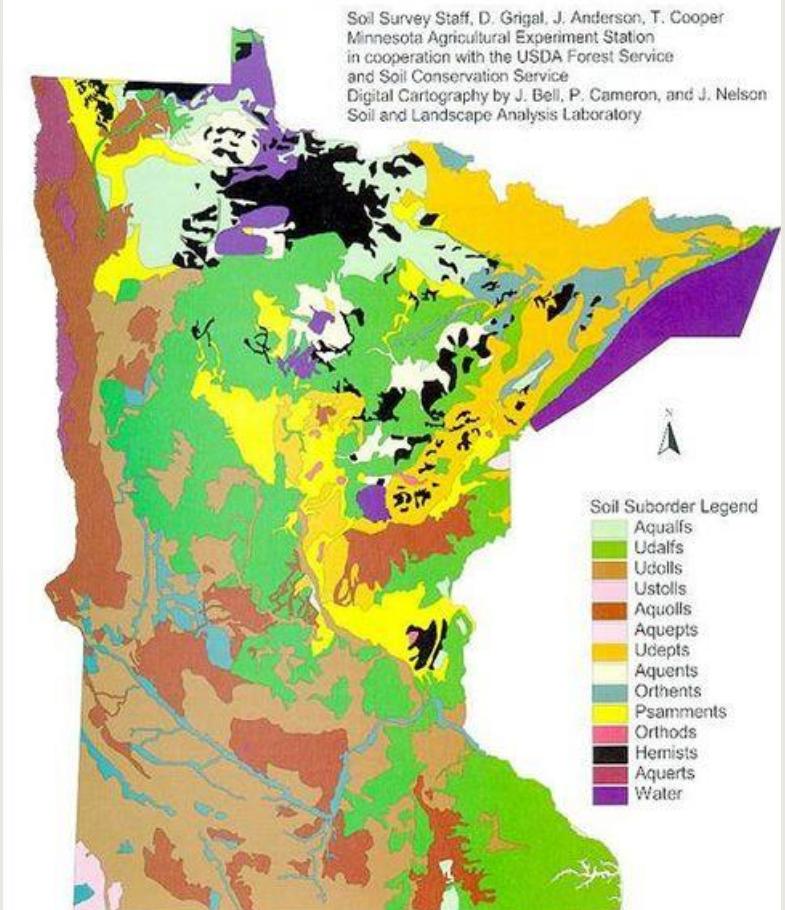


# Creating Soil Maps Using the SSURGO Database & ArcGIS Pro

JESS MULCRONE • U-SPATIAL • UMN • 2024

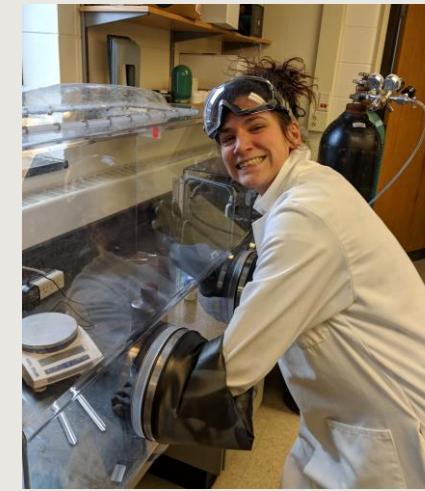
## Soil Suborders of Minnesota



# Hi, I'm Jess



I work at USpatial with the University of Minnesota as a GIS Specialist. Before working here, I lived in Champaign IL working as a researcher for agriculture, ecology, and soil labs at the University of Illinois.



So, making soil maps is right up my ally!

# The SSURGO Database

"The SSURGO database contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. The information can be displayed in tables or as maps and is available for most areas in the United States and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. The information was gathered by walking over the land and observing the soil. Many soil samples were analyzed in laboratories. The maps outline areas called map units. The map units describe soils and other components that have unique properties. The map units are typically named for the major components. The information was gathered at a scale of 1:250,000. The mapping is intended for natural resource planning and management by landowners, township, and county. Some knowledge of soils data and map scale is necessary to avoid misunderstandings.

## SSURGO Homepage

<https://www.nrcs.usda.gov/resources/data-and-reports/soil-survey-geographic-database-ssurgo>

## Web Soil Survey

<https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

Soil Survey Geographic Database (SSURGO)

Home > Resources > Soil Survey Geographic Database (SSURGO)

The Soil Survey Geographic Database (SSURGO) contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. The information was gathered by walking over the land and observing the soil. Many soil samples were analyzed in laboratories. The maps outline areas called map units. The map units describe soils and other components that have unique properties. The map units are typically named for the major components. The information was gathered at a scale of 1:250,000. The mapping is intended for natural resource planning and management by landowners, township, and county. Some knowledge of soils data and map scale is necessary to avoid misunderstandings.

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Technical Information

To obtain technical information about the use of soil data, please contact the NRCS State Soil Scientist in your state, or email [Soils Hotline Staff](#).

Ordering Information

To obtain SSURGO soil spatial and attribute data:

[Web Soil Survey](#) (download only)

[Soil Data Access](#) – Soil Data Access is the name of a suite of web services and applications whose purpose is to meet requirements for requesting and delivering soil survey spatial and tabular data, that are not being met by the current Web Soil Survey and Geospatial Data Gateway websites.

Custom ArcTools for merging SSURGO datasets into a single file geodatabase can be found on the [eSSURGO](#) webpage.

All data are bundled by survey area regardless of the delivery method.

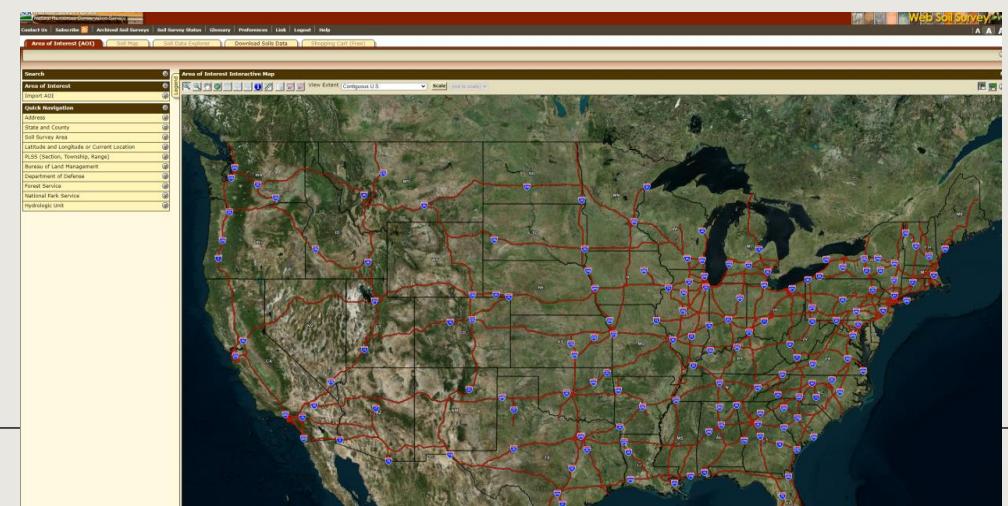
Contact Soils

Please contact us if you see something that needs to be updated, if you have any questions, or if you need accessibility assistance.

[Soils Assistance](#)

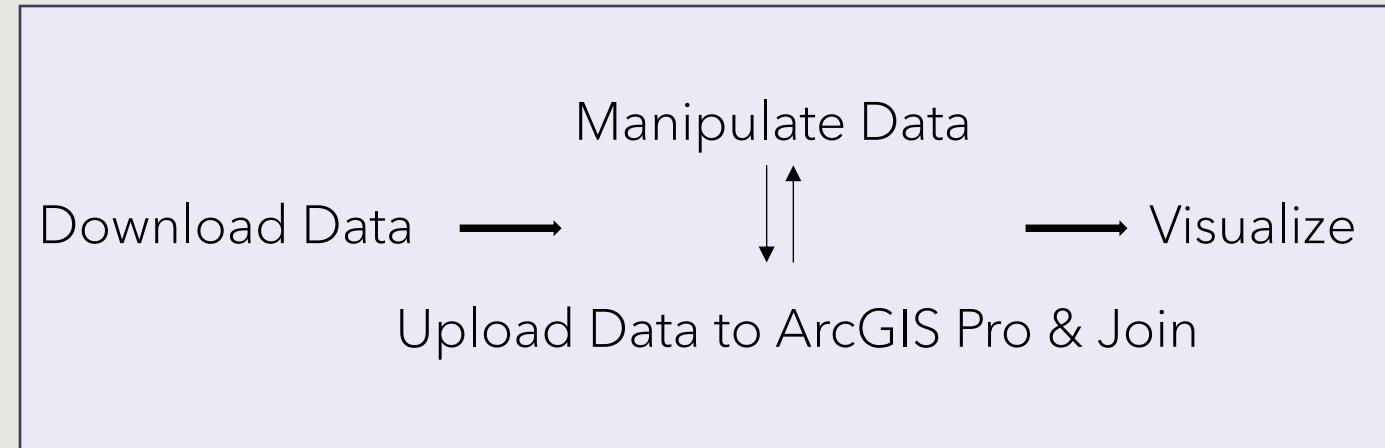
Find Your Local Service Center

USDA Service Centers are locations where you can connect with Farm Service Agency, Natural Resources Conservation Service, or Rural Development employees for your business needs. Enter your state and county below to find your local service center and agency offices. If this locator does not work in your browser, please visit [FSA Service Centers](#).



# Steps to Create a Map from the SSURGO Database

- 1) Get data spreadsheet from SSURGO via download.
- 2) Depending on your end goal, some mix of upload your data to ArcGIS Pro, join your spreadsheet data to other tables, and manipulate your data tables.
- 3) Visualize data by symbolizing map.



# Soil Data Download

Spatial

- From the SSURGO homepage select “Web Soil Survey” link towards bottom of the page, then the green “Start WSS” button. Next select the Download Soils Data tab (pictured right).
- There are 3 main ways to select an Area of Interest (AOI) for which to download data from. You can:
  - Select spatially by uploading a shapefile or drawing the area.
  - Select a county under the Soil Survey Area (SSURGO) section of the Download Soils Data Tab.
  - Select the entire country or an entire state under the U.S. General Soil Map (STATSGO20 section of the Download Soils Data tab).
- Generally, using 2 or 3 will be a better method than 1.
- Download by selecting the link in blue.

County

Entire US/ State

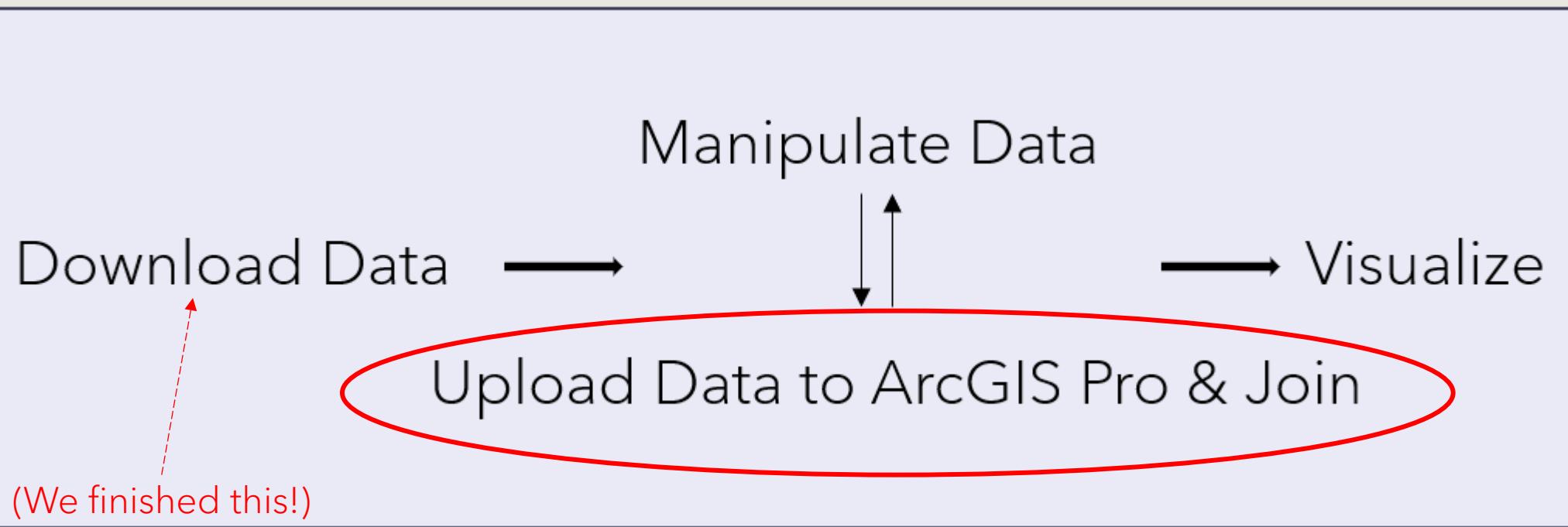
The figure consists of three vertically stacked screenshots of the Web Soil Survey interface, each illustrating a different method for selecting an Area of Interest (AOI) to download soil data:

- Spatial Selection:** The top screenshot shows a map of the United States with a red box highlighting a specific region. A red arrow points to the "Area of Interest (AOI)" tab in the top navigation bar.
- County Selection:** The middle screenshot shows a table titled "Soil Survey Area (SSURGO) Download Links". It lists three areas: Matanuska-Susitna Valley Area (AK000), Anchorage Area, Alaska (AK005), and Greater Fairbanks Area, Alaska (AK010). Each row includes a "State" dropdown (set to "All States and Territories"), a "County" dropdown, and a "Link" column containing a blue download link. Red arrows point to the "County" dropdown for AK000 and the blue "Link" for AK005.
- Entire US/State Selection:** The bottom screenshot shows a table titled "U.S. General Soil Map (STATSGO20) Download Links". It lists states with their corresponding "Download Link" in the "Link" column, preceded by a blue arrow. Examples include Alabama (wss\_gmsoil\_AL\_[2016-10-13].zip), Alaska (wss\_gmsoil\_AK\_[2016-10-13].zip), and Georgia (wss\_gmsoil\_GA\_[2016-10-13].zip).

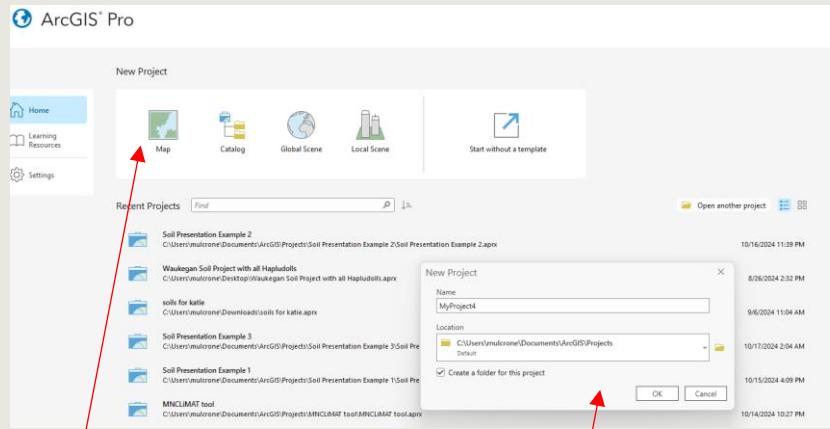
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We're Here:

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# Very Quick ArcGIS Pro Tour:



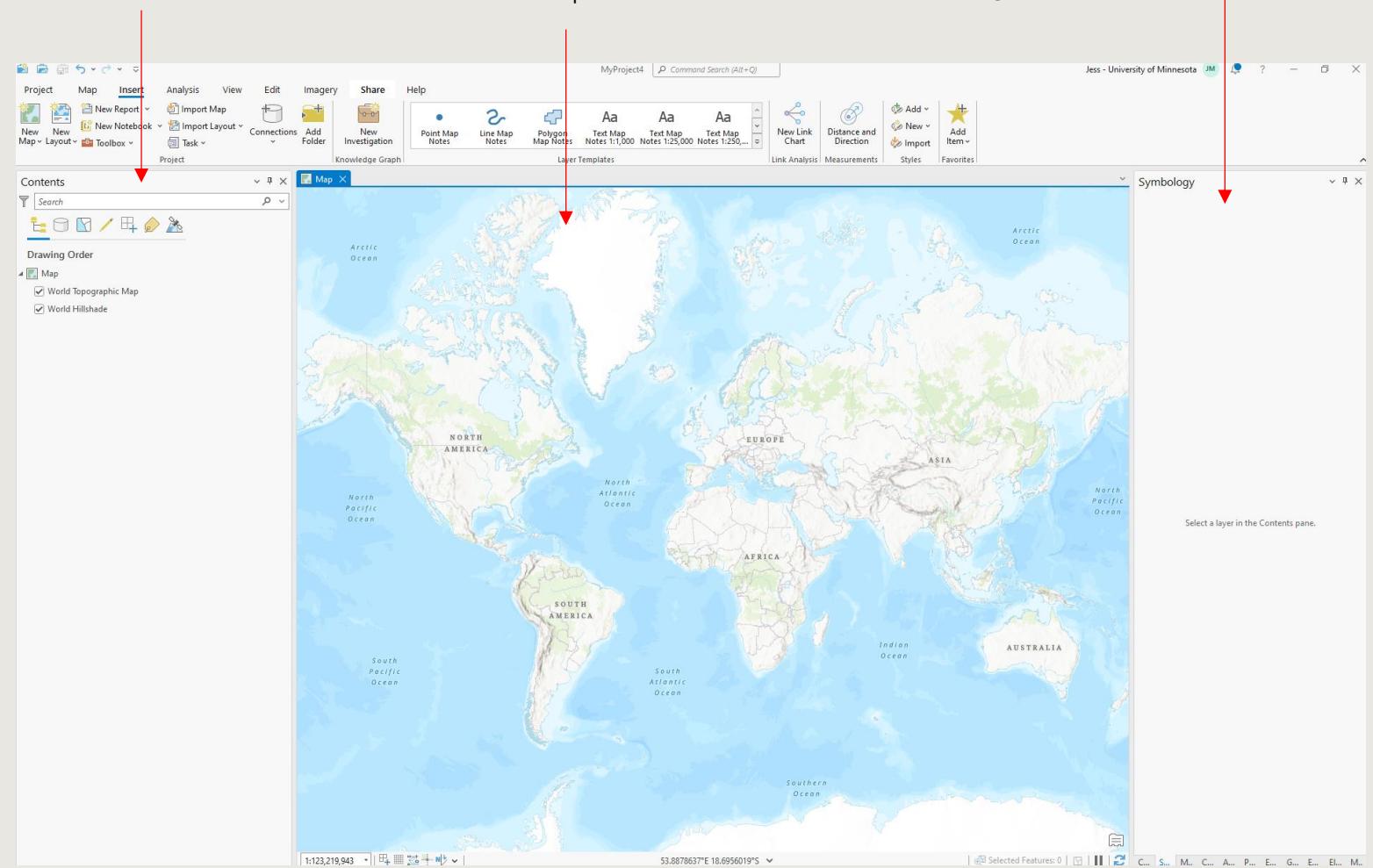
Click on the map to start a new project.

Name it and select OK.

Contents Pane

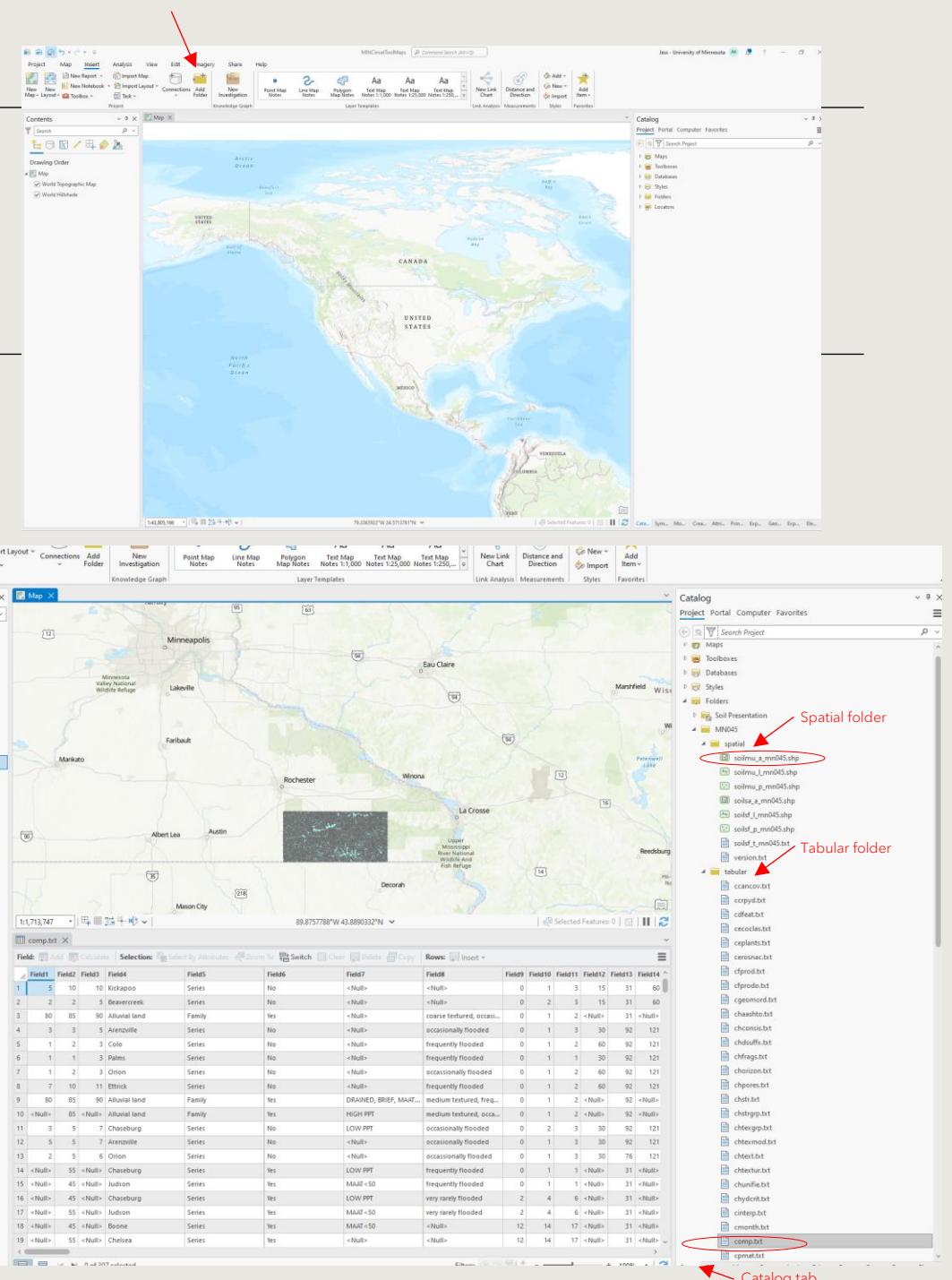
Map

Right hand panel with tabs along the bottom for catalog, geoprocessing, symbolizing, and more.



# Getting Data into ArcGIS Pro

- If you don't have ArcGIS Pro installed on your computer there are instructions here under the ArcGIS Pro section:  
<https://rc.umn.edu/uspatial/software>
- Once you open a new project select "Add Folder" under the "Insert" menu ribbon tab and navigate to the folder you just downloaded from SSURGO (you may need to unzip the folder first).
- Navigate to the "Catalog" tab at the bottom right-hand corner and expand the folder section. You should now see your SSURGO folder. There may be several maps under the spatial tab, but you are likely only interested in "soilmu\_a\_x" file. Drag and drop it into the map and it will appear both on the map and in the contents pane on the left.
- Below the spatial folder there will be a tabular folder. It contains many txt files but most of the time you only need the comp file. Drag and drop this file to the map as well, then right click and select Open in the window that appears to view.
- You now have your data in ArcGIS Pro!



# Using a Soil Data Comp Spreadsheet from SSURGO

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- The comp data table has A LOT of columns (109 to be exact). You likely only need a handful. A few columns that will or might be useful are:
    - mukey (Mapunit key / Field108): A code representing a unique map unit. **This is a very important field.**
    - compname (Component Name / Field 4): The name of the soil series.
    - cokey (Component key / Field109): A code representing a unique component (soil series and characteristics).
    - compct\_r ( Comp percent RV / Field2): The percentage of the component (soil series and characteristics) in the map unit.
    - majcompflag (Major component / Field6): Yes or No indicating whether the soil component is considered a major component of the map unit.
    - taxorder, taxsuborder, taxgrtgroup, taxsubgroup (Order / Field84, Suborder / field85, Great group / Field86, Group / Field87): The taxonomic groups.
  - Unfortunately, the table can lose its column name headers and replace them with way less helpful field numbers. They've always been the same number and order when I've downloaded them but checking that they makes sense every time is smart. For more info on comp table columns see pages 35 - 42 here <https://www.nrcs.usda.gov/sites/default/files/2022-08/SSURGO-Metadata-Table-Column-Descriptions-Report.pdf>
-

# Using a SSURGO Map Attribute Spreadsheet

- The map attribute table is much smaller than the comp table and only has 6 columns.
- The columns you will use are MUKEY, which represents a unique map unit like in the comp table, and the FID, which ties the MUKEY to a specific polygon. The attribute table has one row for each polygon on the map.
- MUKEY is the column used as the join field (or key) when performing joins because it is present in both tables.

	FID	Shape	AREASYMBOL	SPATIALVER	MUSYM	MUKEY
1	39	Polygon	MN045	11	Ac	2216701
2	40	Polygon	MN045	11	Ac	2216701
3	41	Polygon	MN045	11	Ac	2216701
4	522	Polygon	MN045	11	Ac	2216701
5	524	Polygon	MN045	11	Ac	2216701
6	525	Polygon	MN045	11	Ac	2216701
7	526	Polygon	MN045	11	Ac	2216701
8	527	Polygon	MN045	11	Ac	2216701
9	531	Polygon	MN045	11	Ac	2216701
10	532	Polygon	MN045	11	Ac	2216701
11	533	Polygon	MN045	11	Ac	2216701
12	536	Polygon	MN045	11	Ac	2216701
13	537	Polygon	MN045	11	Ac	2216701
14	538	Polygon	MN045	11	Ac	2216701
15	539	Polygon	MN045	11	Ac	2216701
16	540	Polygon	MN045	11	Ac	2216701
17	542	Polygon	MN045	11	Ac	2216701
18	543	Polygon	MN045	11	Ac	2216701
19	544	Polygon	MN045	11	Ac	2216701

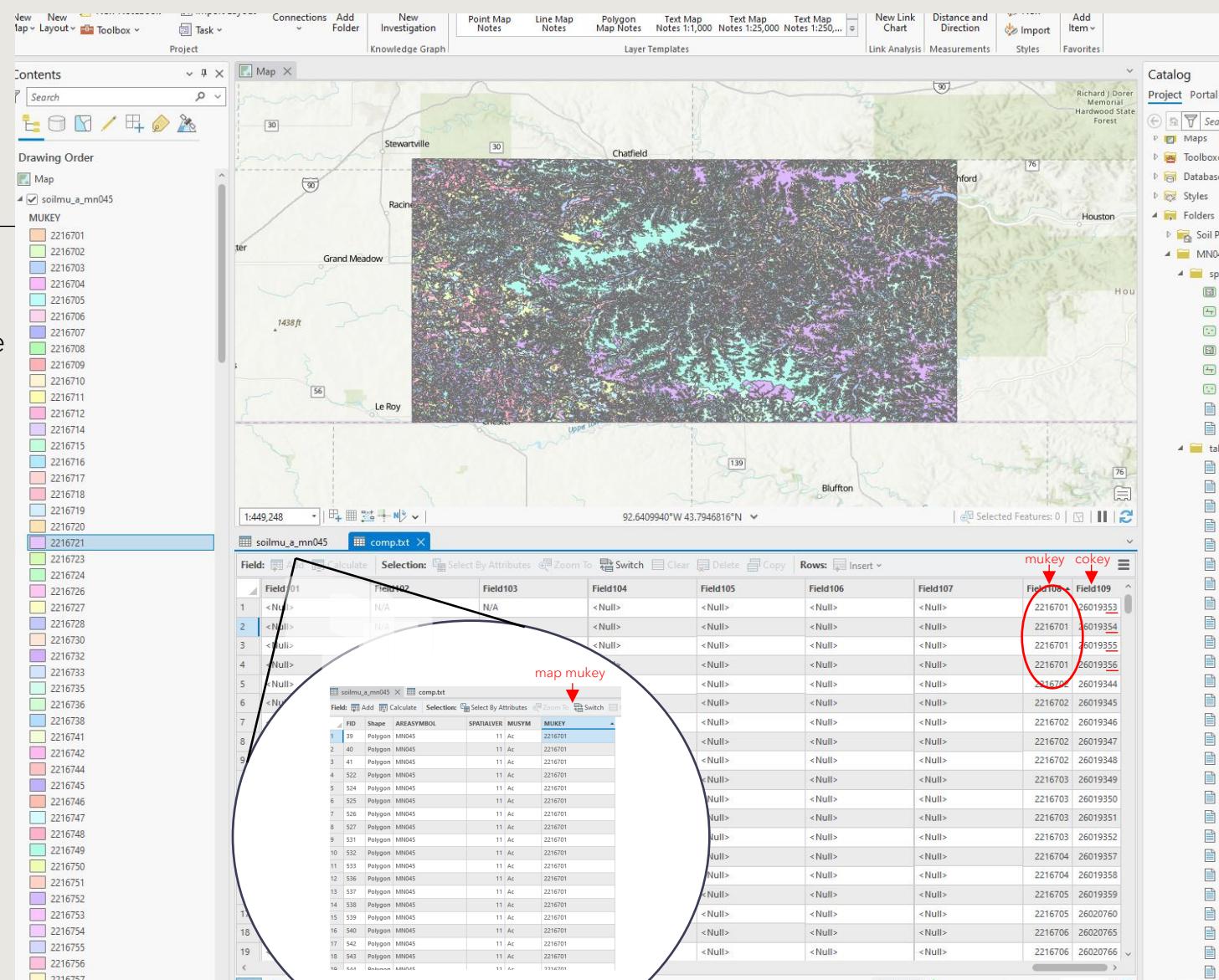
# SSURGO Data Structure

To decide what to do next with our data, we need to think in terms of the SSURGO data structure.

In the screenshot to the right, the comp table is open, and the map attribute table shown in the magnifier.

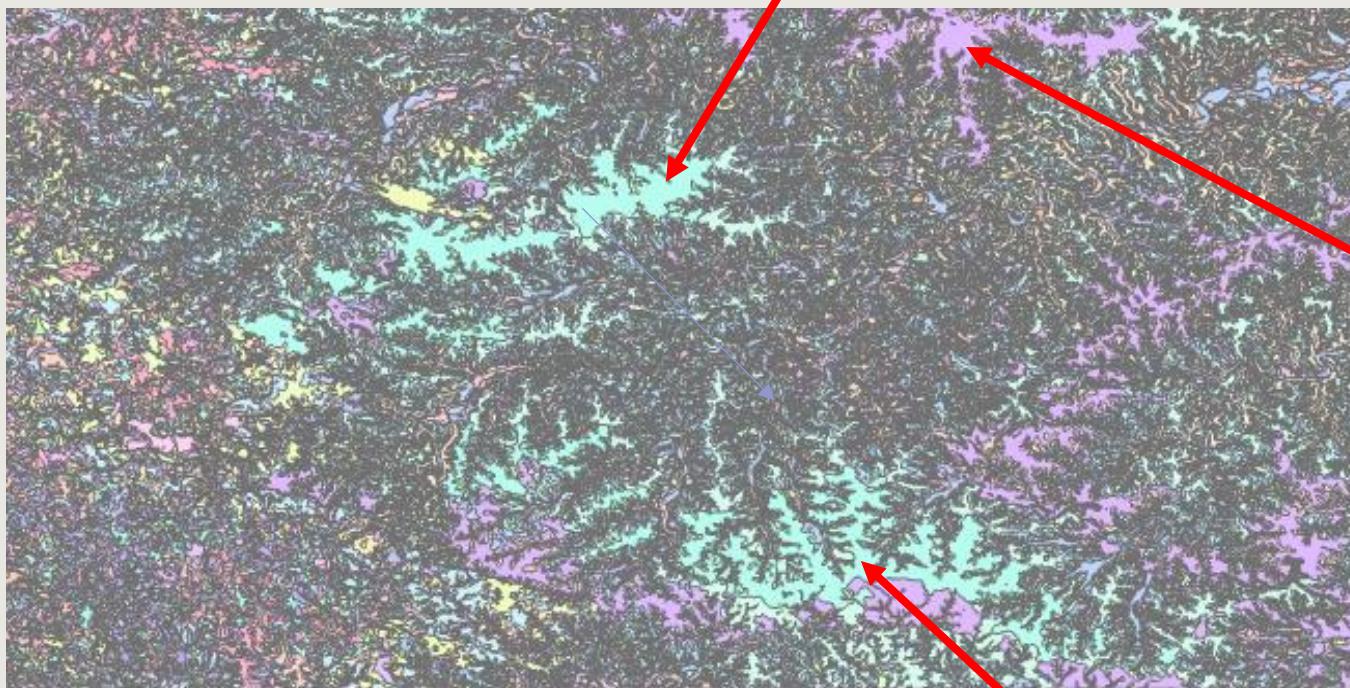
The map on the right is symbolized by mukey. These next points are a little confusing, but **important**:

- Each mukey represents a unique combination of soils, but that mukey often describes multiple polygons.
- Each cokey represents a unique soil component within a map unit. It's a code for a soil name - characteristics\* - mukey combo. There can be multiple cokeys for one soil within a mukey due to different characteristics.
- The comp table has each cokey listed only once, but mukeys have a row in the comp table for each soil they contain.
- Meanwhile, the map attribute table will have a mukey listed as many times as there is a corresponding polygon on the map.
- SSURGO doesn't simply list the soils contained in each mukey because each row contains the information for one polygon with one object ID linking it to the map.



\*I am not sure what the characteristics are or the threshold for difference.

Visual of mukey - soil  
relationship in case it helps!



- The map has an attribute table with mukeys linked to spatial information.
- The information about which soils those mukeys contain comes from the comp table.

MUKEY 1

contains

Soil A

Soil B

Soil C

MUKEY 2

contains

Soil B

Soil D

Soil E

Soil B with  
different  
characteristics

MUKEY 1

contains

Soil A

Soil B

Soil C

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## Example Questions:

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- Which soil series or types are present in specific land parcels?
- Where are all the locations in a county that contain a soil series or type?
- What is the extent of a soil series or type over a region?

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# Example Question 1: Which soil series are present in these land parcels?

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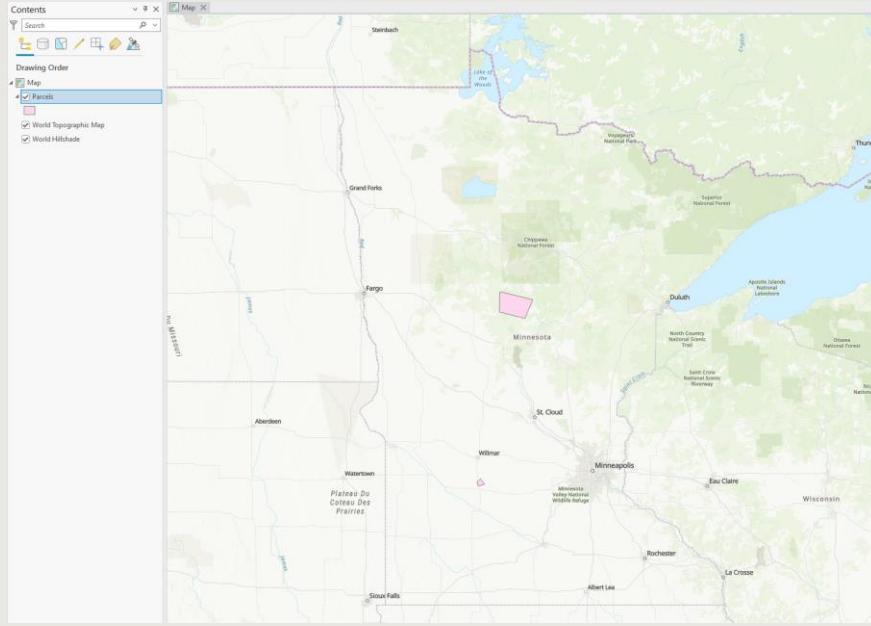
You have: A shapefile of polygons representing land parcels.

You want to know: Which soils are present in those land parcels.

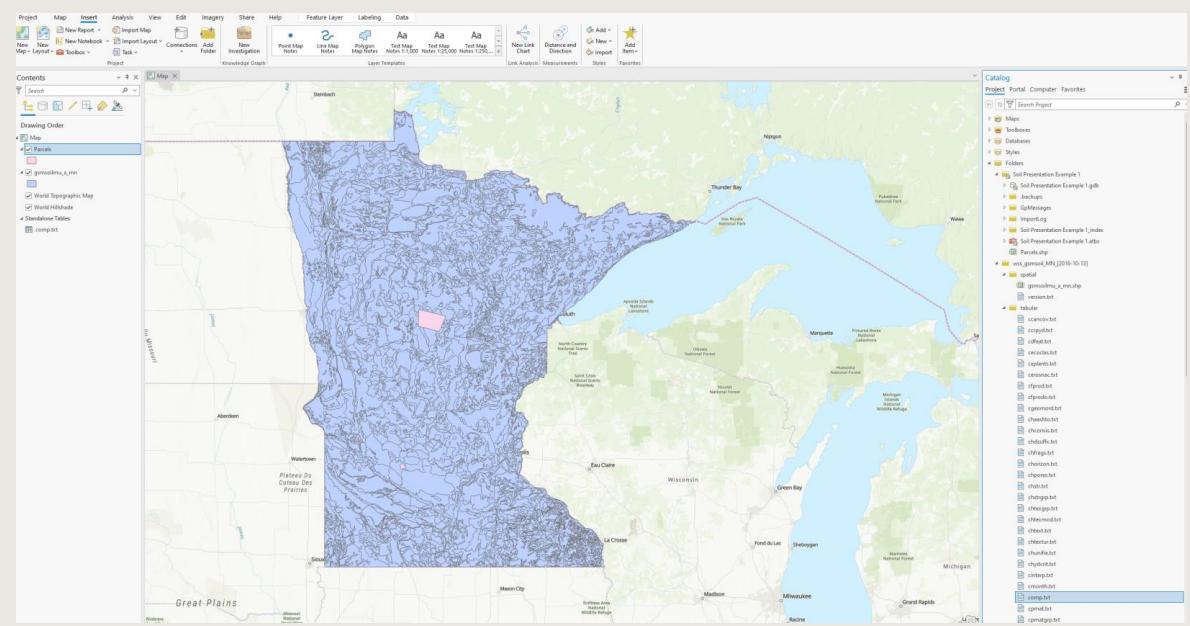
Your product will be: A table.

Steps:

- 1) Download the soil data from SSURGO that covers all the land parcels.
  - 2) Upload the SSURGO tabular and spatial data and your parcel shapefile into ArcGIS Pro.
  - 3) Perform a **spatial join** between the parcel layer and the SSURGO layer to get a table with a row for each mukey in each parcel.
  - 3) Perform a **tabular join** between your new joined table and your comp table using mukey as the join field.
  - 4) You can then sort your table by parcel name to see which soils are in which parcel.
-



So we have a parcel shapefile like this.



And we can get the SSURGO layer that looks like this. What we want is to know which mukeys correspond with the polygons under those two parcels, so we can link it to the comp table and know which soils are in those mukeys and therefore in the parcels.

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## Example Question 1: Which soil series are present in these land parcels?

---

You have: A shapefile of polygons representing land parcels.

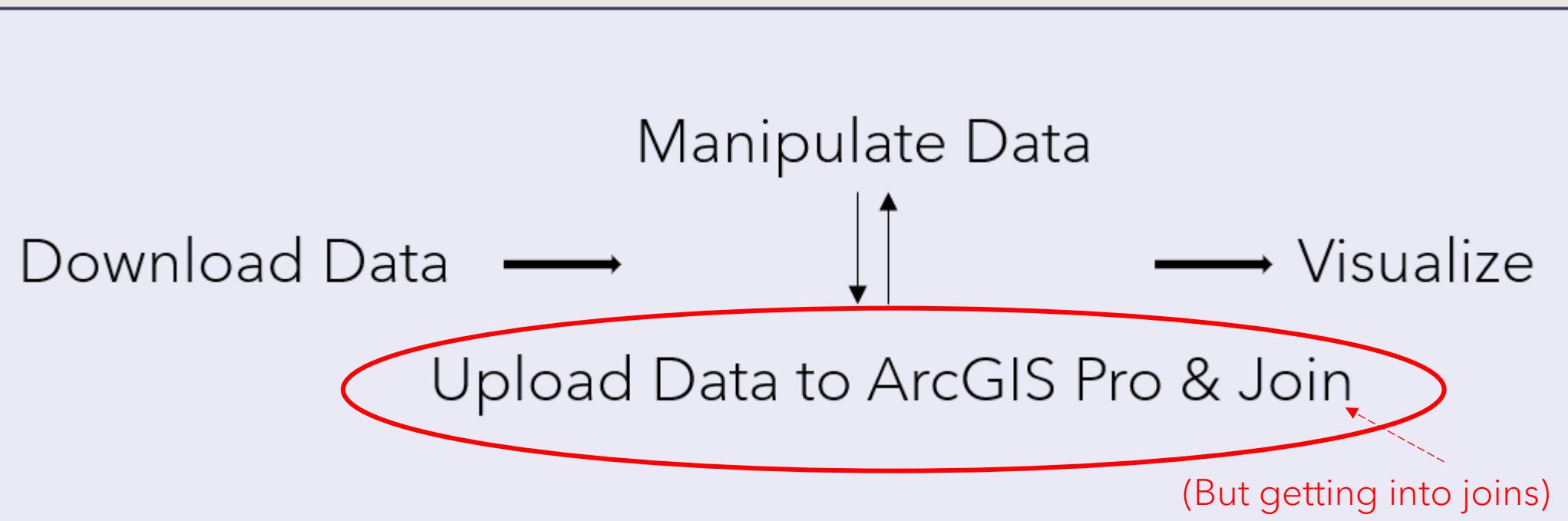
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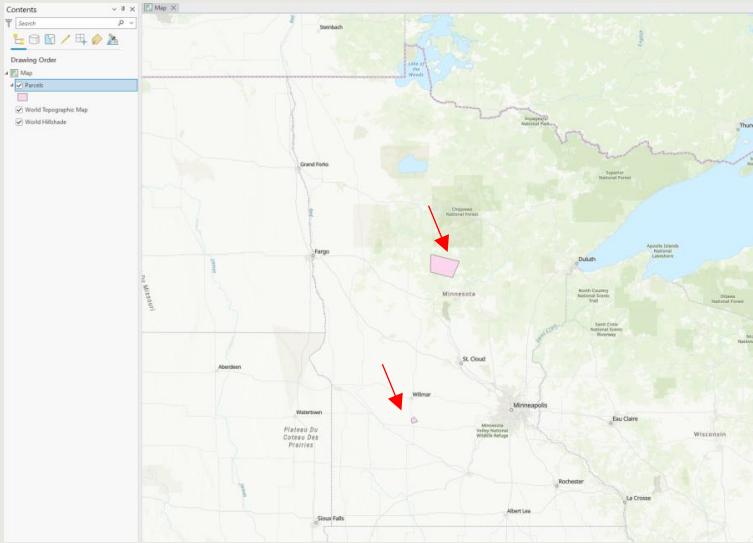
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  - 3) Perform a spatial join between the parcel layer and the SSURGO layer to get a table with a row for each mukey in each parcel.
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  - 4) You can then sort your table by parcel name to see which soils are in which parcel.
-

We're Still Here:



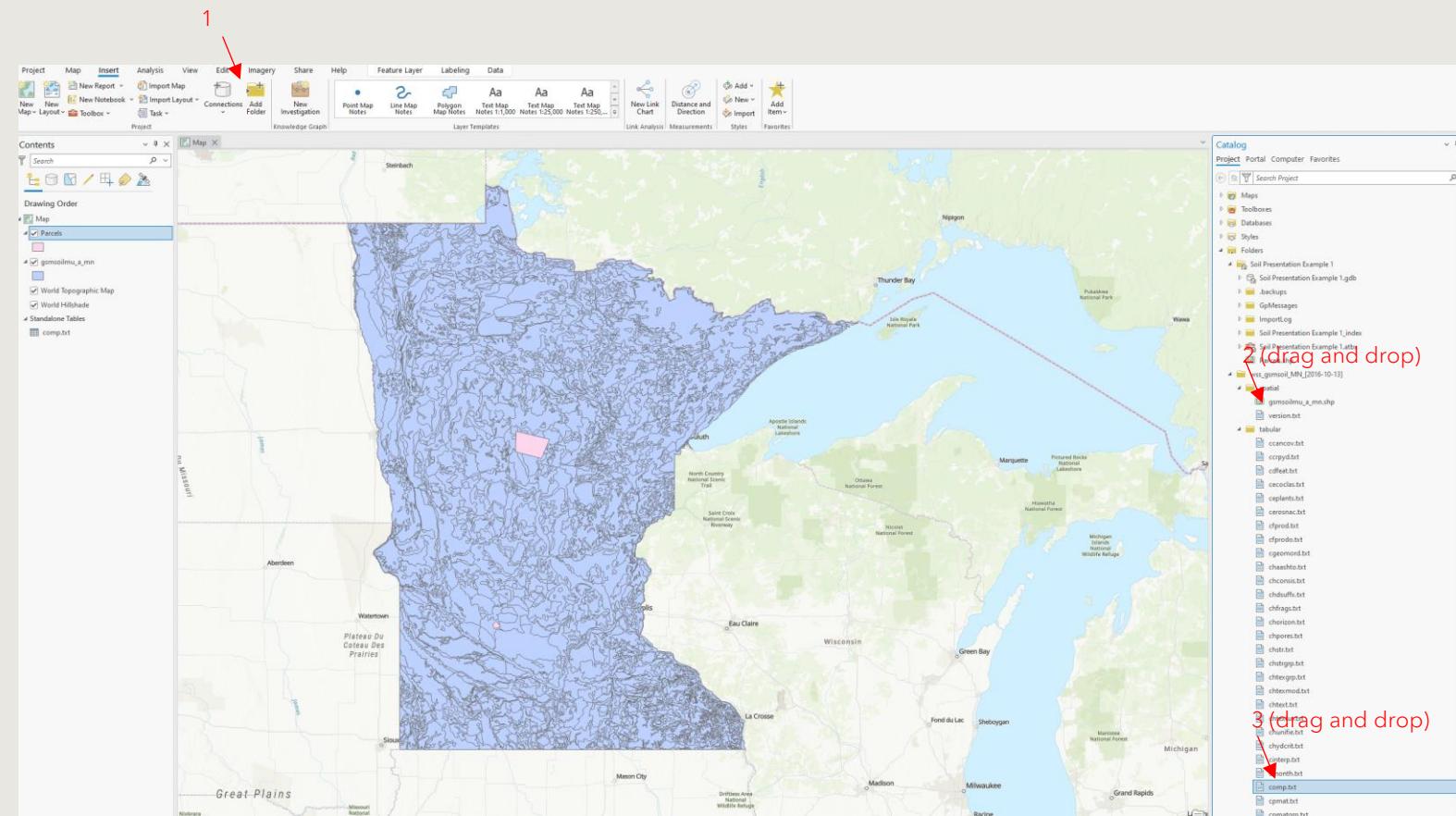
Parcel shapefile with 2 polygons:



1) Download SSURGO data that covers your parcel area.

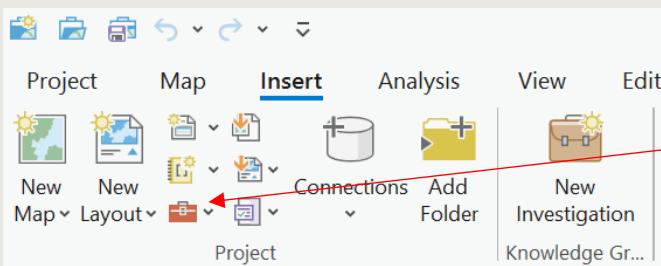
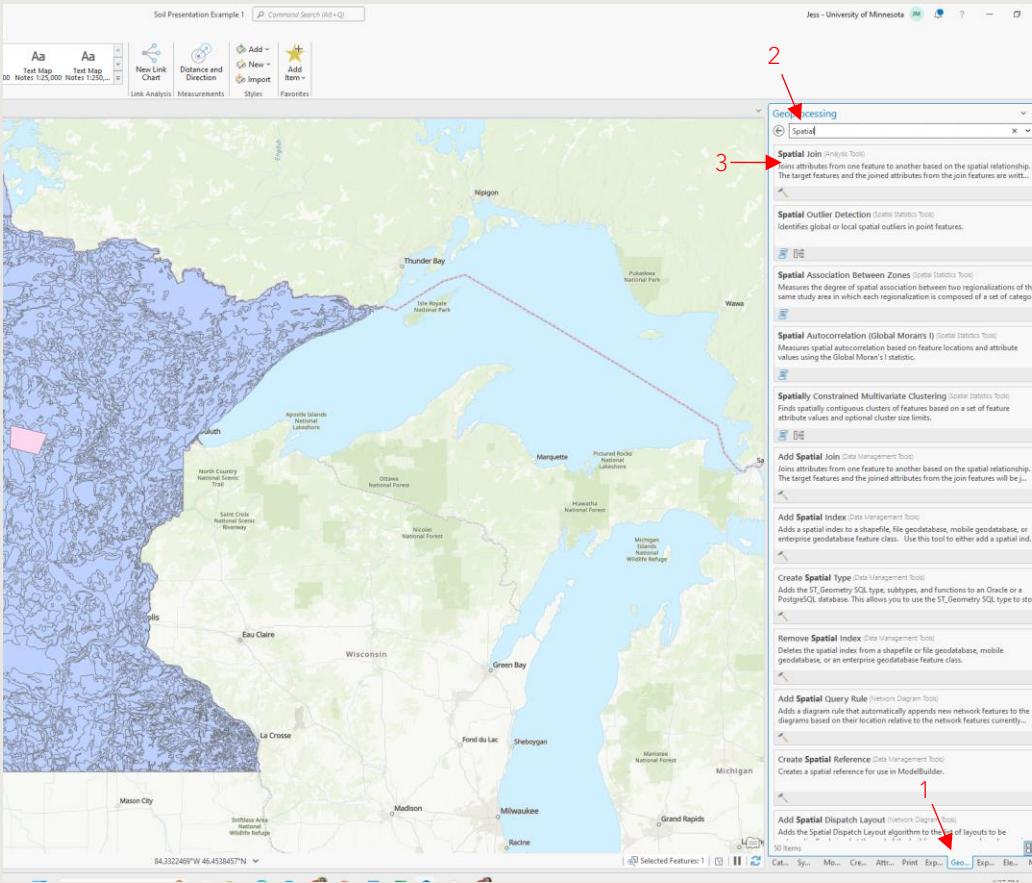
Spatial Extent	Download Size	Download Link
Kansas	9.7 MB	wss_gssoil_KS_[2016-10-13].zip
Kentucky	6.6 MB	wss_gssoil_KY_[2016-10-13].zip
Louisiana	12.8 MB	wss_gssoil_LA_[2016-10-13].zip
Maine	7.2 MB	wss_gssoil_ME_[2016-10-13].zip
Maryland	4.9 MB	wss_gssoil_MD_[2016-10-13].zip
Massachusetts	4.1 MB	wss_gssoil_MA_[2016-10-13].zip
Michigan	9.6 MB	wss_gssoil_MI_[2016-10-13].zip
Minnesota	12.1 MB	wss_gssoil_MN_[2016-10-13].zip
Mississippi	7.7 MB	wss_gssoil_MS_[2016-10-13].zip
Missouri	25.3 MB	wss_gssoil_MO_[2016-10-13].zip
Montana	20.0 MB	wss_gssoil_MT_[2016-10-13].zip
Nebraska	9.8 MB	wss_gssoil_NE_[2016-10-13].zip

2) Upload SSURGO data and parcel data into ArcGIS Pro by selecting Add Folder and navigating to your data (might have to unzip). Then expand the Folders section of your Catalog tab (on the right pane, tabs along the bottom). Expand your downloaded folder and find the map under the spatial folder and comp table under the tabular folder. Drag and drop both.



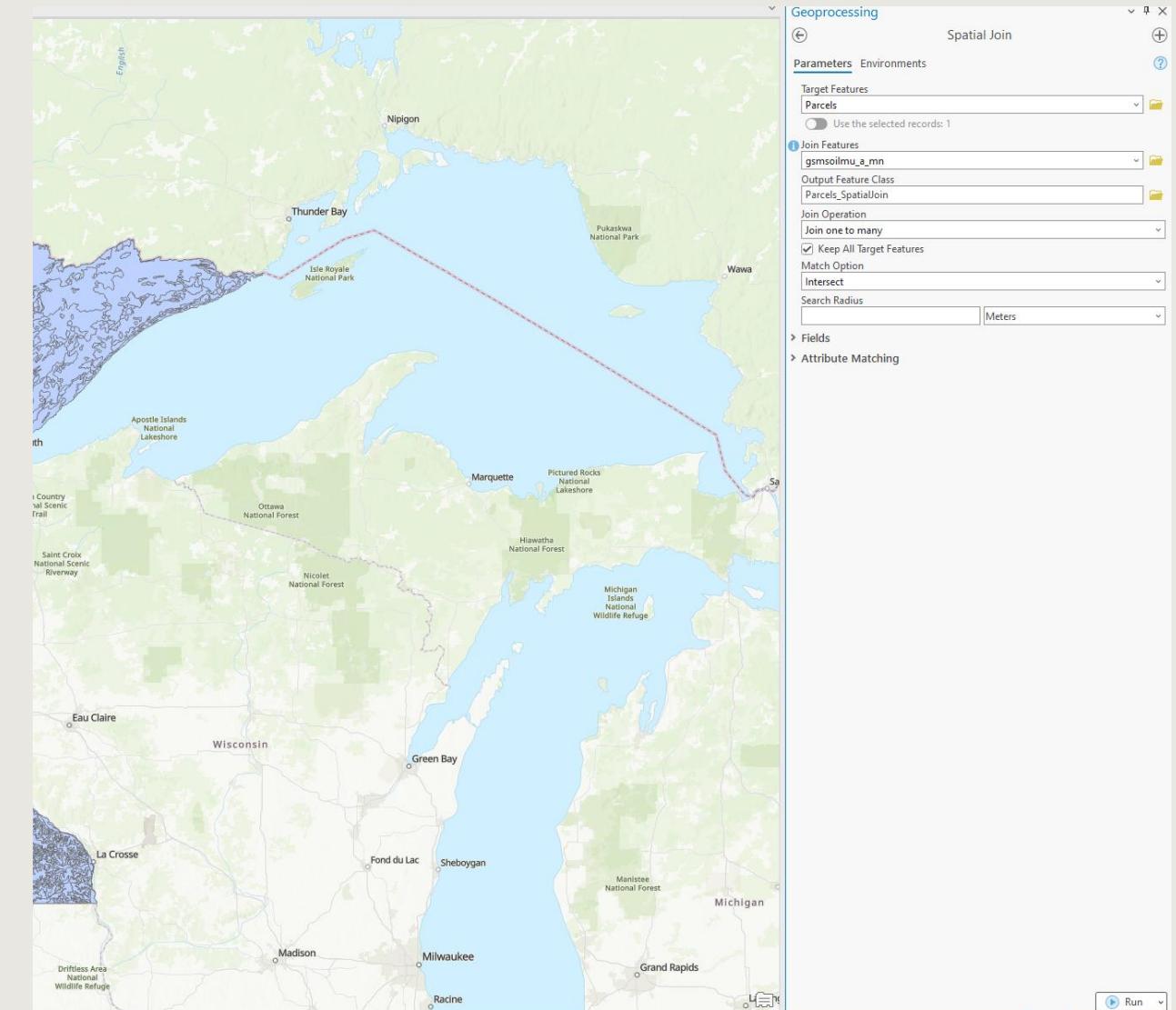
\*Note: Sometimes I have trouble finding the right folder to upload in my downloads folder. When this happens, I move or copy/paste to a new location and find it there. I don't know why this happens.

3) Perform a spatial join between the parcel layer and the SSURGO shapefile layer.



If the geoprocessing tab isn't there, navigate to insert on the top menu ribbon and select the toolbox icon.

Your parcel shapefile will be your target feature and the SSURGO shapefile will be the join feature. Change Join to one-to-many (because there are multiple SSURGO polygons in each parcel) and leave match option as Intersect. Hit Run.



A new layer will appear on in your contents pane named what you wrote in the Output Feature Class field of your spatial join. The default is originalname\_SpatialJoin, so in this case Parcels\_SpatialJoin.

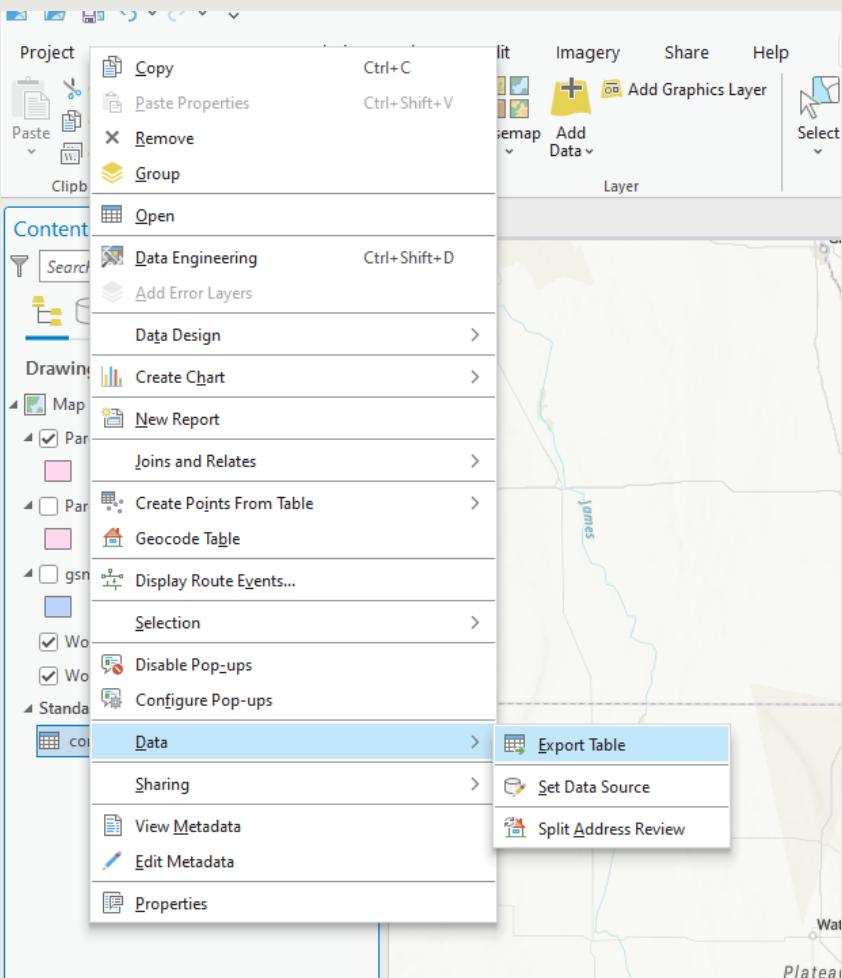
Right click on the new layer and select "Attribute Table" from the popup menu to view the table.

The screenshot shows the ArcGIS Pro interface with a map of the northern Great Plains and upper Midwest. A spatial join has been performed between 'Parcels' and 'gsmsoilmu\_a\_mn'. The resulting feature class, 'Parcels\_SpatialJoin', is selected in the Contents pane. A right-click context menu is open over this layer, with the 'Attribute Table' option highlighted by a red arrow. To the right of the map, the 'Parcels\_SpatialJoin' attribute table is displayed in a table viewer, showing 10 rows of data with columns for OBJECTID, Shape, Join\_Count, TARGET\_FID, JOIN\_FID, Id, AREASYMBOL, SPATIALVER, MUSYM, MUKEY, Shape\_Length, and Shape\_Area.

Field	OBJECTID	Shape	Join_Count	TARGET_FID	JOIN_FID	Id	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	Shape_Length	Shape_Area
1	1	Polygon	1	0	253	0	US	3	s3438	669113	172754.997189	1764380674.305526
2	2	Polygon	1	0	1020	0	US	3	s3472	669147	172754.997189	1764380674.305526
3	3	Polygon	1	0	1111	0	US	3	s3481	669156	172754.997189	1764380674.305526
4	4	Polygon	1	0	1231	0	US	3	s3473	669148	172754.997189	1764380674.305526
5	5	Polygon	1	0	1485	0	US	3	s3464	669139	172754.997189	1764380674.305526
6	6	Polygon	1	0	1521	0	US	3	s3489	669164	172754.997189	1764380674.305526
7	7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526
8	8	Polygon	1	0	1723	0	US	3	s38369	657964	172754.997189	1764380674.305526
9	9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418
10	10	Polygon	1	1	2236	0	US	3	s3511	669186	39172.241479	92157725.037418

The next step is to perform a tabular join between your new joined layer and the comp table, but you may need to change your comp table mukey column to text instead of numerical. You will also likely need to “export” your comp table to make it editable (I don’t know why ArcGIS Pro makes you do this). This will probably feel like an annoying side quest; I’ll try to go through it quickly.

To “export” your comp table (essentially create a copy), right click on it under “Standalone Tables” in the contents pane, select data, and then select Export Table.

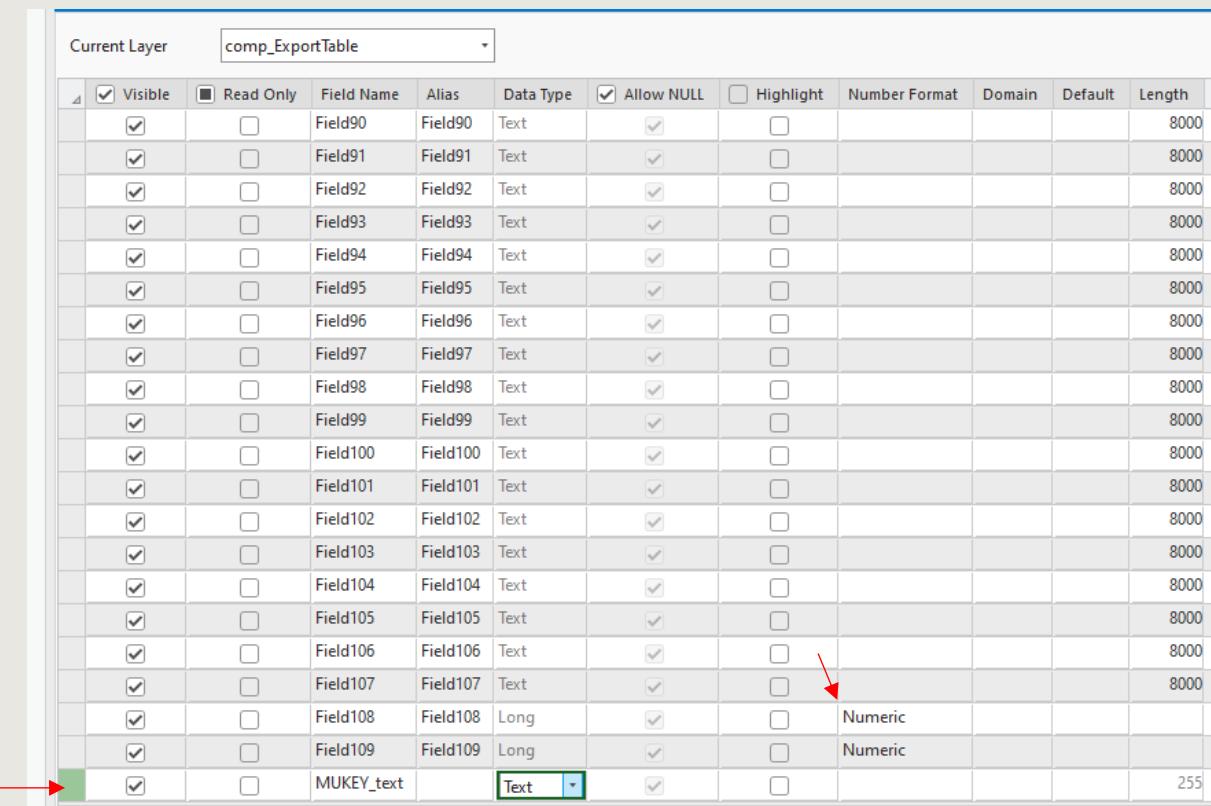


Leave the parameters in the pop up as the defaults and select Run. Your exported table will appear right below your original comp table in the contents pane. Open your exported table (right click > Open) and select the three stacked horizontal bars in the upper right-hand corner. Then select fields view.

A screenshot of the ArcGIS Pro ribbon interface. The 'Data' tab is selected. In the 'Content' pane, there is a 'Standalone Tables' section containing a table named 'comp.ExportTable'. A context menu is open over this table, with the 'Fields View' option highlighted. Other options in the menu include 'Show Field Aliases', 'Reset Field Order', 'Fields View', 'Show domain and subtype descriptions', 'Contingent Values', 'Joins and Relates', 'Related Data', 'Select related records', 'Find and Replace', 'Go to row number', 'Open Data Engineering', and 'Export'. The main workspace shows a map of the Plateau Du Coteau Des Sioux area in Minnesota, with various features and a legend.

SJECTID	Field1	Field2	Field3	Field4	Field5	Field6	Field7	Field8	Field9	Field10	Field11	Field12	Field13	Field14	Field15	Field16	Field17	Field18
1	<Null>	100	<Null>	Water	Miscellaneous area	No	<Null>	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
2	<Null>	8	<Null>	Hegne	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
3	<Null>	7	<Null>	Colin	Series	No	PE+44,DRAINED	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
4	<Null>	1	<Null>	Wahpeton	Series	No	MAAT40-42,MAP19-23	<Null>	0	3	6	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
5	<Null>	1	<Null>	Castel	Series	No	CHANNELLED	<Null>	3	14	25	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
6	<Null>	5	<Null>	Fargo	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
7	<Null>	10	<Null>	Fargo	Series	No	MAP19-23,PE+44,MAA...	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
8	<Null>	63	<Null>	Fargo	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
9	<Null>	2	<Null>	Overly	Series	No	MAP19-23,PE+44,MAA...	<Null>	0	2	3	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
10	<Null>	3	<Null>	Bearden	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	2	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
11	<Null>	17	<Null>	Bearden	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
12	<Null>	5	<Null>	Lindaas	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
13	<Null>	25	<Null>	Fargo	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
14	<Null>	53	<Null>	Hegne	Series	No	MAP19-23,MAAT40-42	<Null>	0	1	1	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
15	<Null>	3	<Null>	Castel	Series	No	CHANNELLED	<Null>	3	14	25	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
16	<Null>	16	<Null>	Castel	Series	No	<Null>	<Null>	0	2	3	<Null>	<Null>	<Null>	<Null>	5 <Null>	4	<Null>
17	<Null>	5	<Null>	Overly	Series	No	MAAT40-42,MAP19-23...	<Null>	0	2	3	<Null>	<Null>	<Null>	<Null>	5 <Null>	7	<Null>
18	<Null>	3	<Null>	Velva	Series	No	MAP19-23,MAAT40-42	<Null>	1	2	3	<Null>	<Null>	<Null>	<Null>	5 <Null>	3	<Null>

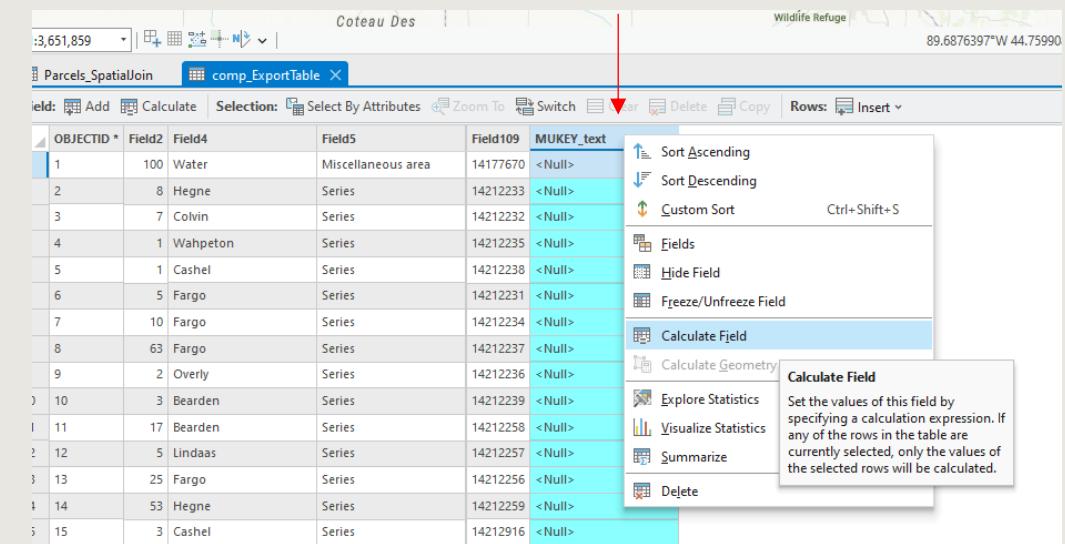
Our mukey field (Field108) is numeric, but we need it to be text to match the data type of the mukey field in the SSURGO shapefile attribute table so we can join them (a join would work if they were both numeric as well, they just need to be the same. I don't know why they aren't the same in the SSURGO database). There will be a row at the bottom of the fields view table that says "Click here to add a new field." Name the new field MUKEY\_text and set the data type to text. You can either save changes with the save icon on the main ribbon or close out of the table and when asked if you would like to save changes, say yes.



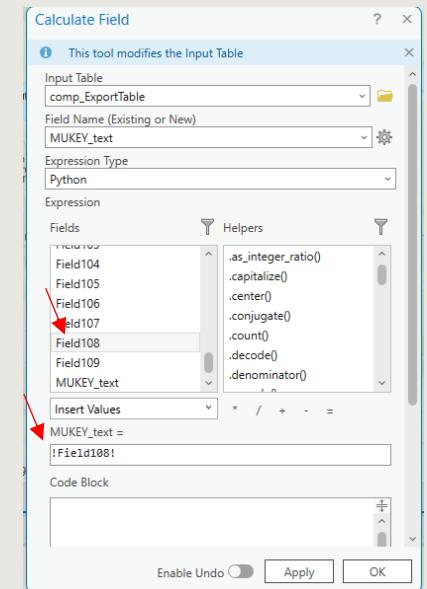
The screenshot shows the ArcGIS Fields View table for the 'comp\_ExportTable'. A red arrow points to the bottom row where a new field is being added. The new field is named 'MUKEY\_text' and its data type is set to 'Text'. Other columns include OBJECTID, Field2, Field4, Field5, Field109, and Field108. The 'Field108' column is currently set to 'Numeric'.

OBJECTID *	Field2	Field4	Field5	Field109	MUKEY_text
1	100	Water	Miscellaneous area	14177670 <Null>	
2	8	Hegne	Series	14212233 <Null>	
3	7	Colvin	Series	14212232 <Null>	
4	1	Wahpeton	Series	14212235 <Null>	
5	1	Cashel	Series	14212238 <Null>	
6	5	Fargo	Series	14212231 <Null>	
7	10	Fargo	Series	14212234 <Null>	
8	63	Fargo	Series	14212237 <Null>	
9	2	Overly	Series	14212236 <Null>	
10	3	Bearden	Series	14212239 <Null>	
11	17	Bearden	Series	14212258 <Null>	
12	5	Lindaas	Series	14212257 <Null>	
13	25	Fargo	Series	14212256 <Null>	
14	53	Hegne	Series	14212259 <Null>	
15	3	Cashel	Series	14212916 <Null>	
		MUKEY_text			Text

A new column will appear at the end of your table called MUKEY\_text. Right click on the header and select calculate field.



In the Calculate Field popup, click in the field that says MUKEY\_text = and then select Field108 from the Fields window so that it populates the MUKEY\_text field with the MUKEY data. Press OK.



4) Perform a tabular join between your new joined layer and the comp table (finally). Right click on your Parcel\_SpatialJoin layer then select Joins and Relates, Add Join, and fill out the popup like below using the MUKEY columns as the join field. Select OK.

The screenshot shows the ArcGIS Pro application window. On the left, the Contents pane lists several layers: 'Parcels' (selected), 'gsmsoil', 'World Topo', 'World H', 'Standalone', and 'comp.t'. A red arrow points from the 'Parcels' entry in the Contents pane to the 'Add Join' option in the context menu. The context menu also includes options like 'Zoom To Layer', 'Selection', 'Label', 'Symbology', 'Data', 'Sharing', 'View Metadata', 'Edit Metadata', and 'Properties'. The main workspace displays a map with a blue polygon layer labeled 'Parcels' and a green polygon layer labeled 'comp.t'. Below the map is a table titled 'SpatialJoin' with the following data:

	Shape *	Join_Count	TARGET_FID	JOIN_FID
1	Polygon	1	0	253
2	Polygon	1	0	1020
3	Polygon	1	0	1111
4	Polygon	1	0	1231
5	Polygon	1	0	1485
6	Polygon	1	0	1521
7	Polygon	1	0	1571
8	Polygon	1	0	1723
9	Polygon	1	1	1581
10	Polygon	1	1	2236

To the right of the map is the 'Add Join' dialog box. It contains the following fields:

- Input Table:** Parcels\_SpatialJoin
- Input Field:** MUKEY
- Join Table:** comp\_ExportTable
- Join Field:** MUKEY\_text
- Checkboxes:**  Keep all input records,  Index join fields

At the bottom of the dialog are 'Validate Join' and 'OK' buttons.

\* In the spatial join we did a few slides ago we needed to select one-to-many, but in tabular joins in this window it will automatically do it for us.

\*Also, we got to the spatial join tool a few slides ago using the Toolbox. This time, with the tabular join, we got there by right clicking on the map layer in the contents pane. This is a shortcut available for the tabular join but not the spatial join. We could also have gotten to the tabular join through the toolbox.

5) Now you can sort your table by parcel to see which soils are present in each polygon. The field here is TARGET\_FID because the shapefile with the parcels was the target in the join and FID is the identifier of each polygon. Your two parcels have FIDs of 0 and 1.



OBJECTID *	Shape *	Join_Count	TARGET_FID	JOIN_FID	Id	AREASYMBOL	SpatialVer	MUSYM	MUKEY	Shape_Length	Shape_Area	OBJECTID	Field2	Field4	Field5	Field109	MUKEY_text
6	Polygon	1	0	1521	0	US	3	s3489	669164	172754.997189	1764380674.305526	1180	2	Water	Miscellaneous area	14234595	669164
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	898	17	Chetek	Series	14234325	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	899	5	Warman	Series	14234339	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	900	1	Greenwood	Series	14234338	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	901	5	Menahga	Series	14234341	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	902	1	Isan	Series	14234324	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	903	2	Mahtomedi	Series	14234327	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	904	3	Mahtomedi	Series	14234330	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	905	10	Menahga	Series	14234326	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	906	3	Meehan	Series	14234329	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	907	1	Emmert	Series	14234332	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	908	8	Menahga	Series	14234335	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	909	1	Water	Miscellaneous area	14234328	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	910	4	Leola	Series	14234331	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	911	1	Mahtomedi	Series	14234334	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	912	1	Mahtomedi	Series	14234337	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	913	31	Chetek	Series	14234340	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	914	5	Menahga	Series	14234333	669146
7	Polygon	1	0	1571	0	US	3	s3471	669146	172754.997189	1764380674.305526	915	1	Seelyeville	Series	14234336	669146
8	Polygon	1	0	1723	0	US	3	s8369	657964	172754.997189	1764380674.305526	1	100	Water	Miscellaneous area	14177670	657964
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1455	4	Normania	Series	14234881	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1456	8	Ves	Series	14234883	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1457	25	Harps	Series	14234886	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1458	2	Mayer	Series	14234882	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1459	5	Doland	Series	14234891	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1460	13	Canisteo	Series	14234885	669187
9	Polygon	1	1	1581	0	US	3	s3512	669187	39172.241479	92157725.037418	1461	20	Seaforth	Series	14234888	669187

\*Note: I've hidden some columns from view to see relevant columns. You can do this by unchecking rows on lefthand side of the fields view.

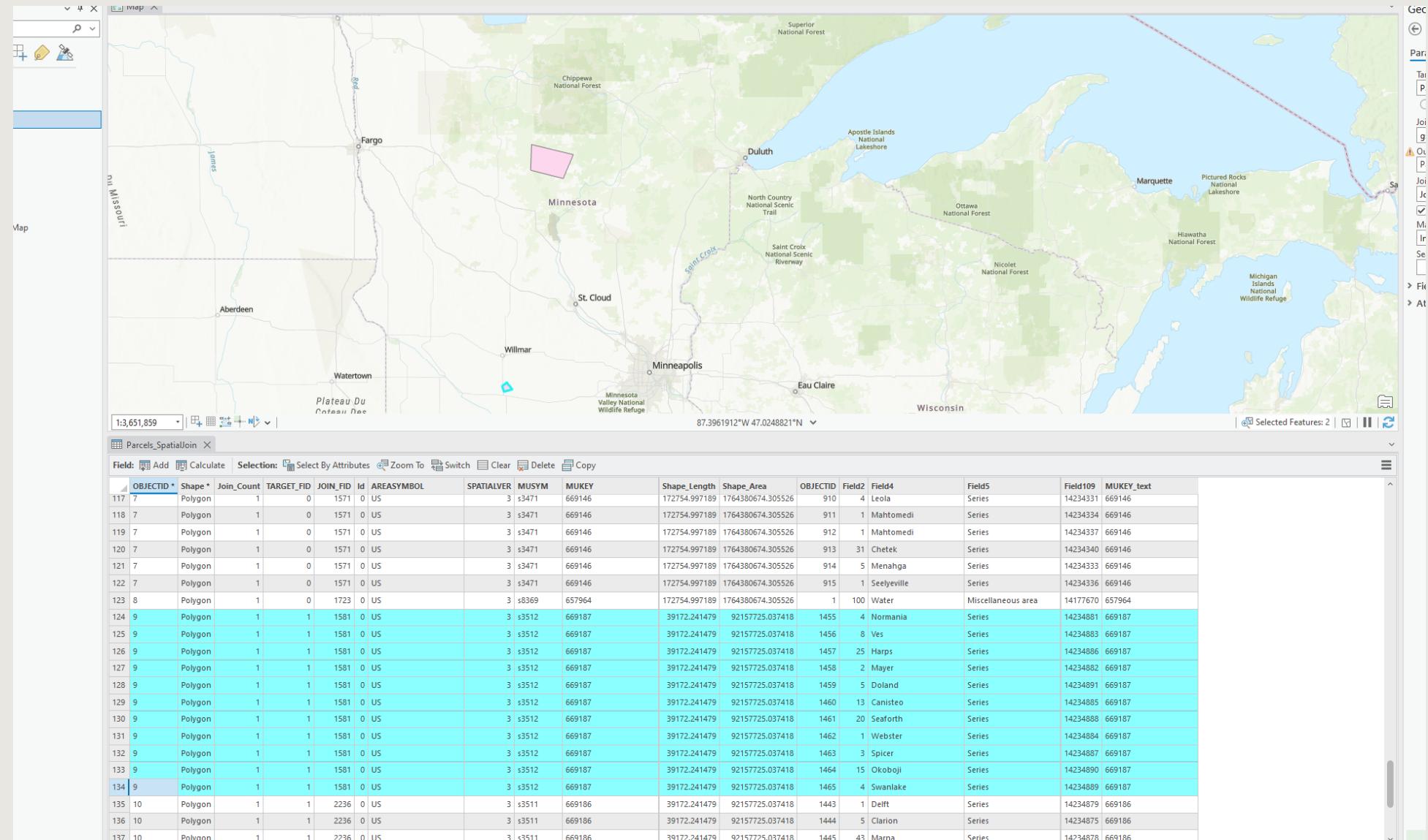
# The Result:

This table is scrolled towards the bottom, but there are many more rows for the larger parcel (TARGET\_FID 0) than the smaller parcel (TARGET\_FID 1).

If you select one row, the corresponding parcel on the map will be highlighted, as well as other rows in the parcel with the same MUKEY.

Every soil contained in each parcel has a row in the table. So if you look at only TARGET\_FID 0, the soils in Field4 are a list of all the soils in that parcel.

You can export this table to excel (we'll do that in the next example) or just get the info straight from this table.



\* Note: The same soil might show multiple times for each parcel. You can delete them by sorting by soil type then right clicking on the number on the left side of the table and selecting delete row (make sure the soils are from different parcels before deleting!). You can do this in excel using the Table to Excel Tool. The soil can show up because it was in two separate MUKEY polygons within the parcel polygon, or because the soil shows up twice in the same MUKEY because of character differences.

We answered a question using SSURGO and  
ArcGIS Pro!

Now let's do one where we make a map.

---

## Example Question 2: Where are all the locations in Fillmore County that contain Dubuque or Fayette soil?

---

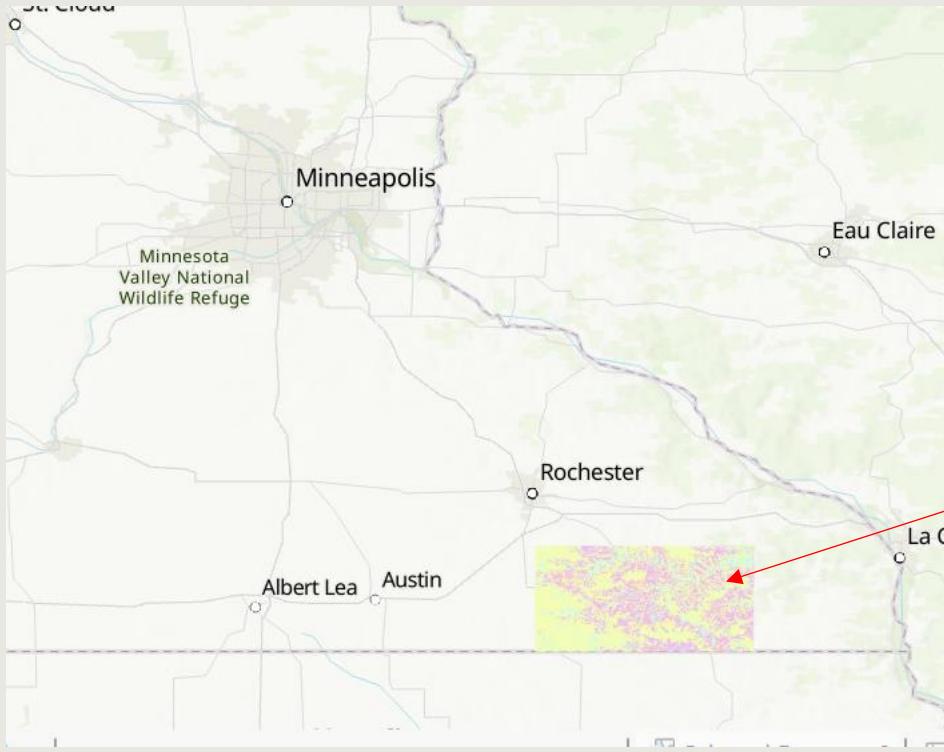
You have: The name of the county and soils type(s) you are interested in.

You want to know: The locations in the county where the soil type of interest is present.

Your product will be: A map.

Steps:

- 1) Download the data for Fillmore county from SSURGO.
  - 2) Upload the SSURGO tabular and spatial data into ArcGIS Pro.
  - 3) Export the SSURGO comp table and open in excel because we need to manipulate the data.
  - 4) Sort the data by soil and delete all rows that are not Dubuque or Fayette.
  - 5) If there a mukey has rows for both Dubuque and Fayette, change soil to Dubuque & Fayette in one row and delete the other as the repeat means both soils are present in the mukey.
  - 6) Export the attribute table for the SSURGO Fillmore County Shapefile and open in Excel. Create a new column called "soil label."
  - 7) Delete duplicate mukeys and copy paste the soil label (Dubuque, Fayette, or Dubuque & Fayette) into your new soil label column for any mukey that was left in the comp table once you whittled it down to Dubuque and Fayette only. For all other rows fill in "other soils."
  - 8) Save and upload the attribute table with the soil label column back into ArcGIS Pro.
  - 9) Join the newly uploaded attribute table to the SSURGO polygon layer.
  - 10) Symbolize the map by soil label.
-



## Fillmore County

We want to link the mukeys of the polygons in the county to the soils each contains so we can show them on the map. Since we're only interested in two soils, it might be easier to start with the comp table and find the mukeys that contain Dubuque or Fayette soils, link those to the attribute table. This avoids a more complicated one-to-many join because each polygon will have one label (Dubuque, Fayette, Dubuque & Fayette, or other soils) instead of many soils.

---

## Example Question 2: Where are all the locations in Fillmore County that contain Dubuque or Fayette soil?

---

You have: The name of the county and soils type(s) you are interested in.

You want to know: The locations in the county where the soil type of interest is present.

Your product will be: A map.

Steps:

- 1) Download the data for Fillmore county from SSURGO.
  - 2) Upload the SSURGO tabular and spatial data into ArcGIS Pro.
  - 3) Export the SSURGO comp table and open in excel because we need to manipulate the data.
  - 4) Sort the data by soil and delete all rows that are not Dubuque or Fayette.
  - 5) If a mukey has rows for both Dubuque and Fayette, change soil to Dubuque & Fayette in one row and delete the other as the repeat means both soils are present in the mukey.
  - 6) Export the attribute table for the SSURGO Fillmore County Shapefile and open in Excel. Create a new column called "soil label."
  - 7) Delete duplicate mukeys then copy paste the soil label (Dubuque, Fayette, or Dubuque & Fayette) into your new soil label column for any mukey that was left in the comp table once you whittled it down to Dubuque and Fayette only. For all other rows fill in "other soils."
  - 8) Save and upload the attribute table with the soil label column back into ArcGIS Pro.
  - 9) Join the newly uploaded attribute table to the SSURGO polygon layer.
  - 10) Symbolize the map by soil label.
-

1 & 2) Download data from SSURGO and upload in ArcGIS Pro. If there are multiple shapefiles use the one that starts with soil\_mu\_a.

**Download Soils Data for...**

Your AOI (SSURGO)

**Soil Survey Area (SSURGO)**

**General Information**

Link Description of Soil Survey Geographic (SSURGO) Database

Download Contents Tabular data, spatial data (if available), template database (if selected), and FGDC metadata

Spatial Data Format ESRI Shapefile, Geographic WGS84

**Options**

- State: Minnesota
- County (optional): Fillmore
- Only show Soil Survey Areas updated since... (input field, Update, Clear buttons)
- Sort by... (Area Symbol dropdown)
- Include Template Database (checkbox checked)

**Soil Survey Area (SSURGO) Download Links**

Name	Area Symbol	Data Availability	Version	Template Database	Download Size	Download Link
Fillmore County, Minnesota	MN045	Tabular and Spatial, complete	Survey Area: Version 20, Sep 7, 2024 Tabular: Version 18, Sep 7, 2024 Spatial: Version 11, Sep 9, 2023	soildb_MN_2003 Access 2003 Version 36	41.1 MB	<a href="#">wss_SSA_MN045_soildb_MN_2003_[2024-09-07].zip</a>

**Project** **Map** **Insert** **Analysis** **View** **Edit** **Imagery** **Share** **Help** **Feature Layer** **Labeling** **Data**

New Map Layout Connections Add Folder Project

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Map Drawing Order Layer Templates Link Analy... Measurements Styles Favorites

**Contents**

Map **soilmu\_a\_mn045** World Topographic Map World Hillshade Standalone Tables comp.txt

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        - soilmu\_l\_mn045.shp
        - soilmu\_p\_mn045.shp
        - solisa\_a\_mn045.shp
        - solisf\_l\_mn045.shp
        - solisf\_p\_mn045.shp
        - solisf\_t\_mn045.txt
        - version.txt
      - tabular
        - ccancov.txt

3) Open the SSURGO comp table in pro and export to Excel using the "Table To Excel" tool under Geoprocessing .

**Project** **Map** **Insert** **Analysis** **View** **Edit** **Imagery** **Share** **Help** **Feature Layer** **Labeling** **Data**

New Map Layout Connections Add Folder New Investigation Knowledge Gr...

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**Catalog**

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Maps Toolboxes Databases Styles Folders

**Geoprocessing**

Table To Excel

**Parameters**

Input Table: comp.txt

Output Excel File (.xls or .xlsx): C:\Users\mulcrone\Documents\ArcGIS\

Use field alias as column header

Use domain and subtype description

Table To SAS (Conversion Tools)

Table To Excel (Conversion Tools)

Table To dBASE (Conversion Tools)

Table To Domain (Data Management Tools)

Table To NetCDF (Multidimension Tools)

4) Sort the Excel comp table by soil and delete all rows that are not Dubuque or Fayette

	A Field1	B Field2	C Field3	D Field4	
1					
2	5	10	10 Kickapoo		Series
3	2	2	5 Beavercreek		Series
4	80	85	90 Alluvial land		Family
5	3	3	5 Arenzville		Series
6	1	2	3 Colo		Series
7	1	1	3 Palms		Series
8	1	2	3 Orion		Series
9	7	10	11 Ettrick		Series
10	80	85	90 Alluvial land		Family
11		85	Alluvial land		Family
12	3	5	7 Chaseburg		Series
13	5	5	7 Arenzville		Series
14	2	5	6 Orion		Series
15	55		Chaseburg		Series
16	45		Judson		Series
17	45		Chaseburg		Series
18	55		Judson		Series
19	45		Boone		Series
20	55		Chelsea		Series
21	45		Boone		Series
22	55		Chelsea		Series
23	55		Chelsea		Series
24	45		Boone		Series
25	45		Boone		Series

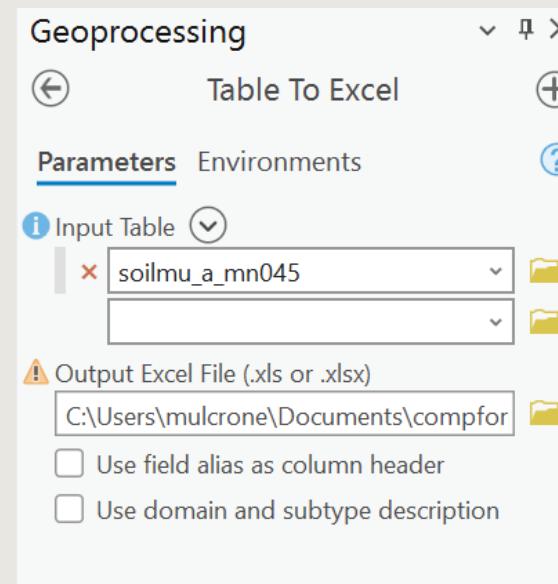
	A Field1	B Field2	C Field3	D Field4	
1				55	Dubuque
2				55	Dubuque
3				55	Dubuque
4				55	Dubuque
5		0	10	10	Dubuque
6		0	10	10	Dubuque
7		0	10	10	Dubuque
8		1	2	2	Dubuque
9	1	1	3	5	Dubuque
10	2	1	3	3	Dubuque
11	3	1	5	15	Dubuque
12	4	15	20	30	Dubuque
13	5	70	85	100	Fayette
14	6	70	85	100	Fayette
15	7	70	85	100	Fayette
16	8	70	85	100	Fayette
17	9	40	70	90	Fayette
18	0	15	35	50	Fayette
19	1				
20	2				

5) Trim the table down to only soil and mukey fields (Field4 and Field108). If there are repeat mukeys for Dubuque and Fayette, change the soil to "Dubuque and Fayette."

	A Field4	B Field108
1	Dubuque	2216727
2	Dubuque	2216728
3	Dubuque	2216730
4	Dubuque	2216732
5	Fayette	2216735
6	Dubuque	2216736
7	Fayette	2216736
8	Dubuque	2216738
9	Fayette	2216738
10	Dubuque	2216741
11	Fayette	2216741
12	Dubuque	2216770
13	Dubuque	2216780
14	Dubuque	2216781
15	Dubuque	2216782
16	Dubuque	2372355
17	Fayette	2372355
18	Dubuque	2372357
19	Fayette	2372357

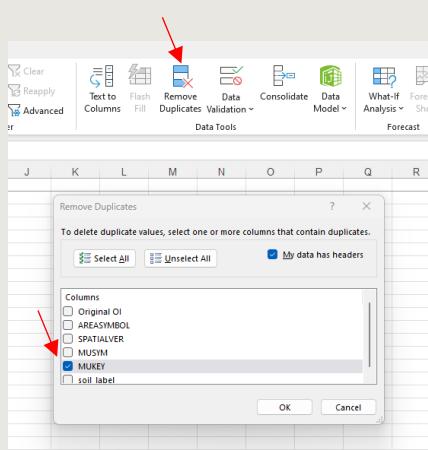
	A Field4	B Field108
1		
2	Dubuque	2216727
3	Dubuque	2216728
4	Dubuque	2216730
5	Dubuque	2216732
6	Fayette	2216735
7	Dubuque & Fayette	2216736
8	Dubuque & Fayette	2216738
9	Dubuque & Fayette	2216741
10	Dubuque	2216770
11	Dubuque	2216780
12	Dubuque	2216781
13	Dubuque	2216782
14	Dubuque & Fayette	2372355
15	Dubuque & Fayette	2372357
16		

6) Export the attribute table for the SSURGO shapefile and open in Excel. Create a new column called "soil label."



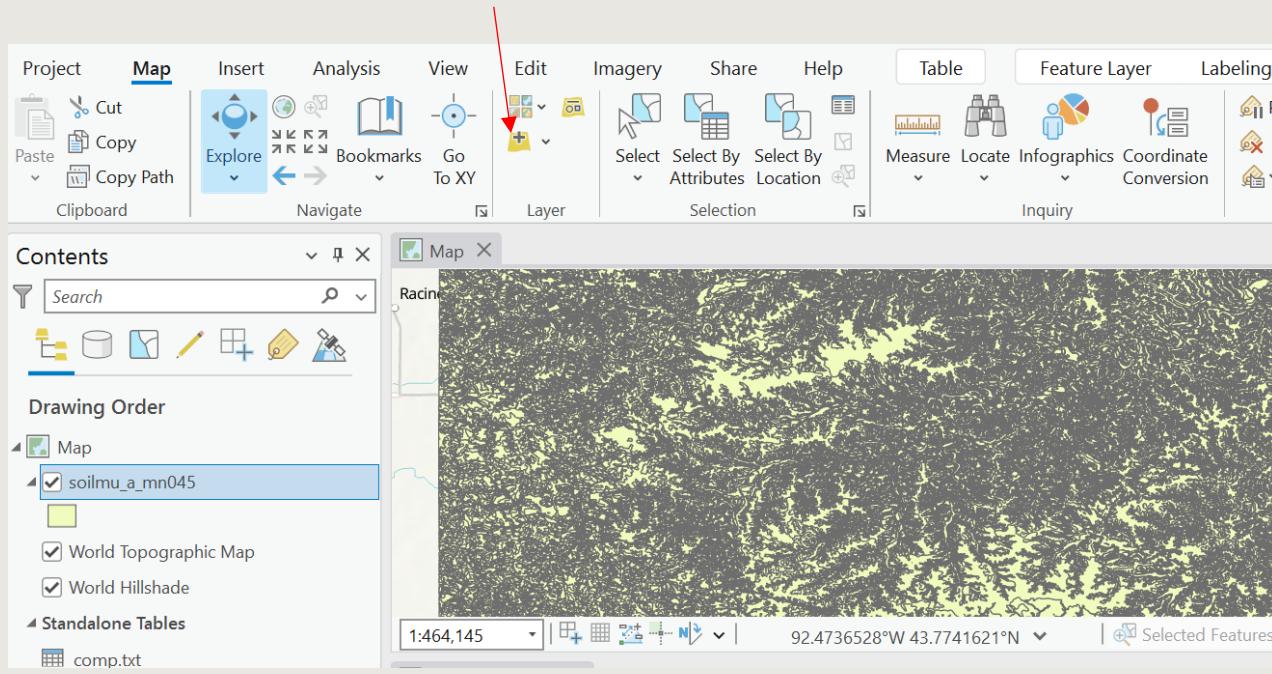
A	B	C	D	E	F
FID	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	soil_label
0	MN045		11 Fh	2216741	
1	MN045		11 Fh	2216741	
2	MN045		11 Fh	2216741	
3	MN045		11 Fh	2216741	
4	MN045		11 Fh	2216741	
5	MN045		11 Fh	2216741	
6	MN045		11 Fh	2216741	
7	MN045		11 Fh	2216741	
8	MN045		11 Fh	2216741	
9	MN045		11 Kd	2216751	
10	MN045		11 Kd	2216751	
11	MN045		11 Kd	2216751	
12	MN045		11 Kd	2216751	
13	MN045		11 Kd	2216751	
14	MN045		11 Kd	2216751	
15	MN045		11 Kd	2216751	
16	MN045		11 Kd	2216751	
17	MN045		11 Kd	2216751	
18	MN045		11 Fd	2216738	
19	MN045		11 Fd	2216738	
20	MN045		11 Fd	2216738	

7) Delete duplicate mukeys by selecting the Remove Duplicates icon under the data tab in the top menu ribbon, checking only mukey, and then selecting OK. Sort by mukey and paste the soil label (Dubuque, Fayette, or Dubuque & Fayette) into the soil label column for any mukey that was left in the comp table (since those are the mukeys with Dubuque or Fayette soils). For all other rows fill in "other soils." Save.

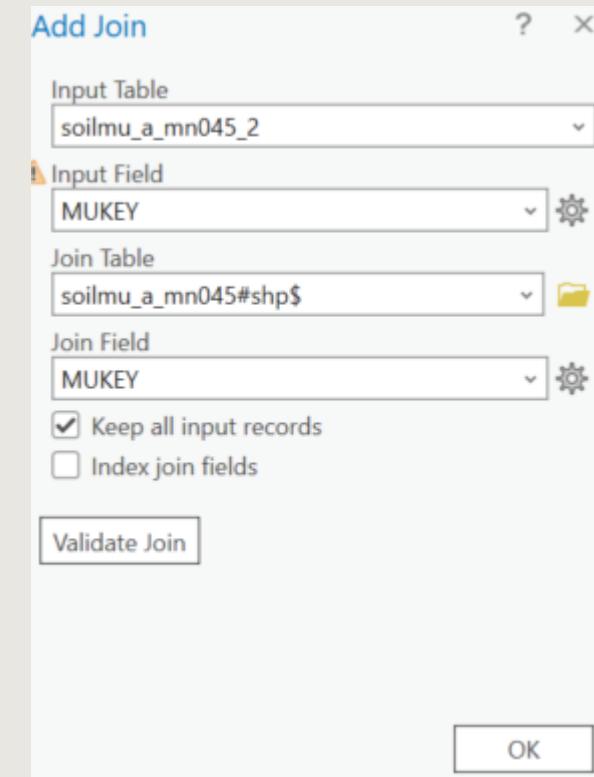


A	B	C	D	E	F	G
1	Original OI	AREASYMBOL	SPATIALVER	MUSYM	MUKEY	soil_label
2	39	MN045		11 Dx	2216727	Dubuque
3	24936	MN045		11 Ds	2216728	Dubuque
4	4434	MN045		11 Du	2216730	Dubuque
5	13797	MN045		11 Dv	2216732	Dubuque
6	23169	MN045		11 Rf	2216770	Dubuque
7	23716	MN045		11 Sa	2216780	Dubuque
8	25659	MN045		11 Sb	2216781	Dubuque
9	10019	MN045		11 Sc	2216782	Dubuque
10	11554	MN045		11 Ff	2216736	Dubuque & Fayette
11	8365	MN045		11 Fd	2216738	Dubuque & Fayette
12	16761	MN045		11 Fh	2216741	Dubuque & Fayette
13	25134	MN045		11 N532C2	2372355	Dubuque & Fayette
14	28287	MN045		11 N533D2	2372357	Dubuque & Fayette
15	402	MN045		11 Fb	2216735	Fayette
16	18214	MN045		11 Ac	2216701	Other Soils
17	18860	MN045		11 Aa	2216702	Other Soils

8 & 9) Upload to ArcGIS Pro by selecting the + under the Map tab and navigating to your saved excel sheet. You may have to select the specific sheet instead of the whole file (this one is called soilmu\_a\_mn045#shp\$).

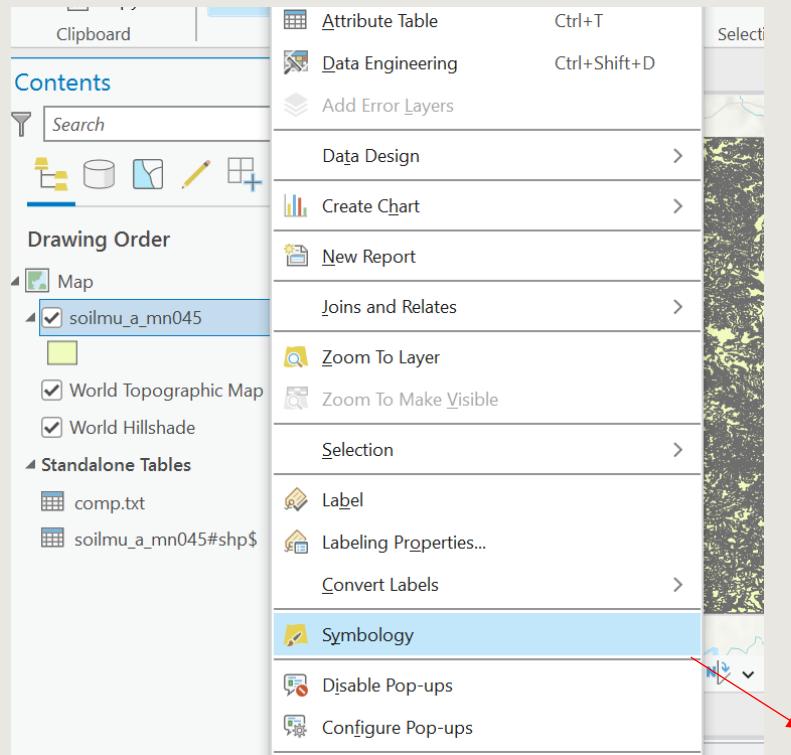


10) Join the new table to the SSURGO polygon layer using MUKEY.

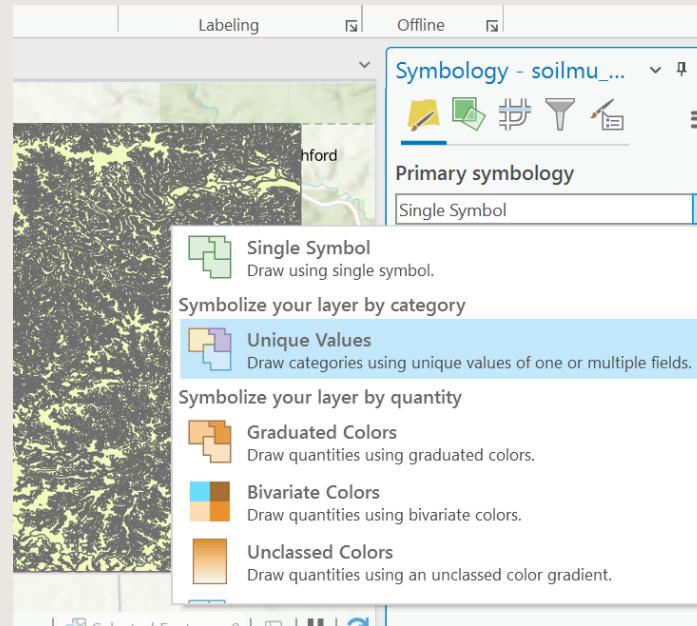


\* We could have used object IDs to join instead and not deleted the duplicate MUKEYS; I've done it that way in the past. But this way is less prone to mistakes.

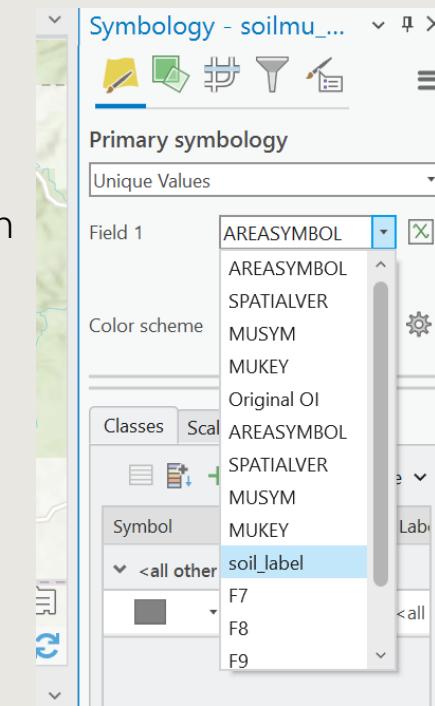
10) Symbolize the map. Right click on the joined SSURGO layer and select symbology.



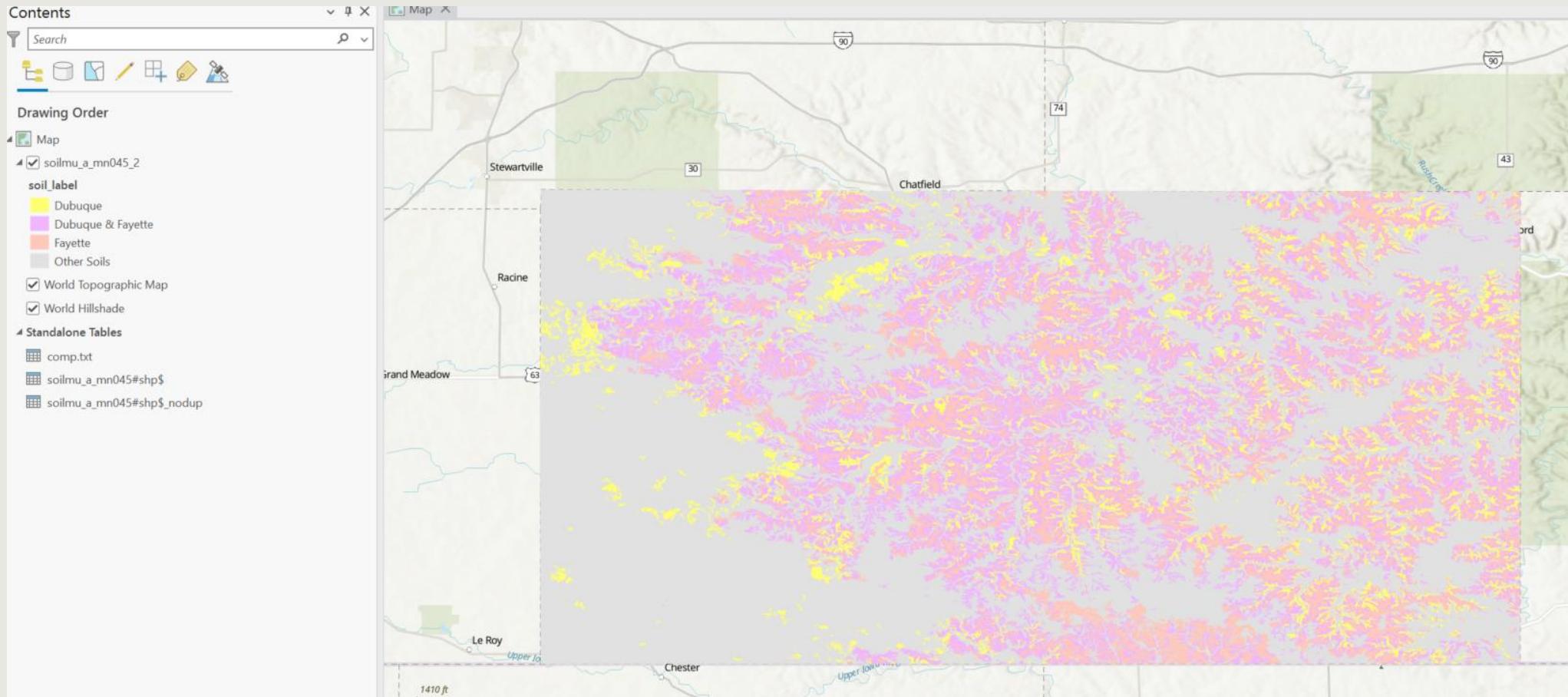
Open the Primary symbology dropdown and select Unique Values.



Open the Field 1 drop down and select "soil\_label"



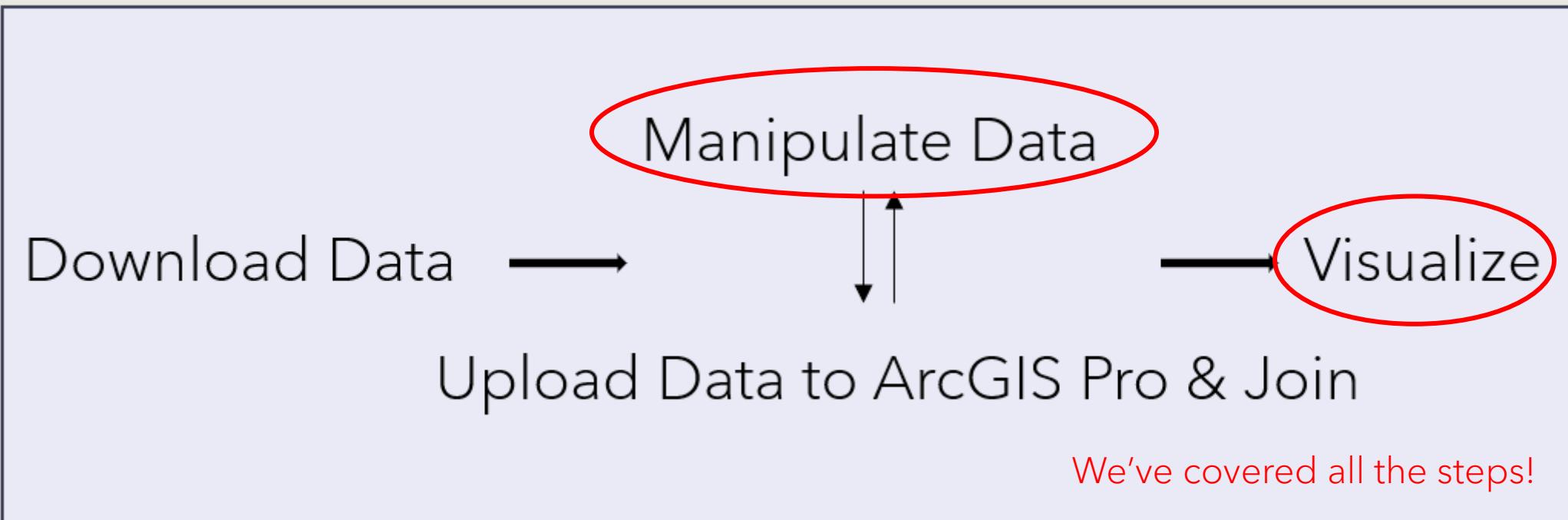
# The Result:



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In The Last Example, We Also Covered:

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# Example Question 3 (Last One!): What is the Midwest extent of Waukegan soils compared to other Typic Hapludoll soils?

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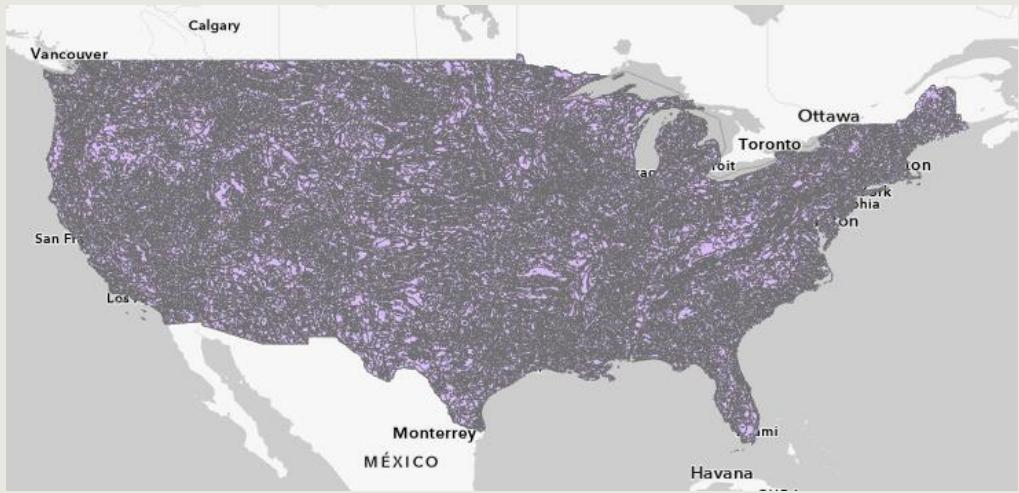
You have: The name of your region and soil type(s) of interest.

You want to know: The locations in the region where the soil types are present.

Your product will be: A map.

Steps:

- 1) Download SSURGO data for the Midwest.
  - 2) Upload the SSURGO tabular and spatial data into ArcGIS Pro.
  - 3) Export the comp table and open in Excel because we need to manipulate the data.
  - 4) Sort by subtype.
  - 5) Add new column called "soil code."
  - 6) Fill in a 3 in the soil code column for every soil that isn't Typic Hapludoll, a 2 for any soil that is Typic Hapludoll but not Waukegan, and a 1 for each Waukegan soil.
  - 7) Upload this new comp table to R then export the attribute table for the SSURGO shapefile from ArcGIS Pro and upload it to R as well.
  - 8) Perform a left join in R.
  - 9) Write code to keep only the row with the lowest number for each mukey because we want the overriding classification for each polygon.
  - 10) Export the resulting table and upload back into ArcGIS Pro.
  - 11) Join newly uploaded table to the SSURGO polygon layer.
  - 12) Symbolize the map by soil code.
-



We have this SSURGO map of the US.

And classify each polygon in the Midwest as:

Waukegan = 1

non-Waukegan Typic Hapludoll = 2

non-Typic Hapludoll = 3

non-Hapludoll = 4

With the most specific classification overriding the others.

We'll want to sort the comp table by these classifications to easily assign codes based on their classification, then join that table to the map attribute table and select the lowest code for each mukey as that one "wins." A mukey might have soils with each code because a mukey could have Waukegan soils as well as many others, but if it has Waukegan at all it should be classified as 1. If a mukey has no Waukegan soils and no non-Waukegan Typic Hapludoll soils, but does have non-Typic Hapludoll soils, it should be a 3. And so on.



We want to use this area.

---

# Example Question 3 (Last One!): What is the Midwest extent of Waukegan soils compared to other Typic Hapludoll soils?

---

You have: The name of your region and soil type(s) of interest.

You want to know: The locations in the region where the soil types are present.

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Steps:

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  - 9) Write code to keep only the row with the lowest number for each mukey because we want the overriding classification for each polygon.
  - 10) Export the resulting table and upload back into ArcGIS Pro.
  - 11) Join newly uploaded table to the SSURGO polygon layer.
  - 12) Symbolize the map by soil code.
-

1 &2) Download data from SSURGO and upload in ArcGIS Pro.

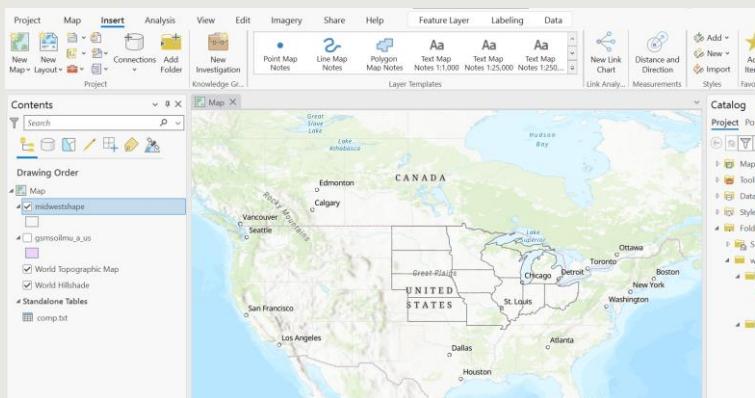
The screenshot shows the 'Download Soils Data' tab selected in the top navigation bar. The main content area displays 'General Information' and 'STATSGO2 Download Links'. A red arrow points from the 'Download Soils Data' tab to the 'Map' tab in the ArcGIS Pro interface above.

**General Information**

- Link: Description of U.S. General Soil Map (STATSGO2)
- Download Contents: Tabular data, spatial data, template database, and FGDC metadata
- Spatial Data Format: ESRI Shapefile, Geographic WGS84

**STATSGO2 Download Links**

Spatial Extent	Download Size	Download Link
(entire data set)	424.7 MB	wss_gsmsoil_US_[2016-10-13].zip
Alabama	9.6 MB	wss_gsmsoil_AL_[2016-10-13].zip
Alaska	76.0 MB	wss_gsmsoil_AK_[2016-10-13].zip
Arizona	9.1 MB	wss_gsmsoil_AZ_[2016-10-13].zip
Arkansas	6.9 MB	wss_gsmsoil_AR_[2016-10-13].zip
California	23.2 MB	wss_gsmsoil_CA_[2016-10-13].zip
Colorado	13.3 MB	wss_gsmsoil_CO_[2016-10-13].zip

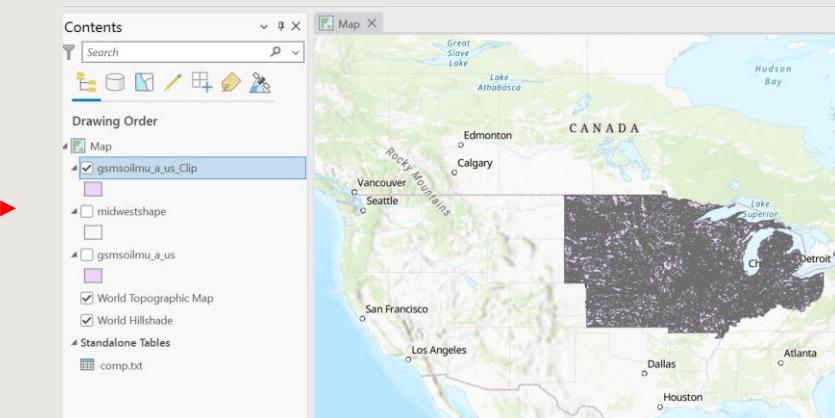


The screenshot shows the ArcGIS Pro interface with the 'Contents' pane open. A red arrow points from the 'midwestshape' layer in the 'Contents' pane to the 'Map' view below. The 'Map' view shows a map of North America with a soil layer ('gsmsoilmu\_a\_us') highlighted in purple. The 'Catalog' pane on the right shows a folder structure for 'wss\_gsmsoil\_US' containing 'spatial' and 'tabular' subfolders.

To get only the Midwest portion of the US map, I used the Clip tool under Geoprocessing (the tab is at the bottom of the pane, you can search Clip and it will come up). I clipped with a shapefile of the extent of the Midwest. You might be able to find shapefiles like this online but sometimes they need to be created. You can email me or USpatial if you ever need help making an extent map to clip from.

The screenshot shows the 'Geoprocessing' pane with the 'Clip' tool selected. A red arrow points from the 'Clip' tool in the 'Geoprocessing' pane to the 'Contents' pane below. The 'Parameters' tab is active, showing the following settings:

- Input Features or Dataset: gsmsoilmu\_a\_us
- Clip Features: midwestshape
- Output Features or Dataset: gsmsoilmu\_a\_us\_Clip



3) Export the comp table to Excel (use the Table to Excel tool).

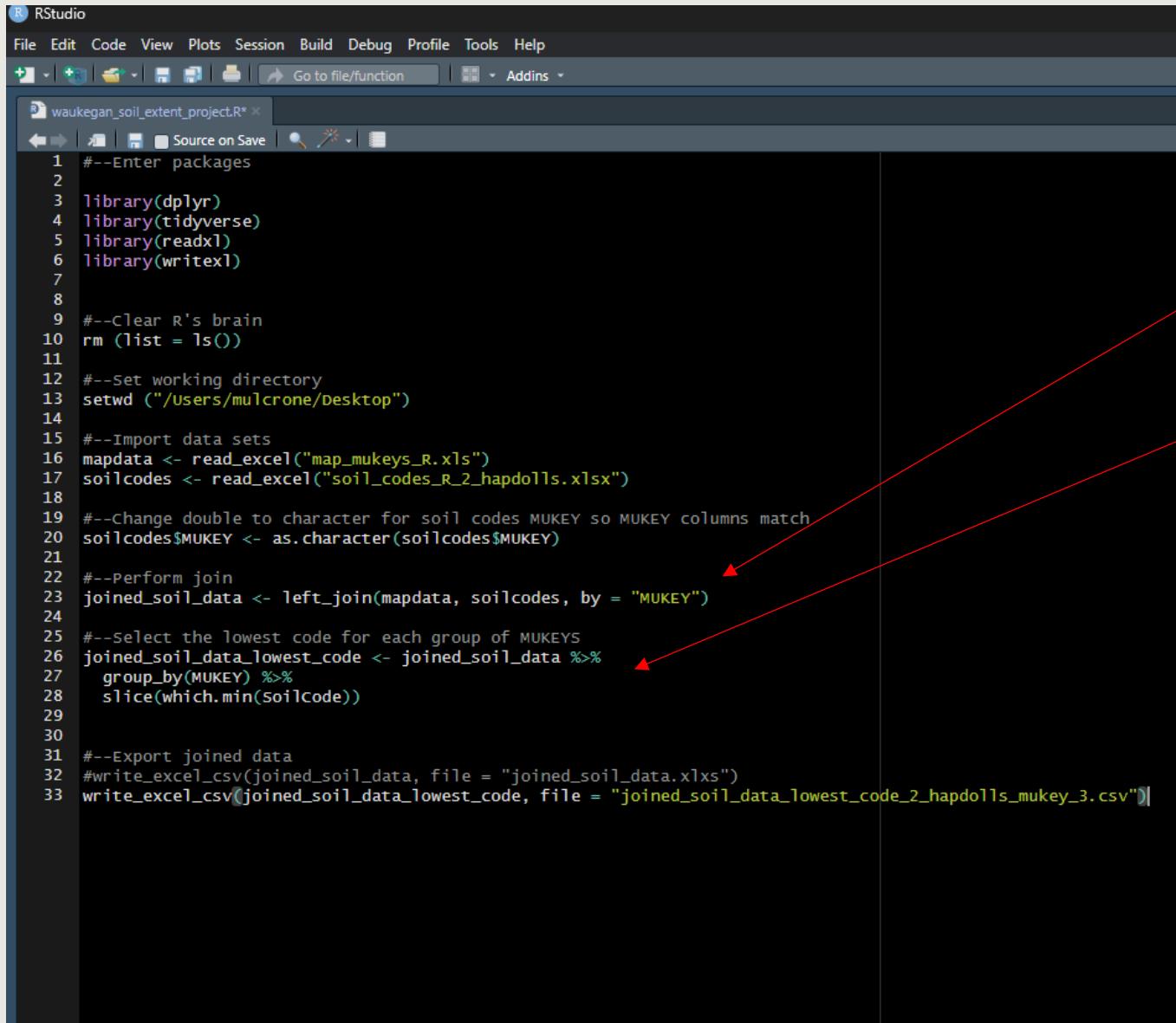
4 &5) Sort the Excel comp table by Sub Order (Field84) and create a column called "soil type."

I	A	B	C	D	E	F	G
	OBJECTID	MUSYM	MUKEY	Series	Sub Order	Soilcode	
866	50335	s4719	665012	Wahpeton	Typic Hapluderts	3	
867	66912	s6897	672385	Sinai	Typic Hapluderts	3	
868	50301	s4719	665012	Wahpeton	Typic Hapluderts	3	
869	64452	s1766	667263	Kenyon	Typic Hapludolls	2	
870	23374	s2248	662194	Dickinson	Typic Hapludolls	2	
871	23374	s2248	662194	Raddle	Typic Hapludolls	2	
872	62334	s6872	672360	Salix	Typic Hapludolls	2	
873	56994	s3619	669294	Moland	Typic Hapludolls	2	
874	52530	s2247	662193	Waukegan	Typic Hapludolls	1	
875	32796	s3783	663284	Coweta	Typic Hapludolls	2	
876	46804	s6052	666553	Rodman	Typic Hapludolls	2	
877	71203	s3598	669273	Wadena	Typic Hapludolls	2	
878	76937	s1764	667261	Kenyon	Typic Hapludolls	2	
879	76937	s1764	667261	Marlean	Typic Hapludolls	2	
880	76937	s1764	667261	Ostrander	Typic Hapludolls	2	
881	76937	s1764	667261	Rossfield	Typic Hapludolls	2	
882	76937	s1764	667261	Saude	Typic Hapludolls	2	
883	53325	s1750	667247	Clarion	Typic Hapludolls	2	
884	76790	s1755	667252	Clarion	Typic Hapludolls	2	
885	64261	s2247	662193	Waukegan	Typic Hapludolls	1	
886	8768	s1708	667205	Dickinson	Typic Hapludolls	2	
887	8768	s1708	667205	Kenyon	Typic Hapludolls	2	

6) Put a 3 in the soil code column for any soil that isn't Typic Hapludoll, a 2 for any soil that is Typic Hapludoll but not Waukegan, and a 1 for any soil that is Waukegan.

This example we aren't deleting duplicate mukeys because we want all the mukey soil codes included in the next step when we select the lowest one.

7) Upload this file into R and export the SSURGO shapefile attribute table and upload to R as well.



The screenshot shows the RStudio interface with a dark theme. The top menu bar includes File, Edit, Code, View, Plots, Session, Build, Debug, Profile, Tools, and Help. A toolbar below the menu contains icons for file operations like Open, Save, and Print. The main area displays an R script named "waukegan\_soil\_extent\_project.R". The code is color-coded, with syntax highlighting for functions like library, read\_excel, and dplyr::left\_join. Red arrows point from the text "8) Perform a left join in R." and "9) Keep only the lowest soil code for each MUKEY." to specific lines of code in the R script. The first arrow points to line 23, which performs a left join between "mapdata" and "soilcodes" datasets. The second arrow points to line 27, which uses the group\_by and slice functions to select the minimum soil code for each MUKEY group.

```
1 #--Enter packages
2
3 library(dplyr)
4 library(tidyverse)
5 library(readxl)
6 library(writexl)
7
8
9 #--Clear R's brain
10 rm (list = ls())
11
12 #--Set working directory
13 setwd ("~/Users/mulcrone/Desktop")
14
15 #--Import data sets
16 mapdata <- read_excel("map_mukeys_R.xls")
17 soilcodes <- read_excel("soil_codes_R_2_hapdolls.xlsx")
18
19 #--Change double to character for soil codes MUKEY so MUKEY columns match
20 soilcodes$MUKEY <- as.character(soilcodes$MUKEY)
21
22 #--Perform join
23 joined_soil_data <- left_join(mapdata, soilcodes, by = "MUKEY")
24
25 #--Select the lowest code for each group of MUKEYS
26 joined_soil_data_lowest_code <- joined_soil_data %>%
27   group_by(MUKEY) %>%
28   slice(which.min(soilCode))
29
30
31 #--Export joined data
32 #write_excel_csv(joined_soil_data, file = "joined_soil_data.xlsx")
33 write_excel_csv(joined_soil_data_lowest_code, file = "joined_soil_data_lowest_code_2_hapdolls_mukey_3.csv")
```

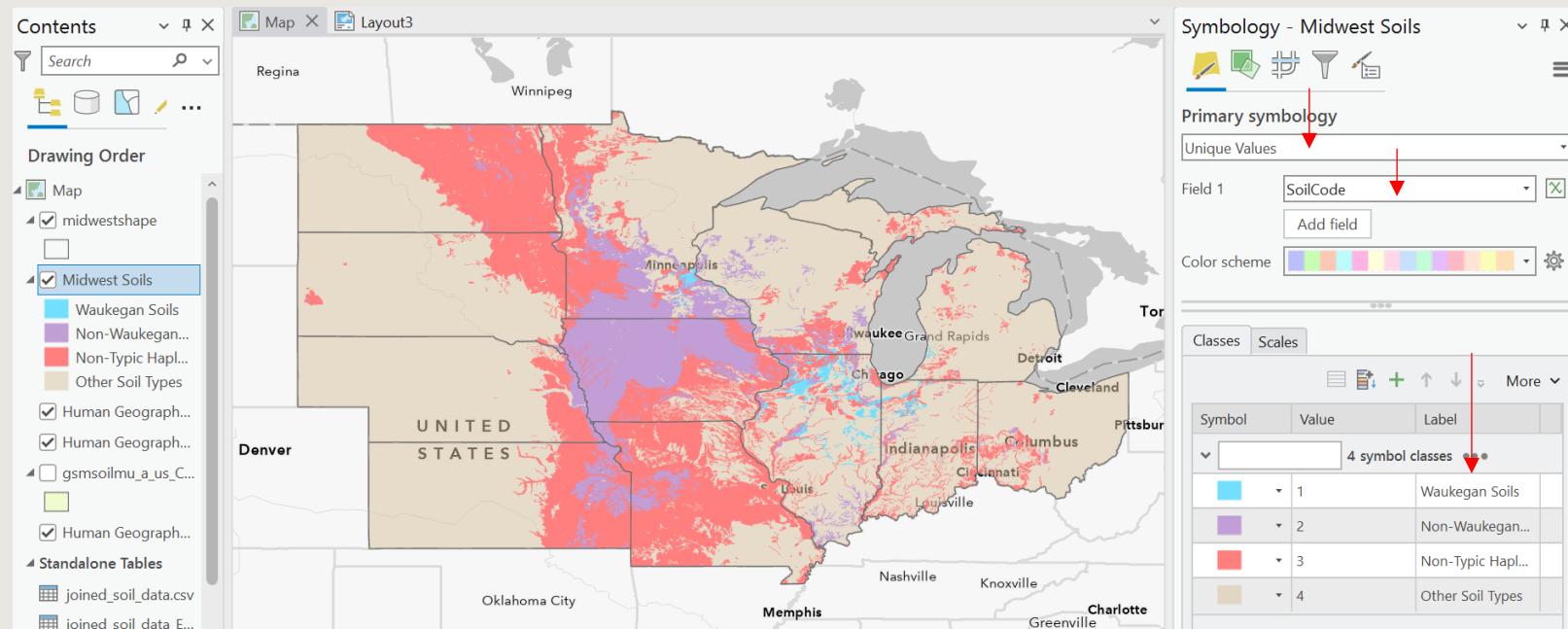
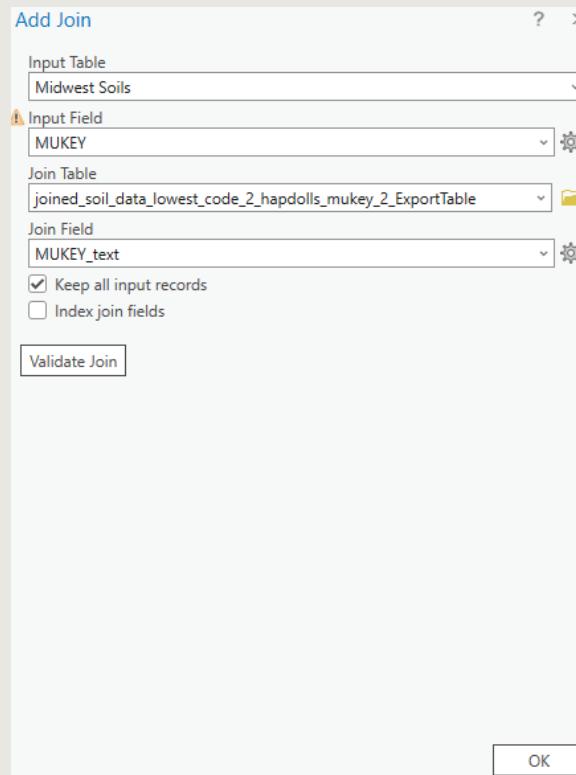
8) Perform a left join in R.

9) Keep only the lowest soil code for each MUKEY.

If you don't use R, this could all be done in Excel as well. If you don't use R and want to learn, I have tutorial on my GitHub that uses an easy soil moisture example that's for complete beginners. I'll link it in the resources slide.

\* The other lines of code are importing, exporting, and doing the pesky conversion of MUKEYs to text from numeric for one of the datasets.

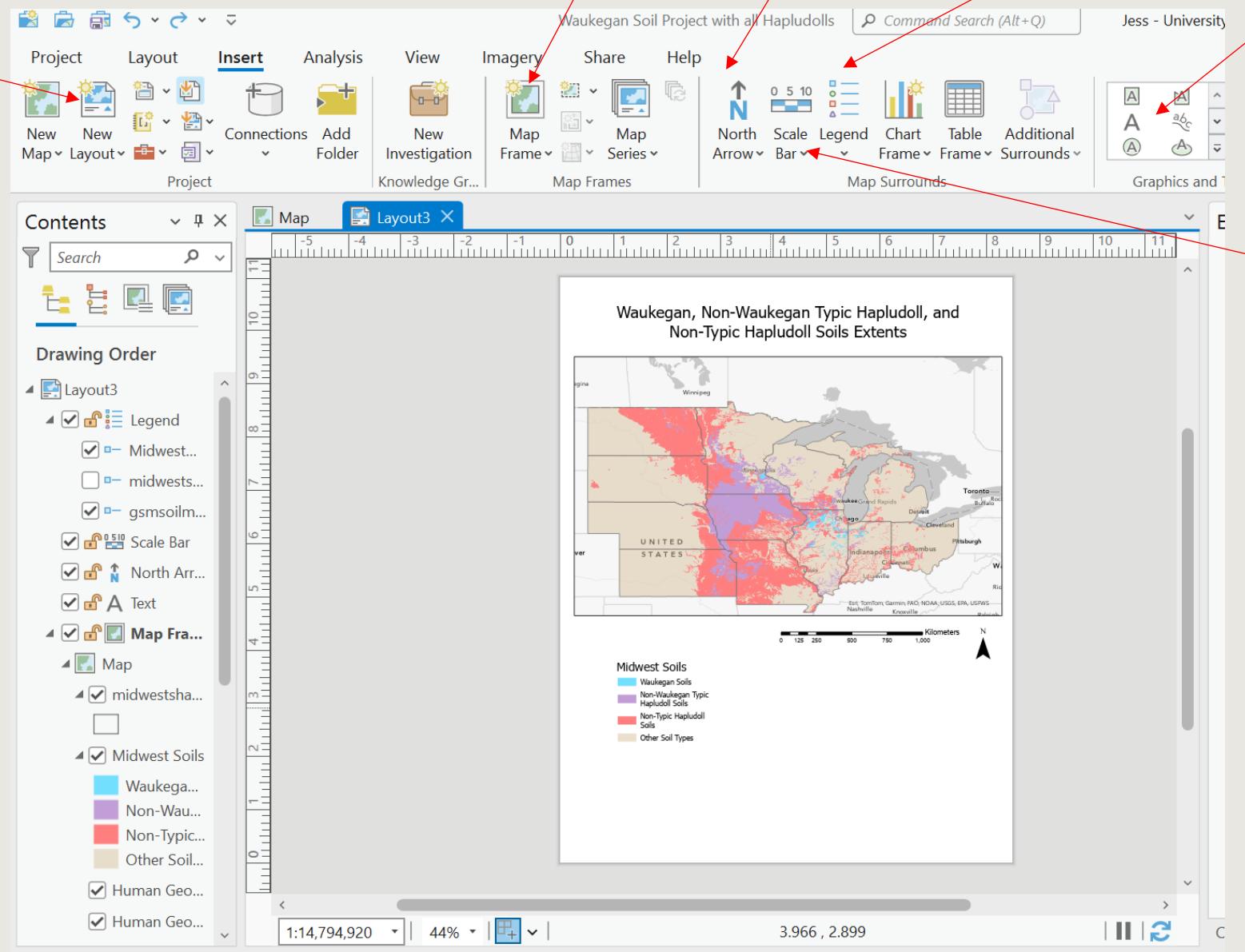
10 & 11) Export the resulting table, upload to ArcGIS Pro, and tabular join (right click > Joins and Relates > Add Join) to the SSURGO polygon shapefile using the MUKEY as the join fields. (The MUKEY in the table from R needed to be changed to text despite being set to text in the code. This just happens sometimes. I changed it using the same steps from the previous example).



12) Symbolize the map by selecting Unique Values and Soil Code. You can change the labels in the legend to display soil and soil type names instead of numbers.

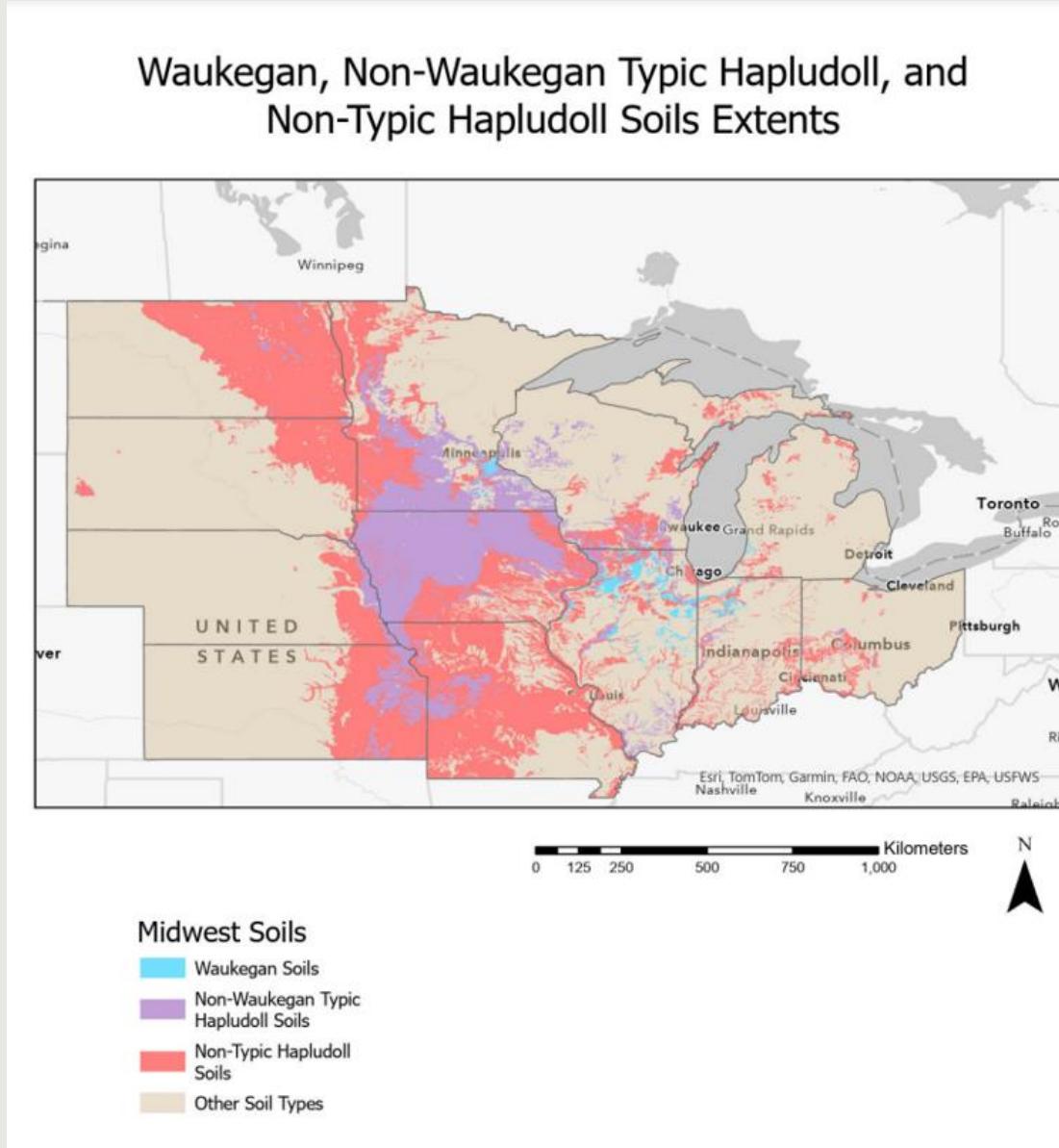
## Optional 13) Format the map

1) Select New Layout



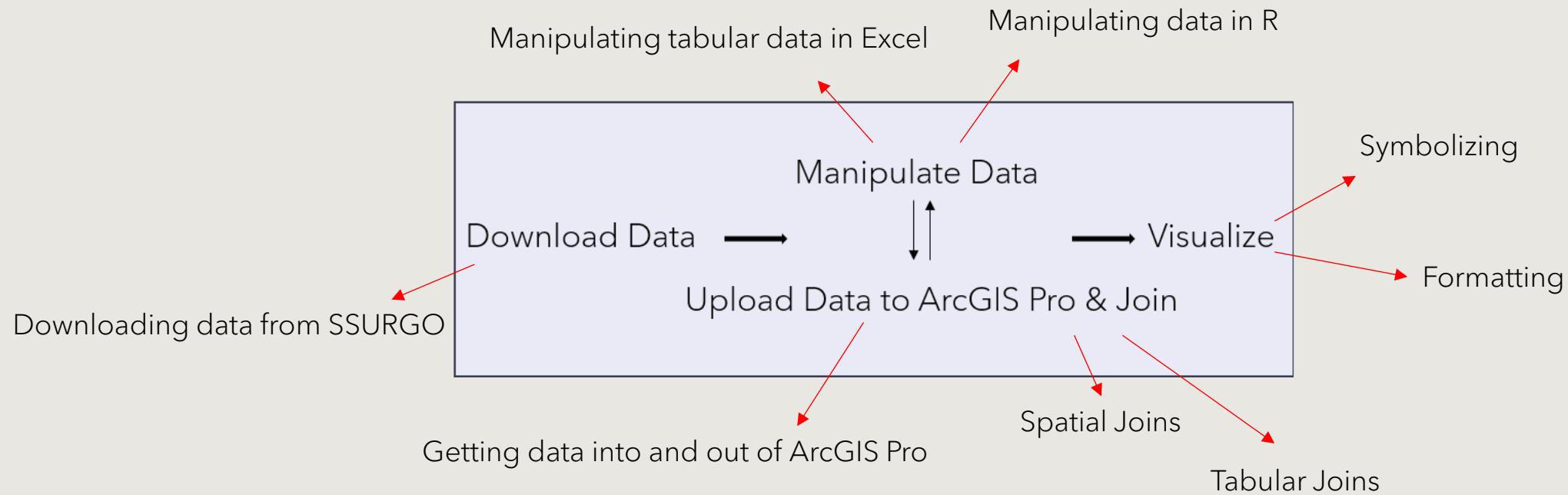
There are more options and settings to format the layout that can take some figuring out, but this is the gist.

# The Result:



Done with Examples!

# Quick Visual Summary of Steps



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## One Final Note: Figuring Out How to Manipulate the Data to Get at Your End Goal Can Be the Hardest Step in Soil Mapping

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- (at least for me)
- The structure of the comp table and mukeys and how everything is linked takes getting used to. And manipulation needs to line up with join requirements and (if applicable) how the results need to be structured for symbolizing. It takes understanding the database and creativity.
- Point being if you're having trouble wrapping your head around how to answer a soil mapping question with SSURGO don't feel bad. It can also be hard to find relevant SSURGO resources online. But it does get easier (and kind of fun) after the learning curve!

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## Also Remember:

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These maps include the soils whether they are a major component or not. Datasets can be filtered to only include major components using the Yes/No magcompflag column (Field6). I don't have a good grasp on how to make that decision.

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# Contact Info and Resources

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- My email is mulcrone@umn.edu.
- The USpatial help desk email is uspatial@umn.edu.

(We prefer you email the help desk so we can keep track of metrics to prove to the University that they should fund us. Soil mapping questions will get routed to me).

- My favorite source for help with ArcGIS Pro is Esri help articles.
  - I haven't found a great source for relevant SSURGO help. The metadata page on the SSURGO website can be helpful but takes getting used to.
  - A beginners R tutorial using a soil moisture example is on my GitHub at <https://github.com/Jemulcrone/resources>. You can learn enough from that tutorial to write all the code used in this presentation.
-

Thanks for listening to my presentation!  
Good luck with any soil mapping you do  
and definitely feel free to reach out with  
any questions ☺