi-transparent

Now, all you have to do is edit the symbology of your masking layer.

I typically use full white at 50% transparency, but use what looks best for your map.

You can also use black to create a darkening effect instead.

Illustration 1 Settings: Basemap



Overall Settings

North Arrow: Grey instead of black

Scale Bar: Uses whole numbers and only uses one division to keep it simple. Grey instead of black.

Mask: Uses a slightly transparent white square bigger than the map. The study area layer then provides a feature layer mask, allowing the data to peak through.

https://pro.arcgis.com/en/pro-app/3.1/help/mapping/layer-properties/use-a-masking-layer.htm

Study Area Polygon

To make the study area boundary, I used the Buffer geoprocessing tool. I buffered the space around the study corridor, and disolved it into one polygon.

https://pro.arcgis.com/en/pro-app/3.1/tool-reference/analysis/buffer.htm

Study Area Outline

Data Source: Generated

Symbol, Polygon

Stroke Layer: 2 pt, #0C3948, Add Dash effect, Dash Template of 5 6

Stroke Layer: 2 pt, #E9EFFF

Fill: None

Roads

Data Source: North Carolina Department of Transportation, NC Route Arcs

Symbol, Line

Transparent so that only the labels are visible

Labels

Major Roads

Font: Lato Black, 8pt

Color: #4E4E4E

Halo: #E1E1E1, 1pt

Placement: Regular Placement, Centered Curved

Minor Roads

Font: Lato, Bold, 8pt

Color: #686868

Halo: #E1E1E1, 0.75pt

Placement: Regular Placement, Centered Curved

ArcGIS Pro Drawing Order

Building Footprints

Data Source: Wake County Open Data

Symbol, Polygon

Outline: none

Fill: #9C9C9C

Parks & Open Space

Data Source: NC One Map

Symbol, Polygon

Fill: #BAC89E

Outline: 0.7pt, #6E6E6E

Parcels

Data Provided Through Project Work

Symbol, Polygon

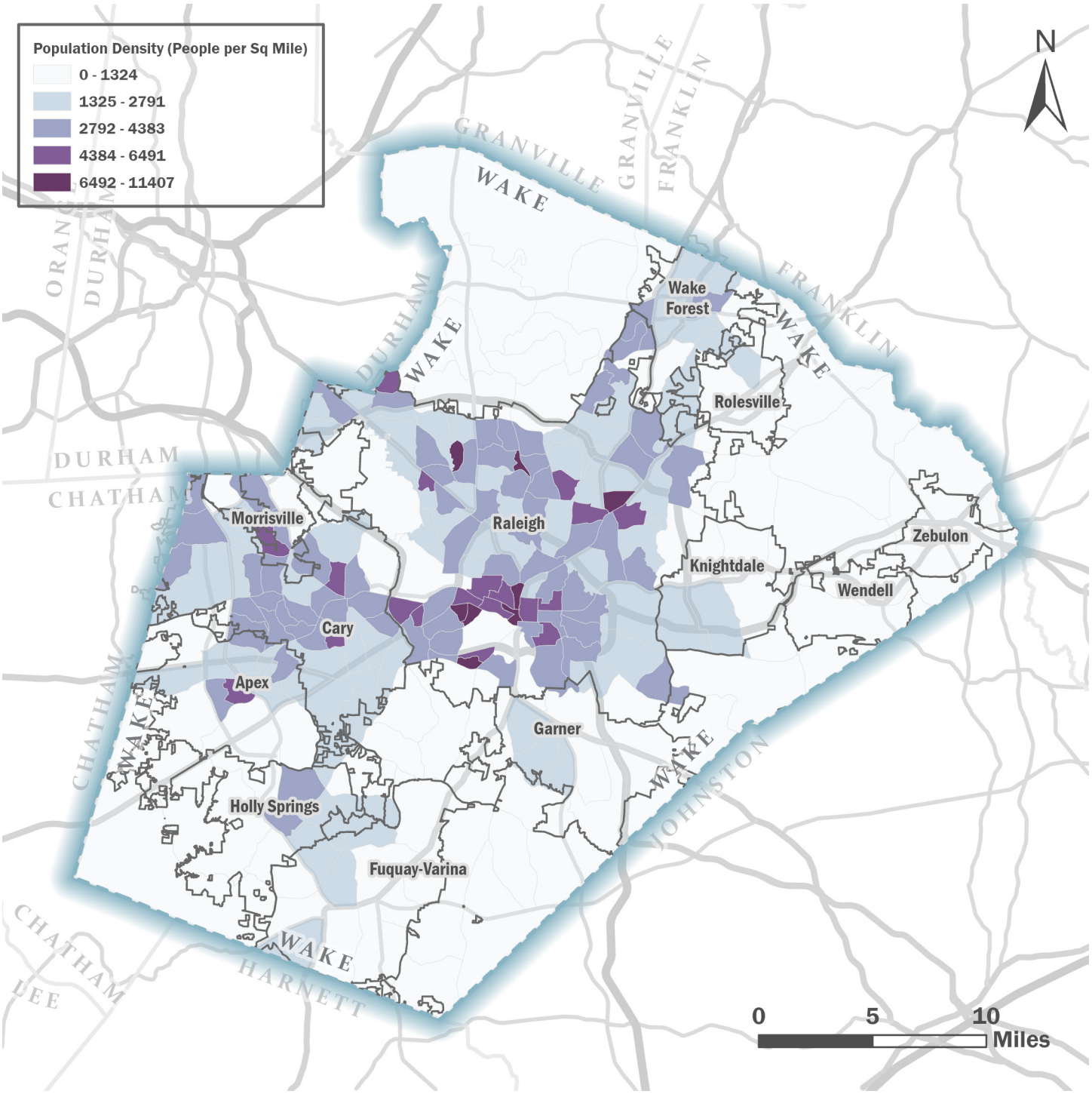
Fill: #D6D9E3

Outline: 0.1pt, #6E6E6E

Layer duplicated. A second parcel layer underneath the first provides the block outline. No changes except to the outline width.

Outline: 2pt, #6E6E6E

Illustration 2 Settings: Data



Overall Settings

North Arrow: Grey instead of black

Scale Bar: Uses whole numbers and only uses one division to keep it simple. Grey instead of black.

Mask: Uses a slightly transparent white square bigger than the map. The county boundary then provides a feature layer mask, allowing the data to peak through. https://pro.arcgis.com/en/pro-app/3.1/help/mapping/layer-properties/use-a-masking-layer.htm

Wake County Boundary

Data Source: Wake County Open Data

Symbol, Polygon

Dashed Outline: 2 pt, #89B4C4,

Fill: None

Fade Effect: Add duplicate gradient stroke, 12 pt, offset 6pt, from #89B4C4 100% transparent to #89B4C4 0% transparent

Municipal Boundaries

Data Source: Wake County Open Data

Symbol, Polygon

Outline: 1pt, #686868

Fill: none

Labels

Font: Franklin Gothic Demi Cond, 9pt

Color: #4E4E4E

Halo: #E1E1E1, 1.5pt

Placement: Regular Placement, Horizontal in Polygon

Population Density

Data Source: United States Census

Symbol, Polygon

Type: Graduated Colors by Population Density

Method: Natural Breaks (Jenks)

Classes: 5

Color Scheme: #EDF8FB, #B3CDE3, #8C96C6, #8856A7, #810F7C

County Boundaries

Data Source: NC One Map

Symbol, Polygon

Outline: 2pt, #CCCCCC

Fill: none

Labels

Font: Constantia, Bold, 11pt, Upper Case, Letter spacing 35%

Color: #797B7D

Halo: 50% Transparent, #FFFFFF, 2pt

Placement: Boundary Placement

Roads

Data Source: North Carolina Department of Transportation, NC Route Arcs

Symbol, Line

Type: Unique Values by RouteClass

Interstates: 4pt, #4E4E4E

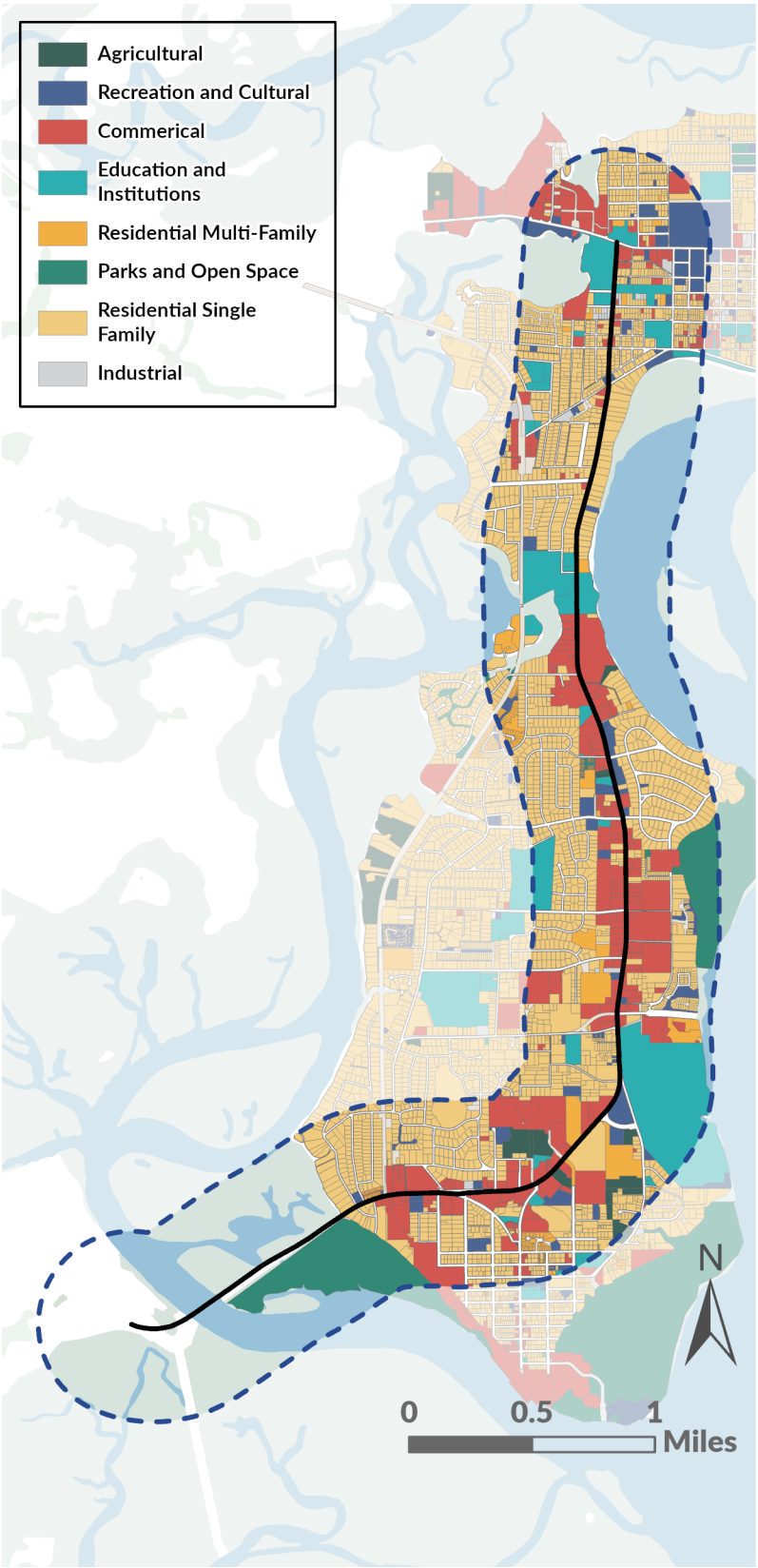
US Routes: 3pt, #686868

NC Routes: 2pt, #828282

All other values removed

ArcGIS Pro Drawing Order

Illustration 3 Settings: Land Use



Overall Settings

North Arrow: Grey instead of black

Scale Bar: Uses whole numbers and only uses one division to keep it simple. Grey instead of black.

Mask: Uses a slightly transparent white square bigger than the map. The study area layer then provides a feature layer mask, allowing the data to peak through.

https://pro.arcgis.com/en/pro-app/3.1/help/mapping/layer-properties/use-a-masking-layer.htm

Study Area Polygon

To replicate the study area boundary, you can use the Buffer geoprocessing tool. Buffer the space around the study corridor, and dissolve it into one polygon.

https://pro.arcgis.com/en/pro-app/3.1/tool-reference/analysis/buffer.htm

ArcGIS Pro Drawing Order

Study Area Outline

Data Source: Generated

Symbol, Polygon

Dashed Outline: 2 pt, #254890, Dash Template of 5 6

Fill: None

Parcels

Data Provided Through Project Work

Symbol, Polygon

Type: Unique Values by Land Use

Many values were grouped together in order to have only eight total categories.

Fill Color Scheme: #3C6259, #4B6594, #D15750, #2DAFB2, #F2AF44, #318976, #f0CB7D, #D1D3D4

Outline: 0.1pt, #B5B7B7

Layer duplicated. A second parcel layer underneath the first provides the block outline. No changes except to the outline width.

Outline: 0.4pt, #B5B7B7

Water and Wetlands

Data Source: US Fish and Wildlife Service

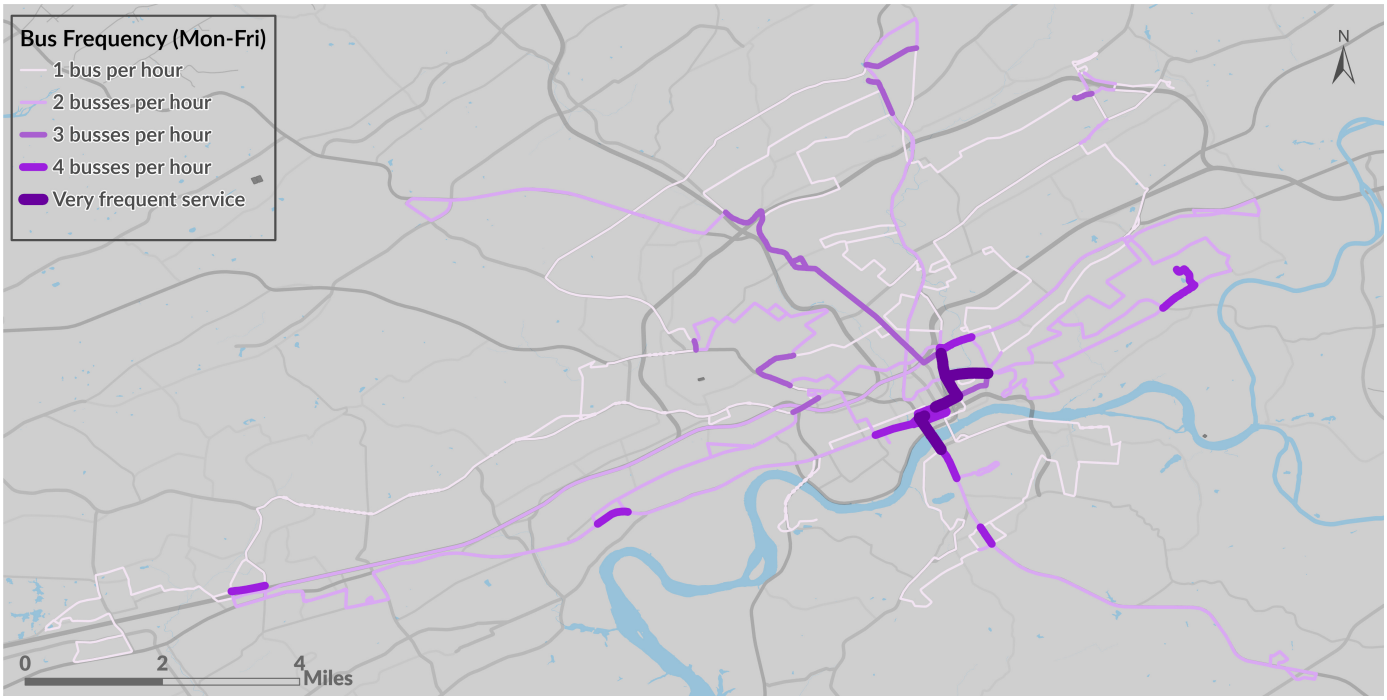
Symbol, Polygon

Type: Unique Values by Wetland Type

Outline: none

Fill: #98C2D9 (Estuarine and Marine Deepwater), #D7E4DE (Estuarine and Marine Wetland)

Illustration 4 Settings: Transit



This map took a lot of tedious data cleaning to make. Since I wanted to try and show overlapping transit routes on the same line, I had to combine the data while keeping the bus frequency attribute. I chose to convert each route into a raster dataset, merge the rasters, then convert it back to line data. This resulted in a messy data set that took quite a bit of cleaning.

I would not recommend this process. If possible, collect transit data in segments that lends itself to this style of map, with frequency as an attribute. This will take longer, but it will be worth it if you will be using the same data over and over again.

Bus Frequency

Data Generated from Information Provided by Knoxville Area Transit

Symbol, Line

Type: Unique Values

Color Scheme:

1.5pt, #EDF8FB,

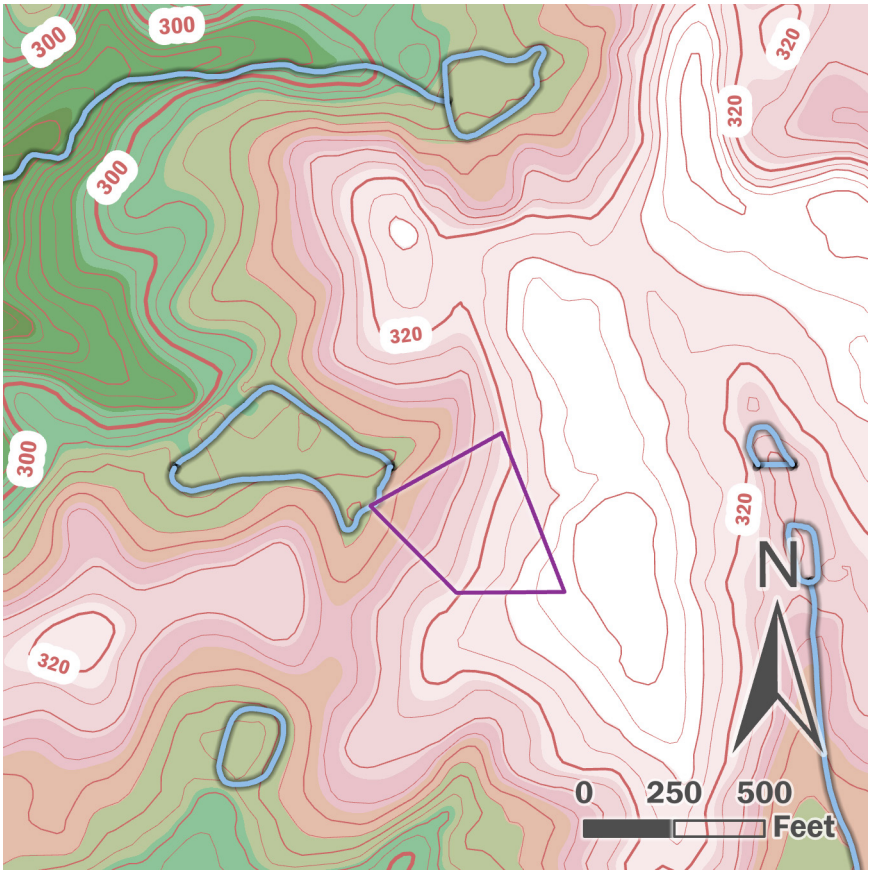
2pt, #B3CDE3,

4pt, #8C96C6,

4pt, #8856A7,

5pt, #810F7C

Illustration 5 Settings: Terrain



ArcGIS Pro Drawing Order

Contours

Data Source: NC One Map

Symbol, Line

100ft Contours: 1.5pt, #CD6666

20ft Contours: 1pt, #CD6666

4ft Contours: 0.5pt, #CD6666

2ft Contours: 0.25pt, #CD6666

Labels

Only 100ft and 20ft contours were labeled.

Font: Franklin Gothic Demi Cond, 9pt

Color: #CD6666

Halo: #FFFFFF, 4pt

Placement: Regular Placement

Terrain

Generated from the contours layer

Symbol, Raster

Type: Classify

Method: Geometric Interval

Color Scheme: Continuous, #709959, #99CDAB, #E7BDC6, #FFFFFF

Classes: 9

References and Image Sources

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Helpful Resources

John Nelson Maps, YouTube

https://www.youtube.com/@JohnNelsonMaps

Adobe Color Wheel

https://color.adobe.com/create/color-wheel

Thank you!