Natural Resources Conservation Service

United States Department of Agriculture

Gridded Soil Survey Geographic (gSSURGO) Database

User Guide

Version 2.2
ArcGIS 10.3
December 2016
National Soil Survey Center
National Geospatial Center of Excellence

Nondiscrimination Statement

The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the basis of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, whether all or part of an individual's income is derived from any public assistance program, or protected genetic information. The Department prohibits discrimination in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases will apply to all programs and/or employment activities.)

If you wish to file an employment complaint, you must contact your agency's EEO Counselor (https://www.ascr.usda.gov/sites/default/files/EEOCounselorListFinal.pdf) within 45 days of the date of the alleged discriminatory act, event, or personnel action. Additional information can be found online at http://www.ascr.usda.gov/complaint_filing_file.html.

If you wish to file a Civil Rights program complaint of discrimination, complete the USDA Program Discrimination Complaint Form, found online at http://www.ascr.usda.gov/complaint_filing_cust.html or at any USDA office, or call (866) 632-9992 to request the form. You may also write a letter containing all of the information requested in the form. Send your completed complaint form or letter by email to program.intake@usda.gov or by mail to:

USDA
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, S.W.
Washington, D.C. 20250-9410

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Table of Contents

Table of Contents....1
Introduction....1
Obtaining gSSURGO Data....1
Download Data from the Geospatial Data Gateway....2
Official Release of SSURGO/gSSURGO Data and Update Exceptions....5
How to Verify SSURGO and gSSURGO Data Creation Dates....6
Raster Data Defined....10
Raster Format Advantages....11
Raster Specifications....11
Associated Tables in the gSSURGO Database....11
National Value Added Look Up (Valu1) Table....12
Working with the Raster Soils Layer (MapunitRaster_10m) in ArcMap™....15
Joining gSSURGO Data with the Muaggatt Table Using the MUKEY Field....15
Other Classification Methods....26
Removing Join Columns from the Attribute Table....26
Using Relationship Classes in a Geodatabase....28
Using Relationship Classes to Find Related Records in Related Tables....38
Performance Tips....44
Displaying Layers in the ArcMap™ Table of Contents....44
Making Newly Added Layers Visible by Default....44
Selecting an Area of Interest to Reduce the Number of Records....46
Creating a Layer File from Selected Features....47
Using a Layer Definition Query to Reduce the Number of Selected Records....48
Bookmarks....50
Turning Off Field Aliases in Attribute Tables....51
Displaying Very Large Rasters....52
Restoring MUKEY Values in Raster Layers....55
Citing gSSURGO Data....58
The Citation for gSSURGO....58
State Tile....58
Conterminous US Tile....58
National Collection of Tiles....58
The Citation for the National Value Added Look Up (Valu1) Table....58

Citation Examples **59**
State Tile **59**
Conterminous US Tile **59**
National Collection of Tiles **59**
National Value Added Look Up (Valu1) Table **59**
Acronyms **60**
References **61**

Introduction

Gridded SSURGO (gSSURGO) is similar to the standard product from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database, but is in the Environmental Systems Research Institute, Inc. (ESRI®) file geodatabase format. A file geodatabase has the capacity to store significantly more data and thus greater spatial extents than the traditional SSURGO product. This allows for statewide or even Conterminous United States (CONUS) tiling of data. gSSURGO contains all of the original soil attribute tables in SSURGO. All spatial data are stored within the geodatabase instead of externally as separate shape files. Both SSURGO and gSSURGO are considered products of the National Cooperative Soil Survey (NCSS).

An important addition to the new format is a 10-meter raster (MapunitRaster_10m) of the map unit soil polygons feature class, which provides statewide coverage in a single layer. This new addition provides greater performance and important analysis capabilities to users of soils data. Statewide tiles consist of soil survey areas needed to provide full coverage for a given State. In order to create a true statewide soils layer, some clipping of excess soil survey area gSSURGO data may be required. The new format also includes a national Value Added Look Up (valu) Table that has several new "ready to map" attributes.

Along with these important advantages, the gSSURGO format has a few disadvantages:

- File geodatabases such as gSSURGO are NOT compatible with the NRCS Soil Data Viewer application.
- The file geodatabase format supports a limited subset of the standard query language (SQL) that the Microsoft® Access® database format or Microsoft® SQL Server® uses.
- Unlike vector layers, the geodatabase is unable to store permanent table relates for raster layers.

Obtaining gSSURGO Data

gSSURGO can be obtained as one or more statewide tiles via free download from the USDA-NRCS Geospatial Data Gateway (GDG) website located at https://gdg.sc.egov.usda.gov/. Depending on file size, the data may also be available on CD-ROM or DVD. The cost for a single CD-ROM is $50; the cost for a single DVD is $100.

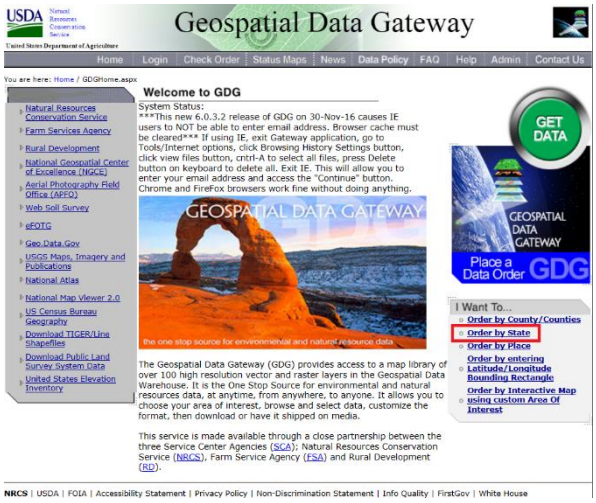
The conterminous U.S. and/or national collection of gSSURGO data can be obtained by contacting the USDA-NRCS National Geospatial Center of Excellence (NGCE) representative Rosemary Rivera (rosemary.rivera@ftw.usda.gov) or by phoning (817) 509-3371. The cost for this service is $250 for non-USDA or non-partnering entities. The customer provides the external storage device and also pays shipping costs.

Note: All gSSURGO User Guide example processes shown in figures and screenshots were prepared using ESRI® ArcGIS™ 10.3 software in a Microsoft® Windows® 7 operating system.

Additional information and ArcGIS™ tools for working with the data may be found on the gSSURGO webpage.

Download Data from the Geospatial Data Gateway

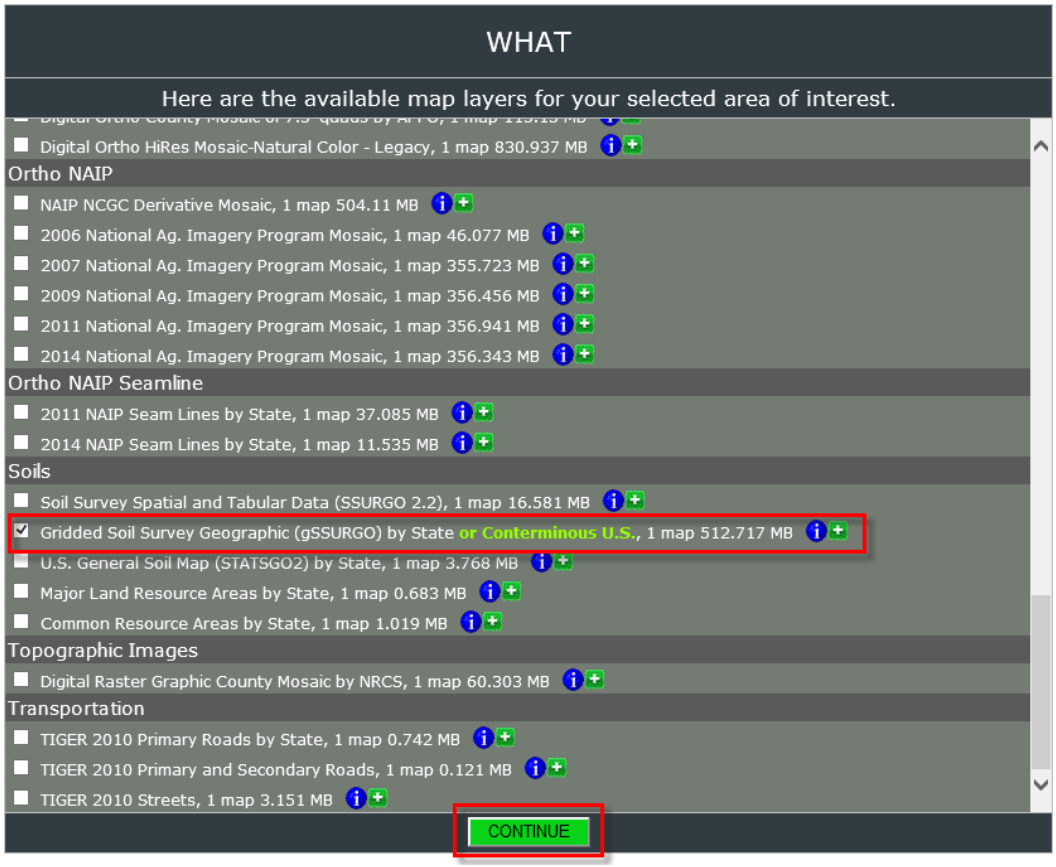
1. Using a web browser, open [https://gdg.sc.egov.usda.gov/.](https://gdg.sc.egov.usda.gov/)



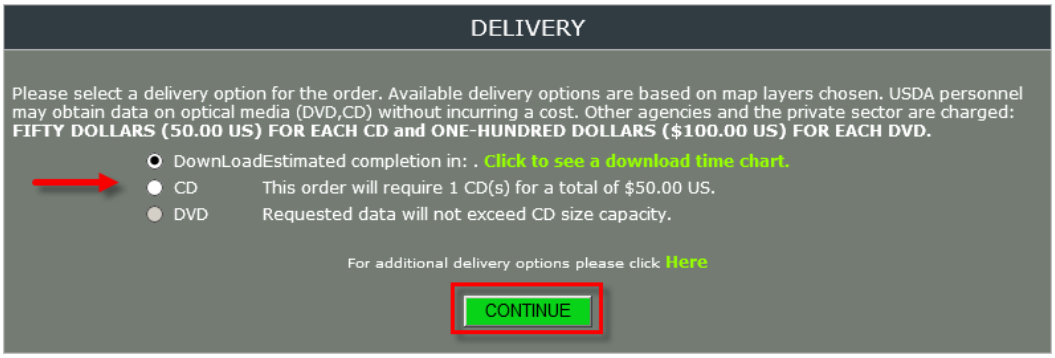
2. Click the **Order by State** link.

3. On the Gateway Order by State web page, select the desired state from the choice list.

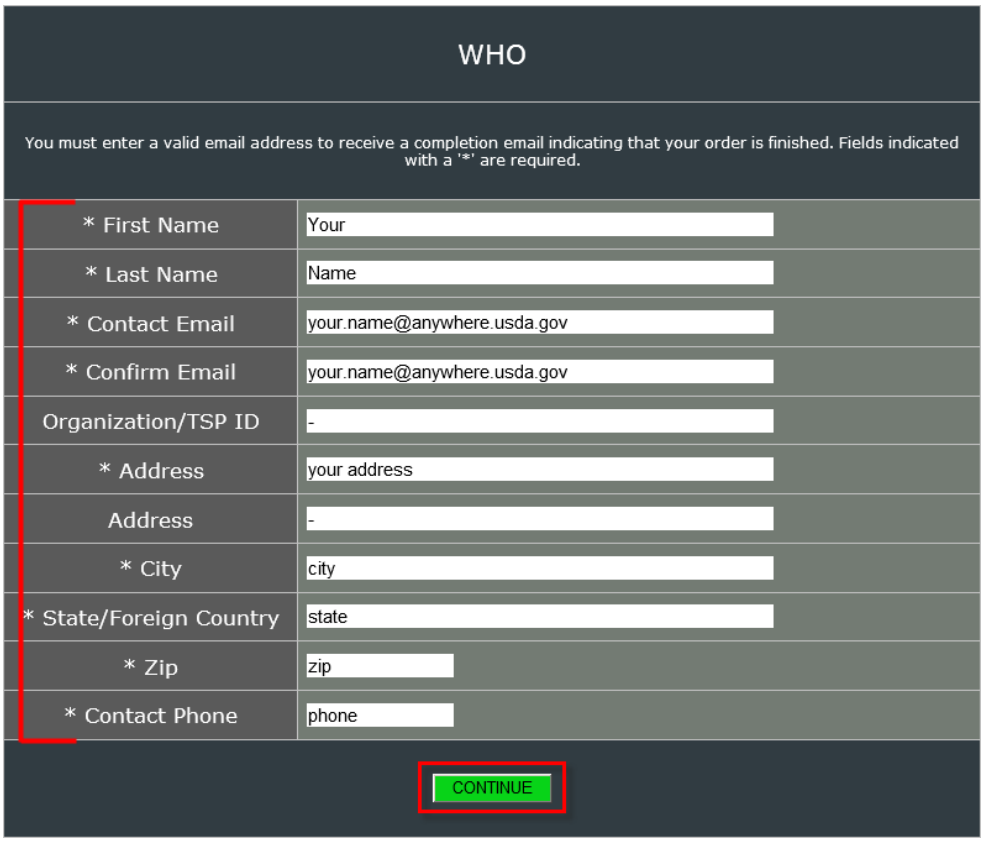
4. Scroll down and click **Gridded Soil Survey Geographic (gSSURGO) by State** and click **CONTNUE**.



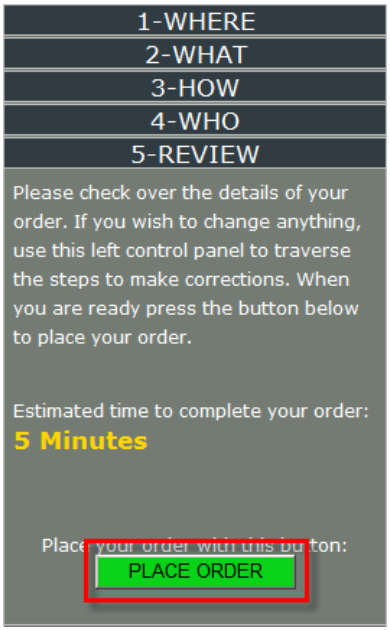
5. Select a Delivery method and click **CONTINUE**.



6. Enter your contact information and click **CONTINUE**.

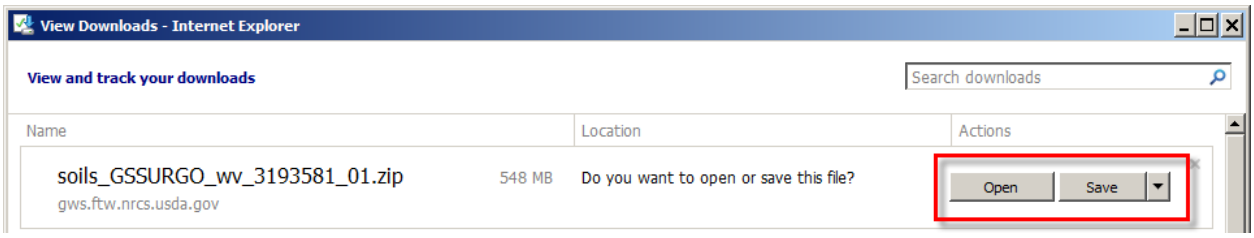


7. Click the **PLACE ORDER** button.



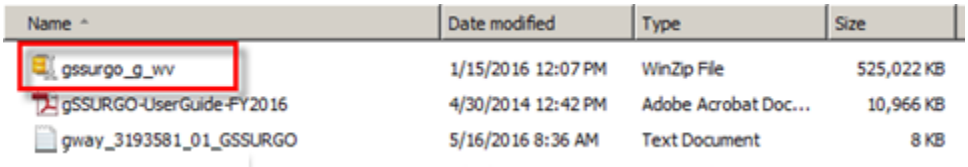
8. You will be notified by email when your order is ready to be downloaded.
9. In the notification email, click on the link to download the WinZip file of the ordered item

10. In the View Downloads dialog open or save the Winzip file to your computer.



11. Unzip the file. The unzipped data is in a folder named *soils*.

12. Extract the *gssurgo_g_xx* zip file to this location.



Official Release of SSURGO/gSSURGO Data and Update Exceptions

The SSURGO data, available to the public on either the USDA-NRCS Geospatial Data Gateway (GDG) or USDA-NRCS Web Soil Survey (WSS), are updated or refreshed annually. The annual refresh normally occurs around October 1, which is the start of the Federal Government's fiscal year.

There can be exceptions to this once-a-year update when:

- A significant error is found in the data, or
- New data becomes available for an area that has not had coverage in the past.

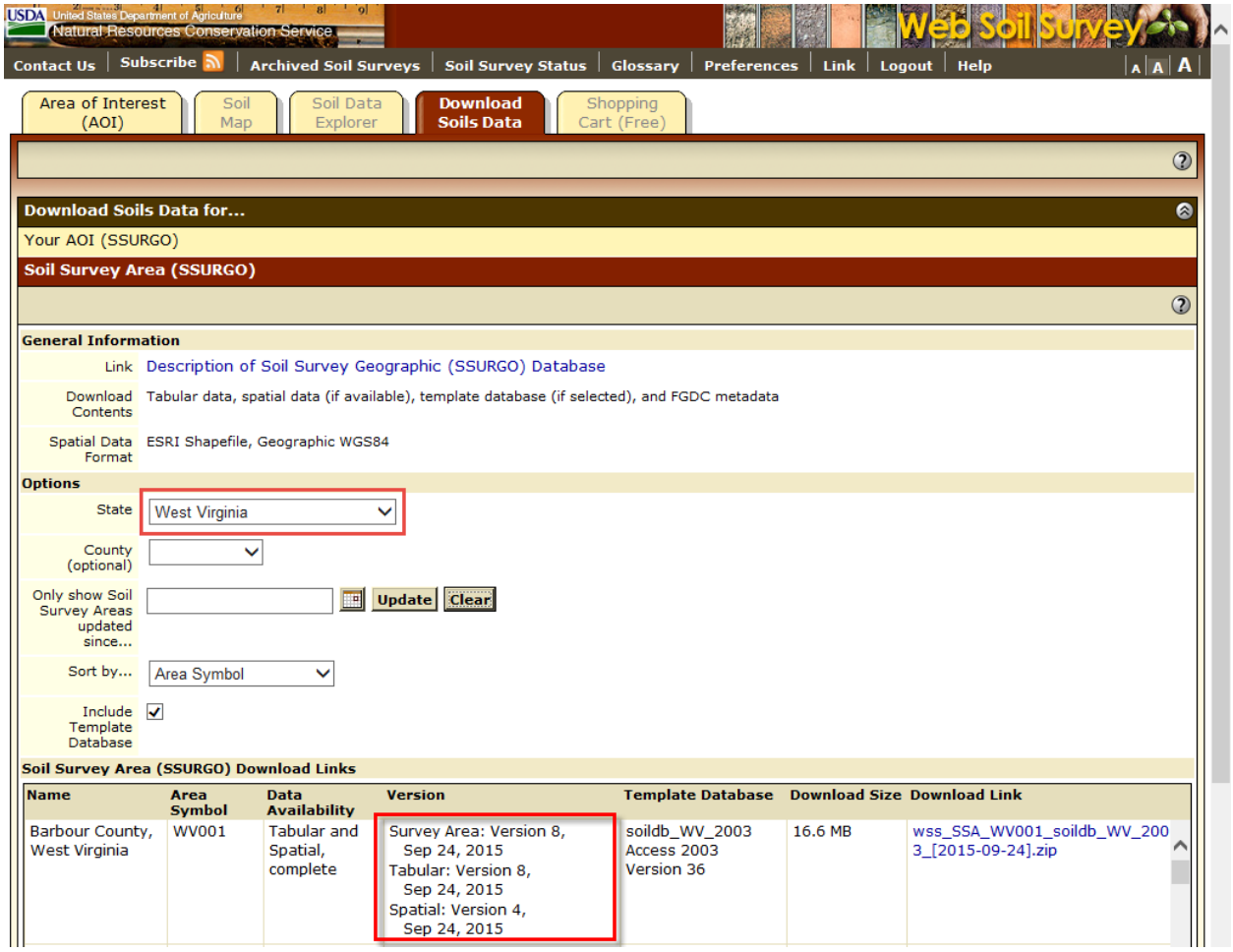
The corrected or new data will be incorporated into the vector SSURGO data available from the Geospatial Data Gateway or Web Soil Survey. However, the gSSURGO data will NOT be updated. gSSURGO, available from the GDG, is created just once each fiscal year based on the October refresh.

How to Verify SSURGO and gSSURGO Data Creation Dates

There are several ways to compare the date of the soils data in gSSURGO with the date of the SSURGO vector data:

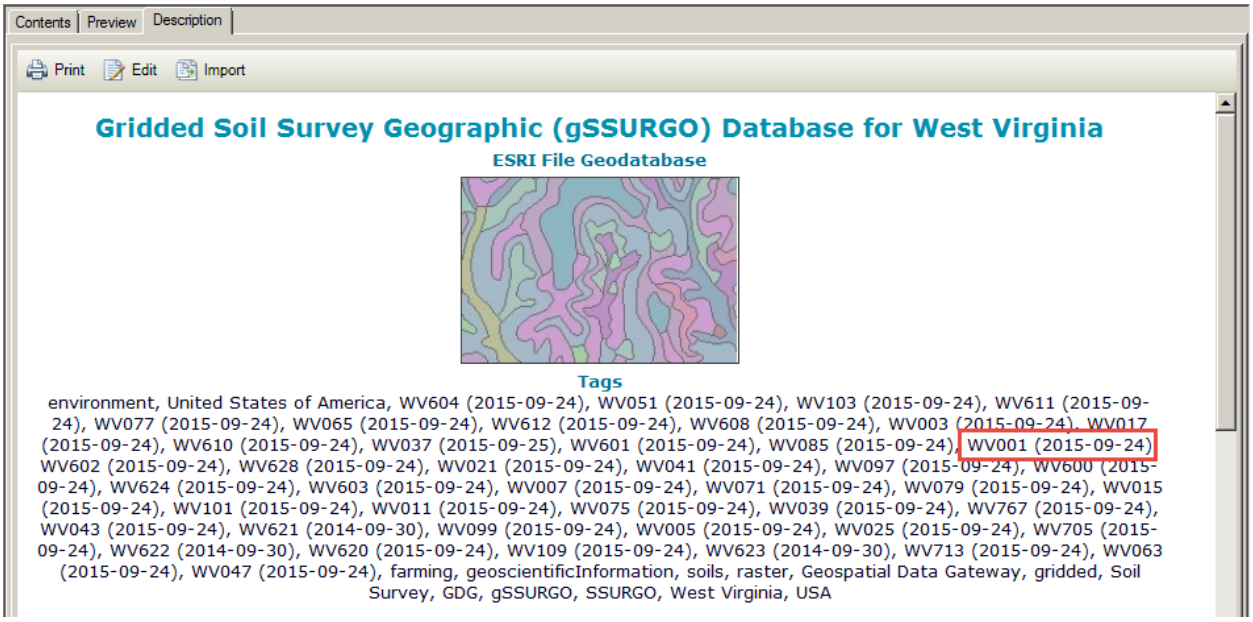
1. View the Web Soil Survey *Download Soils Data* page.

   Select the *Soil Survey Area (SSURGO)*. A list shows all the data for a state.



The individual survey dates from Web Soil Survey can be compared with the gSSURGO metadata. See following example shown in ArcCatalog. For this comparison, the date of the WV001 SSURGO data is "Sep 24, 2015" and the date of the WV001 gSSURGO data is "2015-9-24." The same data exists in both SSURGO and gSSURGO.

2. Open ArcCatalog and view the description for gSSURGO.



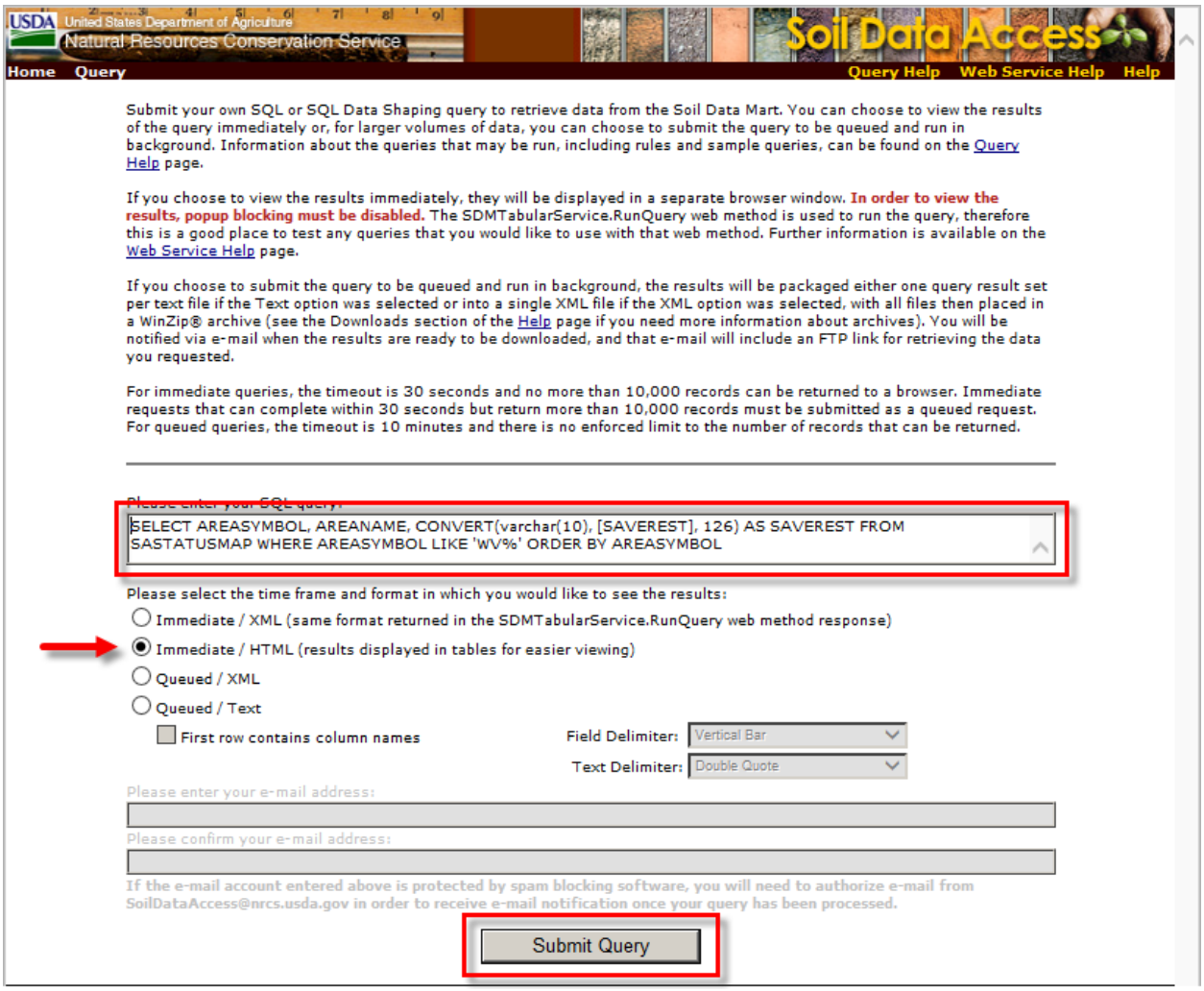
Query the Soil Data Access service at https://sdmdataaccess.nrcs.usda.gov/.

3. Select the option **Submit a custom request for soil tabular data**.

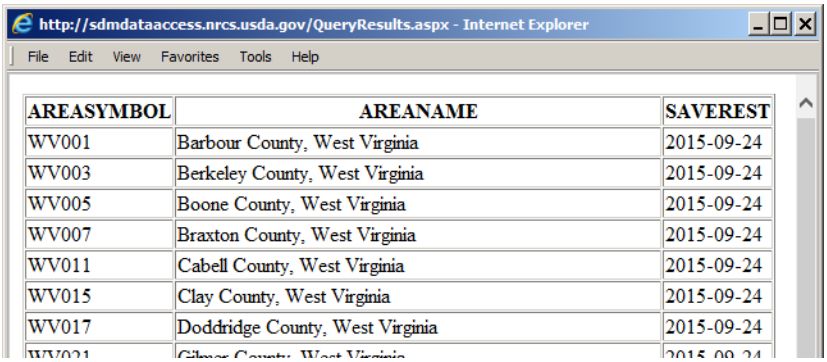
4. Input the following SQL query.

SELECT AREASYMBOL, AREANAME, CONVERT(varchar(10), [SAVEREST], 126) AS SAVEREST FROM SASTATUSMAP WHERE AREASYMBOL LIKE 'WV%' ORDER BY AREASYMBOL

Select the time frame and input. Click the **Submit Query** button.



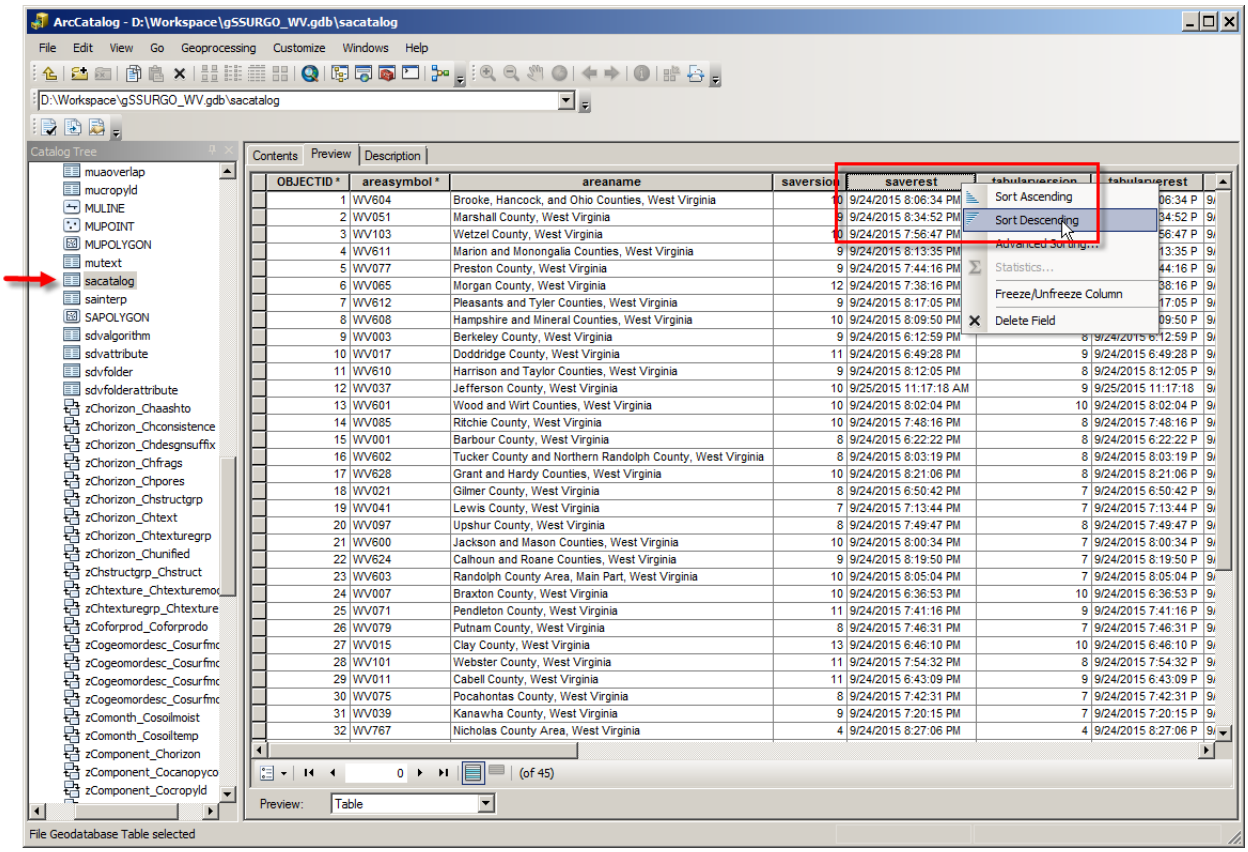
Result



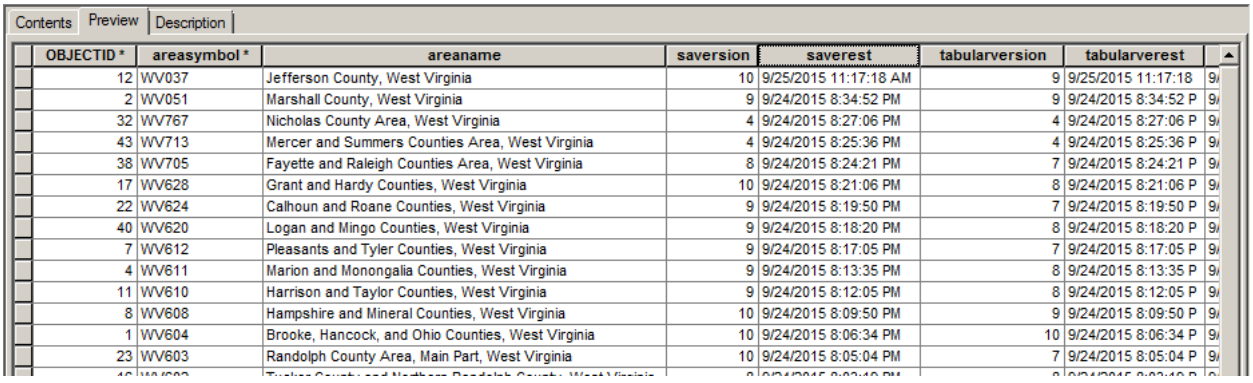
AREASYMBOL	AREANAME	SAVEREST
WV001	Barbour County, West Virginia	2015-09-24
WV003	Berkeley County, West Virginia	2015-09-24
WV005	Boone County, West Virginia	2015-09-24
WV007	Braxton County, West Virginia	2015-09-24
WV011	Cabell County, West Virginia	2015-09-24
WV015	Clay County, West Virginia	2015-09-24
WV017	Doddridge County, West Virginia	2015-09-24

Determine when east survey area version was established.

5. In ArcCatalog, open the *sacatalog* table in the gSSURGO database and sort on the *saverest* column in descending order to find the newest data.



Result



Note that the dates in ArcCatalog and in Web Soils Survey are the same.

ArcCatalog

Contents | Preview | Description

OBJECTID *	areasymbol *	areaname	saversion	saverest	tabularversion	tabularverest
15	WV001	Barbour County, West Virginia	8	9/24/2015 6:22:22 PM	8	9/24/2015 6:22:22 P
9	WV003	Berkeley County, West Virginia	9	9/24/2015 6:12:59 PM	8	9/24/2015 6:12:59 P
36	WV005	Boone County, West Virginia	7	9/24/2015 6:31:53 PM	7	9/24/2015 6:31:53 P
24	WV007	Braxton County, West Virginia	10	9/24/2015 6:36:53 PM	10	9/24/2015 6:36:53 P
29	WV011	Cabell County, West Virginia	11	9/24/2015 6:43:09 PM	9	9/24/2015 6:43:09 P

Web Soil Survey

Soil Survey Area (SSURGO) Download Links

Name	Area Symbol	Data Availability	Version	Template Database	Download Size	Download Link
Barbour County, West Virginia	WV001	Tabular and Spatial, complete	Survey Area: Version 8, Sep 24, 2015 Tabular: Version 8, Sep 24, 2015 Spatial: Version 4, Sep 24, 2015	soildb_WV_2003 Access 2003 Version 36	16.6 MB	wss_SSA_WV001_soildb_WV_2003_[2015-09-24].zip

Raster Data Defined

Unlike feature layers which are made up of points, lines, or polygons, raster data is a cell-based matrix organized into rows and columns. Raster data typically possess a uniform cell size along the X and Y axes. Each cell represents a specific value (Figure 1). In the gSSURGO raster, cell values are represented by integer values, which in turn relate to the MUKEY (map unit key) for a soil map unit. Along with the original cell value, the attribute table also contains a MUKEY column.

(a) (b)

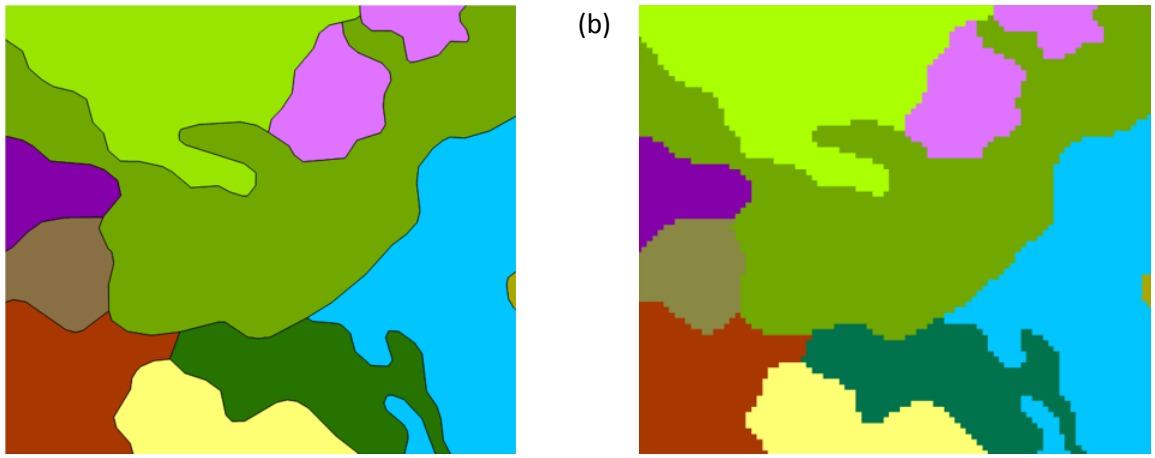


Figure 1.—(a) An example of the traditional vector-based SSURGO map unit polygon format at 1:6,000 map scale; (b) the corresponding new raster-based Gridded SSURGO (gSSURGO) 10-meter map unit format.

Raster Format Advantages

The raster format offers significant advantages over the traditional polygon format when creating maps or performing analyses on a national, statewide, watershed, or regional basis. Map display time and geoprocessing overlay operations are enhanced 15 or 20 times. In addition, many other physical layers used in conjunction with soils data by modelers are commonly in raster format. Examples include land cover, land use, elevation, slope, and climate. Traditionally, raster was not the preferred format due to greater storage requirements. The availability of increased hard drive capacity has minimized this issue.

Raster Specifications

MapunitRaster_10m is the name of the standard file geodatabase raster contained within gSSURGO. It was created by converting the MUPOLYGON feature class to raster format using an Albers Equal Area projection. In order to facilitate analysis based upon areal calculations, a similar Albers Equal Area Conic coordinate system (meters) was selected for each geodatabase. Puerto Rico, the U.S. Virgin Islands, and the lower 48 states share in common the USA Contiguous Albers Equal Area Conic USGS version coordinate system with a horizontal datum of NAD 1983. Alaska, Hawaii, American Samoa, and the Pacific Islands Area each use a different variation of Albers Equal Area Conic coordinate system and a horizontal datum of WGS 1984.

During the conversion process, the output raster cell size is set to 10 meters and snapped to the United States Geological Survey (USGS) National Land Cover Database (NLCD 2006) 30-meter raster. This resolution was chosen to maintain the shape and extent of the original polygons without sacrificing display performance.

This resolution also enhances alignment to other raster layers, including the National Land Cover Database (NLCD) and the USDA National Agricultural Statistical Service (NASS) Cropland Data Layer (CDL). The example in Figure 1(b) exhibits moderate pixilation when compared to the vector in Figure 1(a) because it is being displayed at three times the original digitizing map scale (for illustrative purposes).

Associated Tables in the gSSURGO Database

A complete description of the tables and their relationships is included on the SSURGO webpage. Some of the commonly used tables are described below. Specific information is located in the SSURGO Tables and Columns Report document found on the SSURGO Structural Metadata and Documentation webpage.

Mapunit	Includes soil map unit name and prime farmland designation. Uses MUKEY as the join field with spatial data.
Muaggatt	Includes common soil interpretations for map units. Uses MUKEY as the join field with spatial data.
Component	Includes interpretations and properties for components of map units. Use of this table requires a relate since there are several records in this table for each single MUKEY in the raster data.
Chorizon	Includes data by horizon for components. Use of this table requires a relate since there are several records in this table for each single MUKEY in the raster data.

National Value Added Look Up (Valu1) Table

The National Value Added Look Up (Valu1) Table is designed to facilitate thematic mapping for several important soil properties and interpretations. Similar to the muaggatt table, the Valu1 table is a compilation of 57 pre-summarized or "ready to map" attributes including:

- Soil organic carbon
- Available water storage
- Crop productivity indices
- Crop root zone depths
- Available water storage within crop root zone depths
- Drought-vulnerable soil landscapes
- Potential wetland soil landscapes

Previous versions of this table were national in extent, and could be used in conjunction with any gSSURGO product of the same vintage. As of FY2017, the table is now part of the gSSURGO database and will only contain data for those survey areas in the geodatabase. Related metadata values for themes are included (Figure 2). Table level metadata for specific column definitions are available in the Appendix.

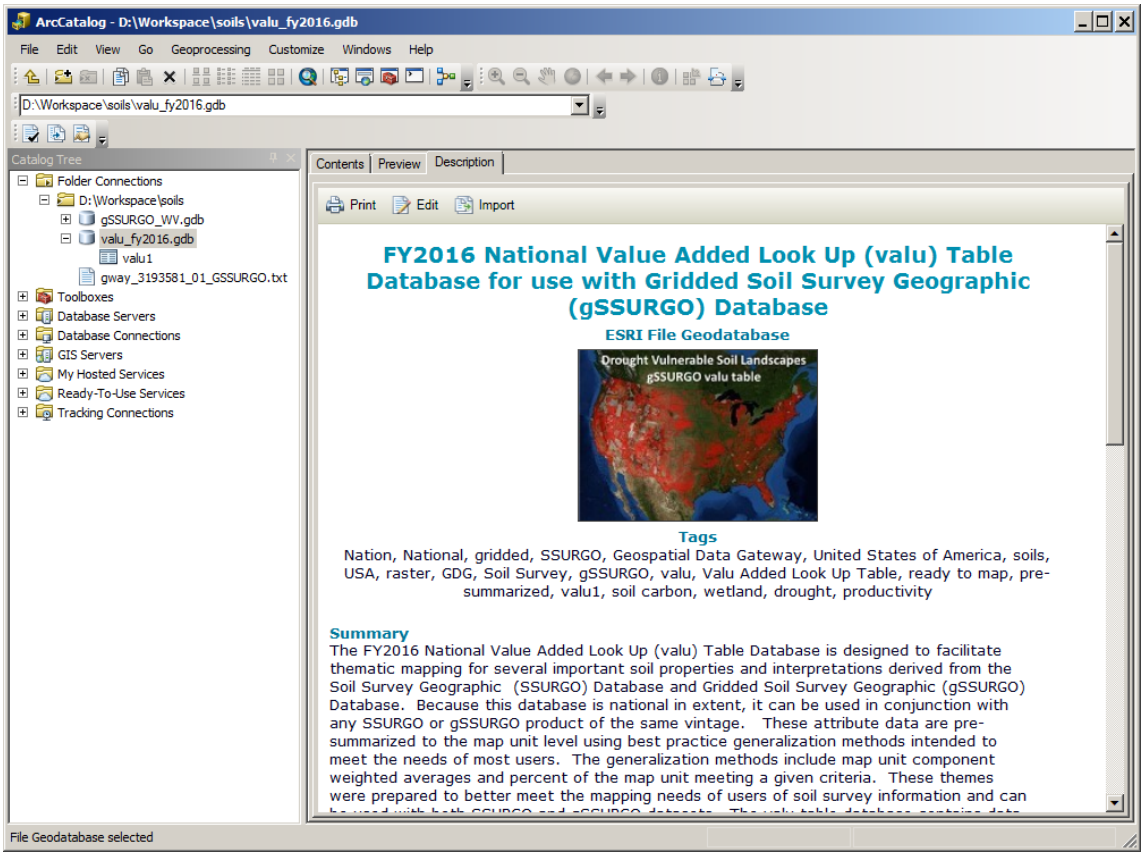


Figure 2.—Screenshot of Valu1 table metadata shown in ArcCatalog™.

These attribute data are pre-summarized to the map unit level using best practice generalization methods intended to meet the needs of most users. The generalization methods include map unit component weighted averages and percent of the map unit meeting a given criteria. These themes

were prepared to better meet the mapping needs of users of soil survey information and can be used with both SSURGO and gSSURGO datasets. The Valu1 table contains data for all areas where SSURGO coverage exists.

Please note that some available water storage values in the Valu1 table differ from similar calculations viewed in Web Soil Survey. These differences are due to the choice of method used to summarize horizon and component level data. Columns in the Valu1 table for available water storage and soil organic carbon were created using strict rules for excluding map unit or component records with missing horizon information or with logical inconsistencies in component percent or horizon depth. Please review the valu table metadata for greater detail about the valu table summary methods.

Soil Organic Carbon (SOC)

The map unit average soil organic carbon values are given in units of grams carbon per square meter for 11 standard layer or zone depths. Table column names begin with "soc." The average thickness of soil map unit component horizons used in these layer/zone calculations is also included. The standard layers include the following depth ranges:

- 0-5cm
- 5-20cm
- 20-50cm
- 50-100cm
- 100-150cm
- 150-150+cm (maximum reported soil depth)

The standard zones include:

- 0-5cm (also a standard layer)
- 0-20cm
- 0-30cm
- 0-100cm
- 0-150cm
- 0-150+cm (full reported soil depth)

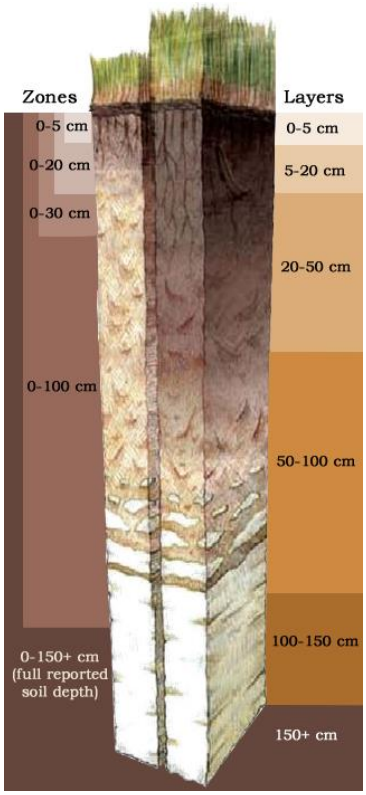


Figure 4.—by Alfred Hartemink

Available Water Storage (AWS)

The map unit average available water storage values are given in units of millimeters for 11 standard layer or zone depths. Table column names begin with "aws." The average thickness of soil map unit component horizons used in these layer/zone calculations is also included. See the information above on soil organic carbon for a list of standard layers and zones.

National Commodity Crop Productivity Index (NCCPI)

The map unit average National Commodity Crop Productivity Index values are provided for major earthy components. (Low index values indicate low productivity, and high index values indicate high productivity.) Table column names begin with "nccpi." NCCPI values are included for corn/soybeans, small grains, and cotton crops. Of these crops, the highest overall NCCPI value is also identified. Earthy components are those soil series or higher level taxa components that can support crop growth. Major components are those soil components for which the MAJCOMPFLAG is "Yes" in the SSURGO component table. A map unit percent composition for earthy major components is provided (Dobos, Sinclair, Jr., and Robotham, 2012).

Crop Root Zone Depths
The map unit average root zone depth values for commodity crops are given in centimeters for major earthy components. Criteria for root-limiting soil depth include the presence of:

- Hard bedrock
- Soft bedrock
- A fragipan
- A duripan
- Sulfuric material
- A dense layer
- A layer having a pH less than 3.5
- A layer having an electrical conductivity greater than 12 decisiemens (dS) per meter within the component soil profile

If no root-restricting zone is identified, a depth of 150 centimeters is used to approximate the root zone depth (Dobos, Sinclair, Jr., and Robotham, 2012).

Available Water Storage within Crop Root Zone Depths
The value for map unit average available water storage within the root zone depth for major earthy components is given in millimeters. Table column is named "rootznaws."

Drought-Vulnerable Soil Landscapes
In the Drought-vulnerable soil landscapes column, map units are identified as either drought vulnerable (1) or not drought vulnerable (0). Drought-vulnerable soil landscape map units have 152 millimeters (6 inches) or less root zone available water storage for major components. Table column is named "droughty."

Potential Wetland Soil Landscapes
The potential wetland soil landscapes (PWSL version 1) information is given as the percentage of the map unit (all components) that meet the criteria for a potential wetland soil landscape. Table column is named "pwsl1pomu." Where water was determined to account for 80 percent or more of a map unit, a value of 999 was used to indicate a water body. This identifies a general water body class for mapping.

The map unit sum of the component percentage representative values is also provided as metadata.

For all columns in the Valu1 table, "NULL" is used where data are incomplete or not available.

The Valu1 table can be used to map 57 attributes. See examples in the following sections.

Working with the Raster Soils Layer (MapunitRaster_10m) in ArcMap™

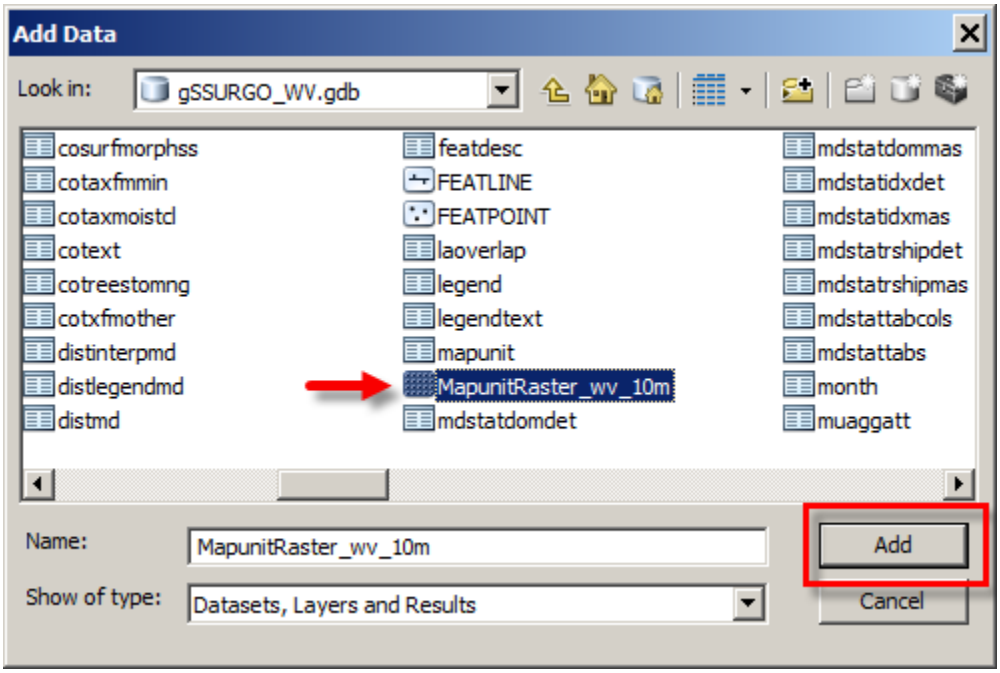
Joining gSSURGO Data with the Muaggatt Table Using the MUKEY Field

The following example shows how to join the gSSURGO spatial data to the map unit aggregated attribute (muaggatt) table using the MUKEY field.

1. **Start ArcMap** with a new blank map.

2. On the Standard toolbar, click the **Add Data** button.

3. From the appropriate file geodatabase (e.g., **gSSURGO_WV.gdb**), select the raster feature class (e.g., **MapunitRaster_WV_10m**), and click the **Add** button.



In Figure 5, it appears that several areas in the south-central part are missing or contain “No Data.” This, however, is not the case. Survey areas occasionally appear blank because the stretched renderer displays these areas as white. This is due to the new MUKEY values that have a much lower range than the rest.

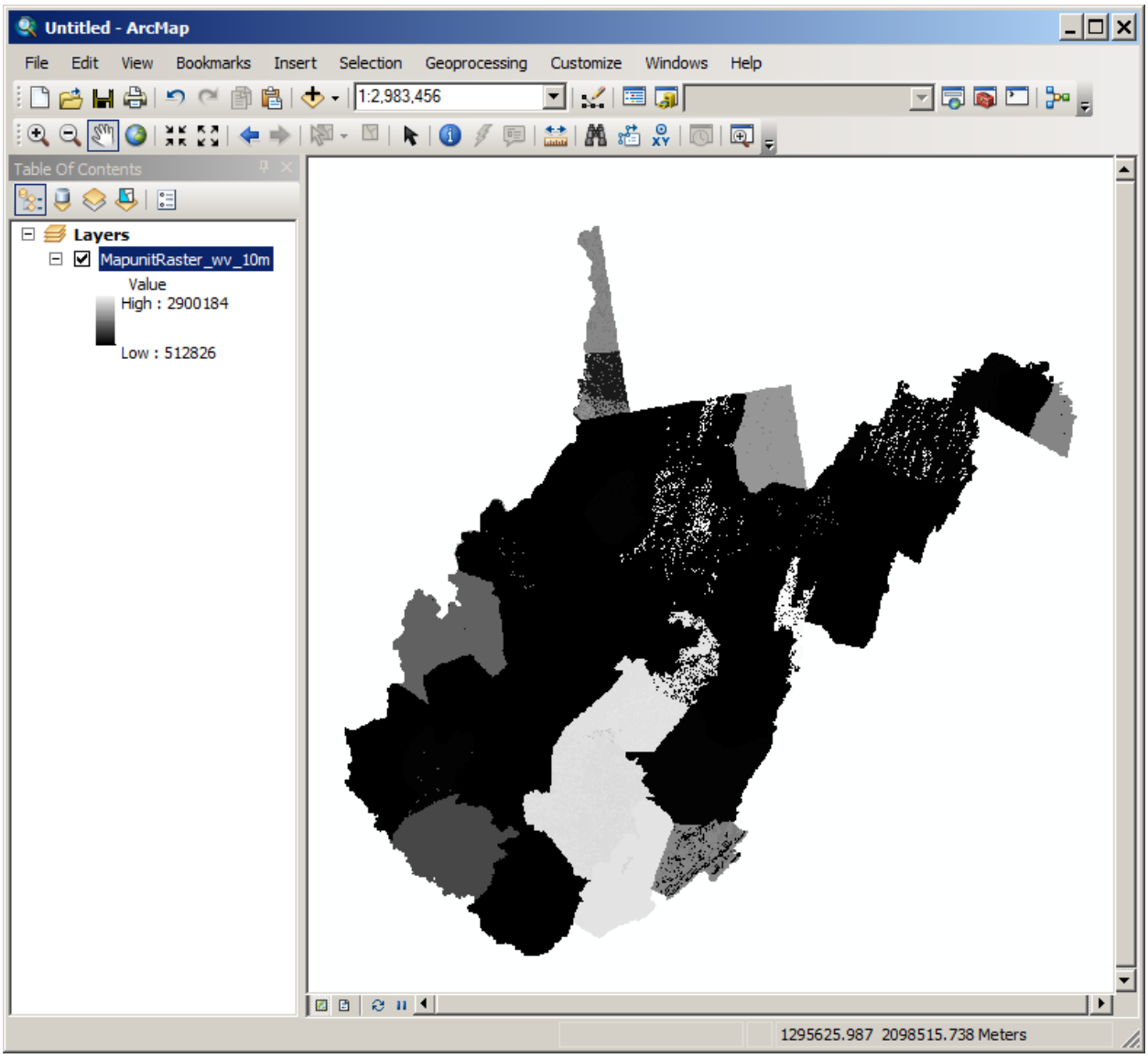
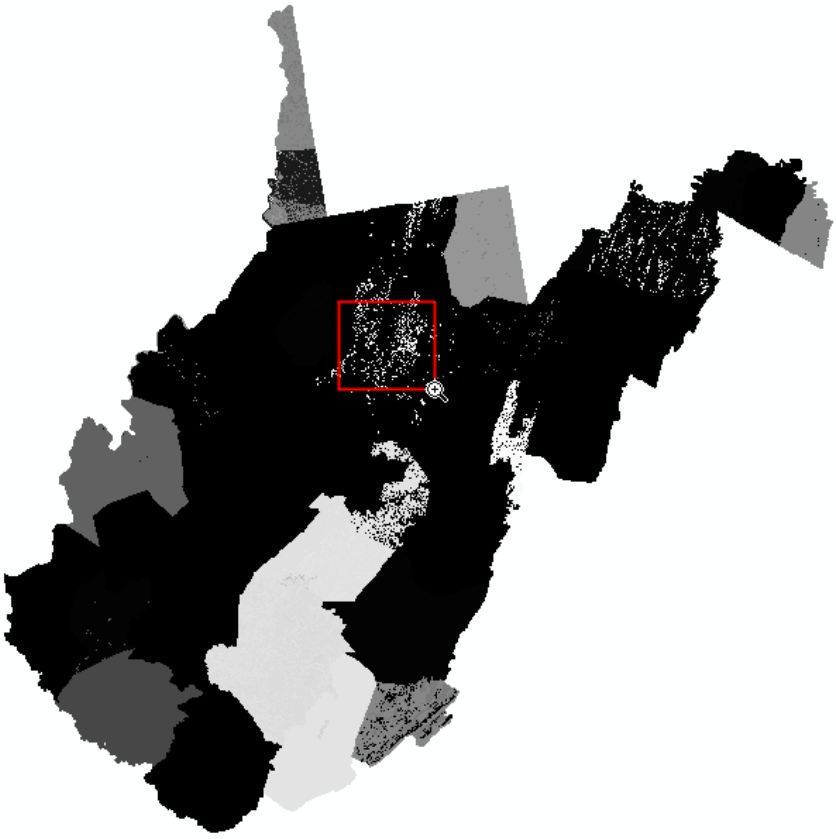


Figure 5.— By default, the raster is symbolized on the Value field using a black to white color ramp.

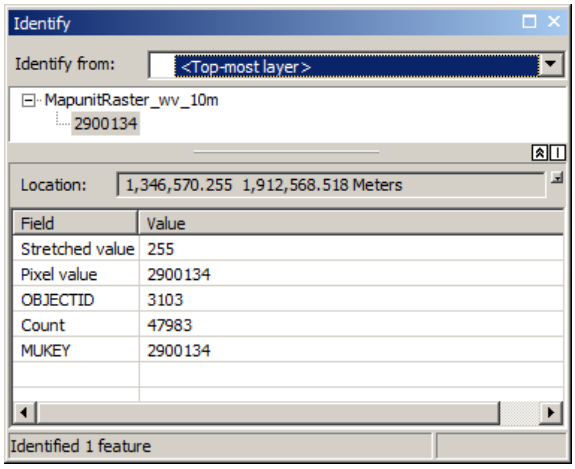
Check to make sure the white areas contain data.

4. Use the Zoom In tool, located on the Tools toolbar, and zoom to an area that appears to be missing attributes (white).



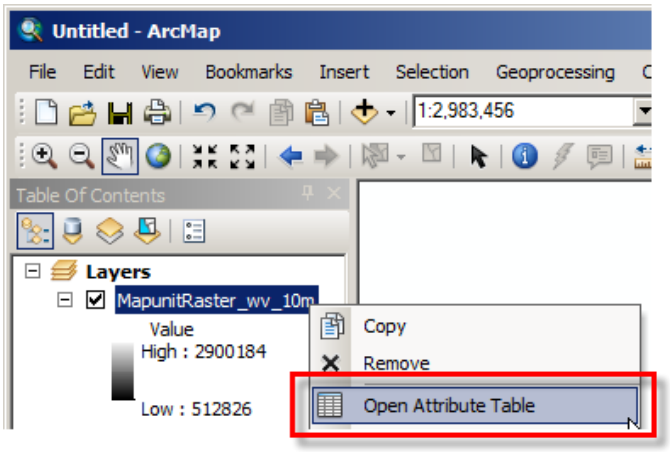
5. Click in a white area with the **Identify** button located on the Tools toolbar.

The identified area contains data.



Determine if there are any “No Data” areas. If the MUKEY field contains data, the display renders white. Where the field contains “No Data,” spatial data probably does not exist.

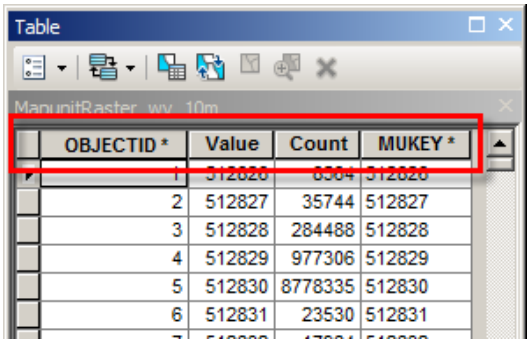
6. Right-click on the raster feature class (e.g., MapunitRaster-WV_10m) and select **Open Attribute Table**.



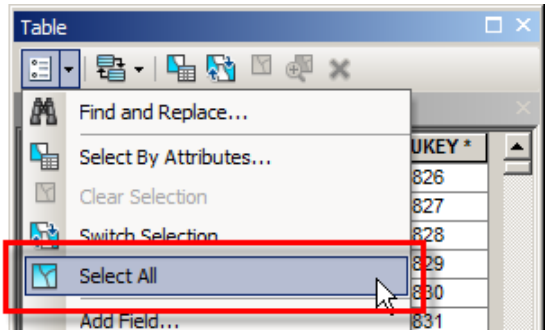
The raster attribute table contains three default fields: OBJECTID, Value, and Count.

- *OBJECTID* uniquely identifies each row in the table.
- *Value* uniquely lists each cell value contained in the raster.
- *Count* lists the number of cells that contain the cell value.

The MUKEY field will be used to join with other soil attribute tables containing the MUKEY column.

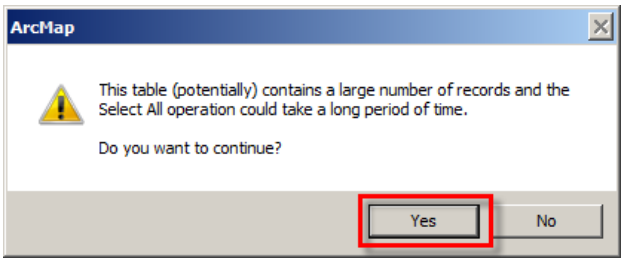


7. In the Table Options drop-down menu click **Select All**.

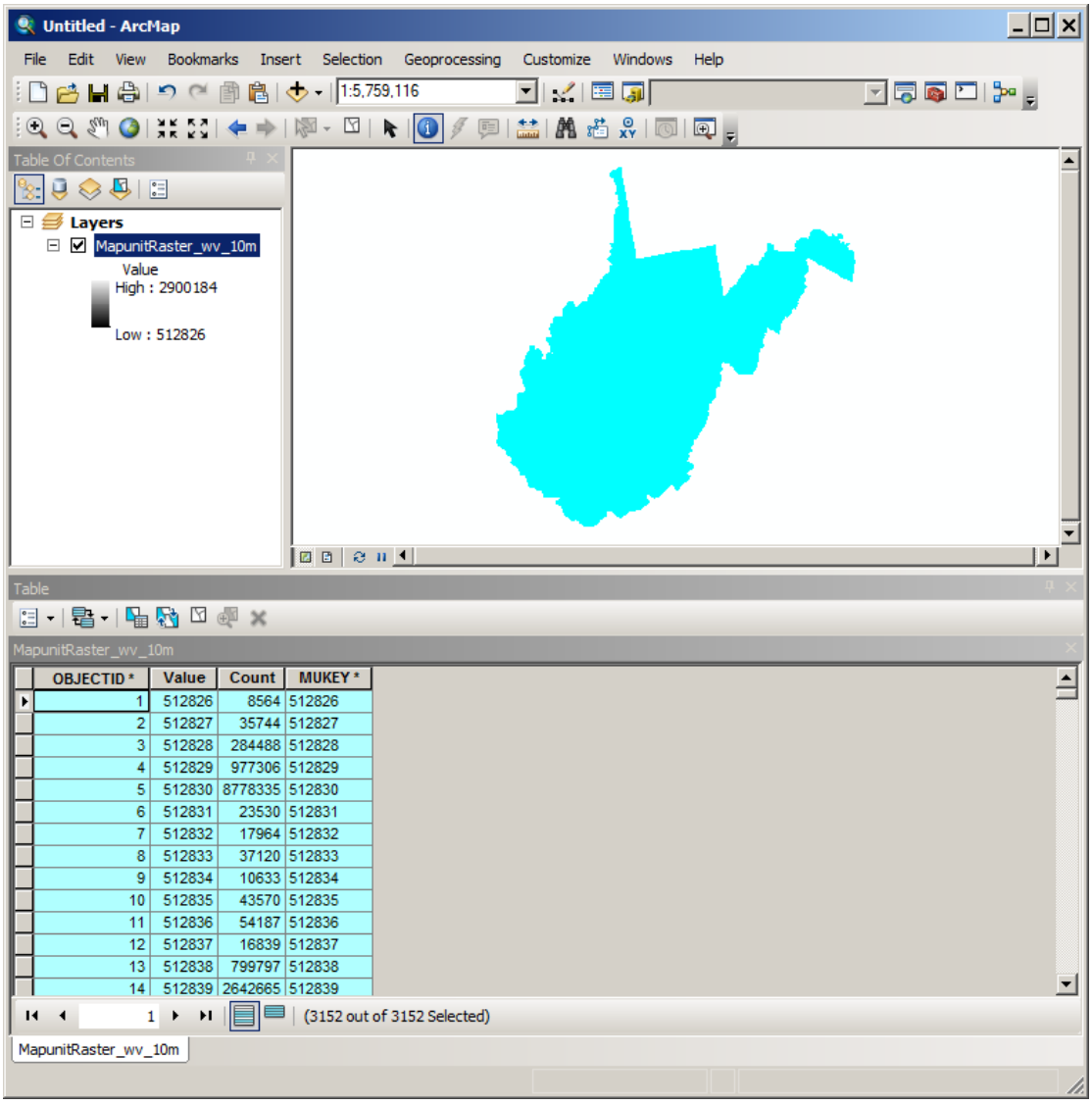


A warning may pop up indicating that the table may contain a large number of records and that the select operation may take significant time.

8. Click **Yes** to continue.



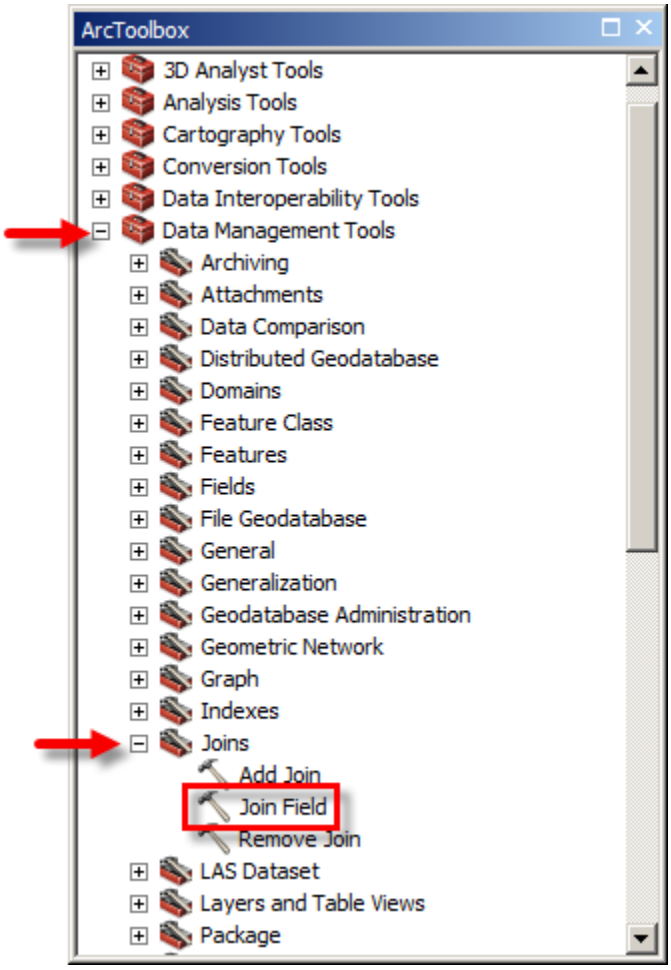
9. Both the ArcMap display and attribute table windows now show all records selected. **Close** the table.



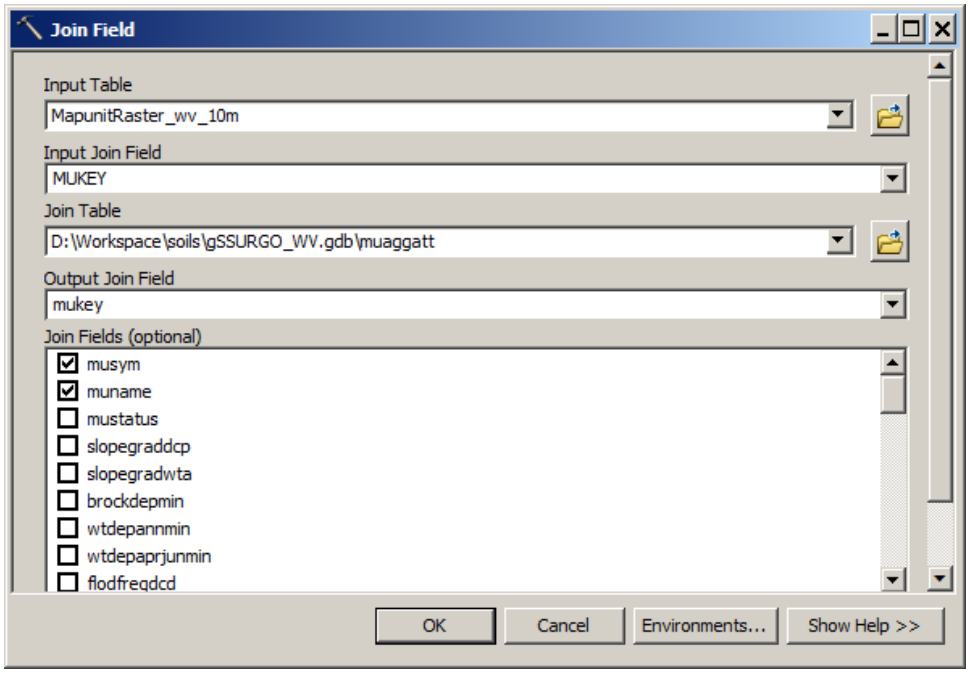
A join is typically established using the **Add Join** tool. This will temporarily append the fields of one table to another with a common attribute, e.g., MUKEY. It may be best to use the **Join Field** tool to permanently add the fields to the table for symbolization purposes. The fields can be dropped later, if necessary.

10. Open **ArcToolbox** located on the Standard toolbar.

11. In ArcToolbox, expand the **Data Management Tools**, expand the **Joins** tools, and double-click on the **Join Field** tool to open a dialog box.



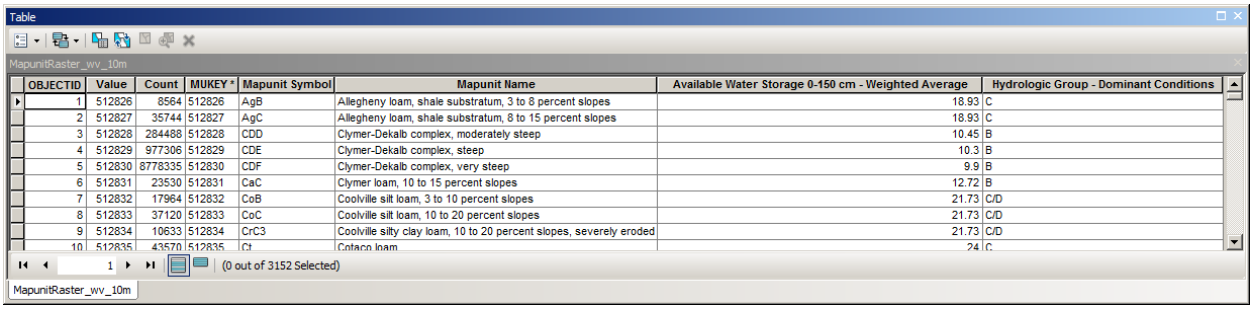
12. In the Join Field dialog:
    - For the Input Table, select **MapunitRaster_WV_10m.**
    - For the Input Join Field, select **MUKEY.**
    - For the Join Table, browse to **muaggatt.**
    - For the Output Join Field, select **mukey.**
    - For the Join Fields (optional), check **musym**, **muname**, **aws0150wta**, and **hydgrpdcd.**
    - Click **OK.**



The attribute table will now contain the additional fields:

- Mapunit Symbol (musym)
- Mapunit Name (muname)
- Available Water Storage 0-150 cm – Weighted Average (aws0150wta)
- Hydrologic Group – Dominant Conditions (hydgrpdcd).

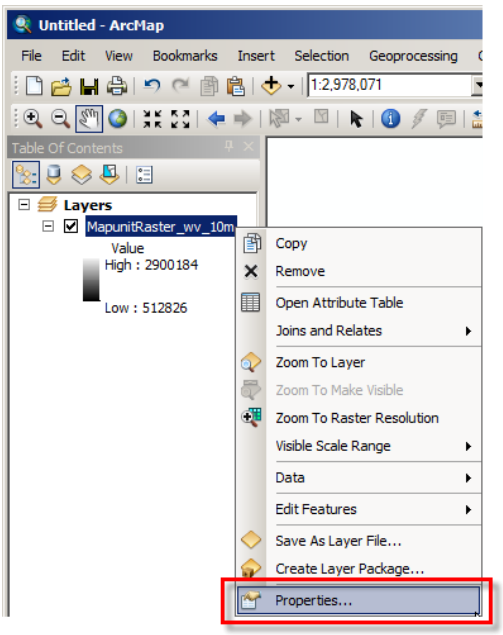
TIP: If the attribute table does not display the additional columns after processing is complete, exit and restart ArcMap™. Add the raster and open the attribute table. The additional columns will appear.



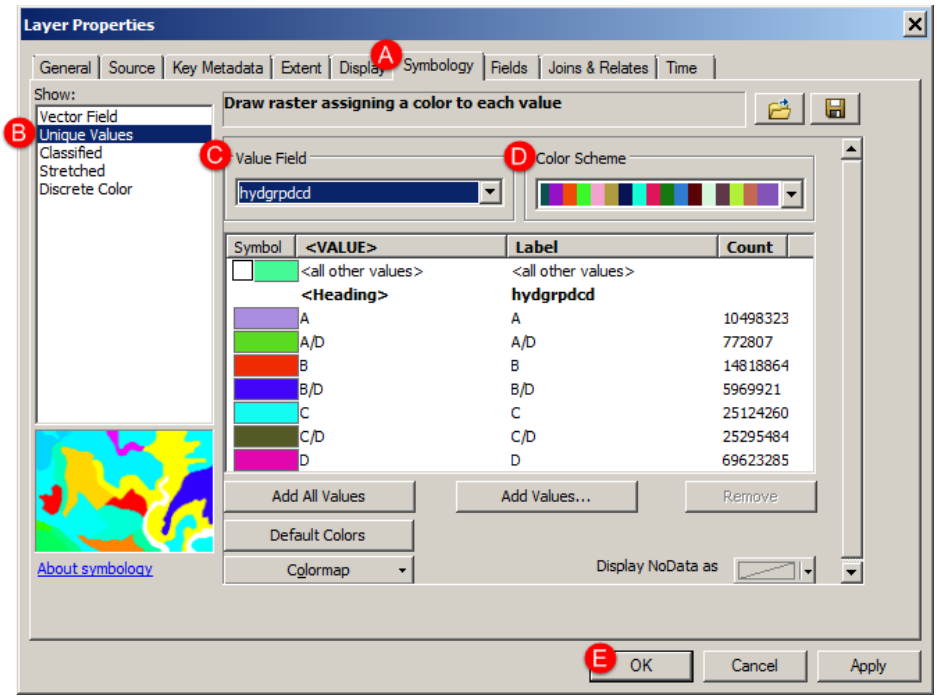
OBJECTID	Value	Count	MUKEY *	Mapunit Symbol	Mapunit Name	Available Water Storage 0-150 cm - Weighted Average	Hydrologic Group - Dominant Conditions
1	512826	8564	512826	AgB	Allegheny loam, shale substratum, 3 to 8 percent slopes	18.93	C
2	512827	35744	512827	AgC	Allegheny loam, shale substratum, 8 to 15 percent slopes	18.93	C
3	512828	284488	512828	CDD	Clymer-Dekalb complex, moderately steep	10.45	B
4	512829	977306	512829	CDE	Clymer-Dekalb complex, steep	10.3	B
5	512830	8778335	512830	CDF	Clymer-Dekalb complex, very steep	9.9	B
6	512831	23530	512831	CaC	Clymer loam, 10 to 15 percent slopes	12.72	B
7	512832	17964	512832	CoB	Coolville silt loam, 3 to 10 percent slopes	21.73	C/D
8	512833	37120	512833	CoC	Coolville silt loam, 10 to 20 percent slopes	21.73	C/D
9	512834	10633	512834	CrC3	Coolville silty clay loam, 10 to 20 percent slopes, severely eroded	21.73	C/D
10	512835	43570	512835	Ct	Cotaco loam	24	C

Symbolize the data based on the entries for Hydrologic Group – Dominant Conditions.

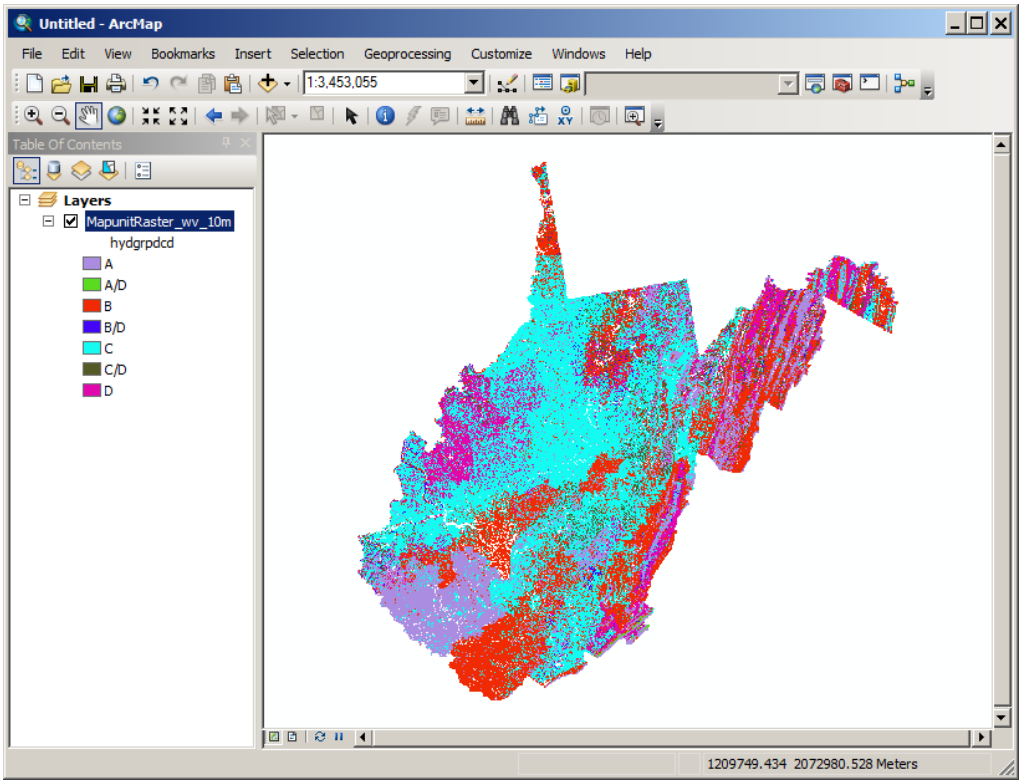
13. Right click on the raster layer and click **Properties**.



14. In the Layer Properties dialog:
    A. Select the **Symbology** tab in the **Layer Properties** dialog box.
    B. In the Show group, select **Unique Values**.
    C. From the Value Field drop-down menu, select **hydgrpdcd**.
    D. Choose a color palette from the **Color Scheme**.
    E. Click **OK**.

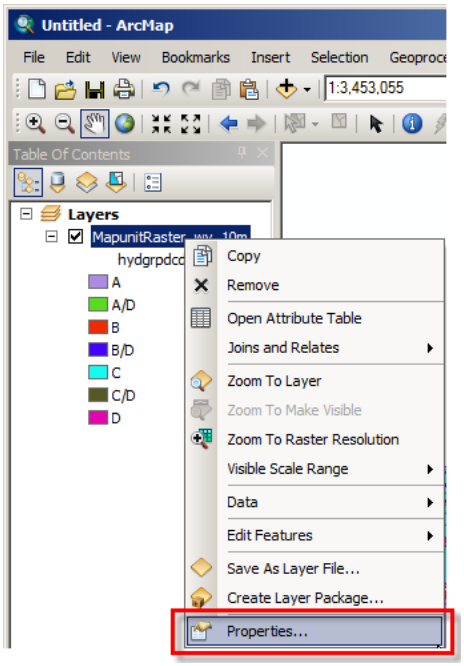


The dominant condition for the map unit is rendered for Hydrologic Group.

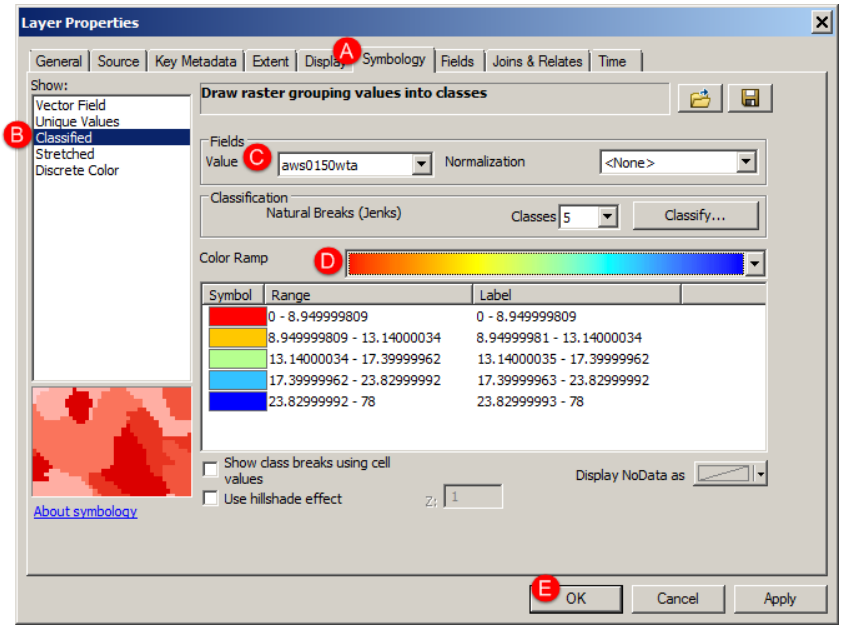


Symbolize the data based on the available water storage

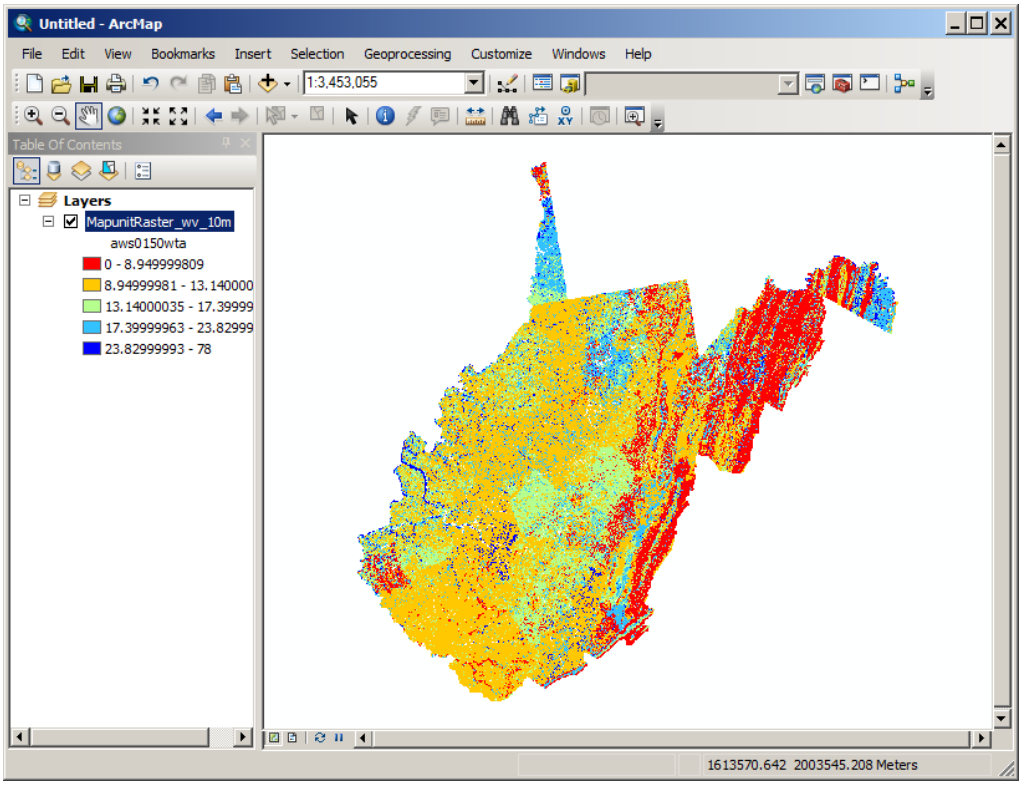
15. Right click on the raster layer and click **Properties**.


Untitled - ArcMap
File
Edit
View
Bookmarks
Insert
Selection
1:3,453,055
Table Of Contents
Layers
A
A/D
B
B/D
C
C/D
D
Copy
Remove
Open Attribute Table
Joins and Relates
Zoom To Layer
Zoom To Make Visible
Zoom To Raster Resolution
Visible Scale Range
Data
Edit Features
Save As Layer File...
Create Layer Package...
Properties...

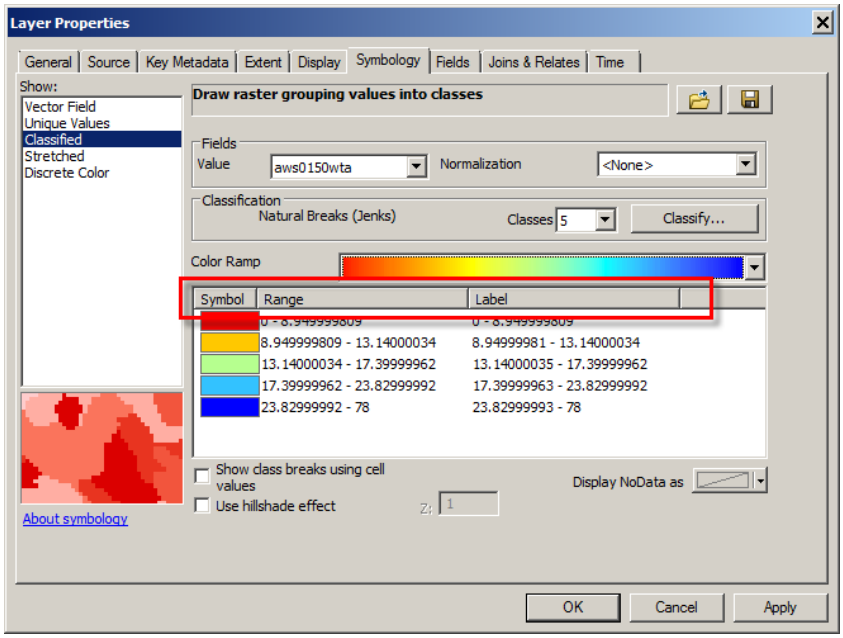
16. In the Layer Properties dialog:
    A. Select the **Symbology** tab in the **Layer Properties** dialog box.
    B. In the Show group, select **Classified**.
    C. From the Value Field drop-down menu, select **aws0150wta**.
    D. Choose a color palette from the **Color Ramp**.
    E. Click **OK**.



The weighted average for the map unit is rendered for Available Water Storage 0-150 cm.



Clicking on the Symbol, Range, or Label column heading in the Layer Properties dialog box allows the user to alter settings, such as the number of decimal places. Changing these settings will also change the layer's legend in the Table of Contents and make it easier to read.



Other Classification Methods

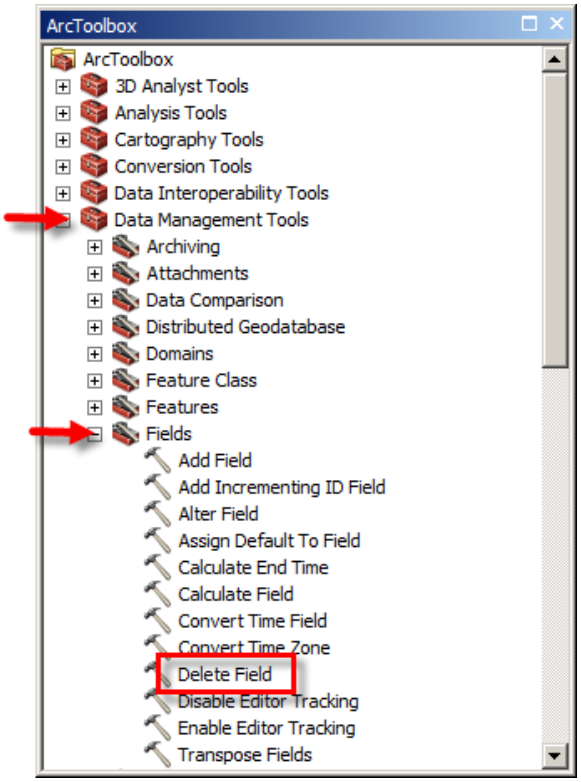
The previous screenshot used the ArcGIS® default Natural Breaks (Jenks) classification method. Other classification options can be applied. It is important to consult a subject matter expert to ensure that appropriate and meaningful breaks are applied to the data.

Removing Join Columns from the Attribute Table

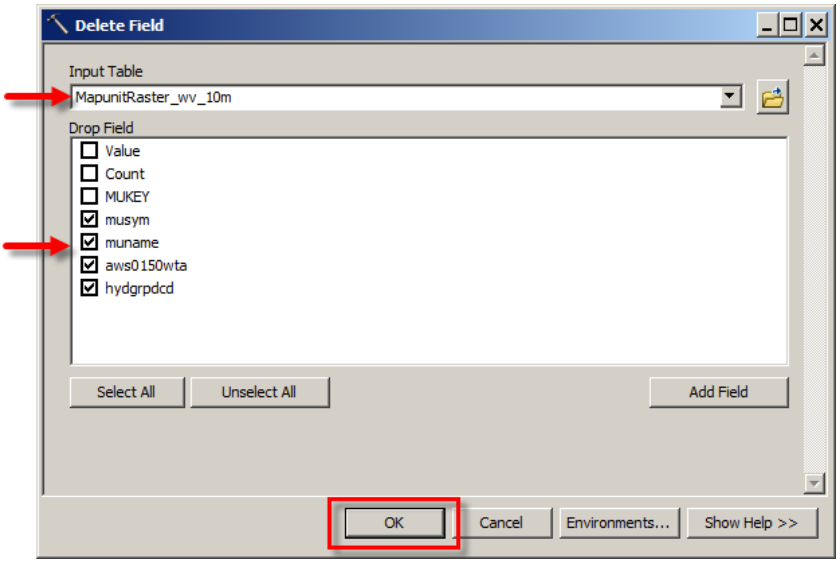
The following example demonstrates how to permanently drop columns (created using JoinField tool) in the attribute table. Please be careful. There is no 'Undo' if the wrong column is dropped. Do NOT try to delete the Value, Count, or MUKEY columns. The Value and Count columns are managed by the geodatabase and cannot be deleted or calculated. See the section "Restoring MUKEY Values in Raster Layers" in the event that the MUKEY column or data is lost.

1. Open **ArcToolbox** located on the Standard toolbar.

2. In ArcToolbox, expand the **Data Management Tools**, expand the **Joins** tools, and double-click on the **Delete Field** tool to open a dialog.



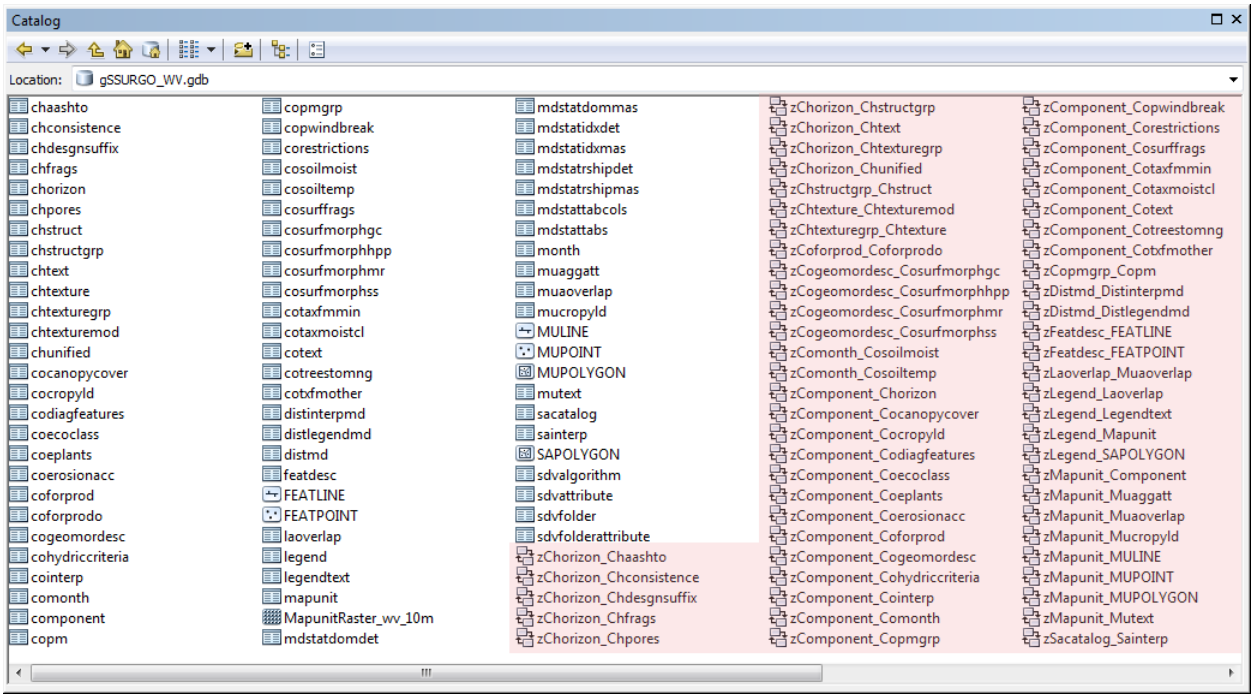
3. Complete the Delete Field dialog:
   - For the Input Table, select **MapunitRaster_WV_10m**.
   - Place a **check** in the box beside the name of the field(s) that you want to delete.
   - Click **OK**.



TIP: If, after processing is complete, the attribute table does not display with the additional fields removed, exit and restart ArcMap™. Add the raster and open the attribute table. The additional columns should be gone.

Using Relationship Classes in a Geodatabase

A relationship class stores information about table relates in a geodatabase. These classes are similar to relationships in a Microsoft® Access® database but are more limited in functionality. The relationships are prebuilt and are tables within the geodatabase. The relationships are shown in ArcCatalog as tables having the z prefix..



Relationship classes can be used to:

- Navigate through related tables using the Identify button
- Select related records in related tables

In the following example, the relationship is traced between the Mapunit Polygon attribute table and the Component Geomorphic Description (cogeomordesc) Table. This is a “top down” approach. It can be useful to “drill down” through the component and horizon tables to investigate differences in interpretation values between adjacent surveys.

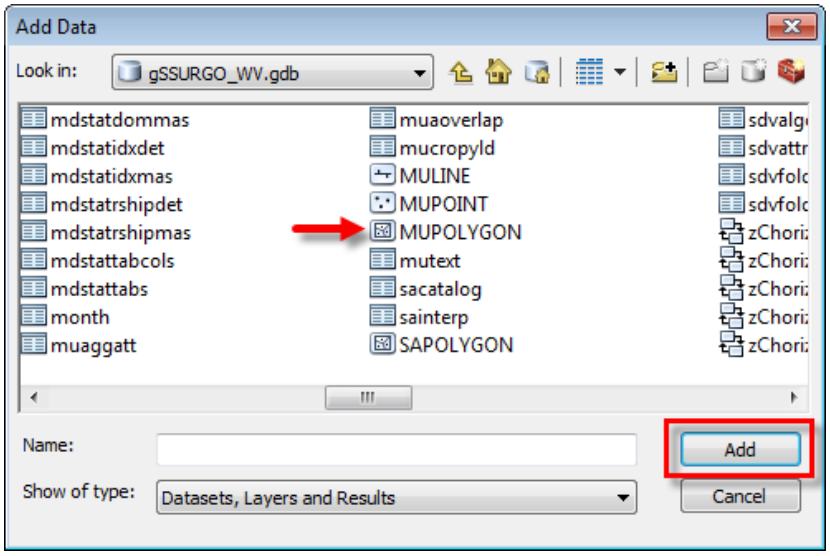
The selection sequence is: MUPOLYGON feature class, mapunit, component, cogeomordesc.

There must be relationship classes in the geodatabase for this to succeed.

1. **Start ArcMap** with a new blank map.

2. On the Standard toolbar, click the **Add Data** button.

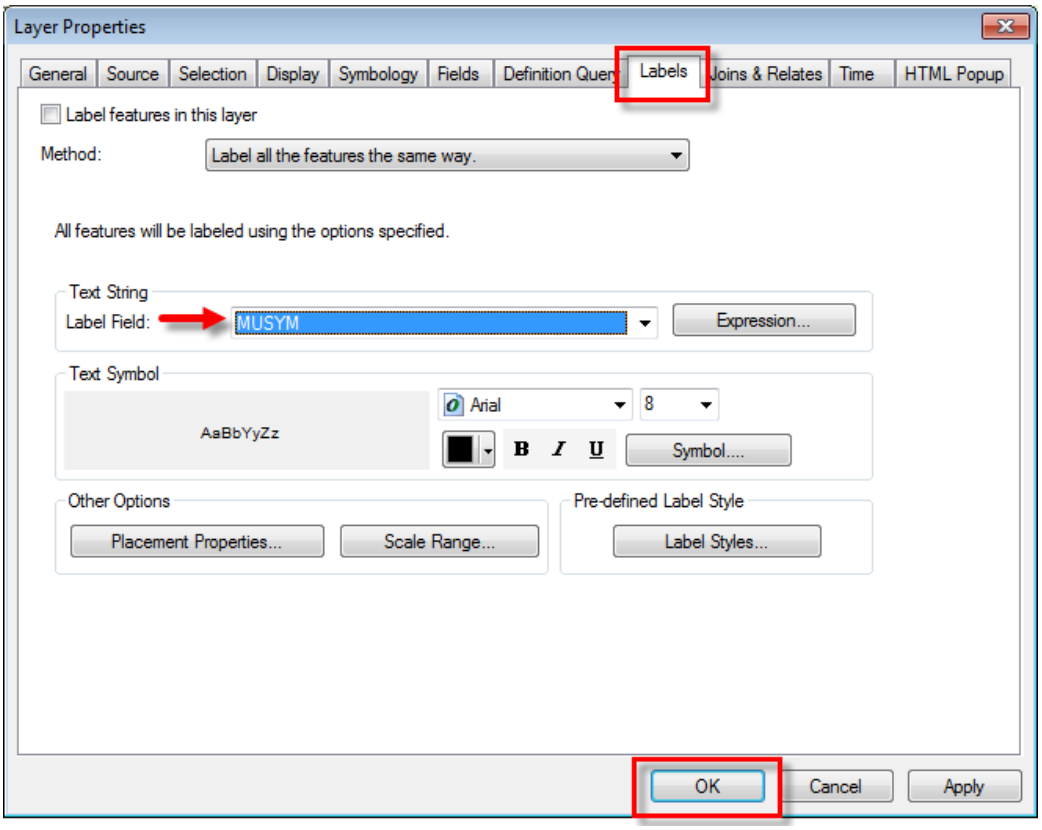
3. In the gSSURGO file geodatabase add the **MUPOLYGON** data layer.



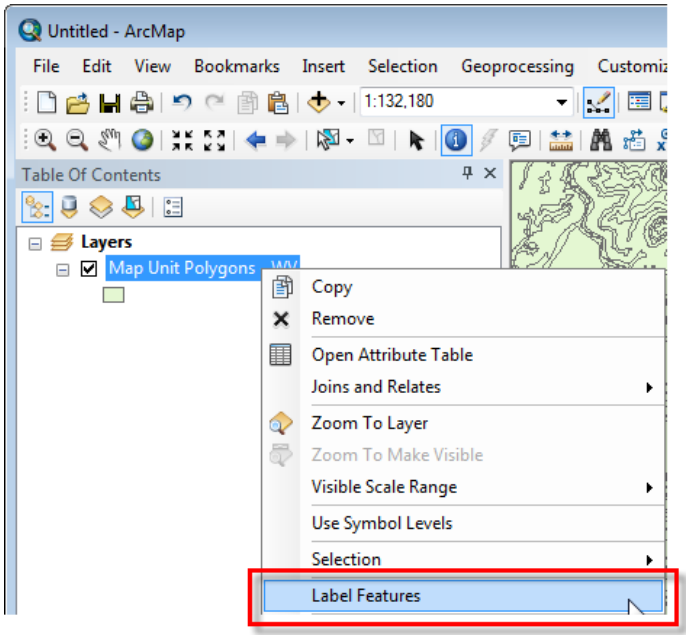
4. Use the **Zoom In** tool, located on the Tools toolbar, and zoom in to an area.

5. In the ArcMap Table of Contents, double click on the **MUPOLYGON** data layer to open the Layer Properties dialog.

6. In the Layer Properties dialog, click on the **Labels** tab. Change the Label Field to **MYSYM** and click **OK**.

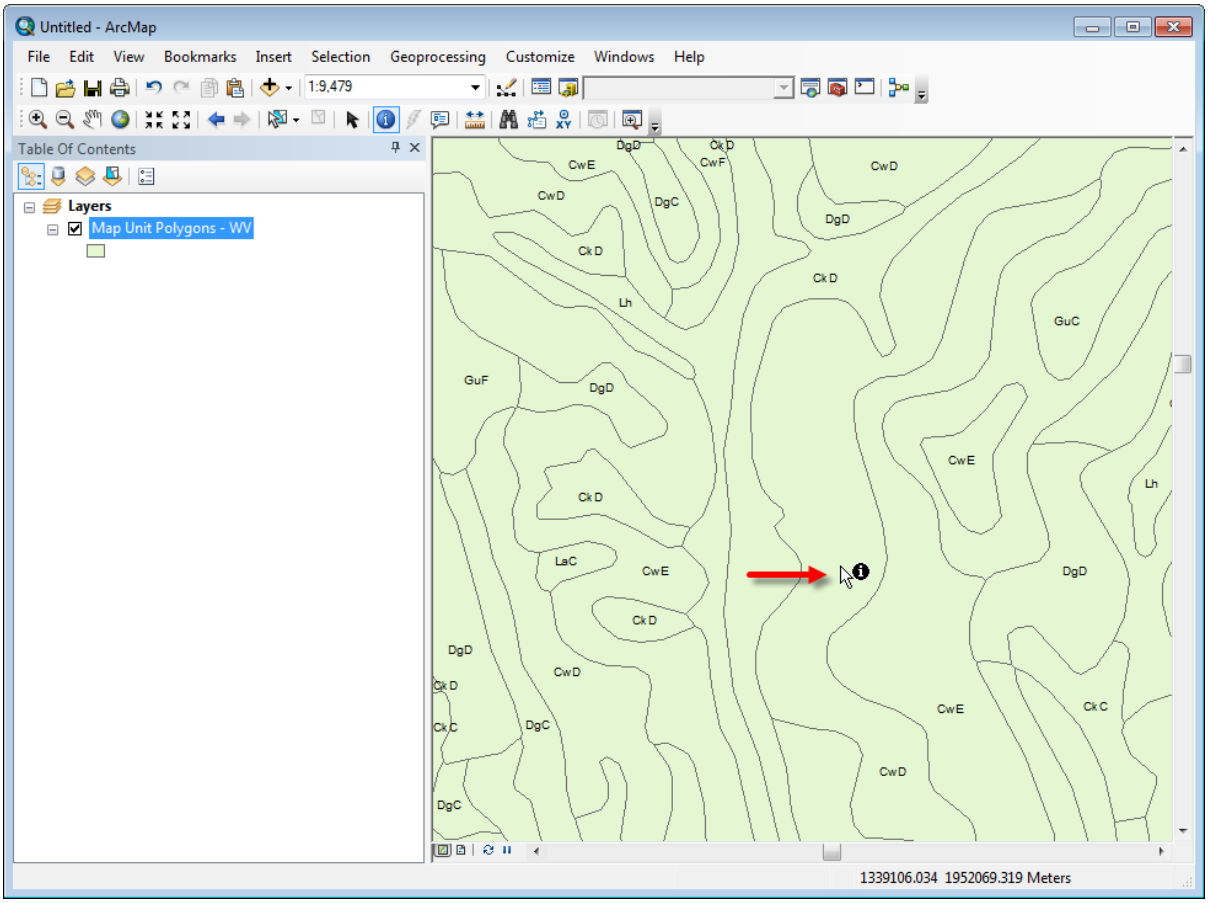


7. Turn on the labels for the MUPOLYGON data layer by right clicking on it in the Table on Contents and select **Label Features**.

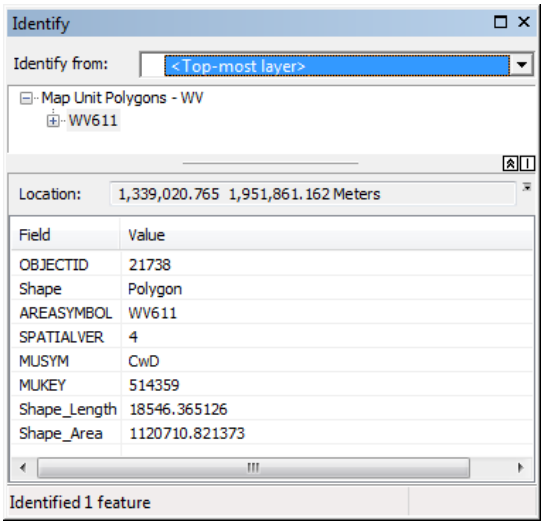


8. Click in a white area with the **Identify** button located on the Tools toolbar and click on a polygon.

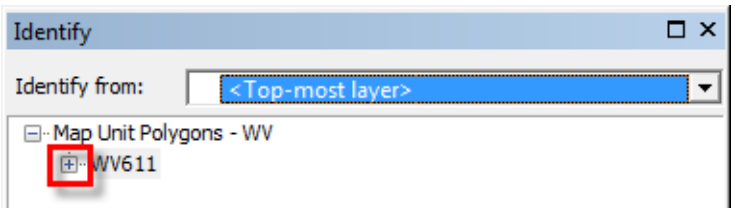
This example shows identifying the polygon for the “Culleoka-Westmoreland silt loams, 15 to 25 percent slopes” soil type.



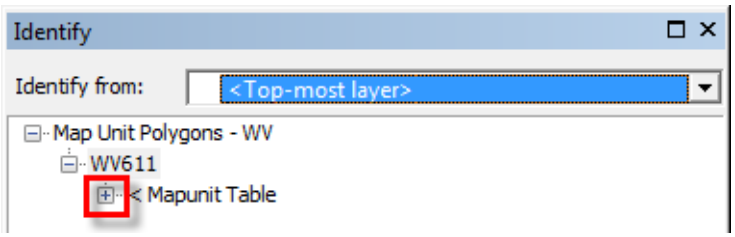
9. The Identify results dialog is displayed.



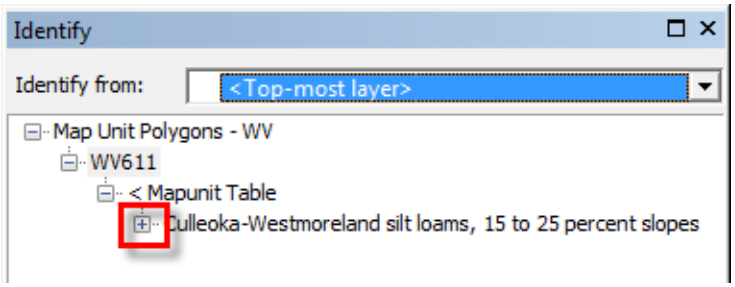
10. In the Identify dialog, click the **plus sign (+)** beside the map unit name to expand the selected map unit.



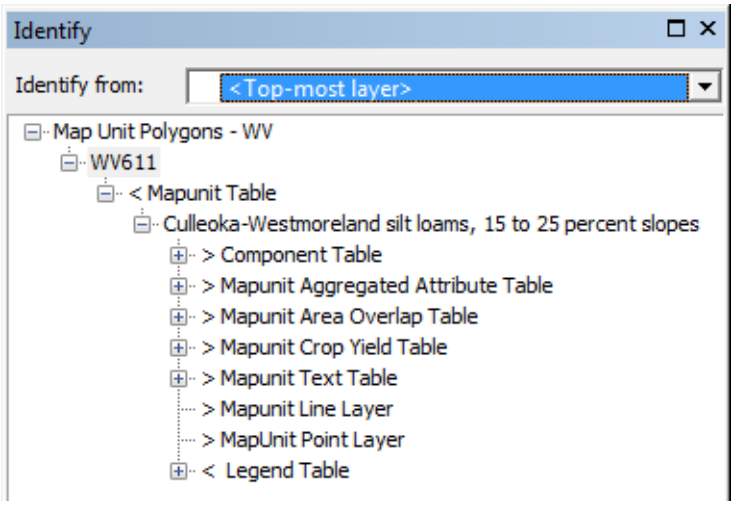
11. Expand the Mapunit Table by clicking on the **plus sign (+).**



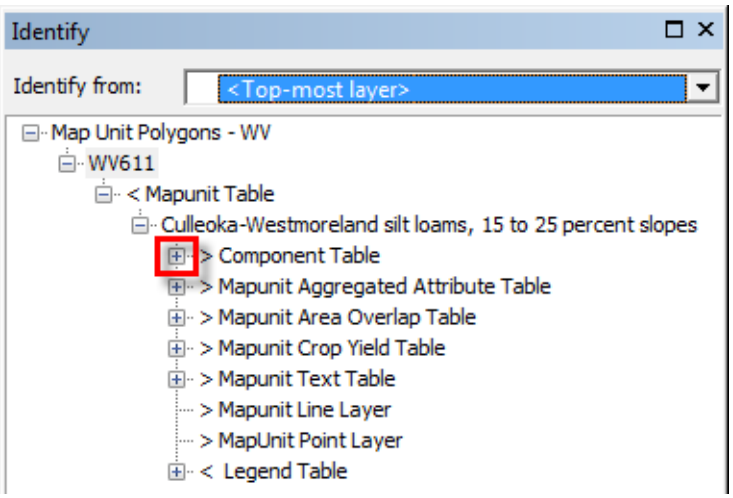
12. Select the **plus sign (+)** beside the map unit name to expand the selected map unit.



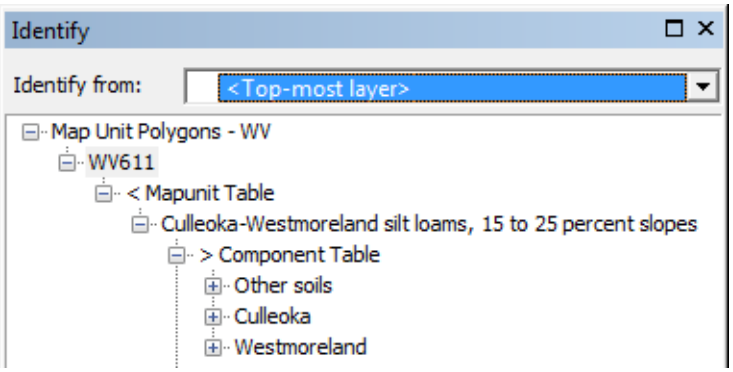
The display shows the relationship classes created from the Mapunit Table and its child tables. If the table does not contain records, there will not be a corresponding plus sign beside the table.



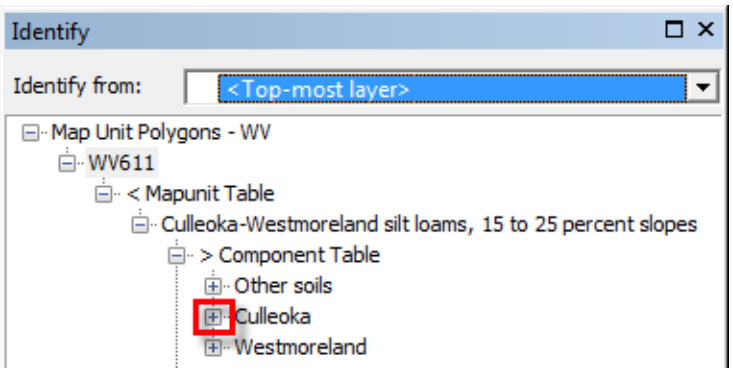
13. Select the **plus sign (+)** beside the Component Table to expand.



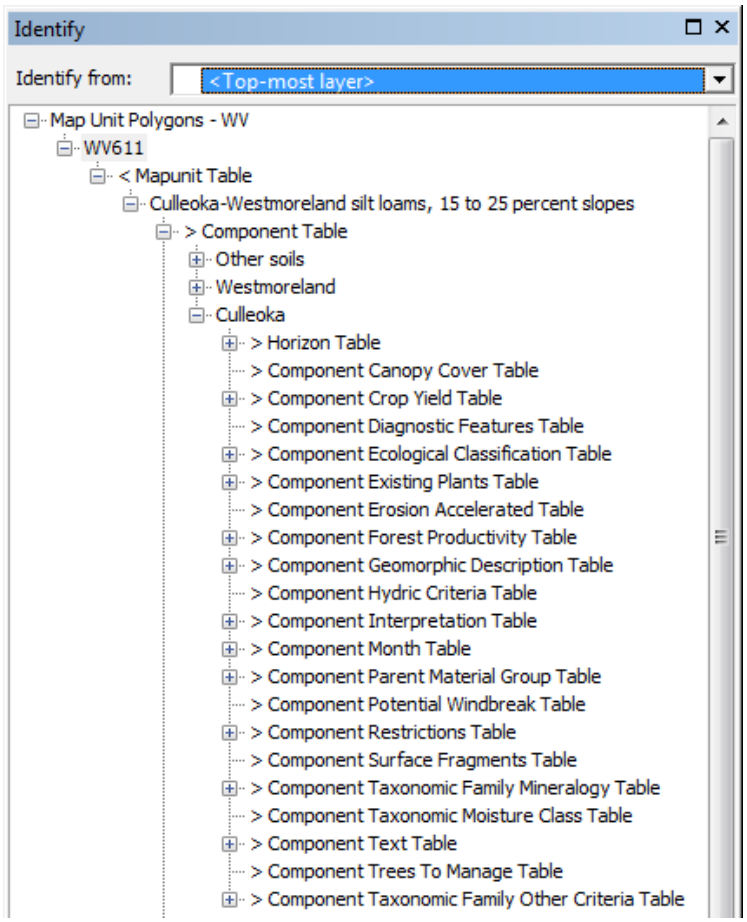
The map unit components; Other soils, Culleoka, and Westmoreland are displayed.



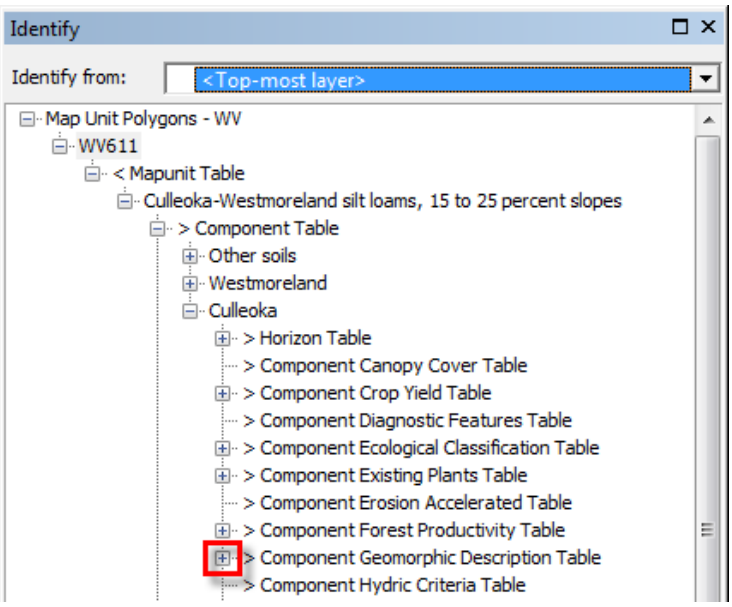
14. Expand the **plus sign (+)** for Culleoka.



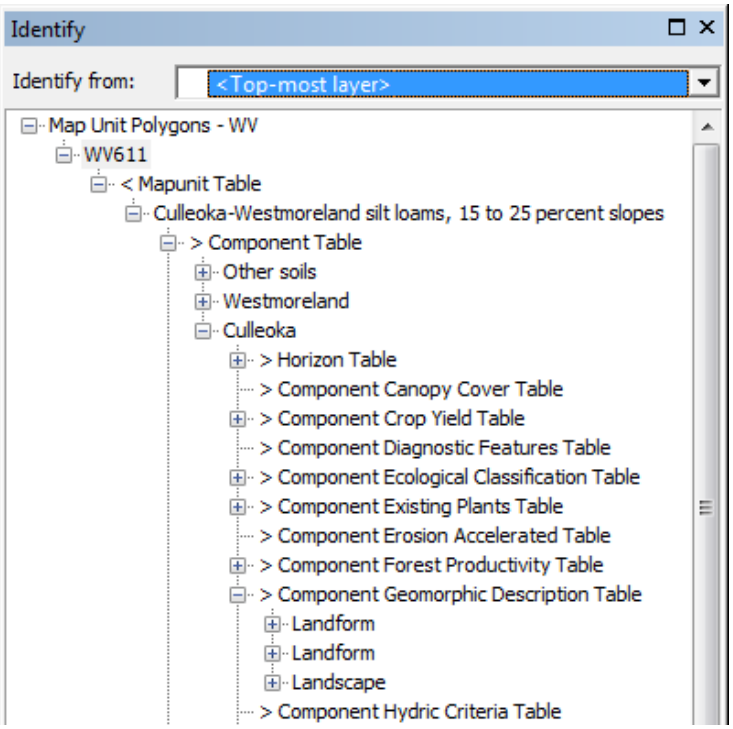
The display shows the relationship classes for the child tables of the Culleoka component.



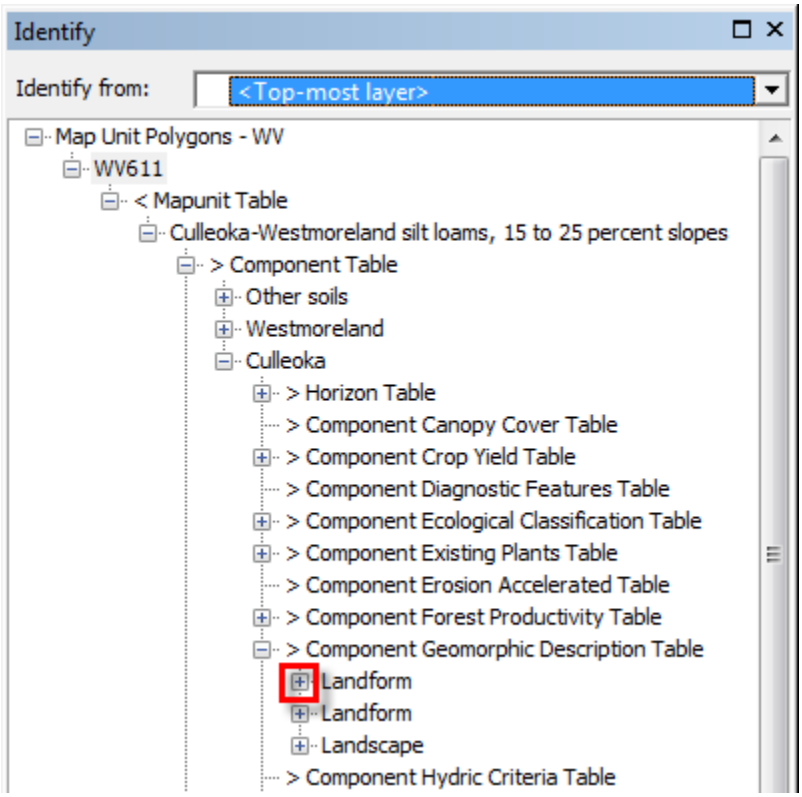
15. Expand the **plus sign (+)** beside the Component Geomorphic Description Table



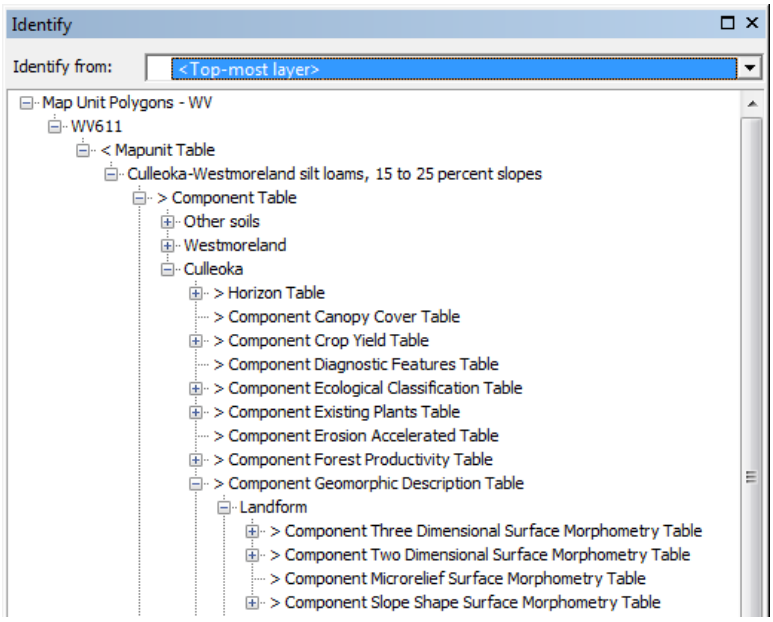
The landform and landscape positions of the Culleoka component are displayed.



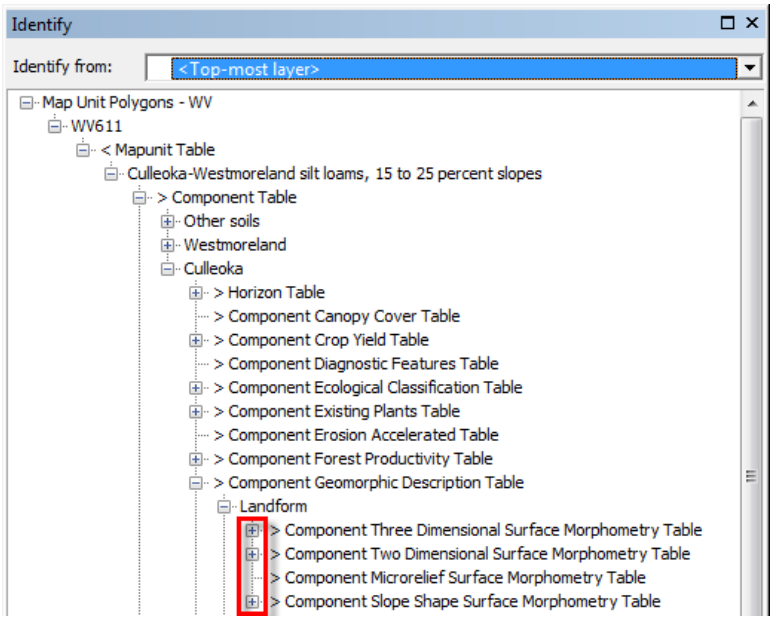
16. Expand the **plus sign (+)** beside the Landform that appears first in the list.



The Landform Components are listed.



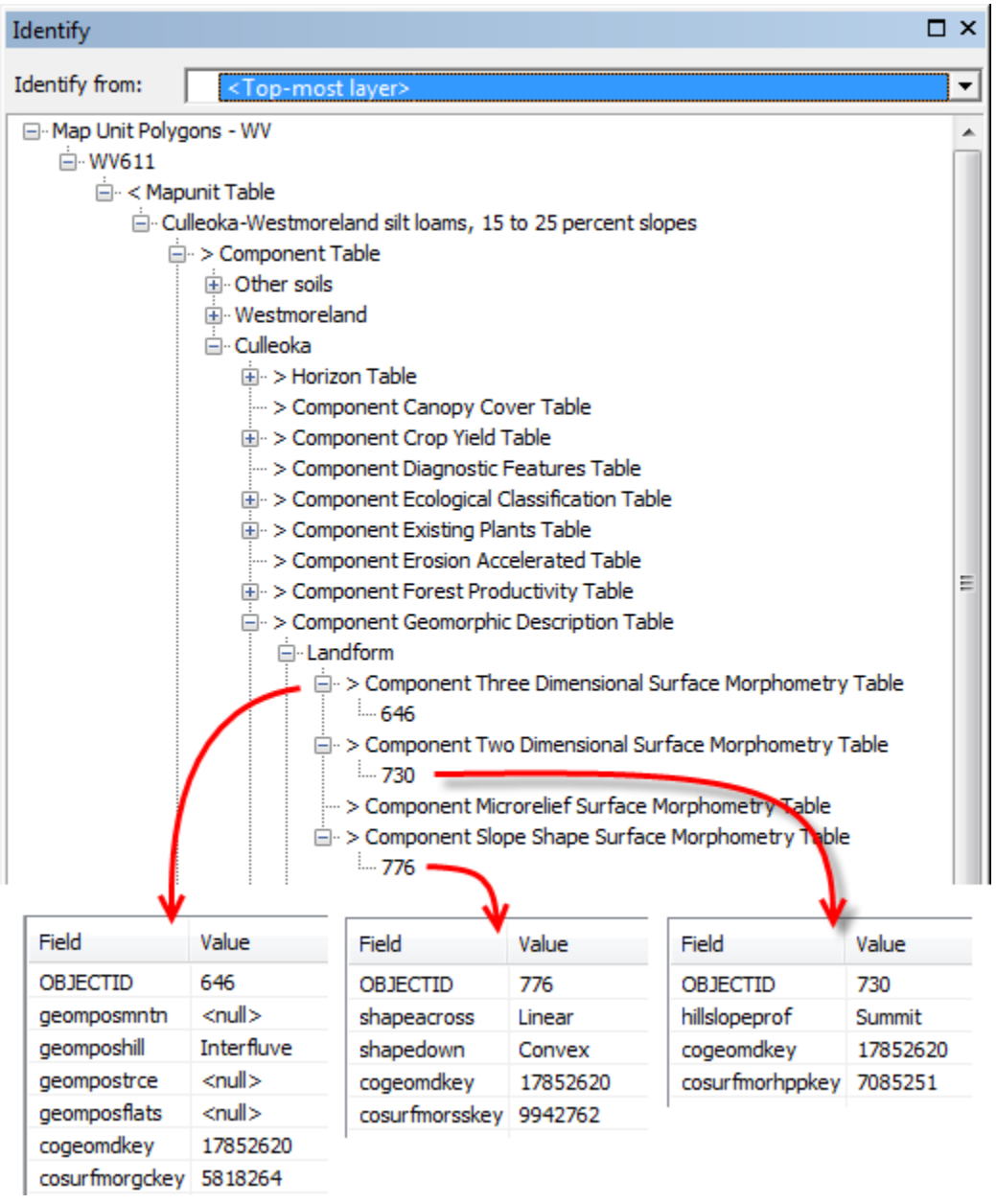
17. Expand the **plus sign (+)** beside each Landform Component.



In order for the values to make sense, click on the individual numeric values to decode.

The table aliases are displayed in the Identify results tree. A table alias is one of the properties that was set when the relationship classes were created.

The Landform record can also be expanded to display information contained in four child tables of the Component Geomorphic Description Table. In this example, no related information exists in the Component Microrelief Surface Morphometry Table.



Using Relationship Classes to Find Related Records in Related Tables

In the following example, the relationship is traced between the Component Geomorphic Description (cogeomordesc) Table and the Map Unit Polygon attribute table. This is the "bottom up" approach.

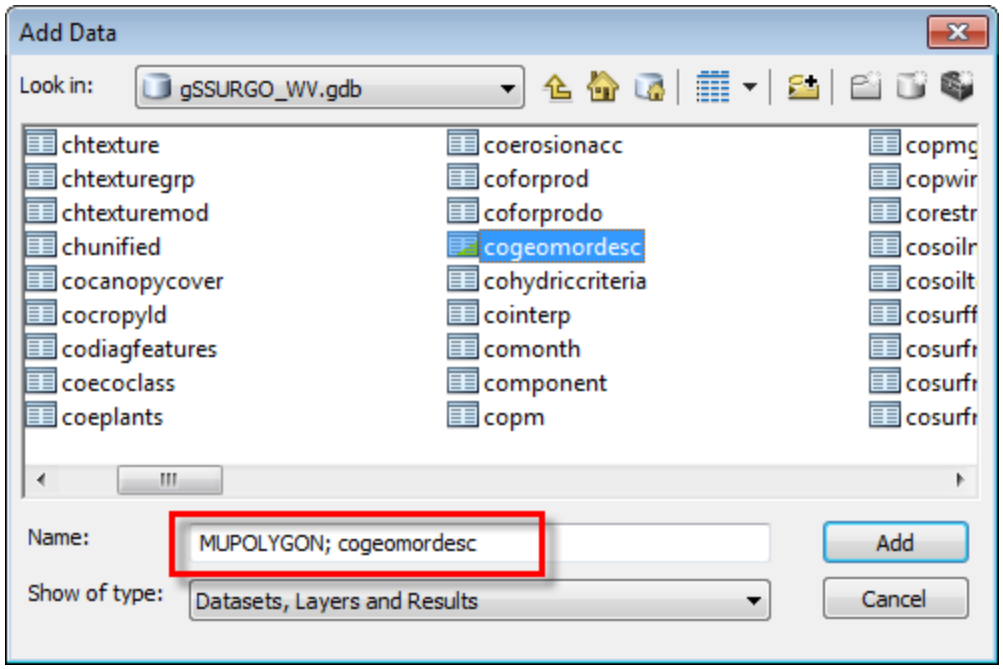
The selection sequence is: cogeomordesc, component, mapunit, MUPOLYGON feature class.

Find map units containing "flood plains". Begin with the cogeomordesc table.

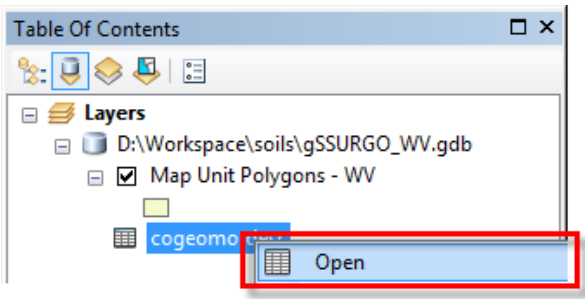
1. **Start ArcMap** with a new blank map.

2. On the Standard toolbar, click the **Add Data** button.

3. In the gSSURGO file geodatabase add the **MUPOLYGON** data layer and the **cogeomordesc** table.



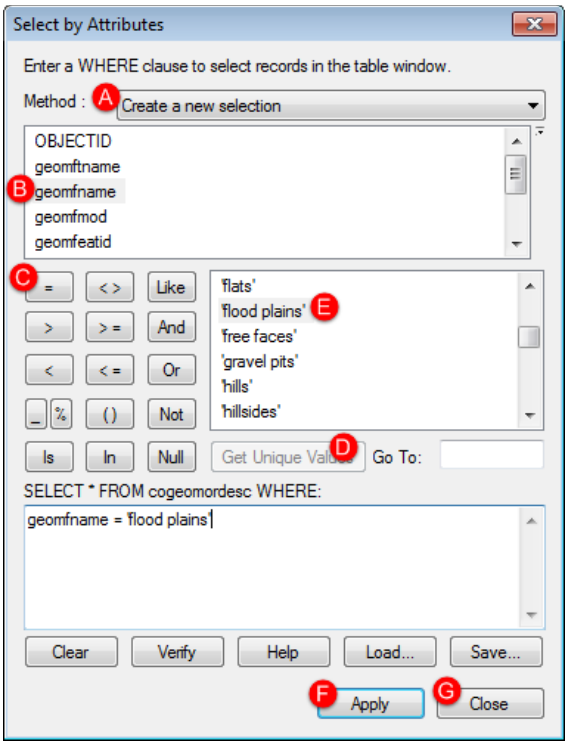
4. In the Table of Contents, right click on the **cogeomordesc** table and click **Open**.



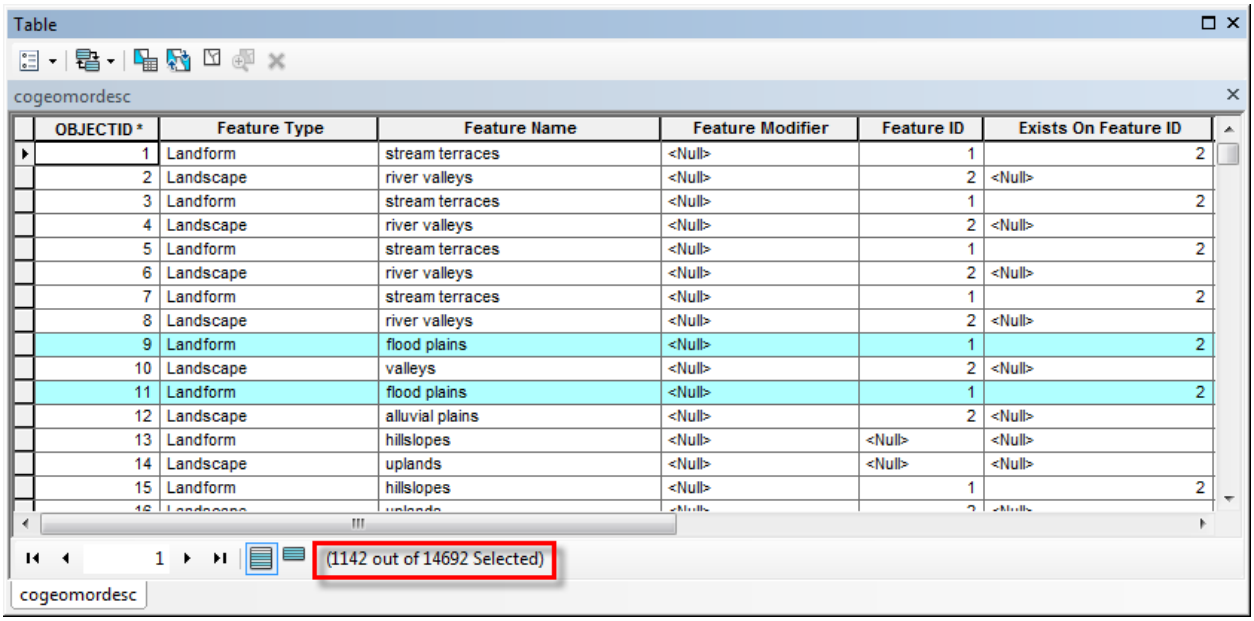
Narrow the number of records to work with.

5. In the attribute table, click on the **Select by Attributes** button.

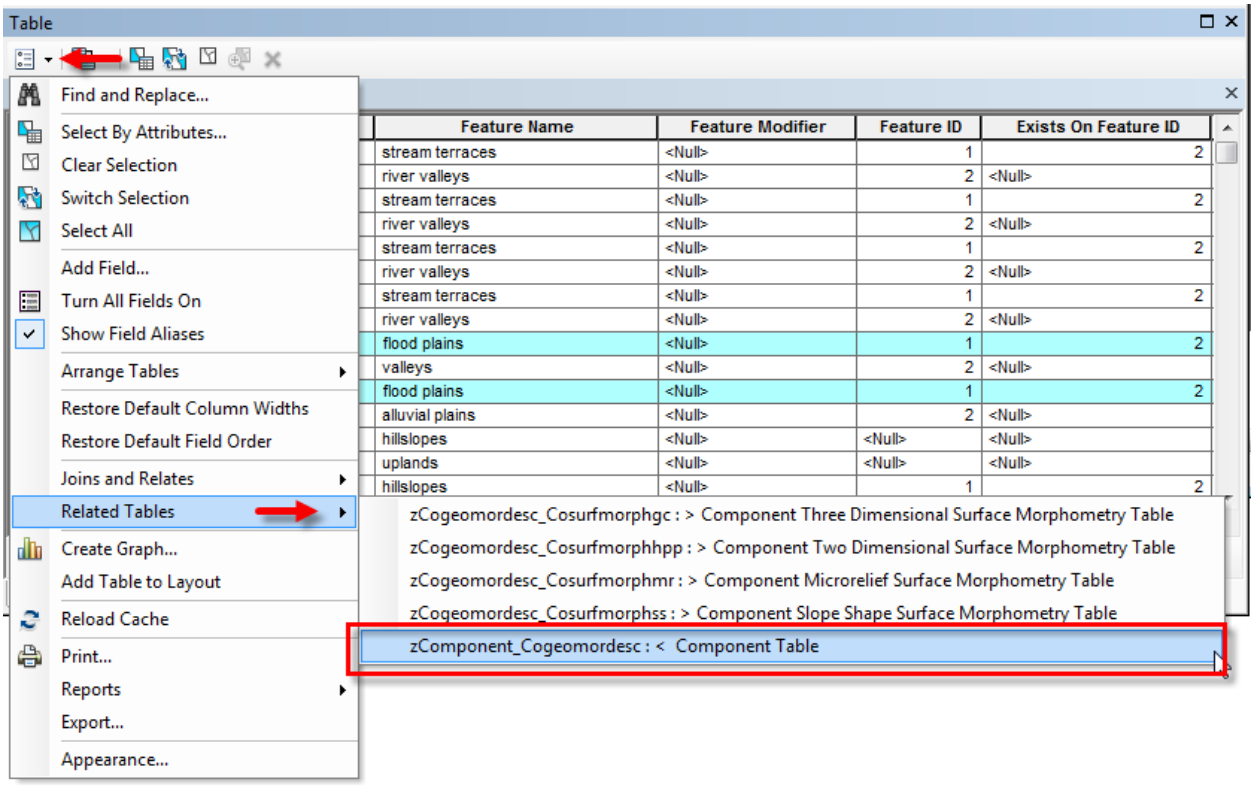
6. Complete the **Select by Attributes** dialog box:
   A. Method: **Create New Selection**
   B. Double-click on **geomfname** (Feature Name).
   C. Single-click on **equals sign (=)**.
   D. Click on the **Get Unique Values** button for a list of values for the feature name field.
   E. Double-click on **flood plains** to complete the selection.
   F. Click **Apply.**
   G. Click **Close**.



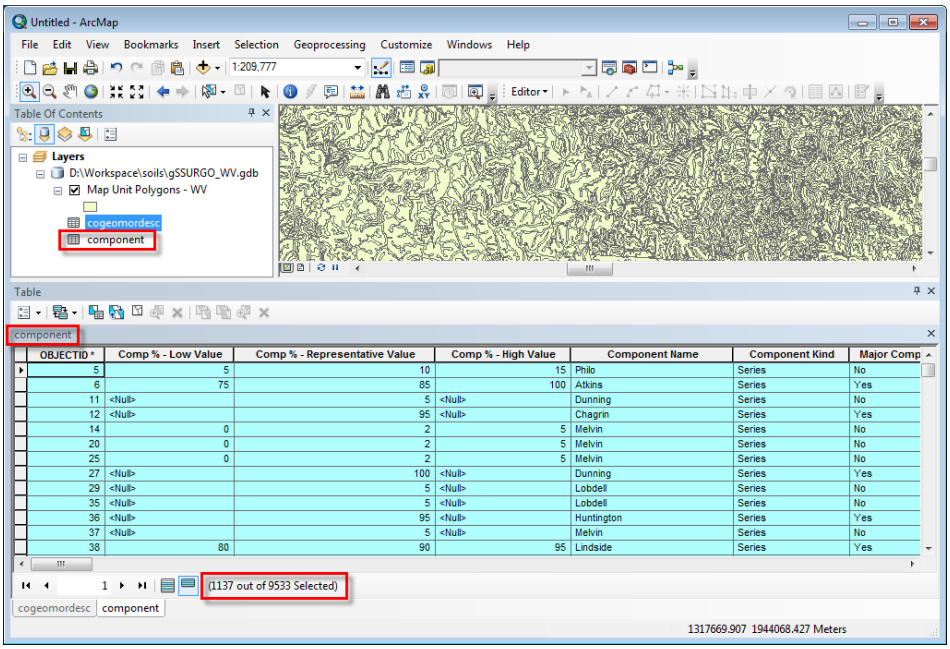
In this example, the query selected 1142 records from the 14692 contained in the table.



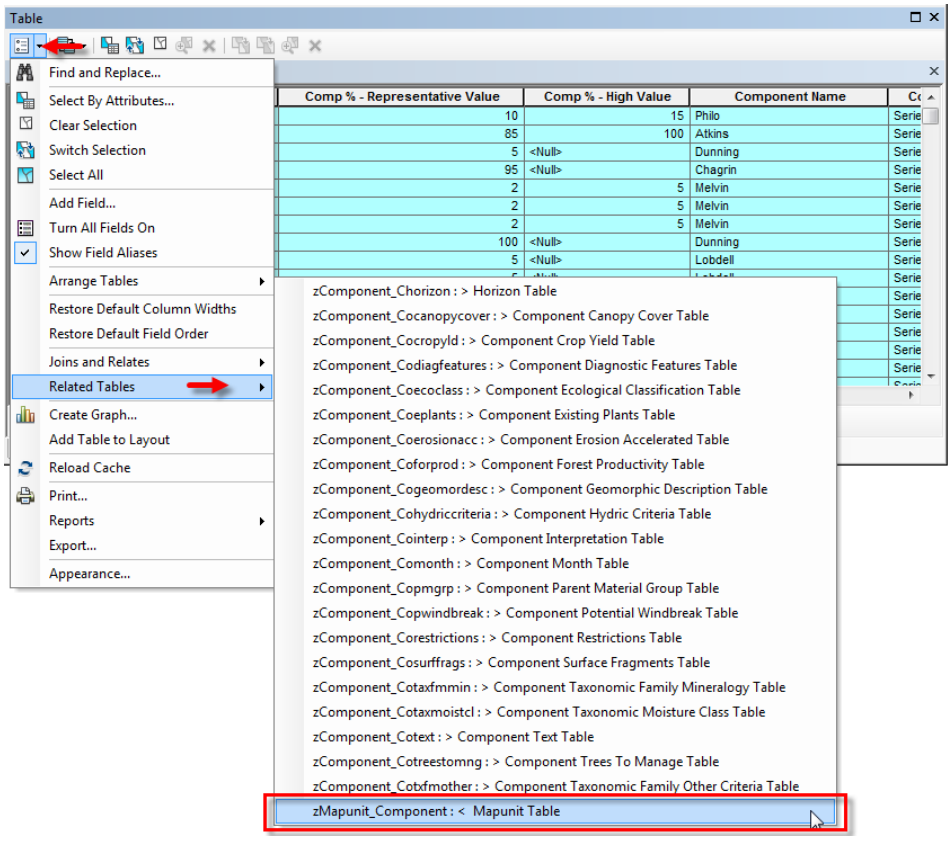
7. Click **Table Options** drop-down menu in the cogeomordesc table, click on **Related Tables>zComponent_Cogeomordesc**.



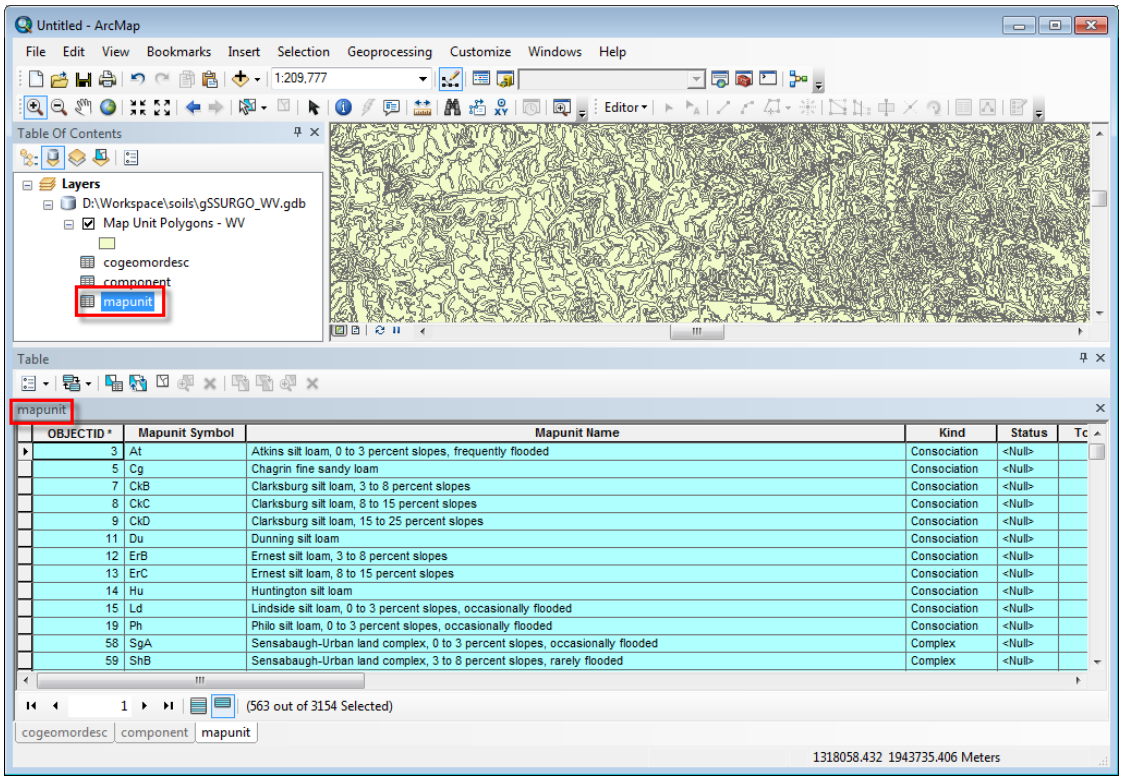
The component table is added to the Table of Contents and will open with all related records selected. In this example, 1137 records out of 9533 were selected.



8. Click **Table Options** drop-down menu in the component table, click on **Related Tables>zMapunit_Component_Mapunit Table**.

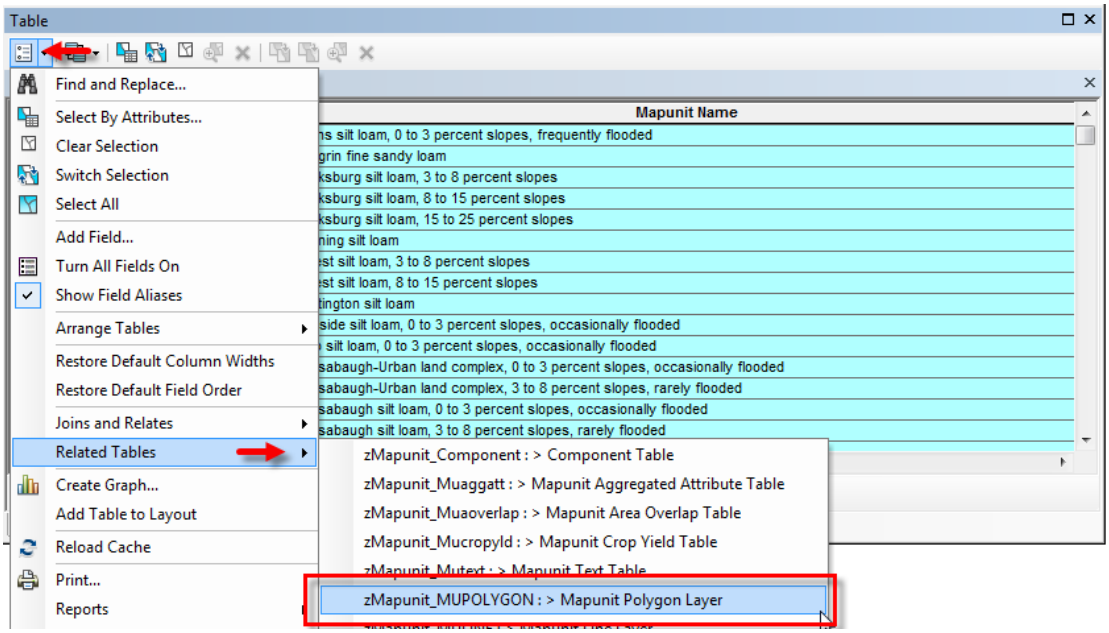


The mapunit table is added to the Table of Contents. There are 563 out of 3154 records selected.

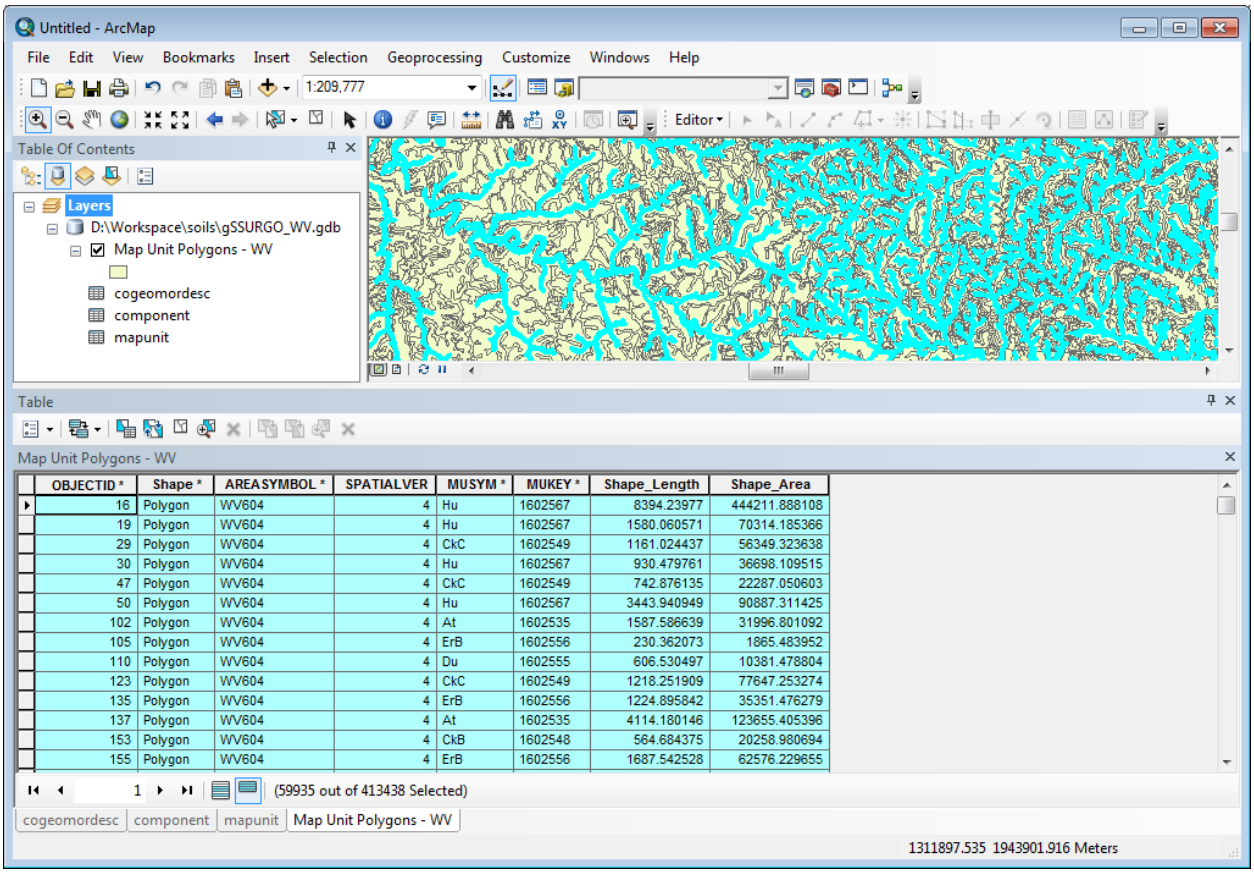


9. Click **Table Options** drop-down menu in the mapunit table, click on **Related Tables>zMapunit_MUPOLYGON:>Mapunit Polygon Layer**.

This may take some time to process, depending on how many records are selected.



In this example, 59935 map unit polygons have a component with the landform “flood plain.”



The Map Unit Polygons feature class is already in the Table of Contents.

10. If needed, turn on the MapUnit Polygons feature class in the Table of Contents to display the data.

11. Zoom to the Full Extent by clicking on the **Full Extent** button located on the Tools toolbar.

At the end of this “bottom up” approach to relationship classes is a display of flood-plain map units.

Note: In this example, the percentages of the components were not taken into consideration, only the presence or absence of flood plains.

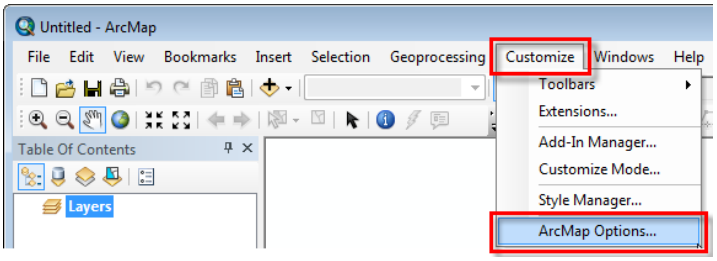
Performance Tips

Displaying Layers in the ArcMap™ Table of Contents

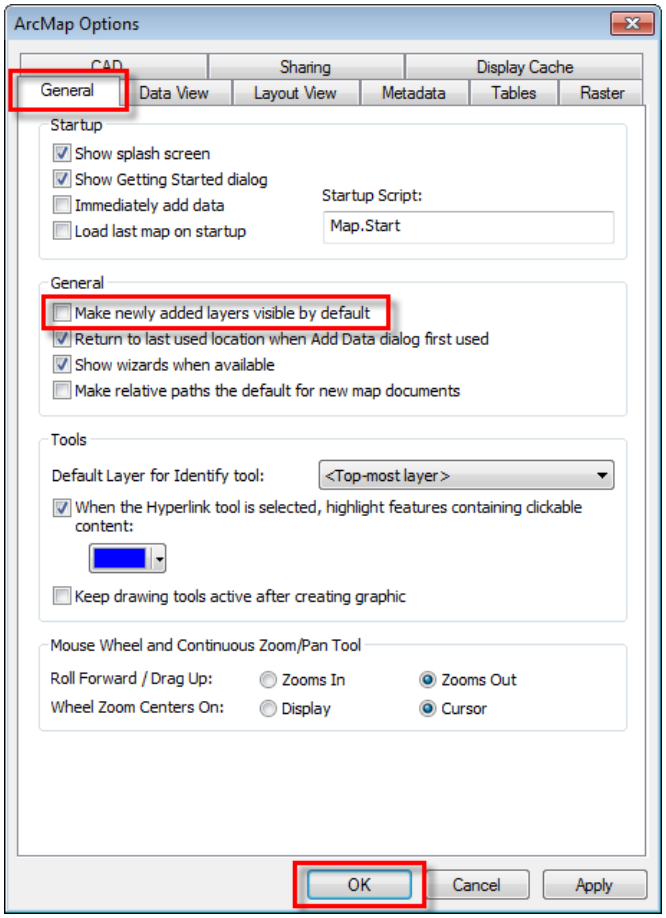
Making Newly Added Layers Visible by Default

Normally ArcMap™ automatically begins to display a map layer as soon as the user adds it to the Table of Contents. When working with very large feature classes that have thousands, if not millions, of records, turning off the default draw can greatly speed up the process. This gives the user an opportunity to first modify the layer symbology or to zoom to a new location. This default setting can easily be changed by the user and need only be changed once.

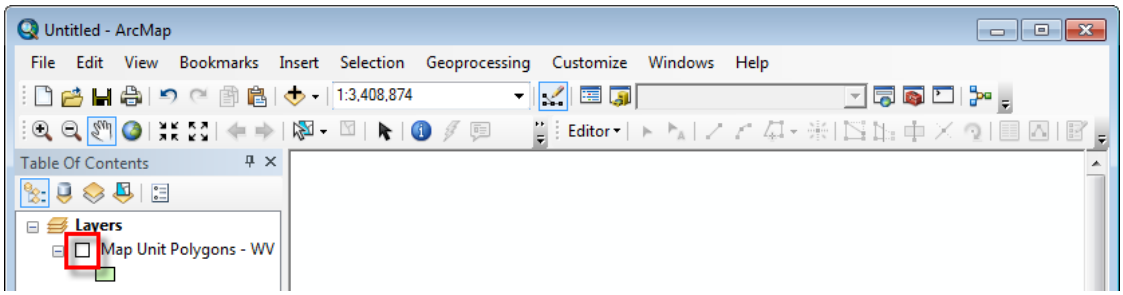
1. From the ArcMap Main Menu, click **Customize>ArcMap Options**.



2. In the ArcMap Options dialog, click the **General** tab. Uncheck the box to **Make newly added layers visible by default**. Click **OK**.



By unchecking this option the data layer is not drawn when added to the Table of Contents. Once the West Virginia file geodatabase has been added there are more than 400,000 records in the geodatabase.

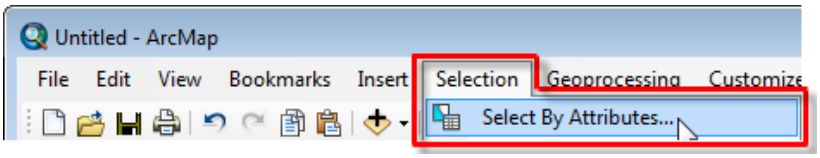


By selecting a smaller area of interest before proceeding will help speed up the process.

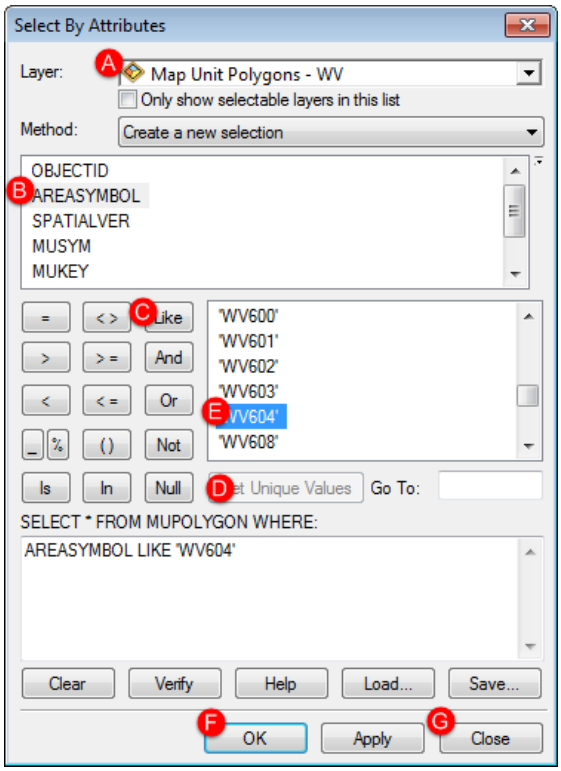
Selecting an Area of Interest to Reduce the Number of Records

If a specific area is needed, a selection to reduce the number of records to draw in the display area is useful. This example demonstrates selecting a soil survey area.

1. On the ArcMap Main menu click **Selection>Select By Attributes**.



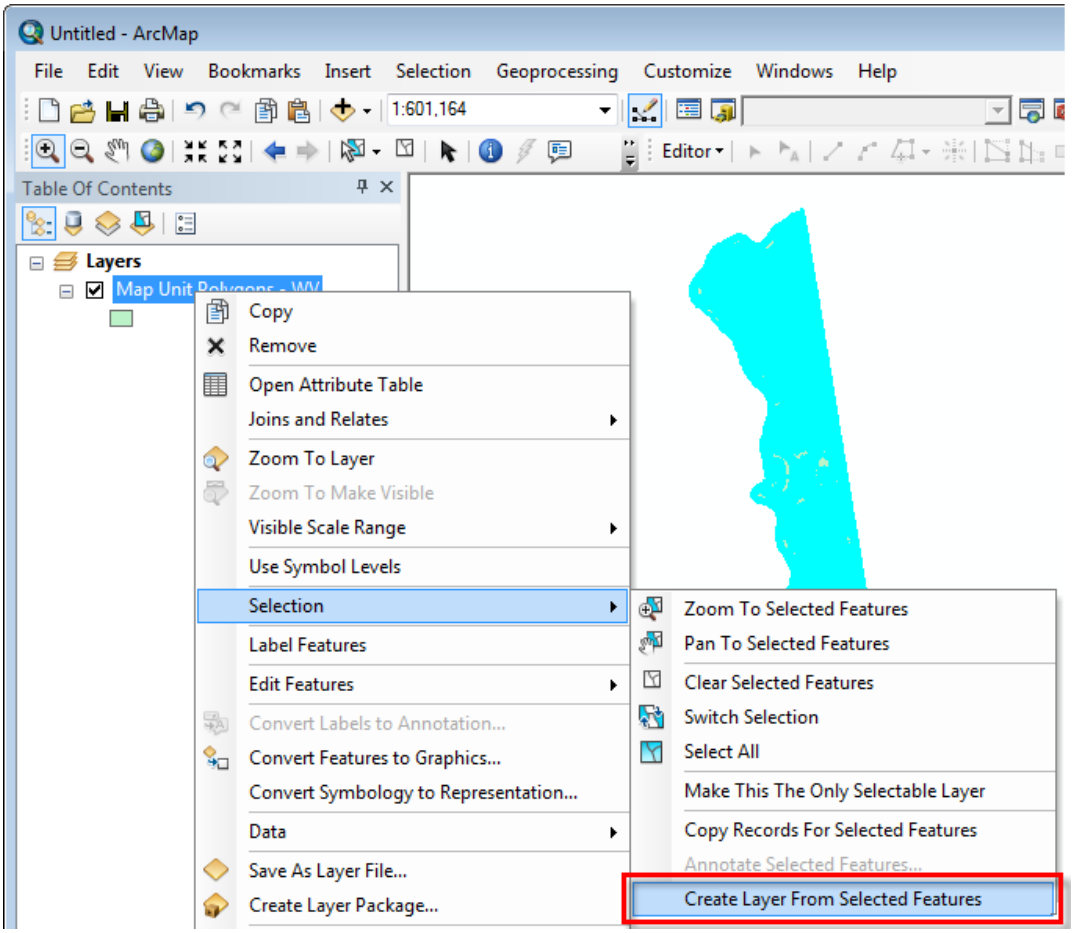
2. Complete the Select by Attributes dialog box:
   A. Select **Map Unit Polygons** for Layer.
   B. Double-click on **AREASYMBOL**.
   C. Single-click on **Like**.
   D. Click on the **Get Unique Values** button.
   E. Double-click on **WV604**.
   F. Click **OK**.
   G. Click **Close**.



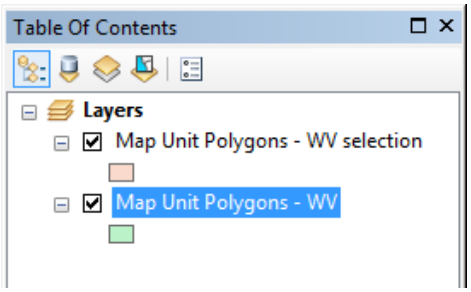
Creating a layer file to be used over and over again for analysis will eliminate the need to create a selected set each time specific data are needed.

Creating a Layer File from Selected Features

1. Right-click on the feature class (e.g., **MapUnit Polygons-WV**), click on arrow next to **Selection**, and select **Create Layer From Selected Features**.



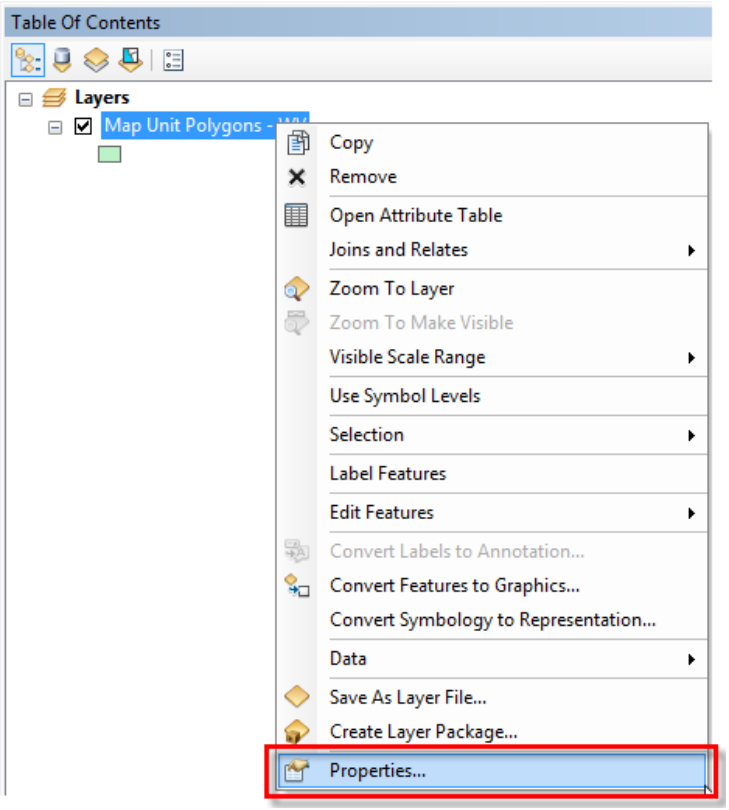
The new layer is automatically added to the Table of Contents. Adjust the symbology, if desired.



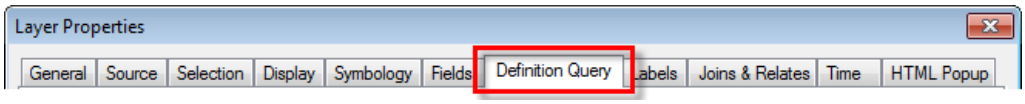
Using a Layer Definition Query to Reduce the Number of Selected Records

A definition query can be used to reduce the number of records before displaying in ArcMap.

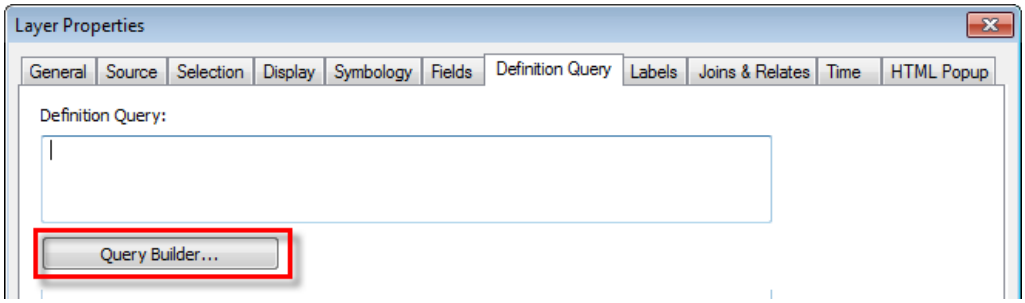
1. In the ArcMap Table of Contents, right-click on the feature class (e.g., **Map Unit Polygons - WV**) and click **Properties.**



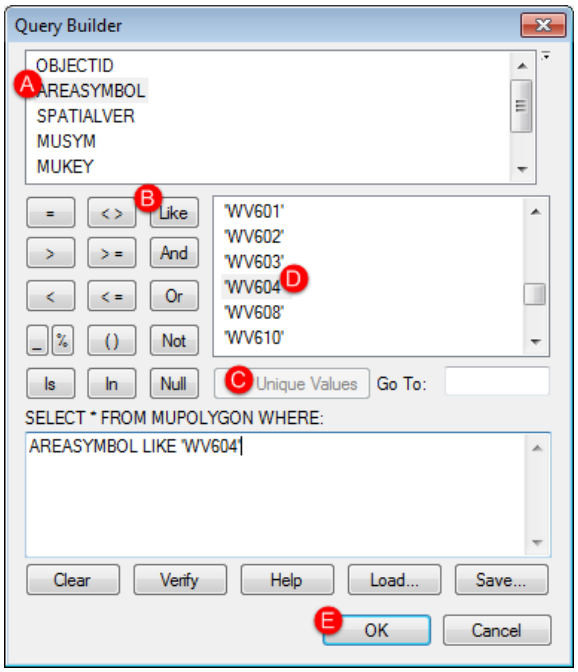
2. In the Layer Properties dialog click on the **Definition Query** tab.



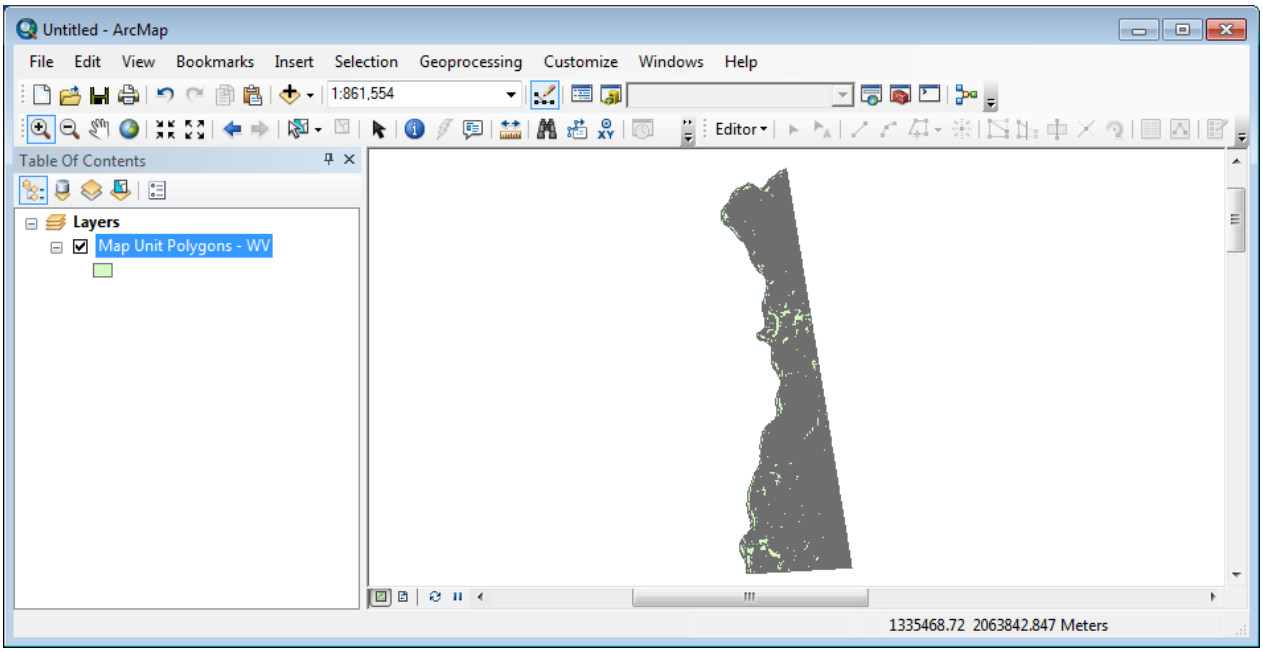
3. Click on the **Query Builder** button.



4. In the **Query Builder** dialog:
   A. Double-click on **AREASYMBOL.**
   B. Single-click on **Like.**
   C. Click the **Get Unique Values** button.
   D. Double-click on **WV604**.
   E. Click **OK**.



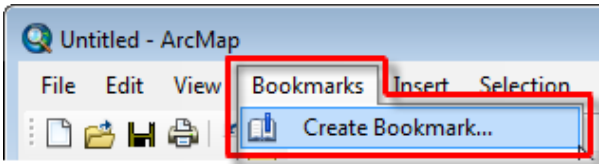
The display area is automatically updated with only the polygons defined in the query.



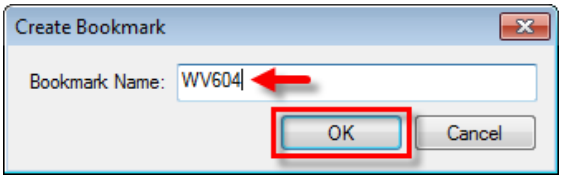
Bookmarks

A bookmark can be created to save a specific geographic extent. This reduces the amount of time it takes to navigate to an area of interest.

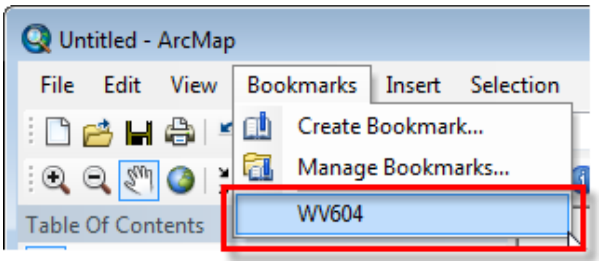
1. From the ArcMap Main menu click **Bookmarks>Create Bookmark**.



2. In the Create Bookmark dialog enter a **name** and click **OK**.

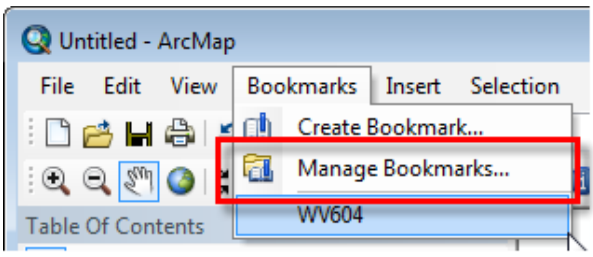


3. To navigate to the bookmarked area click on **Bookmarks** on the ArcMap Main menu and click on the bookmark **name**.



ArcMap will zoom to the geospatial extent set in the bookmark.

Bookmarks can be deleted or renamed. The order of bookmarks can also be changed in the order you want them to appear in the menu. This can be done by clicking on **Bookmarks>Manage** Bookmarks on the ArcMap Main menu.



Turning Off Field Aliases in Attribute Tables

A geodatabase can store aliases for column or field names. This makes it easier to view a table. The longer names, however, can result in a very wide table. The field aliases can easily be turned off using the Options button at the bottom.

This example shows field aliases that are “off”.

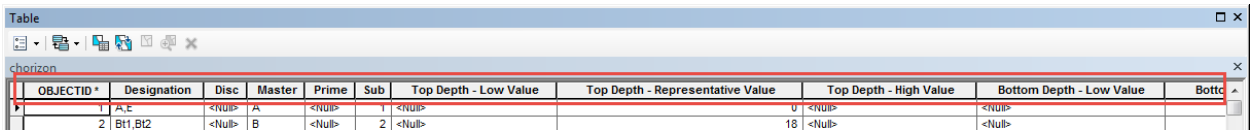
1. **Start ArcMap** with a new blank map.

2. On the Standard toolbar, click the **Add Data** button.

3. Add the **chorizon** table.

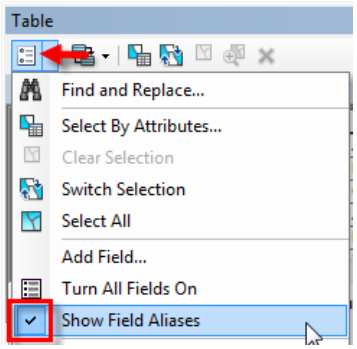
4. Right click on the chorizon table and select **Open**.

Notice that the columns in the table contains descriptive headers.

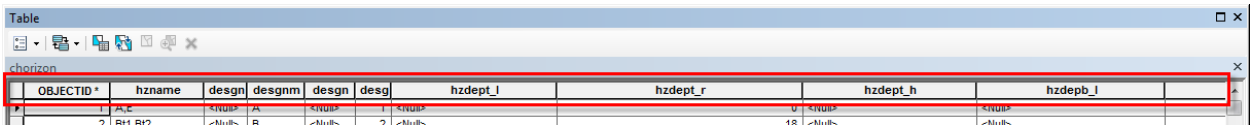


Change the setting to turn off the field aliases.

5. Click on the Table Options drop-down menu and uncheck **Show Field Aliases**.

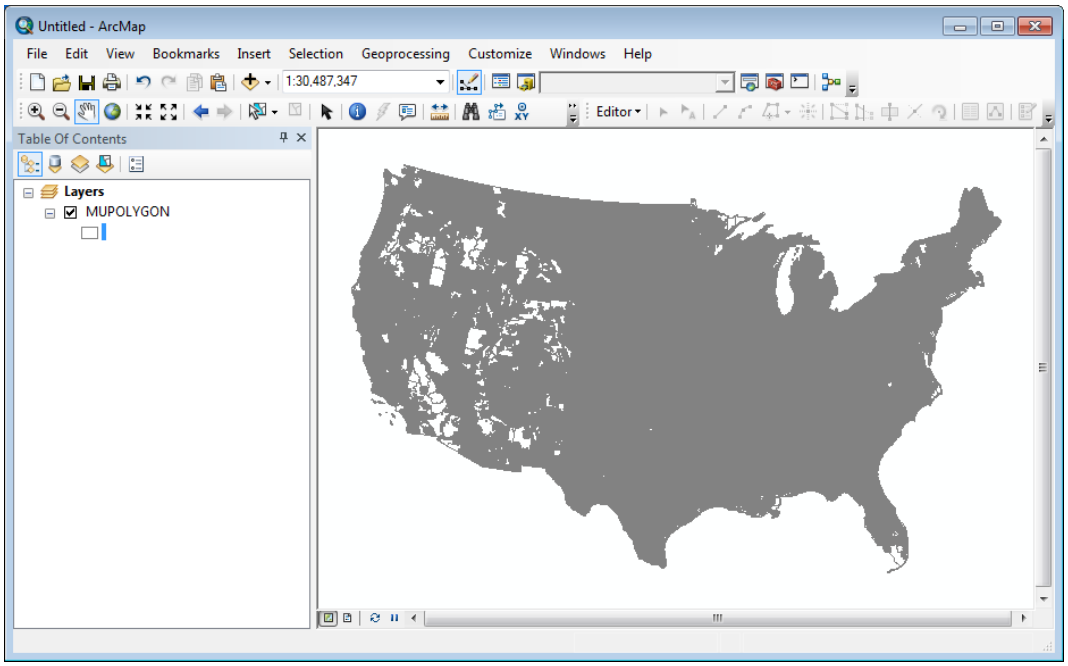


Notice that the columns no longer display descriptive headers.



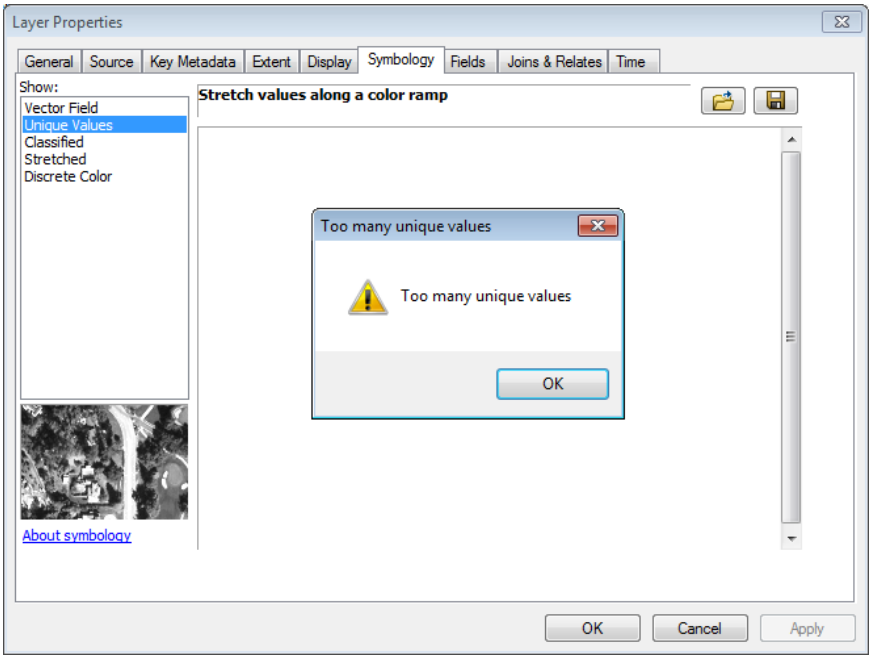
Displaying Very Large Rasters

There are settings in ArcMap that can affect the way raster layers are displayed. In this example, the raster layer (October 2012 CONUS gSSURGO geodatabase) contains 290,786 unique MUKEY values.

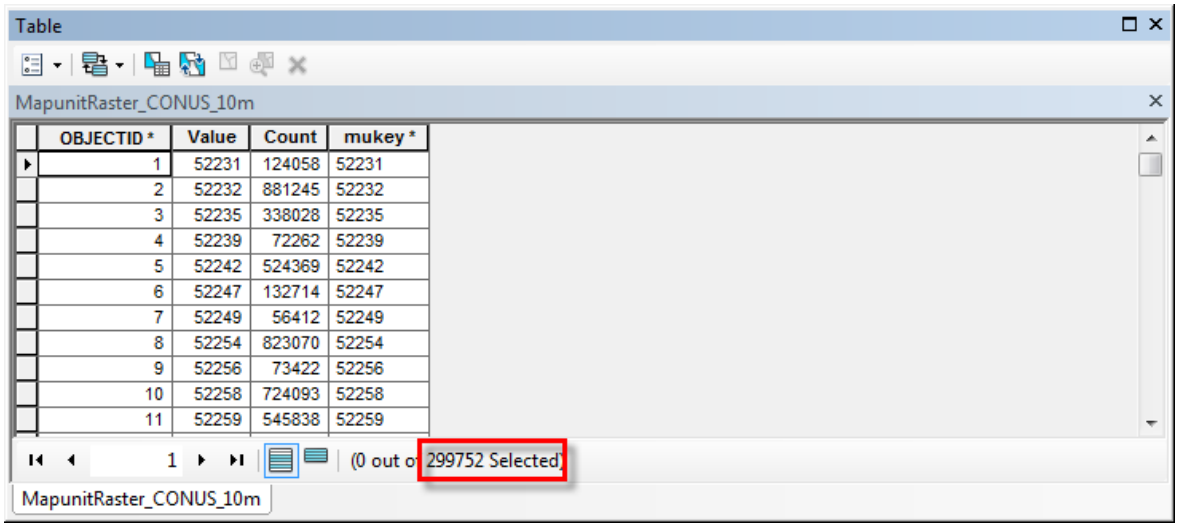


ArcMap normally defaults to the “stretched value” renderer for raster layers.

Attempting to alter symbology for an existing raster layer may not be possible for the Unique Values option. If not possible, a warning message is displayed.

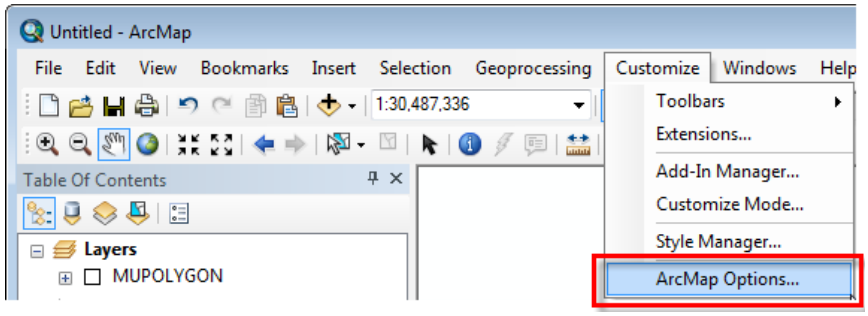


Open the attribute table for the offending raster to determine how many records there are. The number of unique values is listed at the bottom of the table.

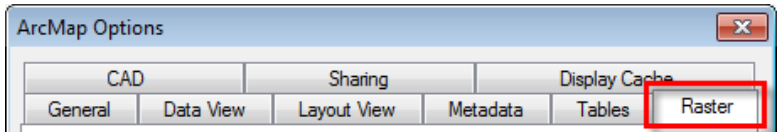


To alter the values to display a large raster, from the ArcMap menu:

1. From the ArcMap Main menu click **Customize>ArcMap Options**.



2. In the ArcMap Options dialog, select the **Raster** tab.

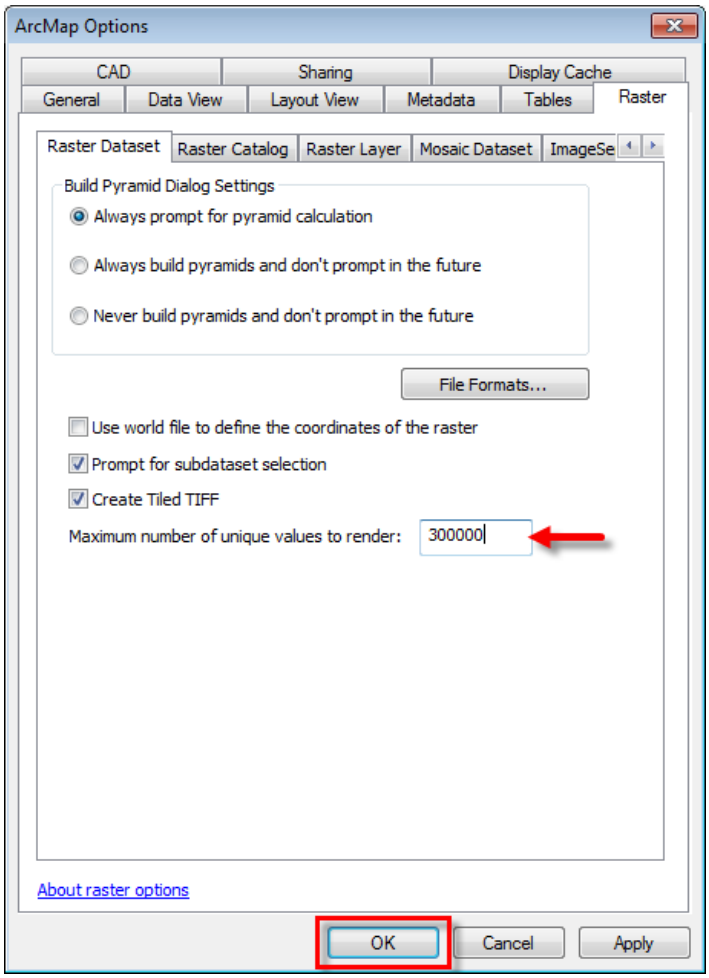


3. Change the maximum number of unique values to render to a number greater than would normally be in the data and click **OK**.

WARNING: Setting this value too high, especially on a Windows XP computer, can cause ArcMap™ to use up all of the available RAM and crash the application.

Computers running Windows® 7 with 8 gigabytes or more of RAM may allow this value to be set to 300,000 or greater.

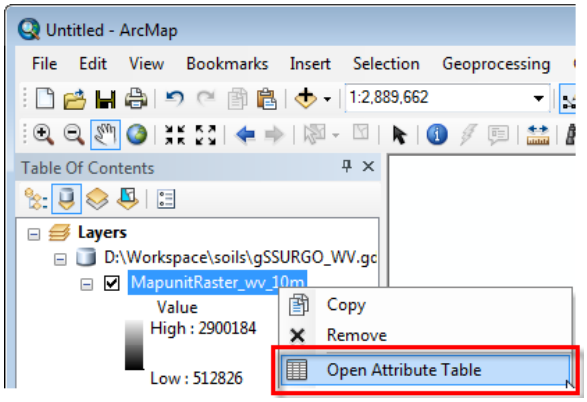
The symbology can now be changed to Unique Values.



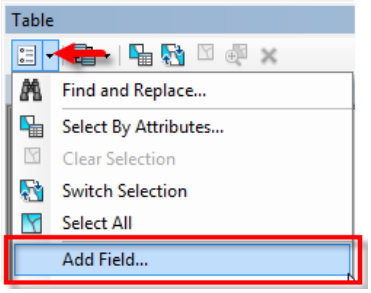
Restoring MUKEY Values in Raster Layers

Depending upon the version of ArcGIS being used, some geoprocessing procedures can cause the *MUKEY* column to be lost from the attribute table of output raster layers. The MUKEY column can be manually added back to the raster.

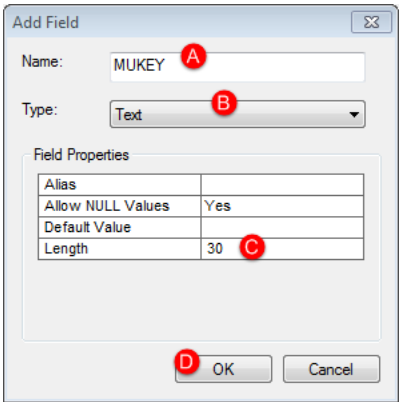
1. In ArcMap, open the attribute table of the raster by right-clicking on the raster feature class (e.g., MapunitRaster_WV_10m) and click **Open Attribute Table**.



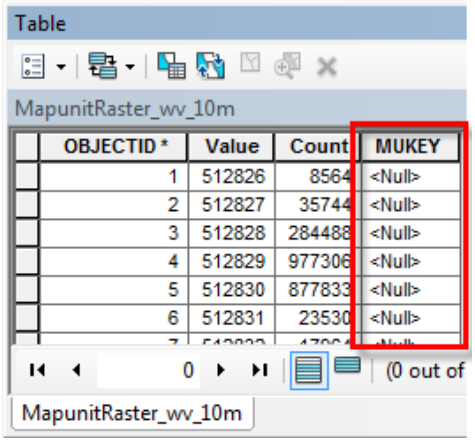
2. Click on the Table Options drop-down menu and select **Add Field**.



3. Use the following parameters to complete the Add Field dialog box:
   A. Name: **MUKEY**
   B. Type: **Text**
   C. Length: **30**
   D. Click **OK**.

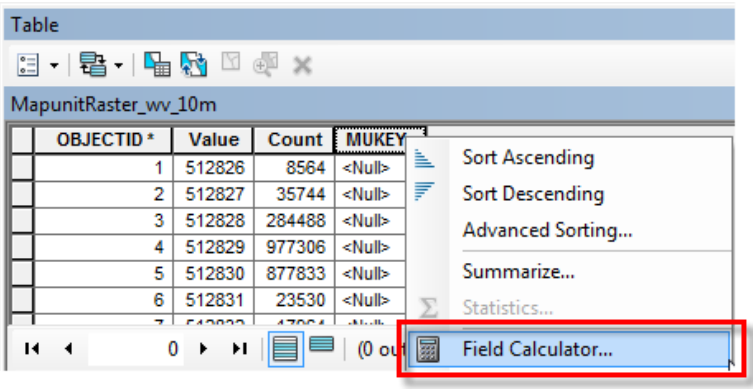


The newly added column will not have data. All values are <NULL>,



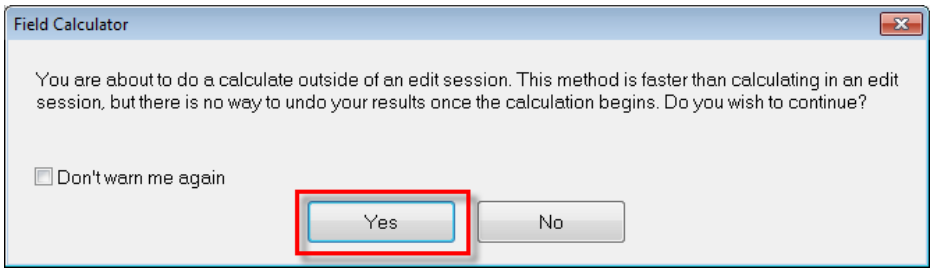
Add the MUKEY values by calculating the Value field to MUKEY with the Field Calculator.

4. Right-click on the MUKEY column header and select **Field Calculator**.



A message will pop up warning that a calculation will be performed outside an edit session.

5. Click **Yes**.



Complete the Field Calculator dialog.

6. In the Field Calculator dialog:
   A. Double-click on **Value** to complete the statement.
   B. Click **OK**.

The MUKEY column is populated.

Citing gSSURGO Data

It is a good scientific practice to cite all the data sources and methods used to conduct the assessment or research study. A section on methods and materials commonly cites other literature sources, which are listed in a reference section.

These gSSURGO and National Value Added Look Up (valu) Table data are anticipated to be released on an annual basis using a Soil Data Mart database snapshot source taken in October (the start of the Federal fiscal year). The metadata (Description tab in ArcCatalog®) provides information about the source date for the gSSURGO product.

The USDA Natural Resources Conservation Service recommends the following citations be used in internal and published documents that describe assessments and studies which used the Gridded SSURGO (gSSURGO) data product and the National Value Added Look Up (valu) Table Database.

The Citation for gSSURGO

State Tile

Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for State name. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/. month, day, year (FYyear official release).

Conterminous US Tile

Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for the Conterminous United States. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/ month, day, year (FYyear official release).

National Collection of Tiles

Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for the United States of America and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/ month, day, year (FYyear official release).

The Citation for the National Value Added Look Up (Valu1) Table

Soil Survey Staff. National Value Added Look Up (Valu1) Table for the Gridded Soil Survey Geographic (gSSURGO) Database for the United States of America and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/. month, day, year (FYyear official release).

Citation Examples

The following examples are for the FY2014 gSSURGO dataset for the State of West Virginia. Such citations should appear in the reference section of your document.

State Tile

Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for West Virginia. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/. January 15, 2014 (FY2014 official release).

Conterminous US Tile

Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for the Conterminous United States. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/. January 15, 2014 (FY2014 official release).

National Collection of Tiles

Soil Survey Staff. Gridded Soil Survey Geographic (gSSURGO) Database for the United States of America and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/ January 15, 2014 (FY2014 official release).

The following example is for the National Value Added Look Up (valu) Table. Such citations should appear in the reference section of your document.

National Value Added Look Up (Valu1) Table

Soil Survey Staff. National Value Added Look Up (Valu1) Table for the Gridded Soil Survey Geographic (gSSURGO) Database for the United States of America and the Territories, Commonwealths, and Island Nations served by the USDA-NRCS. United States Department of Agriculture, Natural Resources Conservation Service. Available online at https://gdg.sc.egov.usda.gov/ January 15, 2014 (FY2014 official release).

See https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053368 for recommended citations for other data provided by the USDA Natural Resources Conservation Service and the National Cooperative Soil Survey.

Acronyms

AWS	Available Water Storage
aws0150wta	Available Water Storage 0 to 150cm - Weighted Average
CDL	Cropland Data Layer
cm	centimeter
cogeomordesc	Component Geomorphic Description Table
CONUS	Conterminous United States
dS	decisiemens
ESRI®	Environmental Systems Research Institute, Inc.
FY	Fiscal Year (Federal fiscal year begins October 1 of each year)
GDG	Geospatial Data Gateway
gSSURGO	Gridded Soil Survey Geographic Database
hydgrpdcd	Hydrologic Group - Dominant Conditions
m	meter
MAJCOMPFLAG	Major Component Flag
muaggatt	Map Unit Aggregate Attribute Table
MUKEY	Map Unit Key
muname	Map Unit Name
MUPOLYGON	Map Unit Polygon
musym	Map Unit Symbol
NAD	North American Datum
NASS	National Agricultural Statistical Service
NCCPI	National Commodity Crop Productivity Index
NCSS	National Cooperative Soil Survey
NGCE	National Geospatial Center of Excellence
NLCD	National Land Cover Database
NRCS	Natural Resources Conservation Service
PWSL	Potential Wetland Soil Landscapes
RAM	Random Access Memory
SACATALOG	Survey Area Catalog
SAVEREST	Survey Area Version Established
SOC	Soil Organic Carbon
SQL	Standard Query Language
SSURGO	Soil Survey Geographic Database
US	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey
Valu	Value Added Look Up Table
WGS	World Geodetic System
WSS	Web Soil Survey

References

Note: Data were created using ArcGIS® software by Esri. ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright © Esri. All rights reserved. For more information about Esri® software, please visit http://www.esri.com/.

Dobos, Robert R., H. Raymond Sinclair, Jr., and Michael P. Robotham. 2012. National commodity crop productivity index (NCCPI) user guide, Version 2. United States Department of Agriculture, Natural Resources Conservation Service, Lincoln, Nebraska.

Hartemink, A. 2013. Soil profile image. Global Soil Map.net web site http://www.globalsoilmap.net/ Accessed September 2013.

Homer, C., and others. 2015. Completion of the 2011 National Land Cover Database for the Conterminous United States. Photographic Engineering and Remote Sensing 81:345–354. Data are available online at http://www.mrlc.gov/nlcd2011.php.

United States Department of Agriculture National Agricultural Statistics Service Cropland Data Layer. Published crop-specific datalayer. Multiple years. Available online at https://nassgeodata.gmu.edu/CropScape/.

United States Department of Agriculture, Natural Resources Conservation Service. 2013a. Description of Gridded Soil Survey Geographic (gSSURGO) Database. Available online at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628.

United States Department of Agriculture, Natural Resources Conservation Service. 2013b. General Manual Title 430, Part 402—Soil Survey, Subpart A. Available online at NRCS eDirectives - Subpart A - Introduction.