In this lab, we'll use a number of conventions to help you understand ArcGIS. When you see a numbered list, like below:

1. Then it means that each number is an action for you to do in order.
2. Each number in the list will correspond to a numbered icon in the screenshot shown (when possible)
3. Look for the number in the screenshot to see visually the order of steps for you to take

Every so often, instead of putting each numbered step into a list, we may put it into a sentence in parentheses (4). Those numbers still correspond to the numbers in the image.

We'll also occasionally *italicize* rather than "quote" new terminology or a *specific thing* we want you to do (such as the name of an item we want you to click, like the *Symbology* menu). We do this because it's often easier to read than quoting and removes the confusion quotes can create with new users.

Finally, we highly recommend that you put all of your lab data folders inside a folder named C:\GIS (you'll need to create this folder yourself). Whenever we reference data in this lab, we'll be giving you paths relative to C:\GIS. If you put it into a different folder, you'll need to figure out where it is on your own.

1. Open up ArcMap

First, let's open up ArcMap, one of the main components of ArcGIS Desktop. You can do this any way you know how, but if you're less familiar with Windows, the easiest way is to search for it.

1. Click on the *Start* (Windows) button.
2. Start typing your search terms - in this case, *ArcMap*
3. Click on the ArcMap *tile* when it appears, and ArcMap will launch, showing a loading screen first

Your version of ArcMap may be different, so it may not show "ArcMap 10.3" - it may show "ArcMap 10.2" or some other number instead - this is ok.

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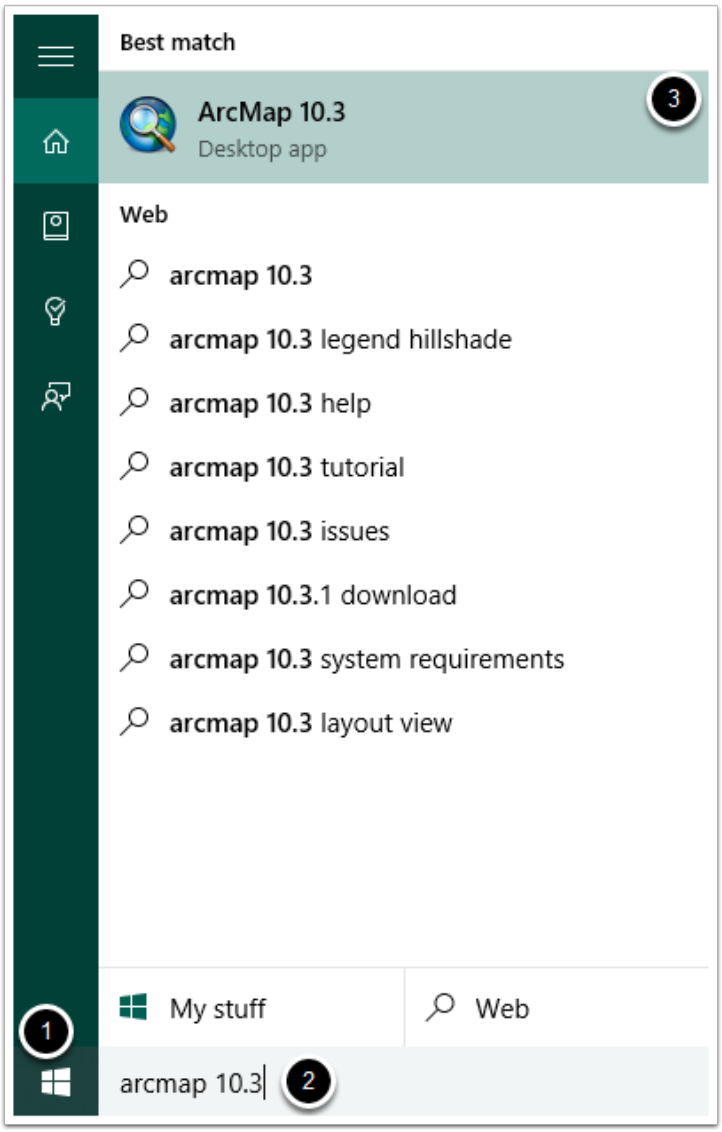
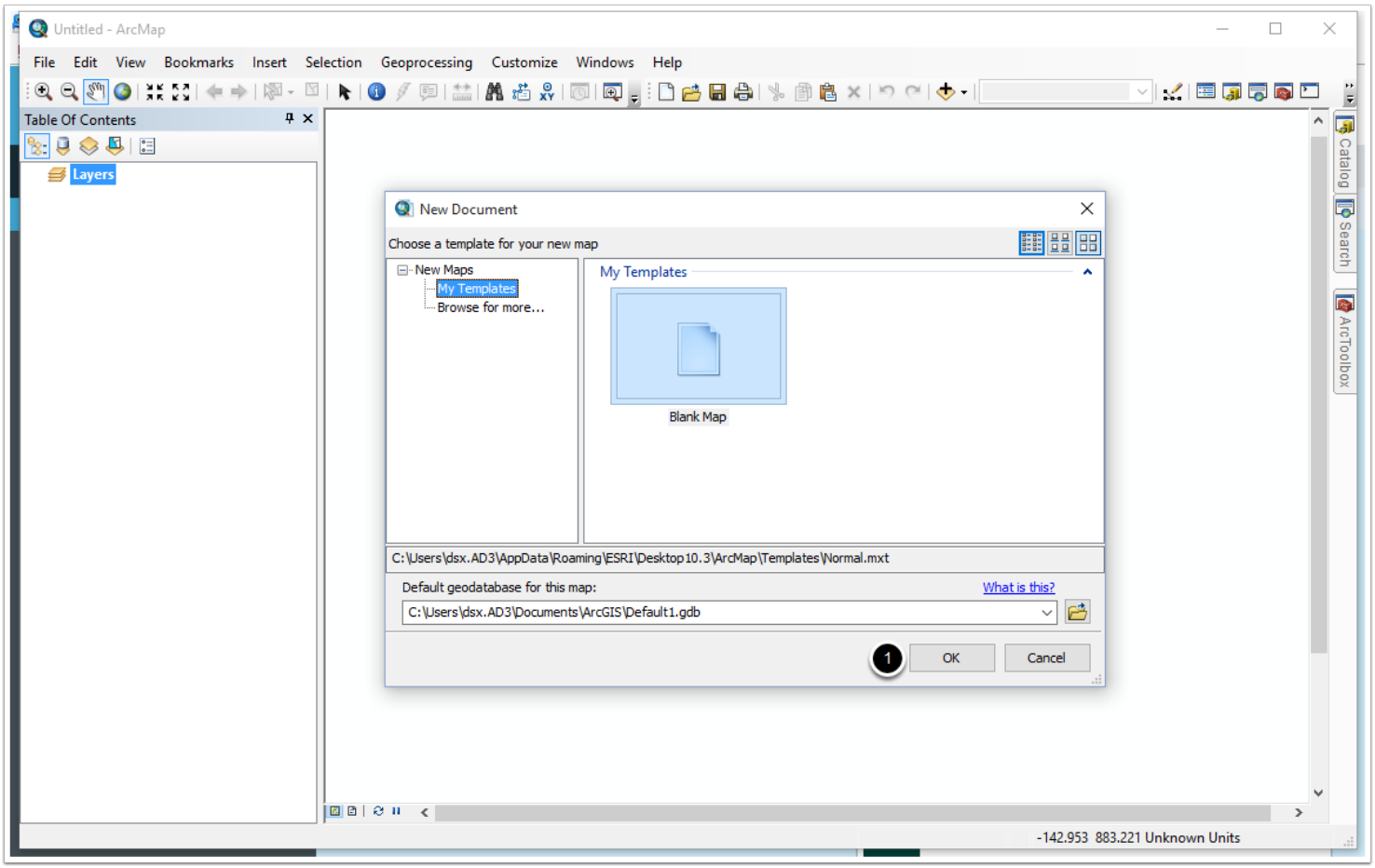

Best match
ArcMap 10.3
Desktop app
3
Web
arcmap 10.3
arcmap 10.3 legend hillshade
arcmap 10.3 help
arcmap 10.3 tutorial
arcmap 10.3 issues
arcmap 10.3.1 download
arcmap 10.3 system requirements
arcmap 10.3 layout view
My stuff
Web
1
arcmap 10.3
2

1.1 Create a new map document

When ArcMap loads for the first time, it gives you the option to create a new document.

1. Feel free to explore this *dialog* for a moment, but then, click the *OK* button to create a new map. We'll go over this dialog in more detail when you know more about ArcMap

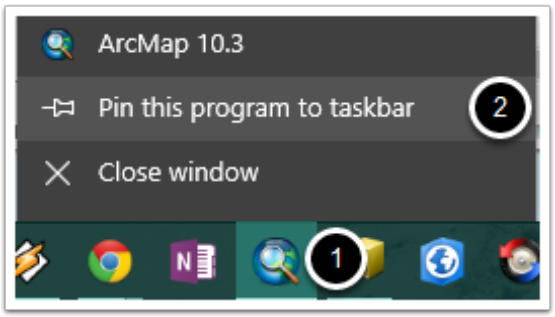


1.2 Pin to taskbar for quick access

I like to be able to quickly access ArcGIS when I need it, and to not have to search for it every time, so I pin it to my taskbar. If you like, you can do the same.

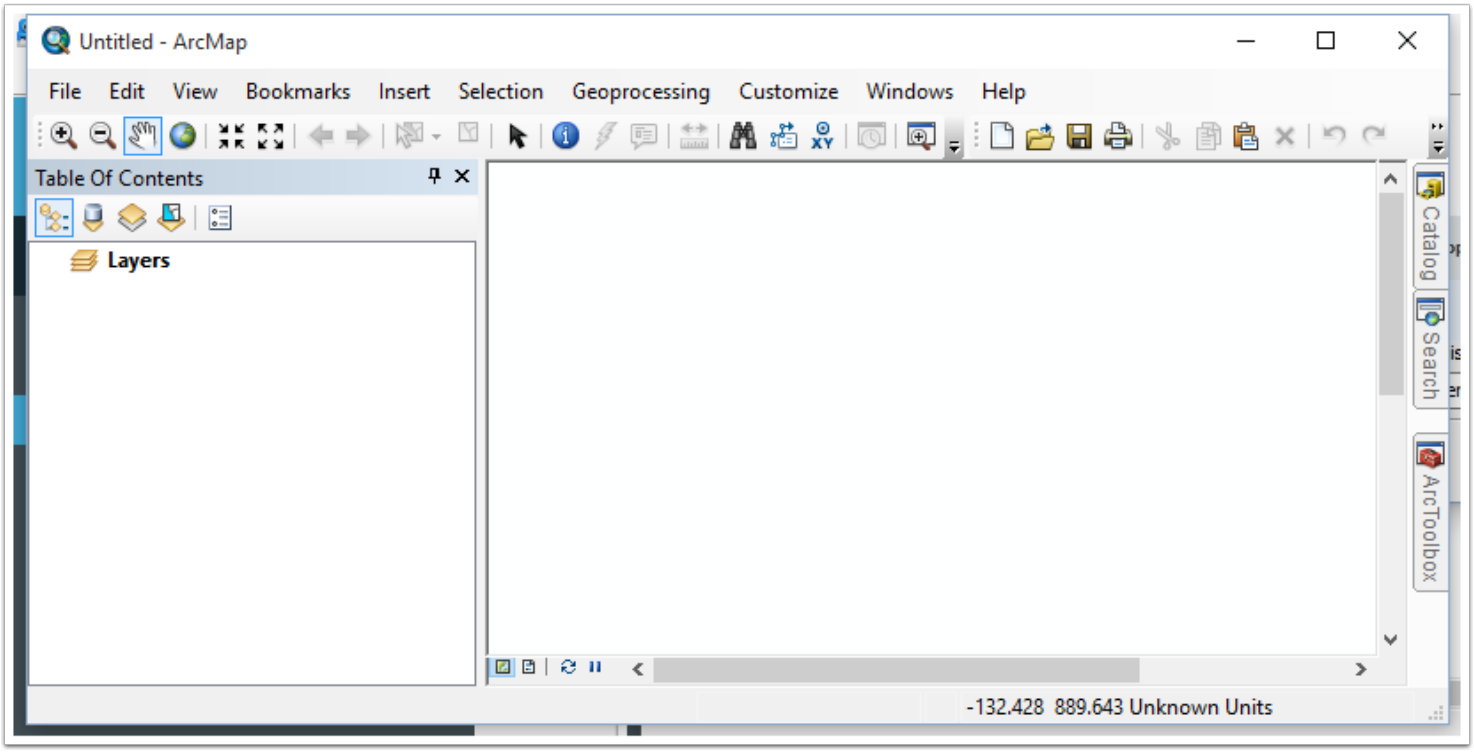
1. Right click on the ArcMap icon on the taskbar
2. Select *Pin this program to taskbar* in the menu that comes up (note that it will look different on versions of Windows prior to Windows 10)

Now, even when ArcGIS is closed, it will show up at the bottom of your screen and if you click it, it will open.



2. Look around a bit

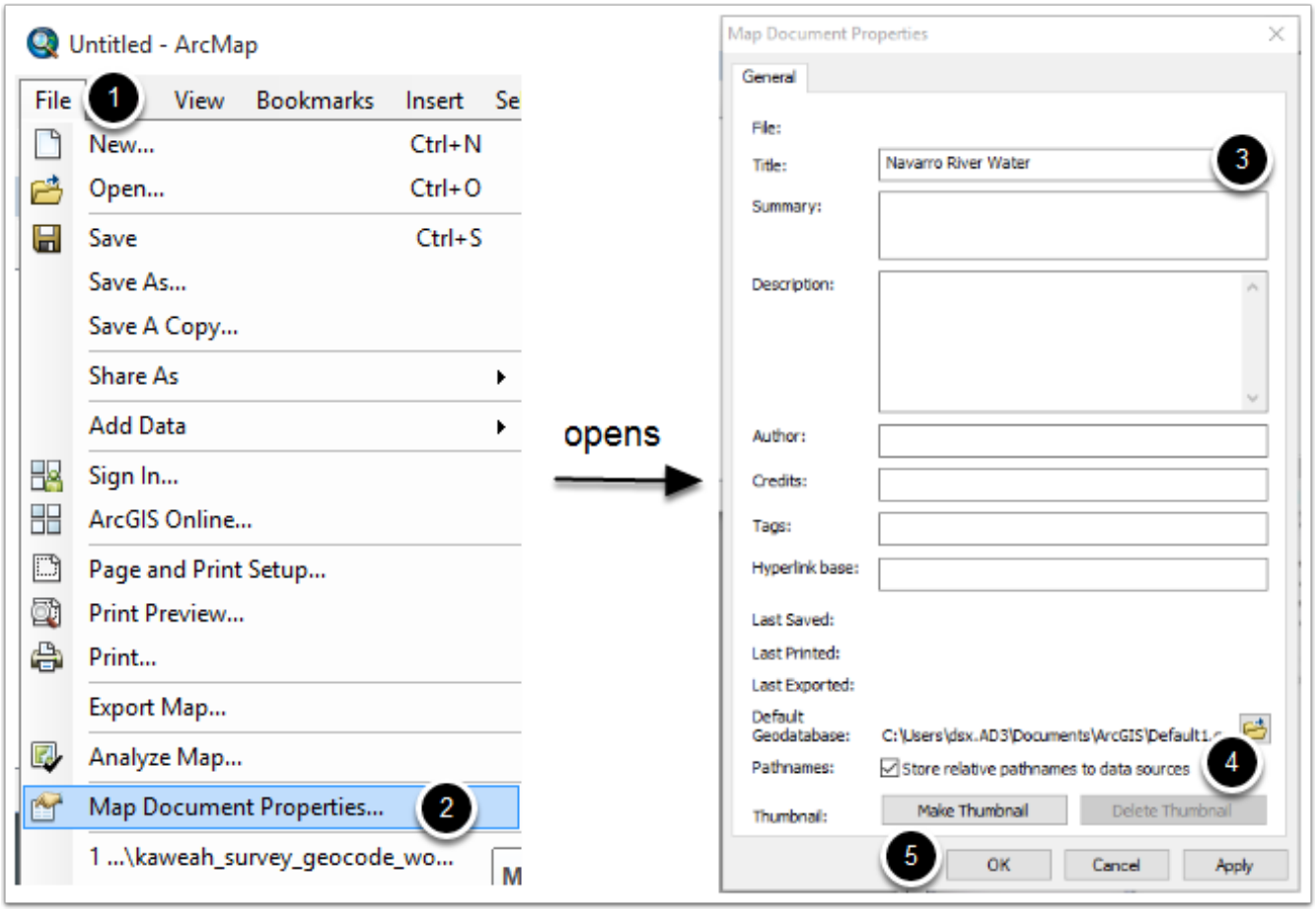
What do you notice about the ArcMap interface? What kinds of *conventions* is it using? It has menus - what can you do with them? It also has *toolbars* with icons and *windows/panes* that can attach to different sides of the screen. Take some time to look through the menus and hover your mouse on the toolbar items to see what they do.



2.1 Edit document properties

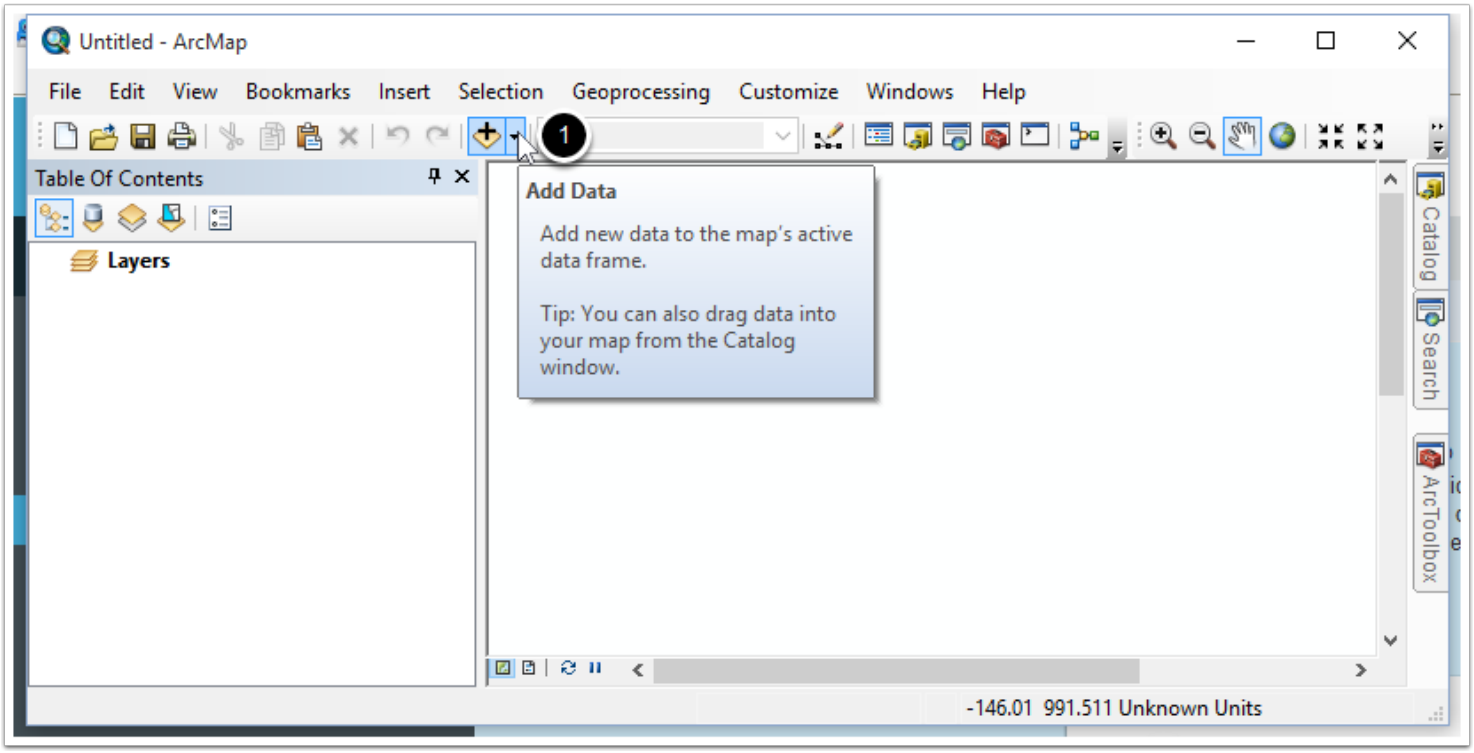
Let's open the map document properties so we can change our *metadata* and set some options.

1. Open the file menu
2. Select *Map Document Properties*
3. In the *Title* box, type *Navarro River Water* - Give your maps good titles and metatata to prevent problems later, such as not knowing the purpose or contents of a map
4. Near the bottom, check the box for *Store relative pathnames to data sources* - this option helps ensure that if you send the document and data to someone else, they won't have problems. Instead of saying where the data in the document is stored on your computer, the document remembers where the data is *relative to the path of the document*. So if the data is in a subfolder and you save your files to a network drive (or external drive), those files and layers will work for other people too should they open them on their computer.
5. Click OK to save the properties



3. Adding data into your map

Now it's time to make ArcGIS do some work! Let's add some geospatial data to our map. To do this, click the *Add Data* button in the main toolbar (1). Note that the *tooltip* you get when you hover your mouse over the button says "You can also drag data into your map from the Catalog window." Remember that for later.



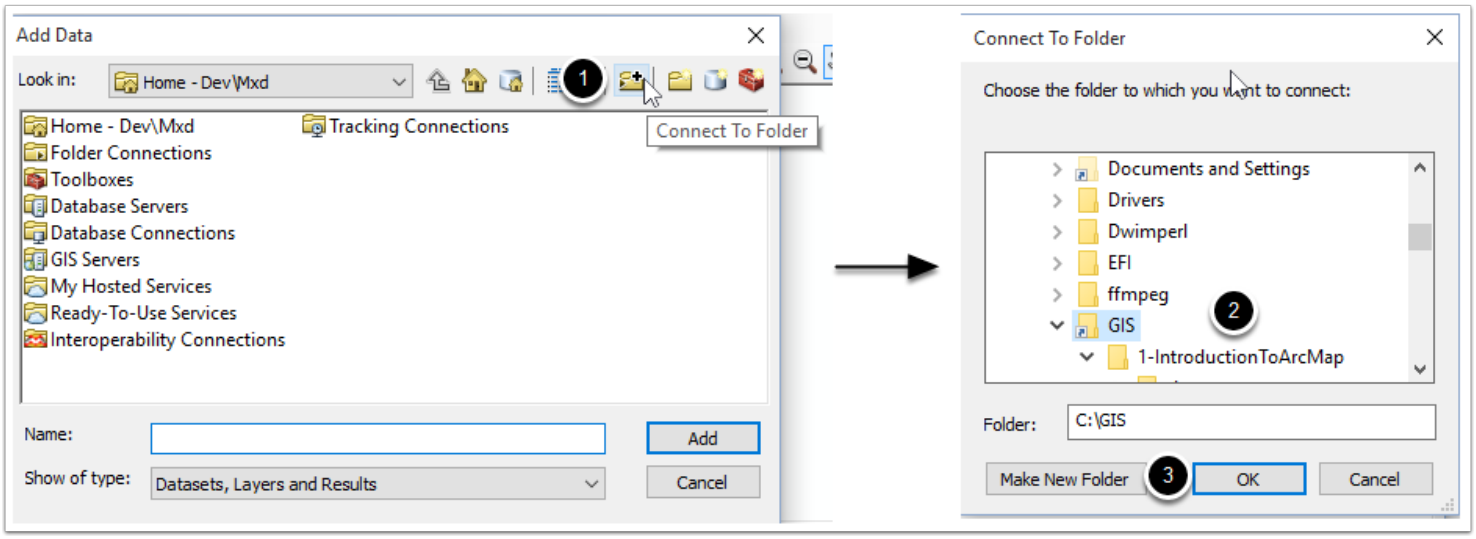
3.1 Connecting to Folders

Now we get the *Add Data Dialog Box* on our screen - it will look familiar to other dialogs you've seen to open documents or select a file. But it will also look different. Instead of showing you your computer's files, it's showing you all of the different data sources it can read from - servers, databases, online sources, your computer, and more. To read data from your computer, ArcGIS uses something called a *Folder Connection.* Folder connections are similar to a cross between a shortcut to a folder on your computer and one of these other data sources.

In order to access our data, we need to create one of these. So we need to use the *Connect to Folder* button located on the top toolbar inside this dialog box.

1. Click the *Connect To Folder* button.

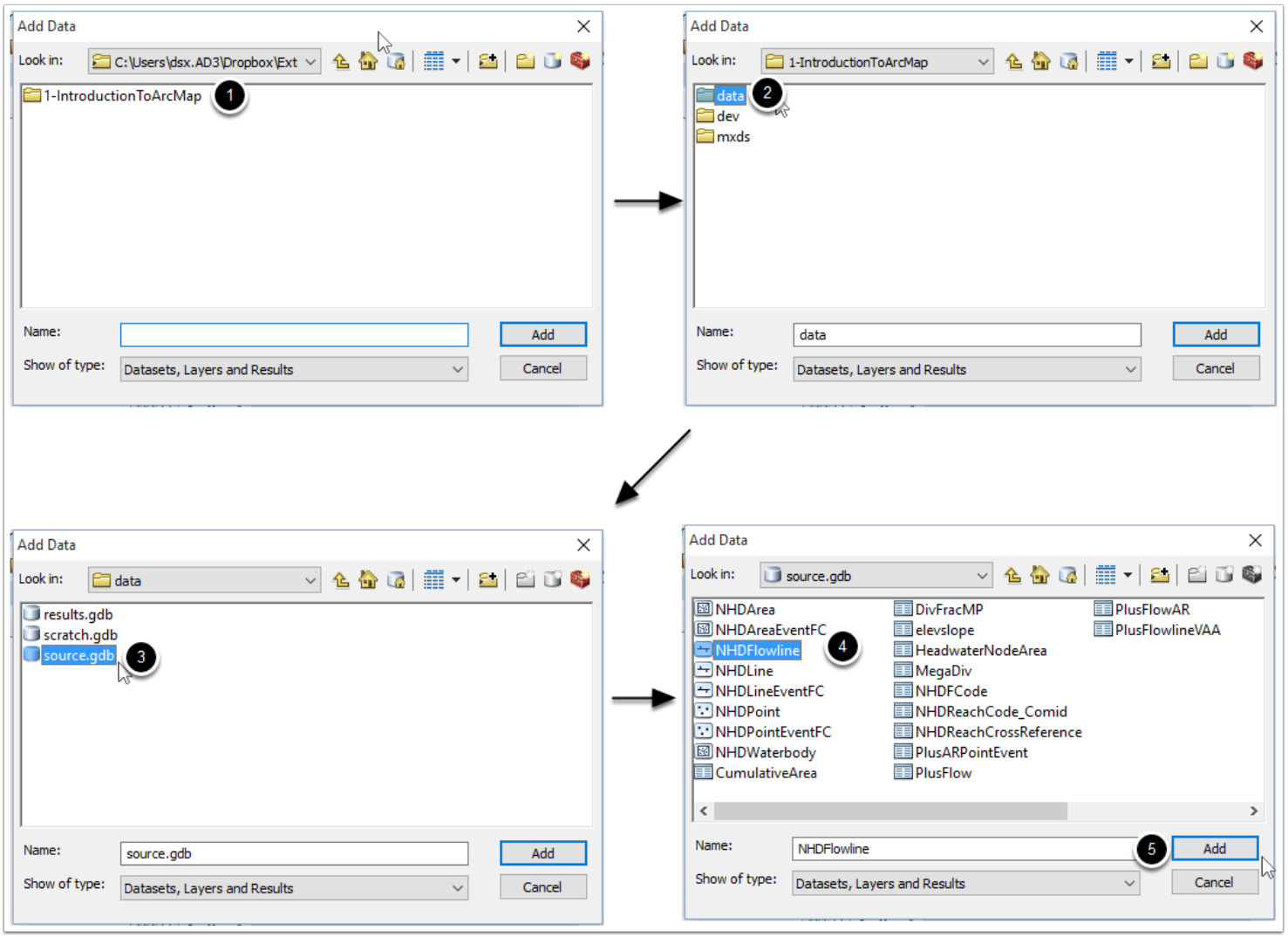
2. A dialog box will pop up asking you select a folder. Select your C:\GIS folder (or wherever you have placed your lab data). **Your screen will look different from the screenshot below**.
3. Click OK to finish creating the folder connection.



3.2 Find your data

Once you create your folder connection, ArcGIS will open it for you. In the future, you can access it from the *Folder Connections* data source (see previous screenshot).

1. To go find the data we want to add, navigate into the 1-IntroductionToArcMap folder (if you moved your data around, you will not have this folder and your screen will look different)
2. Open the *data* folder we created for you.
3. Open the *source.gdb* geodatabase. A *geodatabase* is a type of database that lives directly in your files. It's a way to group all kinds of geospatial data together. We'll learn more about them later, but for now, note that the icon for a geodatabase is different from folder icons in order to tell you at a glance that it's a geodatabase, and that the file extension is *.gdb.* What else on the screen has this same icon?
4. Select NHDFlowline from the items in the geodatabase,
5. Then click *Add*


Add Data
Look in: C:\Users\dsx.AD3\Dropbox\Ext
1-IntroductionToArcMap
1
Name:
Add
Show of type: Datasets, Layers and Results
Cancel
Add Data
Look in: 1-IntroductionToArcMap
data
2
dev
mxds
Name: data
Add
Show of type: Datasets, Layers and Results
Cancel
Add Data
Look in: data
results.gdb
scratch.gdb
source.gdb
3
Name: source.gdb
Add
Show of type: Datasets, Layers and Results
Cancel
Add Data
Look in: source.gdb
NHDArea
NHDAreaEventFC
NHDFlowline
4
NHDLine
NHDLineEventFC
NHDPoint
NHDPointEventFC
NHDWaterbody
CumulativeArea
DivFracMP
elevslope
HeadwaterNodeArea
MegaDiv
NHDFCode
NHDReachCode_Comid
NHDReachCrossReference
PlusARPointEvent
PlusFlow
PlusFlowAR
PlusFlowlineVAA
Name: NHDFlowline
5
Add
Show of type: Datasets, Layers and Results
Cancel

4. What is it?

Your screen will slowly draw a large blob - what is it? Can you figure it out from the layer name or the shape? Can you figure out how to zoom around and look closer? On my computer, ArcGIS chose to show this data in red - yours may show up differently - we'll change it to a more appropriate color later.

1. From what I see, it's a pretty solid red mass, with some breaks in it, and it's named NHDFlowline. In the *Table of Contents* on the left, notice that you have a listing for this *layer (*consider for a moment why it's called that). We can leave the item in our map document, but *turn it off* so we can't see it, but can see other layers underneath instead. We do this by clicking the check box next to its name to clear the checkbox. Your map window will turn blank again, in this case, but in other cases, you will see what is below the layer you hid.
2. Click the check box again to turn the layer back on.

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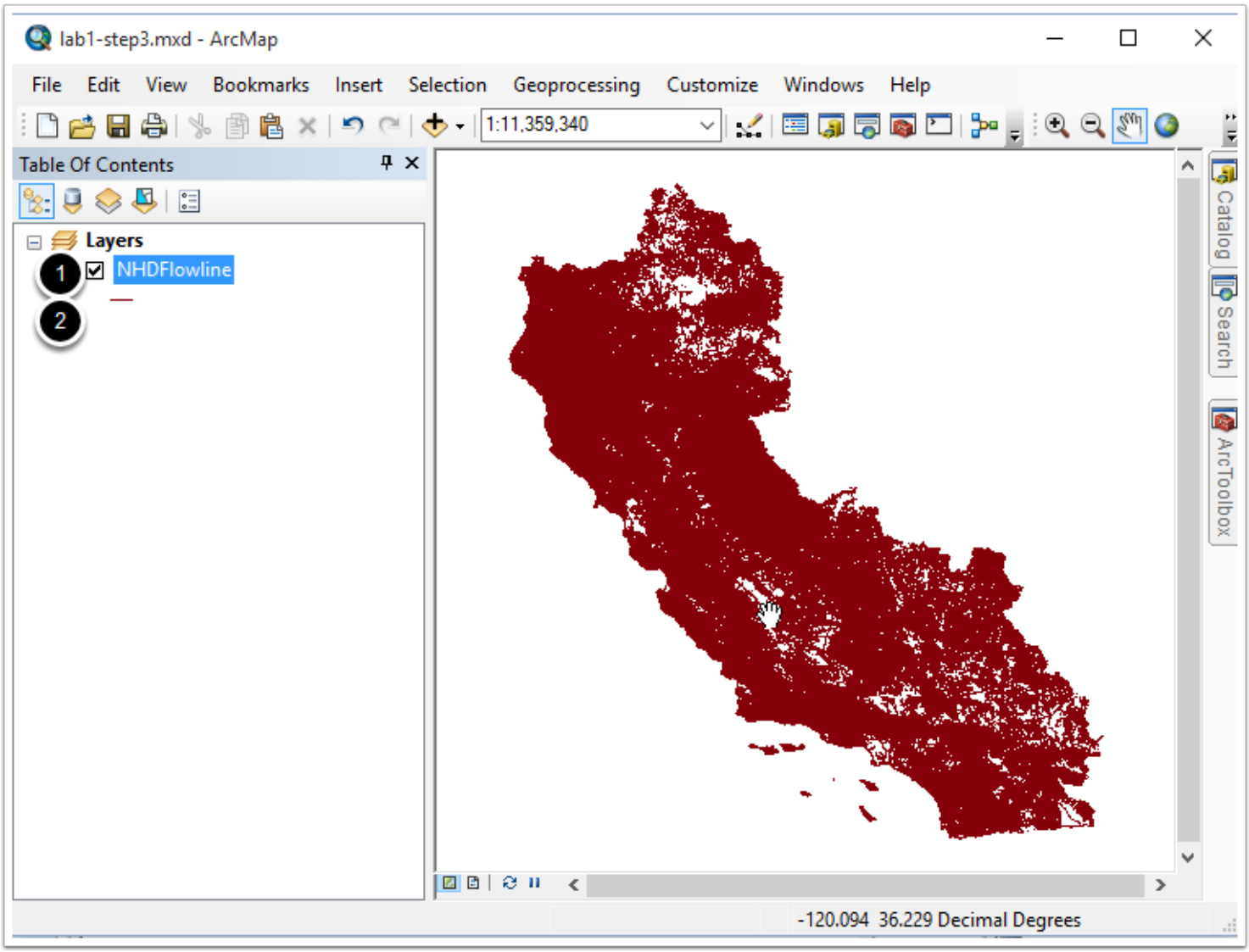
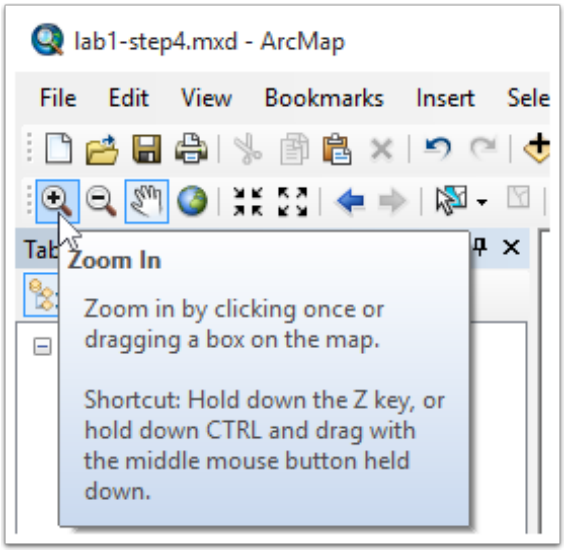

lab1-step3.mxd - ArcMap
File
Edit
View
Bookmarks
Insert
Selection
Geoprocessing
Customize
Windows
Help
1:11,359,340
Table Of Contents
Layers
1
NHDFlowline
2
Catalog
Search
ArcToolbox
-120.094 36.229 Decimal Degrees

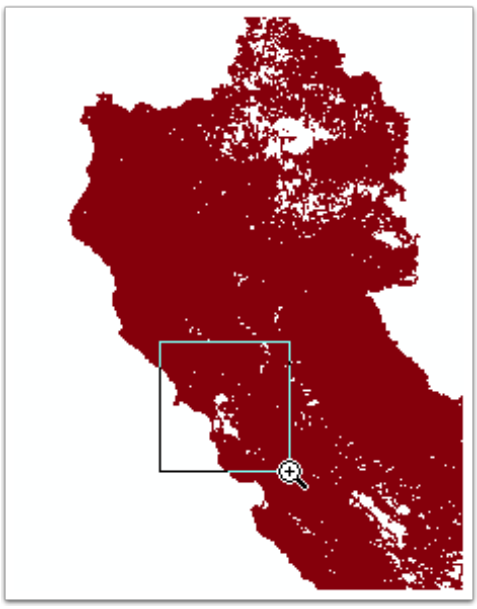
4.1 Zooming In

Let's figure out what this data is - activate the zoom tool by clicking on the magnifying glass with the plus sign on the tool bar. Scrolling with a mouse wheel also works, but in this exercise we'll use the tool.



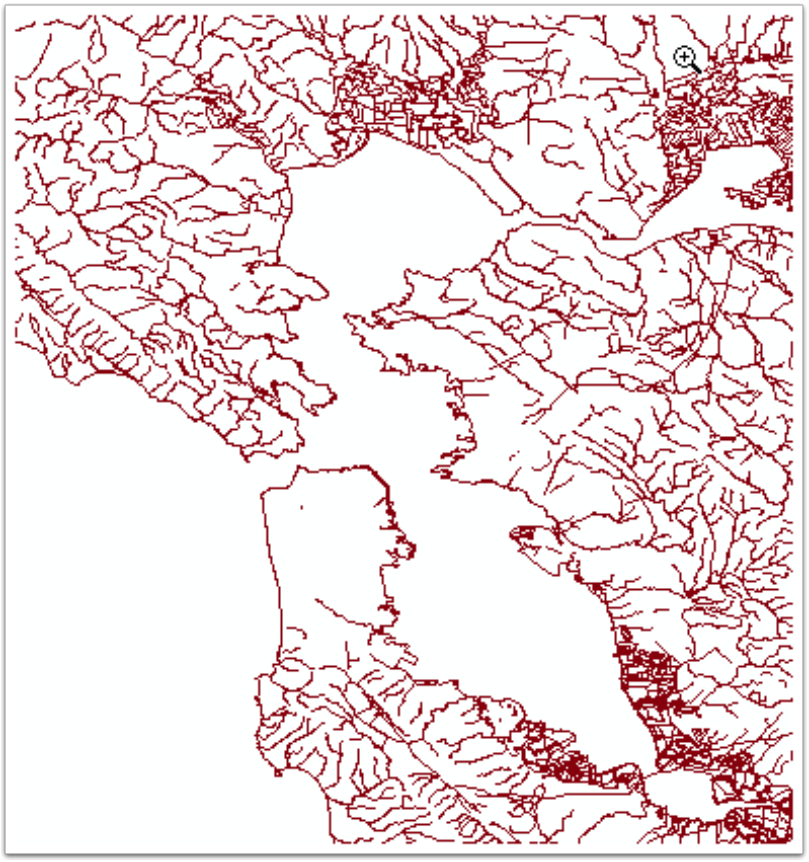
4.2 Click and drag

Click in a spot in the map window - somewhere in the middle of the red area and, while holding the left mouse button down, drag it to create a rectange similar to the screenshot here. This is the zoom window that ArcGIS will zoom to - it will show this area only on your screen.



4.3 A better scale to see features

Now that we are zoomed in, we'll see a lot of lines on the map - what do they mean? Why do they show up as solid red when we are zoomed out? We can start to get a sense of what the data might be - it could maybe be a transportation network or water moving - something that we'd choose to represent with lines. Given the waviness of the lines, we'd probably speculate that they are rivers, but let's confirm by inspecting the data.

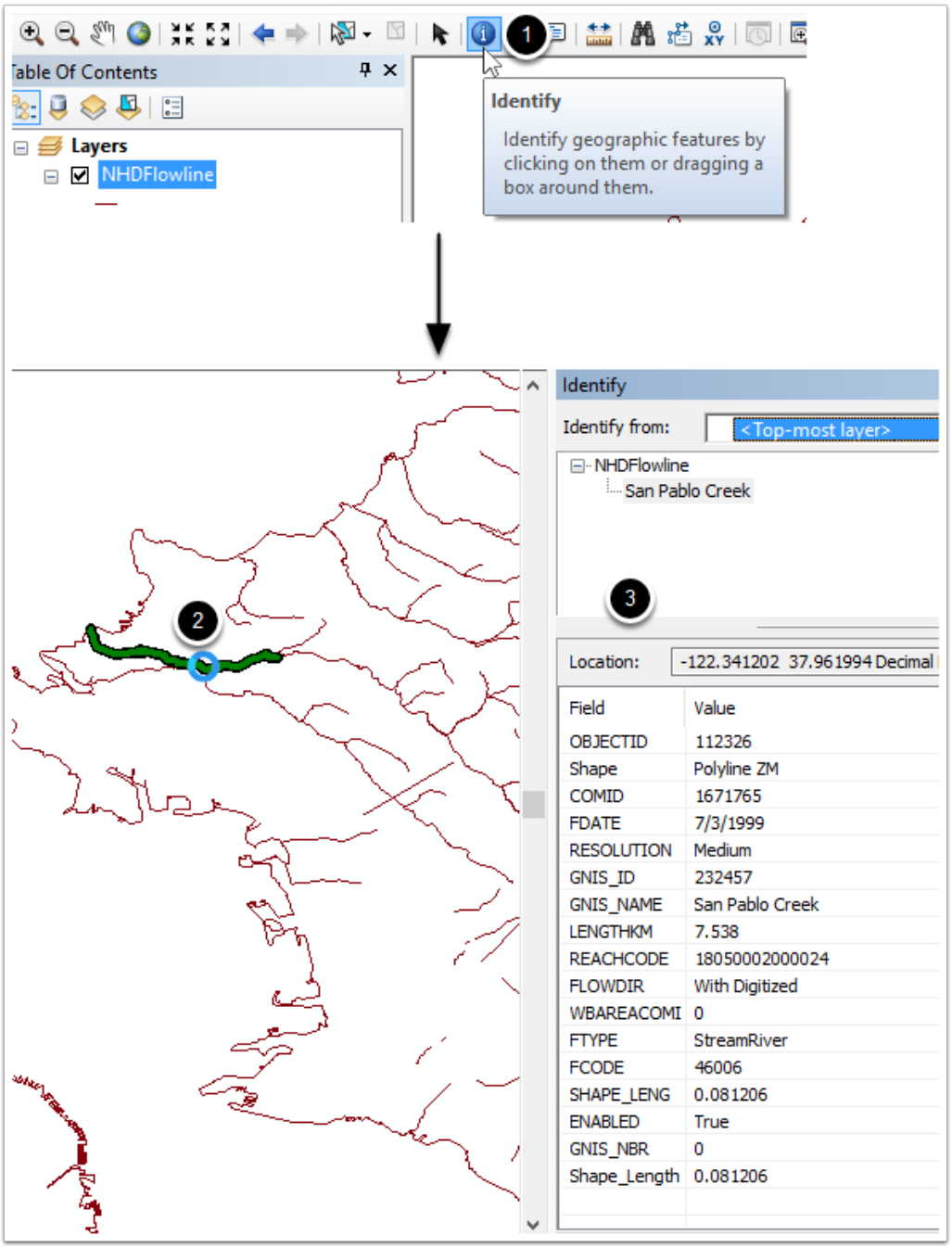


4.4 Identifying features

Activate the *Identify* tool by clicking the *i* in a blue circle on the toolbar (1). The identify tool helps us quickly answer the question "what am I looking at on the map." When you are using that tool and click on something (2), you will get a popup pane (3) with *attribute information* for that *feature.*

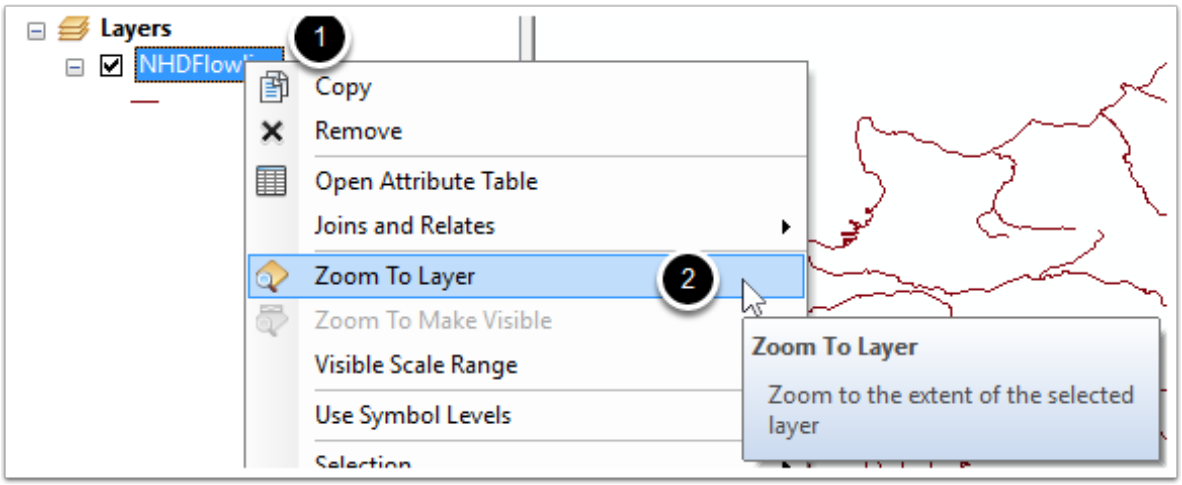
In this screenshot, I've clicked on San Pablo Creek, according to the GNIS_NAME attribute on the feature - you will probably click on a different feature, so your screen will look different, but click on a few features and explore the data a bit. These attributes seem to confirm our hypothesis that the *feature class* is for rivers (which is correct).

The data is from a dataset covering the entire United States called the National Hydrography Dataset (NHD) and this particular version is NHDPlus, version 2, which comes with some additional attribute information. The NHD includes information and features for rivers, water bodies, and watersheds in the US. In this case, we're displaying the rivers (flowlines) on our map.



4.5 Returning to an overview

Let's zoom back out, but do it quickly. Right click on *NHDFlowline* in the Table of Contents (1) and select *Zoom To Layer (2).* This zooms our view out to the layer's full *extent* (shows the entire layer on screen).



5. Setting Symbology

Now that we know we are looking at rivers, let's make them a more appropriate color. To do this, we deal with the part of cartography called *symbology.* There are multiple ways to accomplish this in ArcMap with different options, but for now, we'll use the fastest method.

Symbology is concerned with how we choose to display out GIS data - there is no one way to represent any GIS dataset - you as the analyst and cartographer choose how to show it to the viewer and have the responsibility of choosing something that makes sense and conveys the information appropriately. As such, ArcGIS provides great flexibility to you to change how your data appears. Let's quickly do that now.

1. Click on the red line underneath *NHDFlowline* in the Table of Contents. This red line is there both to remind us of the symbology for the layer and also to provide us quick access to change the symbology
2. Click on the symbol for *River* in the *Symbol Selector*
3. Click *OK* to save your symbol and look at it on the map.

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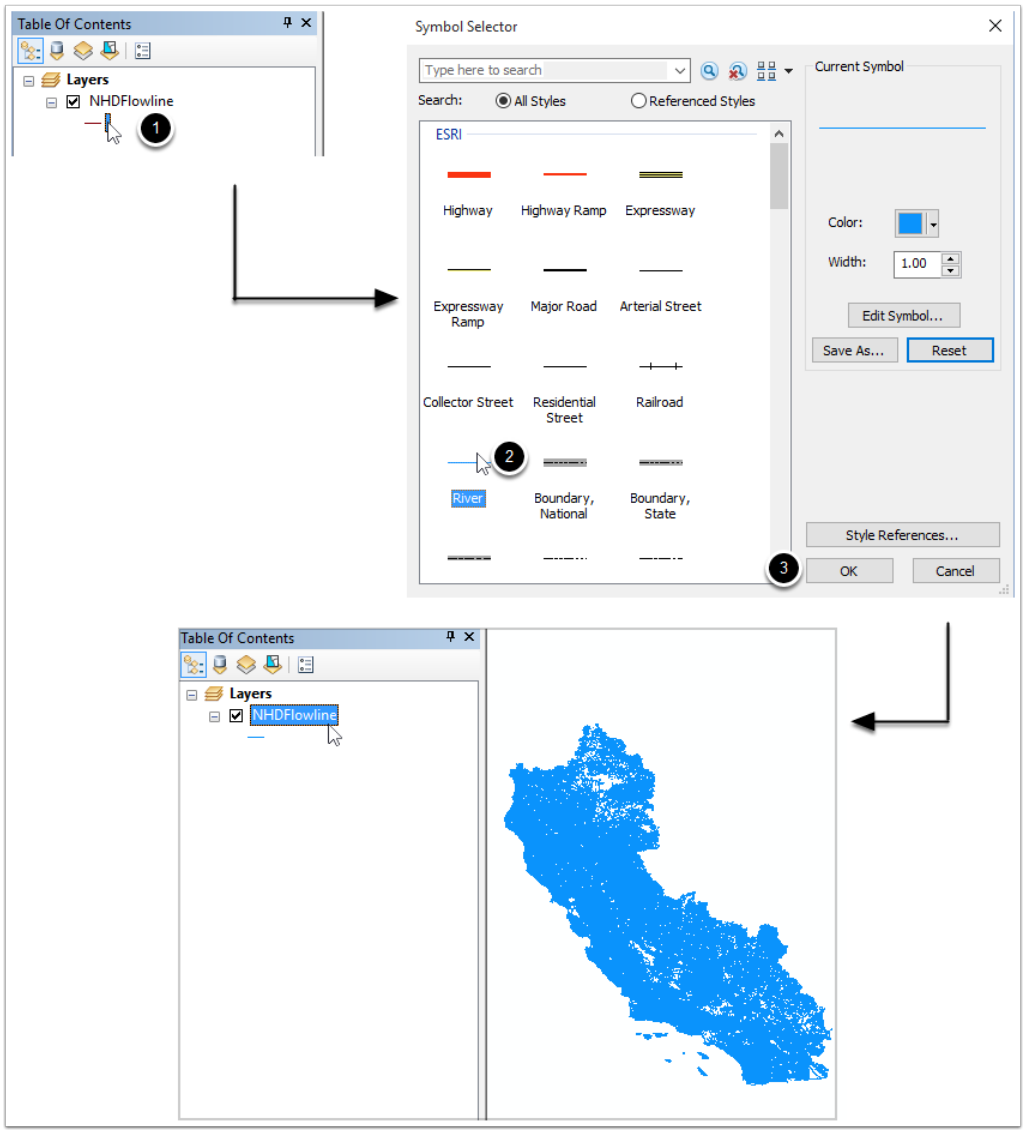


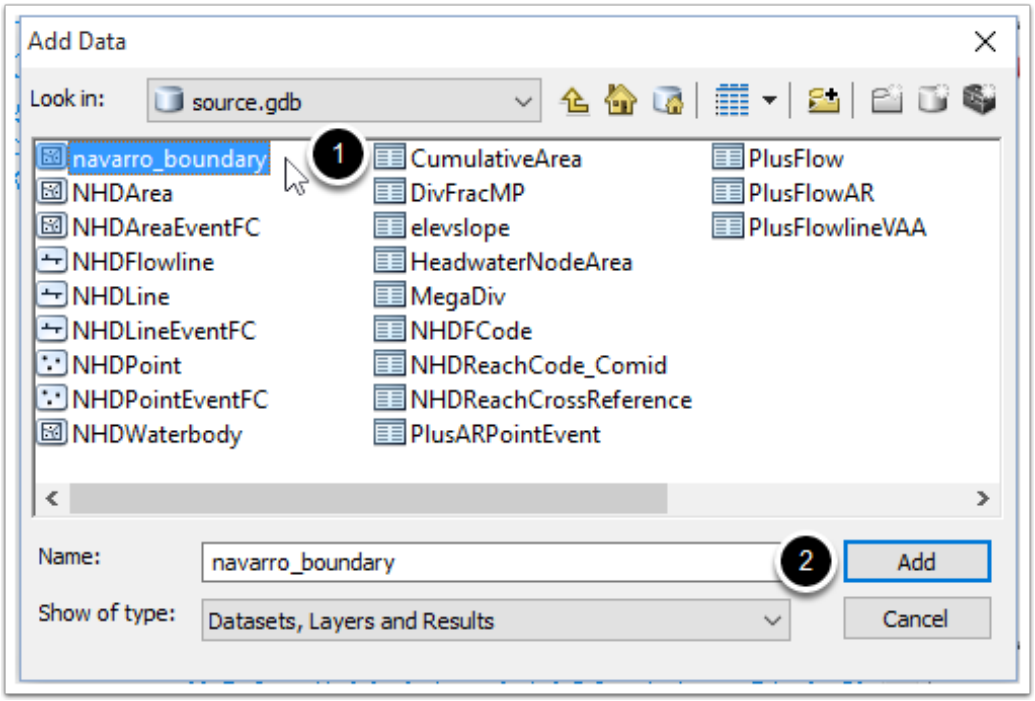
6. Add Navarro River Watershed

The NHDPlus Flowline data covers all of hydrologic region 18 (most of California, and parts of Oregon, Nevada, and Arizona). You may have also noticed that it's slow to *render* - that is, to be drawn on your computer screen. So, now we'll add a region of interest that we can use for the rest of this exercise that will limit the drawing time and data processing.

For this project, we're interested in the Navarro River watershed on the coast of northern California. Watersheds are often good areas of interest because in using them for boundaries, we usually preserve ecological units within them rather than artificially splitting them up. In running an analysis at the scale of a watershed, you can see important interactions at work. If you find your watersheds are splitting up

something important, try using a larger watershed (or using something else in combination with a watershed) to define your *region of interest (ROI)*.

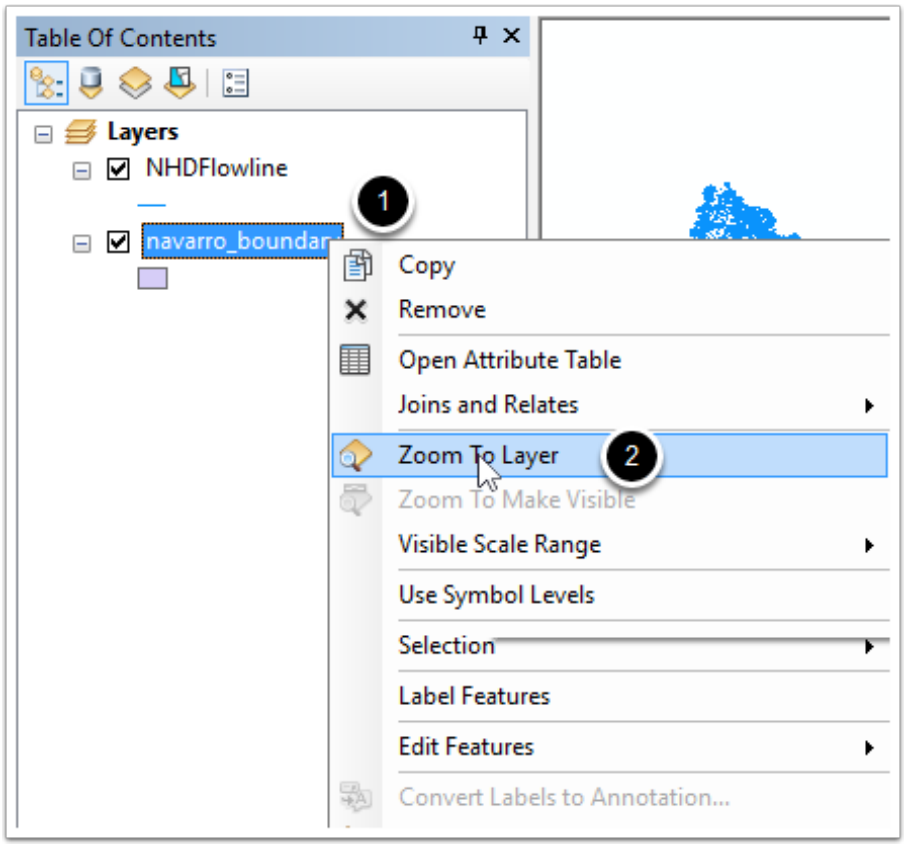
Open the Add Data box (remember how? Look back to when you added the NHDFlowline layer if you forgot). In the same geodatabase as the flowline data is another layer named *navarro_boundary*. Select that (1) and click *Add* (2).



6.1 Zoom to the layer

You won't really be able to see the layer at first, so let's zoom directly to it.

1. Right click on the *navarro_boundary* layer in your table of contents
2. Select *Zoom To Layer*.



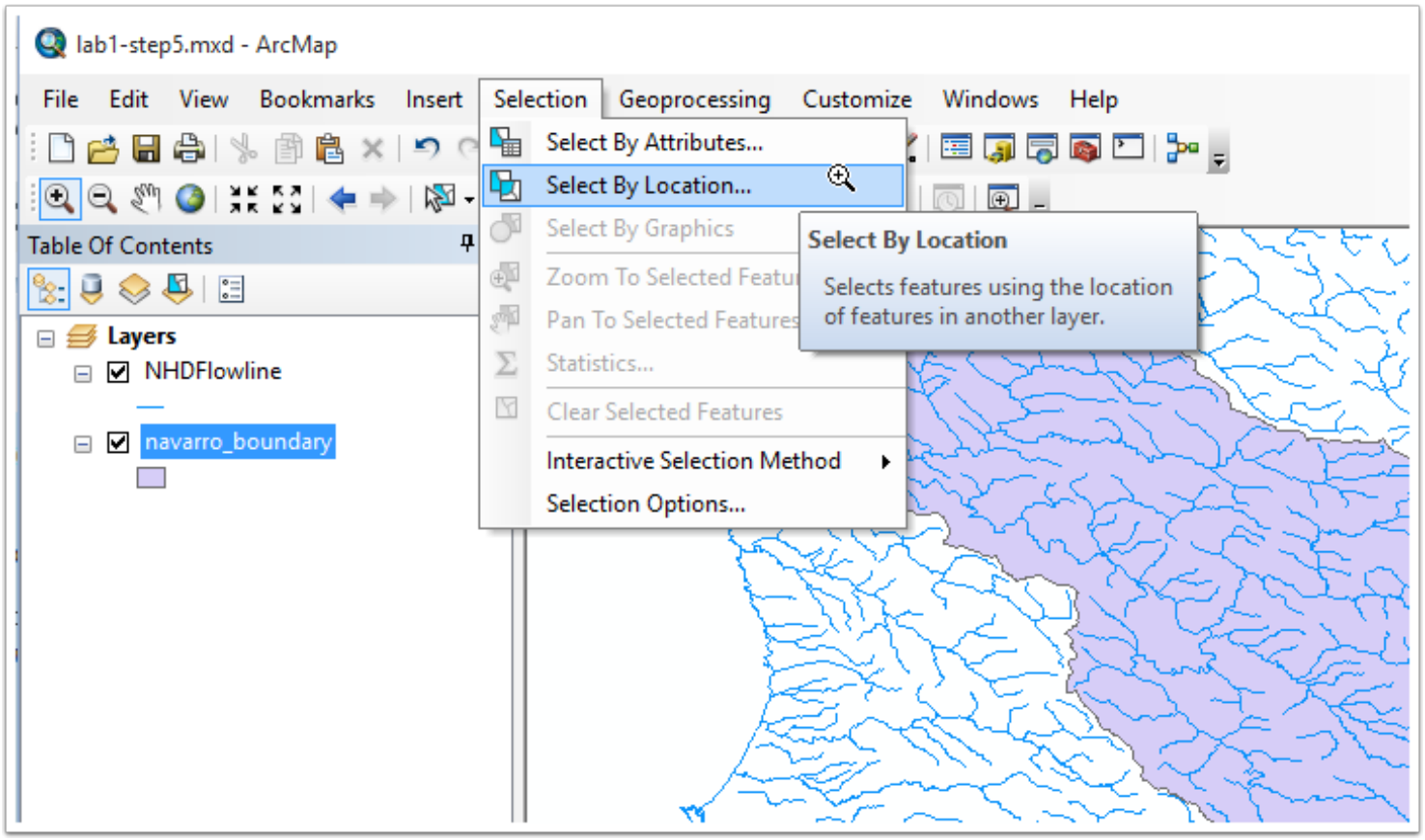
7. Select the streams within the watershed

In order to subset our stream data to the navarro river watershed, we need to first *select* the streams that are part of the watershed. A *selection* is similar to when you highlight a sentence with your cursor in a word processor - you're telling ArcGIS that you want to do operations only on that group of features (in this case, streams). Once we have a selection, we can manipulate it to make a new dataset with just the selected items.

This is where the rubber meets the road, so to speak. While we've already looked at records using the identify tool to see what is in a location, what we are doing now is the first time where we are going to

make decisions based on the spatial relationship of two separate datasets. That's a core functionality in GIS.

1. To get started with this operation, go to the *Selection* menu in the top menu bar and click on it.
2. Then click *Select By Location*.



7.1 Selecting by location

Select by location gives us a selection based upon a relationship to another set of features. It has *many* options, but let's just start with something basic. We're going to select all of the stream lines that touch the Navarro River watershed boundary. Many of the parameters will be set correctly by default, but feel free to look around at them.

Before proceeding, I encourage you to take a look and see if you can figure out what to do in this box. Principally, which layer is the *source layer* and which one is the *target layer*.

1. For *Selection method,* use *select features from*

2. In the *Target layer(s)* box, check the box next to *NHDFlowline*. We choose this one here because the target layer is the one that we will be selecting features on.
3. In the *Source layer* dropdown, choose *navarro_boundary.* We use navarro_boundary for this option because it is the layer we want to compare with NHDFlowline, but we don't want to select features in it. We want it to guide the selection based on the *relationship* we select in the next item.
4. In the *Spatial selection method for target layer feature(s)* dropdown, use the default of *intersect the source layer feature*. Think of this option as asking you "what relationship does a feature in NHDFlowline (target) and features in navarro_boundary (source) need to have in order for the feature in NHDFlowline to be selected?" In this case, they merely need to *intersect.* Intersect indicates that if the features touch anywhere - no matter how little - then the whole feature in the target layer is selected.
5. Click OK to run the selection

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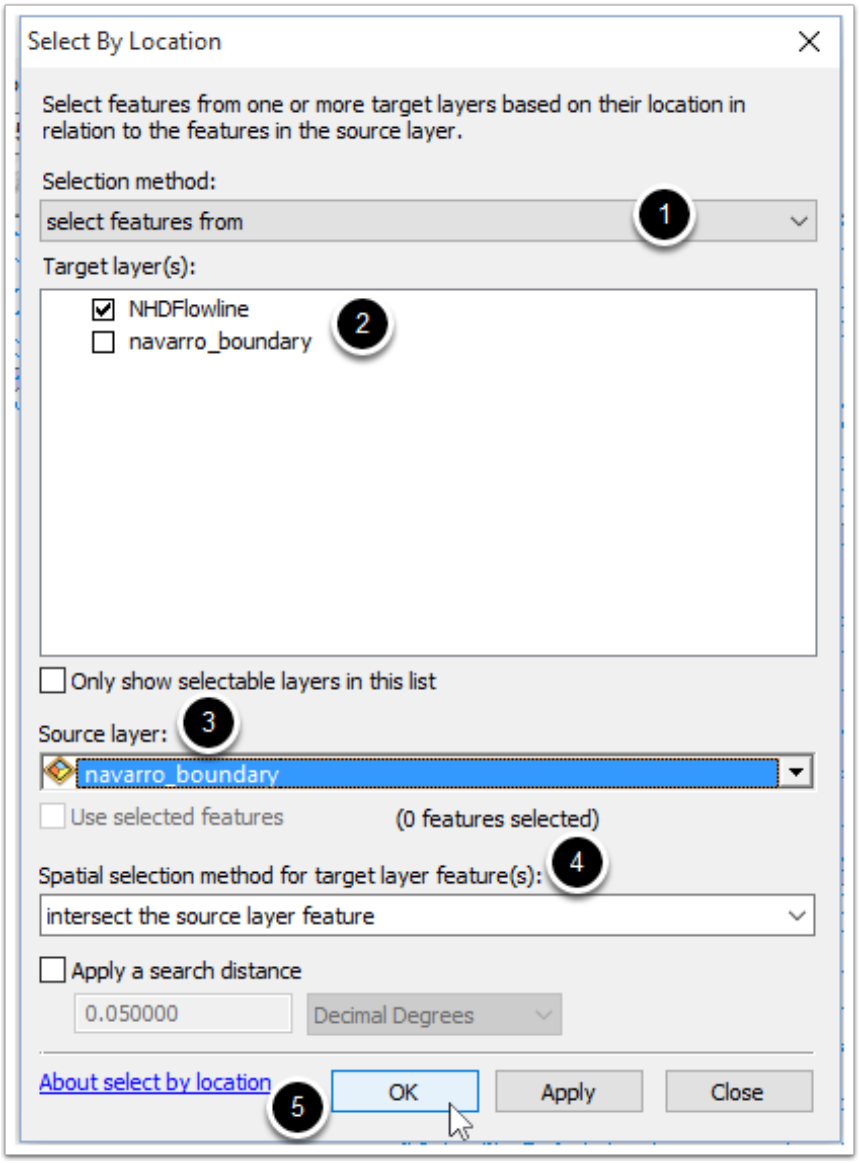
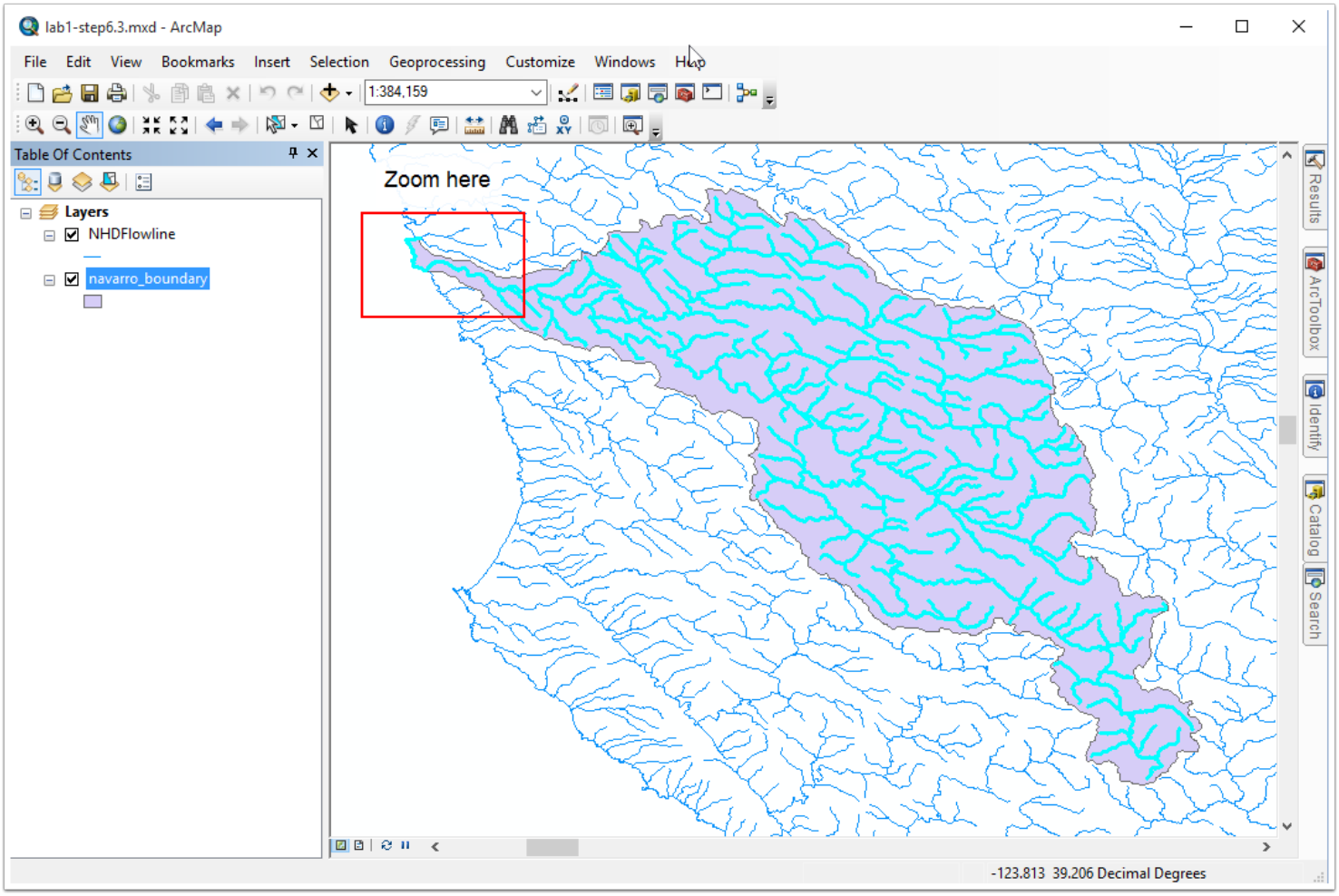


7.2 Validating our selection

Now, we'll see in light blue any features that are part of our new selection (side note: the color that selections appear in is configurable. Can you find that option? It's not immediately obvious for someone new to GIS).

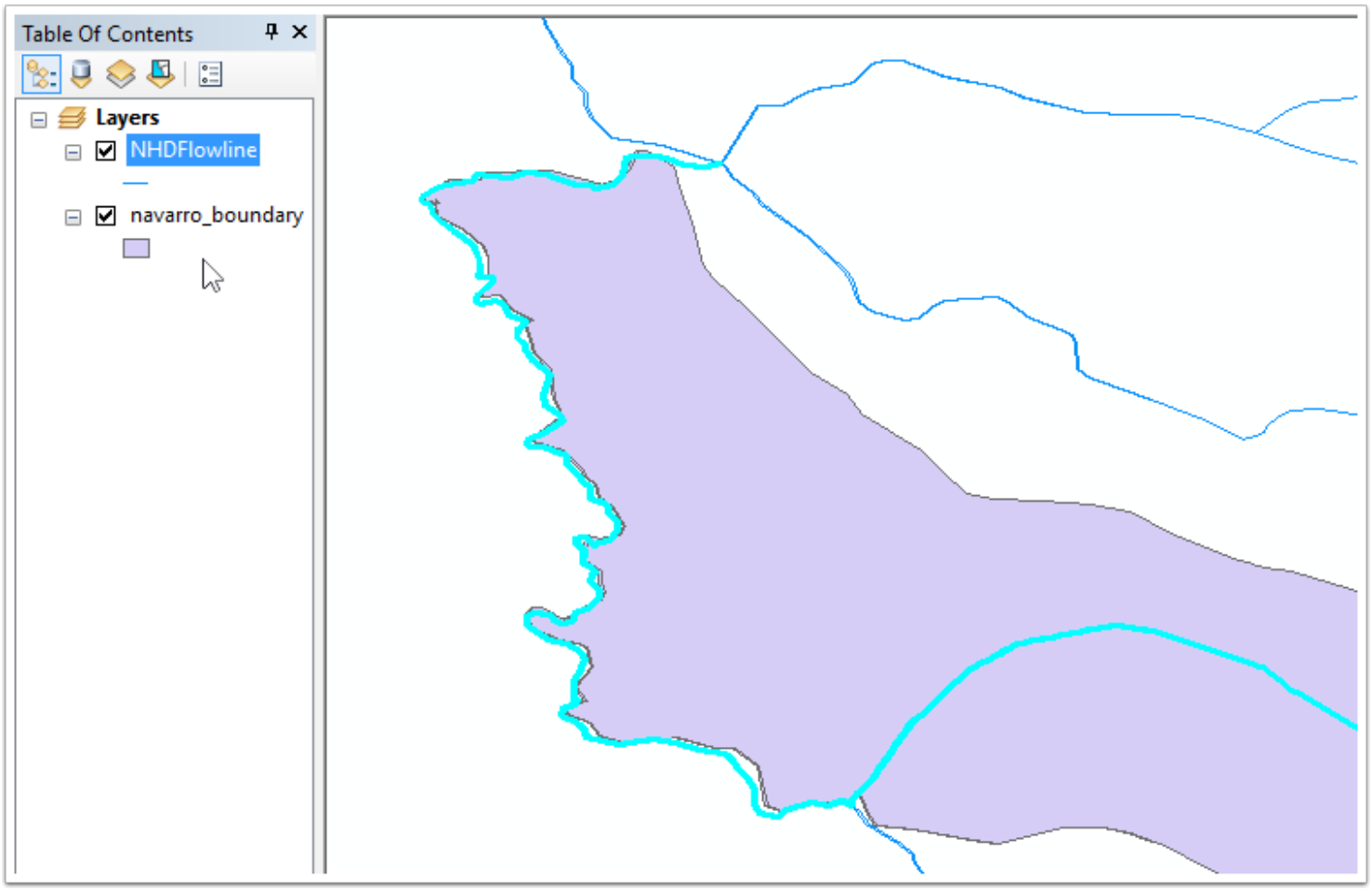
Let's verify our selected features look appropriate. It's always good to validate GIS operations and make sure you get the expected results, and if you don't, determine whether you didn't because you expected the wrong thing, your workflow doesn't get you where you wanted to go, or you (or ArcGIS) made a minor error. Mostly, this selection looks correct, but I notice something odd on the coast - it looks like the coastline is selected, and I didn't want that.

Use the zoom tool to zoom into the area on the coast.



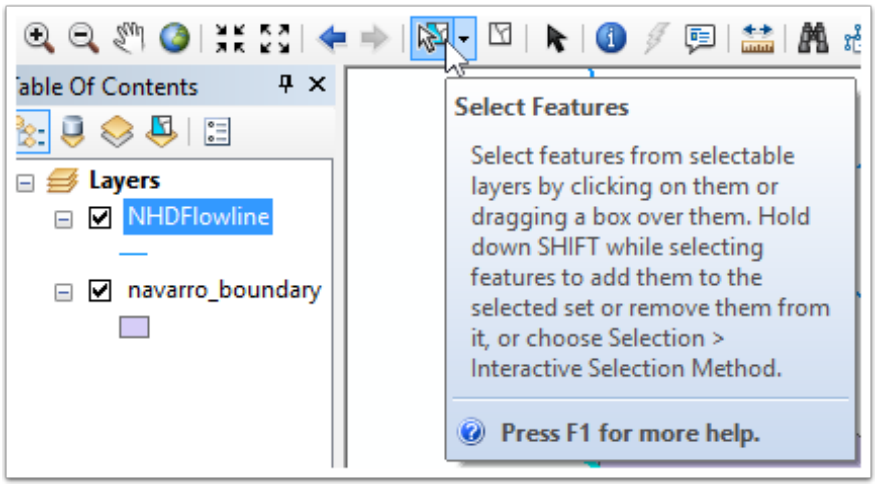
7.3 A coastal selection

Yep, it looks like coastline (if you want to confirm, use the identify tool again to see what's there). Let's remove this item from our selection using the manual selection tools.



7.4 Manual selection

On the main toolbar, activate the *Select Features* tool to begin interactive selection.



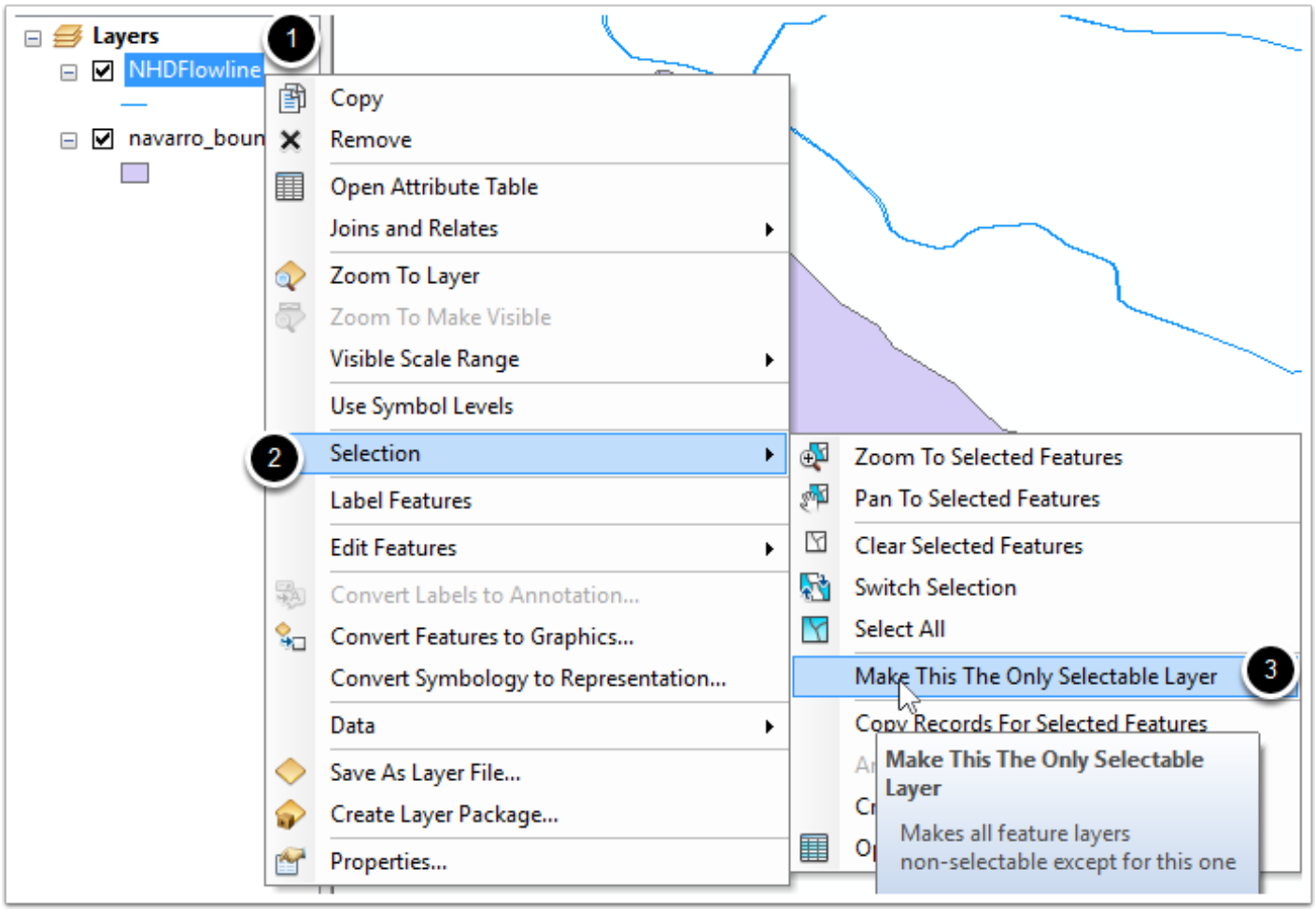
7.5 Setting up the selection

First, let's make sure the changes we want to make occur only on the NHDFlowline layer. By default, interactive selection affects all layers, and your map display will get messy when you start clicking around!

We'll set some options in this step to prevent that, but if at any time your selection becomes a problem that you can't correct, click the button to the right of the *Select Features* button on the toolbar (from the previous step), and your selection will be cleared. Then go back to the Select By Location step (again, don't do this if your selection remains intact).

Let's make it so that only the flowlines can be selected.

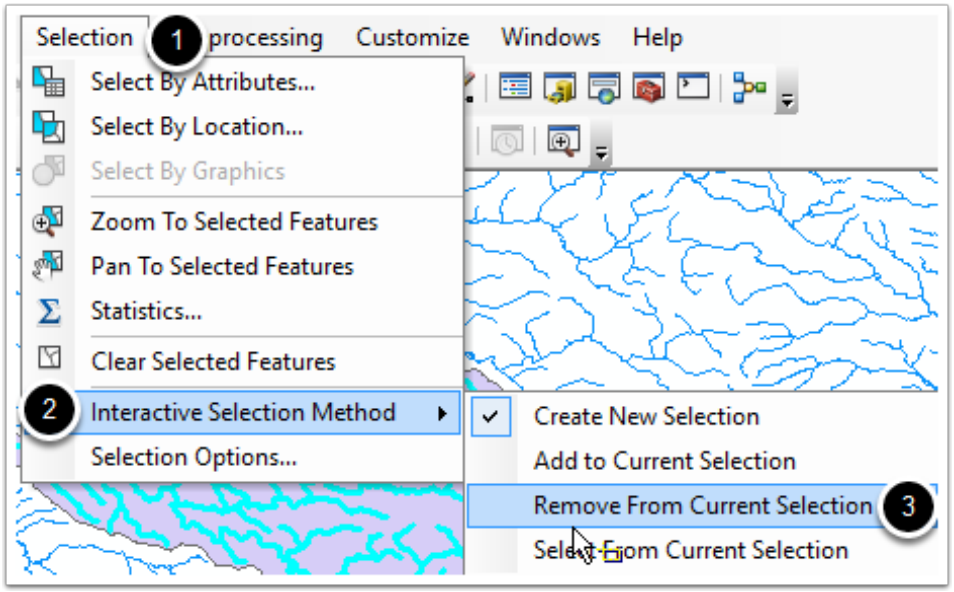
1. Right click on the layer in the Table of Contents
2. Go to the *Selection* submenu
3. Choose *Make This The Only Selectable Layer* - after choosing this option, interactive selection will only modify this layer and won't select features in other layers


Layers
NHDFlowline
navarro_boun
1
Copy
Remove
Open Attribute Table
Joins and Relates
Zoom To Layer
Zoom To Make Visible
Visible Scale Range
Use Symbol Levels
2
Selection
Label Features
Edit Features
Convert Labels to Annotation...
Convert Features to Graphics...
Convert Symbology to Representation...
Data
Save As Layer File...
Create Layer Package...
Properties...
Zoom To Selected Features
Pan To Selected Features
Clear Selected Features
Switch Selection
Select All
Make This The Only Selectable Layer
3
Copy Records For Selected Features
Make This The Only Selectable Layer
Makes all feature layers non-selectable except for this one

7.6 Changing the selection method

By default, if you were to click on the map now, it would *add* the features under the curso to your selection. Since we want to remove something, we need to change the selection mode - there are shortcut keys to temporarily do this (holding shift), but instead of using those, let's use the menus this time around.

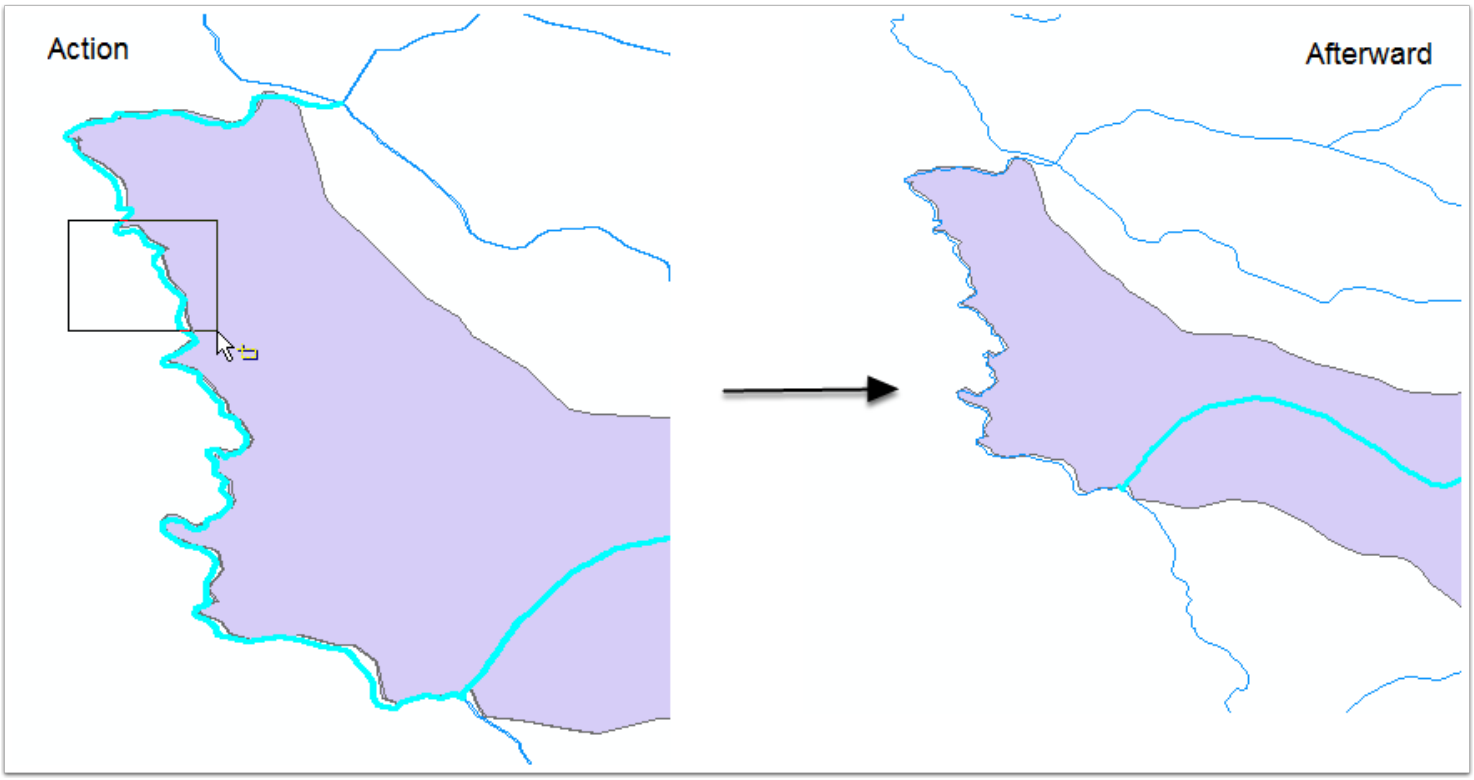
1. Open the *Selection* menu
2. Hover over the *Interactive Selection Method* flyout
3. Choose *Remove From Current Selection* to change the selection method so that when we click on the map, items will be removed.



7.7 Modifying the selection

Now, we've set up the selection tool. To remove the coastline from our selection, just click and drag a small box over any part of the coastline. Afterward, that *feature* will no longer be highlighted and it will no longer be part of our selection.

Note: You don't have to create a box around the entire feature that you want to select - your selection just needs to touch each feature you want selected *somewhere*. If it turns out that you select too few features, you can hold down the shift key and select another feature to add more features to your selection.

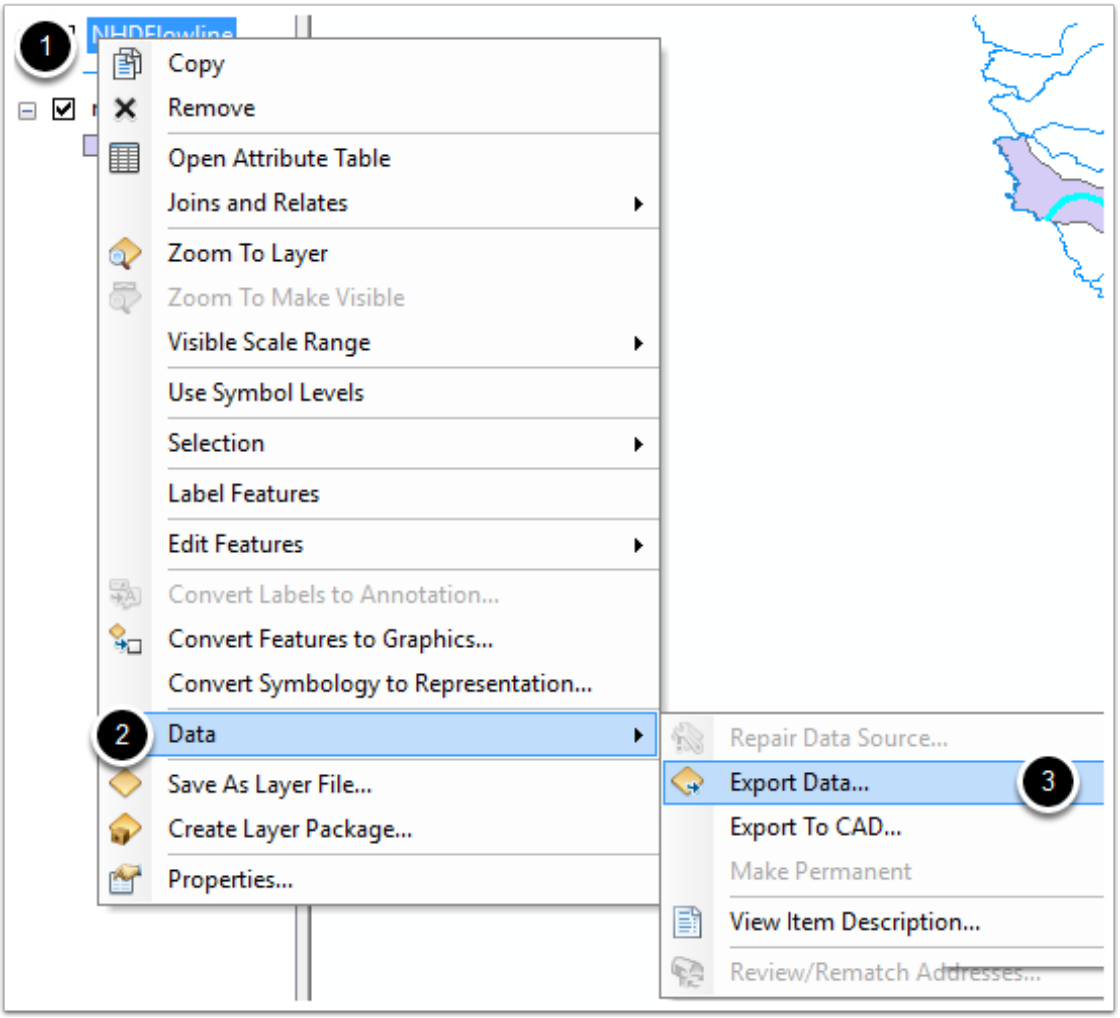


8. Saving out our new data layer

Now that we have a selection of the rivers in Navarro River watershed, let's save our selection as a new *feature class* (NHDFlowline and navarro_boundary are both feature classes) so we can use it in our map permanently. To do this, we want to *export* the selection.

1. Right click on *NHDFlowline* in the table of contents
2. Highlight the *Data* flyout menu

3. Click on *Export Data*



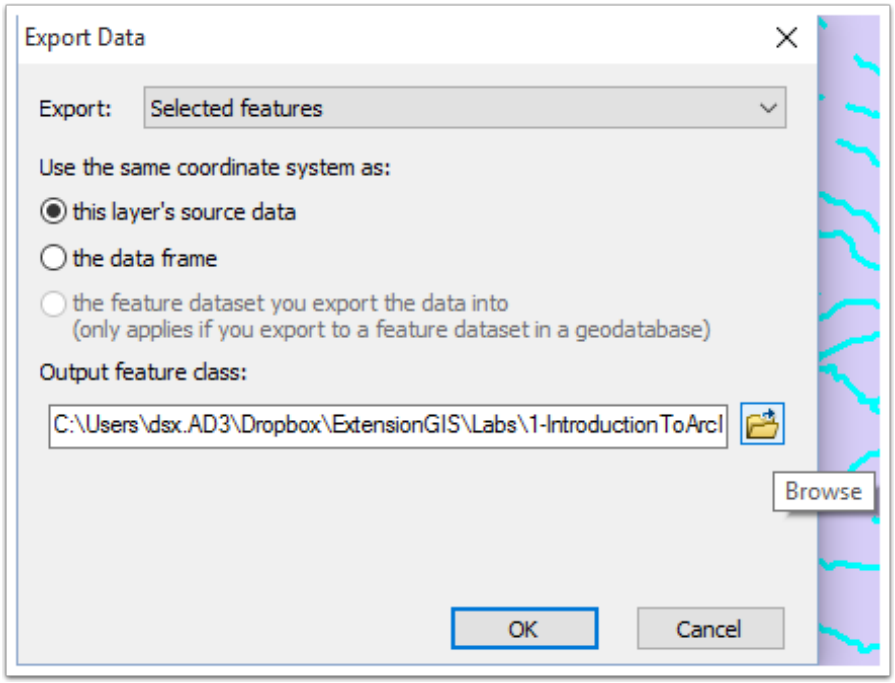
8.1 The Export Data dialog box

A dialog box will pop up. It's easy to want to skip over the options here, but each of them is important to notice. First, you might notice that you can select the output location, and we'll do this in a moment. But then, bring your eyes back up to the top where it says *Export: Selected features*.

What's going on here? Take a look at the options in the dropdown menu. In our export, we can choose what parts of the source data to include. When we have a selection, ArcGIS will automatically choose to export only selected features, and otherwise it chooses *All features.* This is handy, but also risky, because if you have a selection on a layer, which happens quite a lot in regular validation and other workflows, you might accidentally export only part of your dataset - be careful with that! In fact, **most common operations in ArcGIS will work with a layer as if it is only composed of the selected**

records. If you don't want that behavior, in most cases you'll need to clear your selection (which we'll do in a moment).

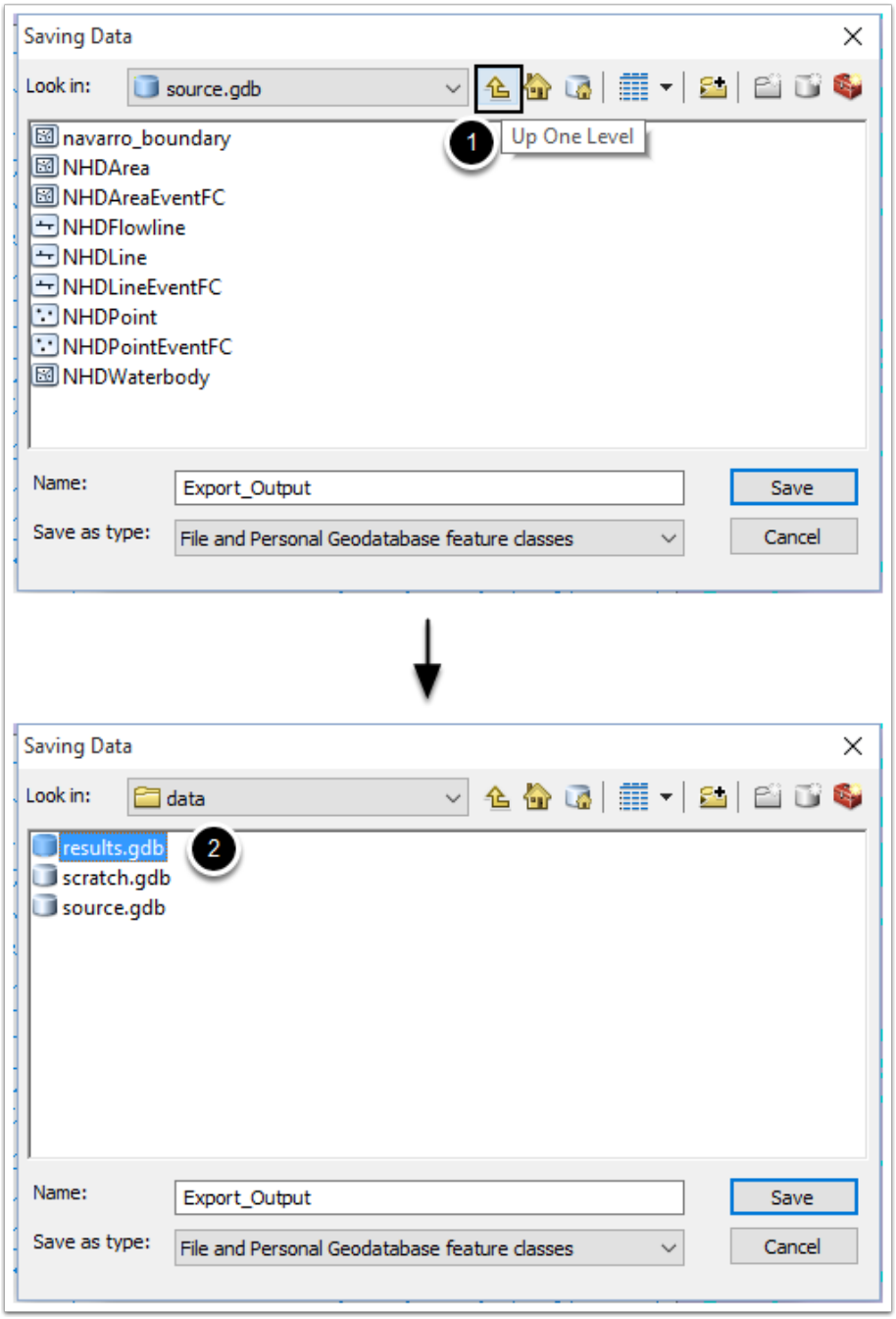
1. For now, let's set an output location. Click the *Browse* button under *Output feature class.*



8.2 Finding the right location

ArcGIS will take us to the default geodatabase for your map document (we'll cover what that is in the next lecture), but let's not export it here - we'll keep our *derived* project data separate from our source data from third parties. You will need to navigate to the folder you stored your data in (C:\GIS, for example) and then find the geodatabase named *results.gdb* (2) inside of the *data* folder.

If it happened to take you to *source.gdb* when you clicked browse, then you can follow these instructions. Click the *Up One Level* arrow (1). Then enter the *results.gdb* geodatabase by double clicking on it (2).

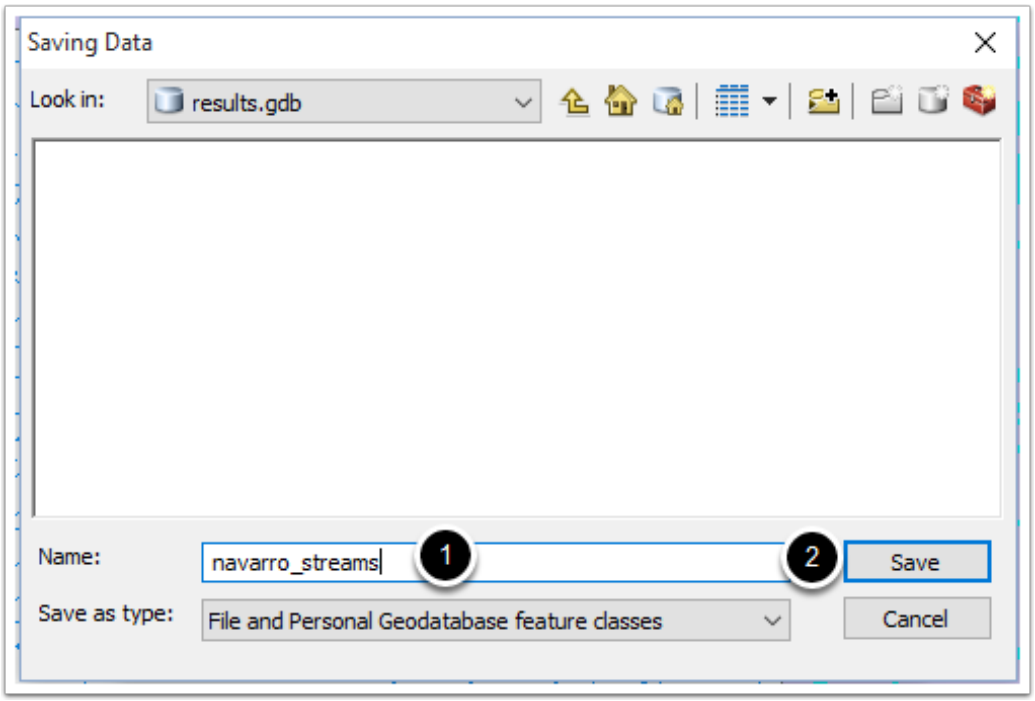


8.3 Give it a name

Now, type a name in the box near the bottom titled *Name*. Call the layer *navarro_streams* (1). Note the underscore. Any ideas on why we might put an underscore in a name?

Historically, many computer programs had trouble with spaces. Some components with that trouble are still a part of ArcGIS and they create mysterious errors. It's best to avoid the problem entirely and use something like underscores in place of spaces.

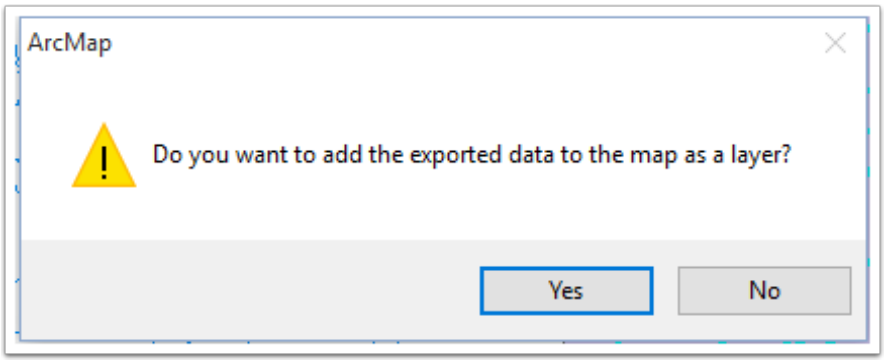
Next, click *Save* (2). Then, click *OK* in the *Export Data* box (not shown).



8.4 Do you want to add the exported data to the map as a layer?

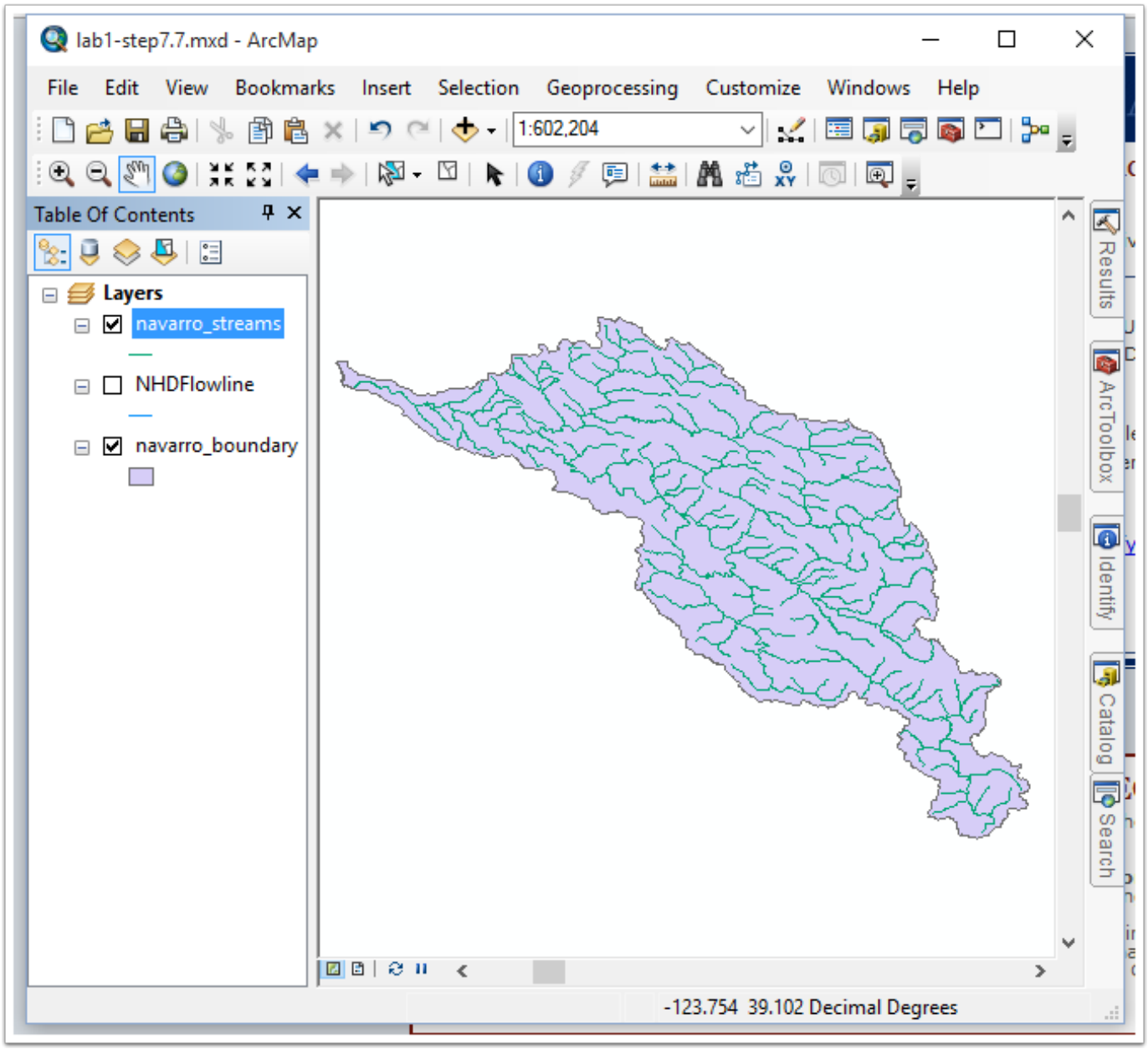
Whenever you export data, you will get the prompt from ArcMap asking "Do you want to add the exported data to the map as a layer?" I recommend that you **always** click less - this way if you committed the error I mentioned before of accidentally having something (or the wrong thing) selected, you can inspect the layer and correct the issue now before you get rid of the source data or get too far down the road in your analysis. In this case, we want the streams anyway for cartographic reasons.

Click *Yes.*



8.5 Verify our data

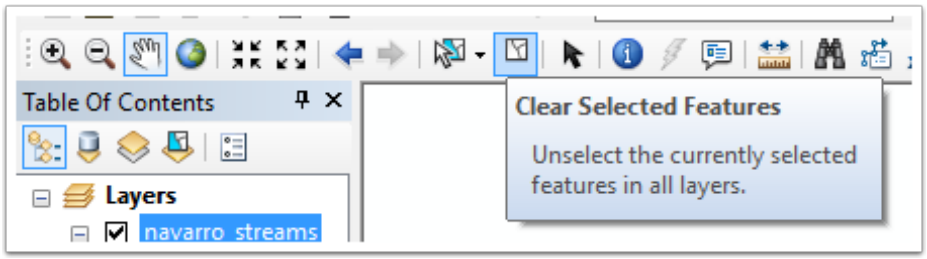
Verify your exported data looks correct by turning off NHDFlowline so that the selection temporarily disappears and the surrounding data is hidden. Zoom around and take a look. You'll also notice that the color was again set to a random color (green in my case). Apply appropriate symbology as we did before. Once you're ready, proceed to the next step.



8.6 Clear selected features

Now that we're done with our selection, let's clear our selected features.

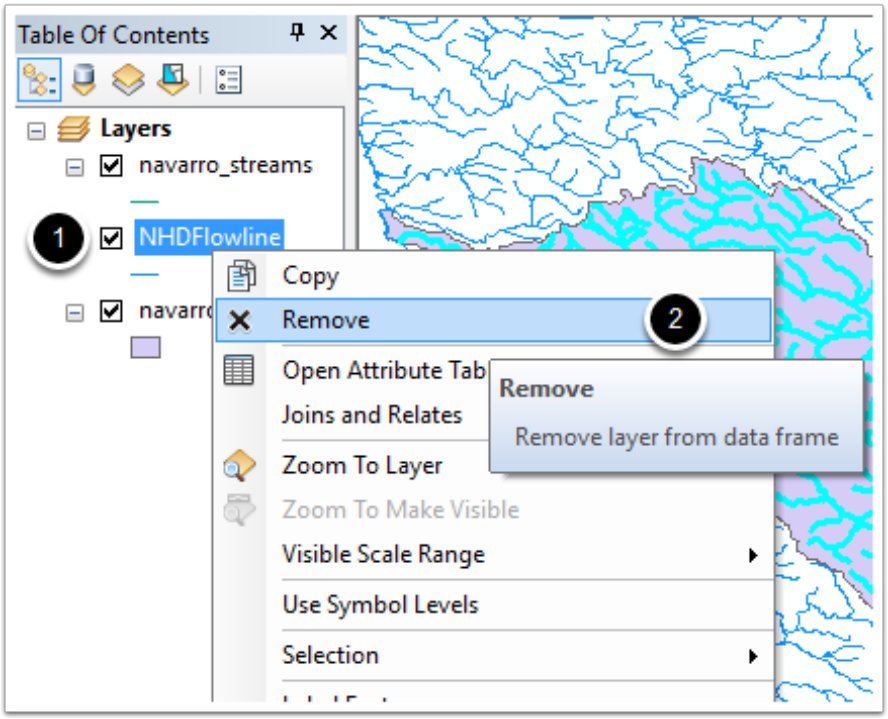
1. Click the *Clear Selected Features* button on the main toolbar. The selection will disappear from your display and would need to be recreated manually if we wanted it back.



8.7 Remove NHDFlowline

Now that we've subsetted our data, we can remove NHDFlowline from our map document. We could add it back later, should we want to, but we don't need it in this document.

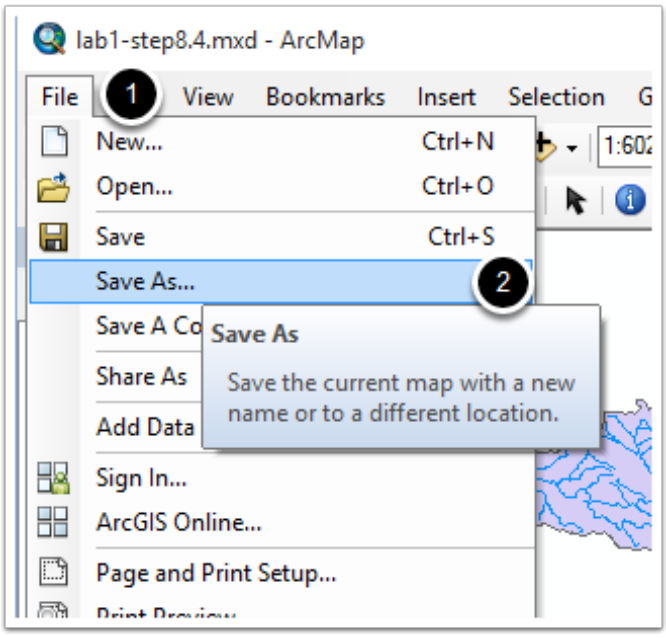
1. Right click on NHDFlowline
2. Click on *Remove*

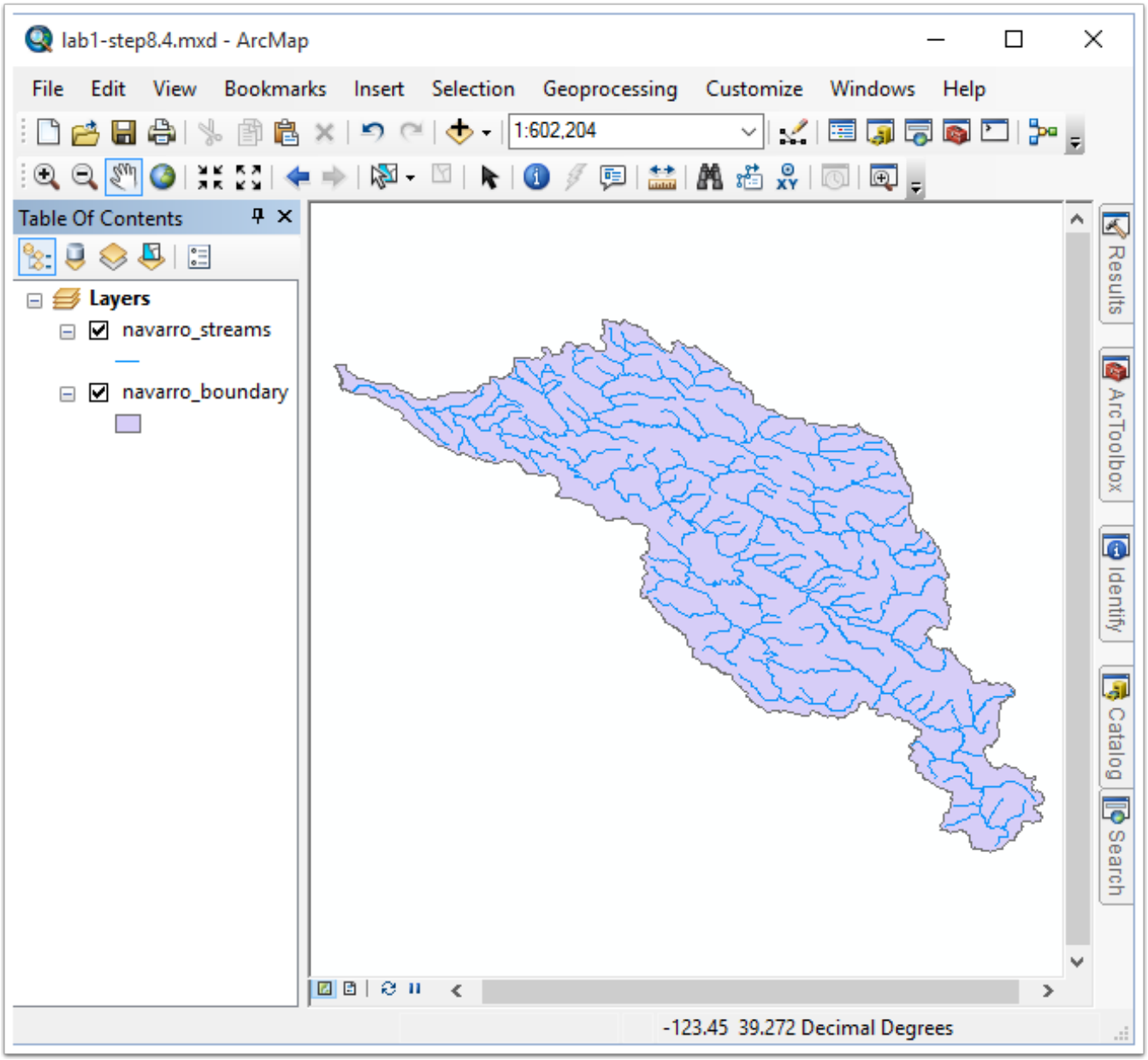


8.8 Save your map document

Now, save your work (ArcGIS is known to crash!).

1. Open the *File* menu
2. Choose *Save As*
3. Follow the normal procedure for saving files - I'd recommend saving in the folder *map_documents* inside your class folder. Navigate to that location and give it a name of your choosing (not shown).



8.9 Save your map document

You now have a version of the Navarro River and its surrounding watershed to use in a future analysis - nice work! Make sure to save this map document somewhere that you can find it - you'll use it in the next lab assignment.