CART Soil Map Toolbox (version 4.0).

This is the user guide for **CART Soil Map Toolbox (version 4.0**); compatible with ArcMap 10.4 – 10.7.1. Earlier versions of ArcGIS Desktop will not be able to run the tool, so please have ITS do an upgrade to at least 10.5 if this is an issue.

The purpose of the CART Soil Map Toolbox is to provide developers or resource soil scientists more detailed information about the way soils data are being used by the CART application. Hopefully this information in the form of soil maps and reports can be used to improve queries for Soil Data Access and to validate the methods being used to summarize soils data to the land unit level. This ArcMap tool is not part of the actual CART application.

For those who have already installed the toolbox, Slide 8 begins the section on running the CART Soil Map tool and looking at the output products.

January 24, 2020

Input Spatial Data Layers

Input Data

The CART Soil Map tool is currently pulling data from three web services:

- https://sdmdataaccess.sc.egov.usda.gov
- http://csip.engr.colostate.edu:8083/csip-soils/d/wepot/2.1
- https://intapi.eauth.usda.gov/nrcs/cp/NRCS_RS_ConservationResourcesWQM/m/wqm/rfactor/1.2

These URLs are designed for handling AOI data requests from custom applications and do not have a webpage designed for web browsers.

Even though the databases behind the services contain spatial data, these three services are designed to return only data, not map layers. Soil Data Access can return coordinate data for soil features, but usually requires a script to convert that information into polygon geometry needed to create a map layer that ArcGIS can display.

Users may substitute a local PLU layer for the CLU web feature service.

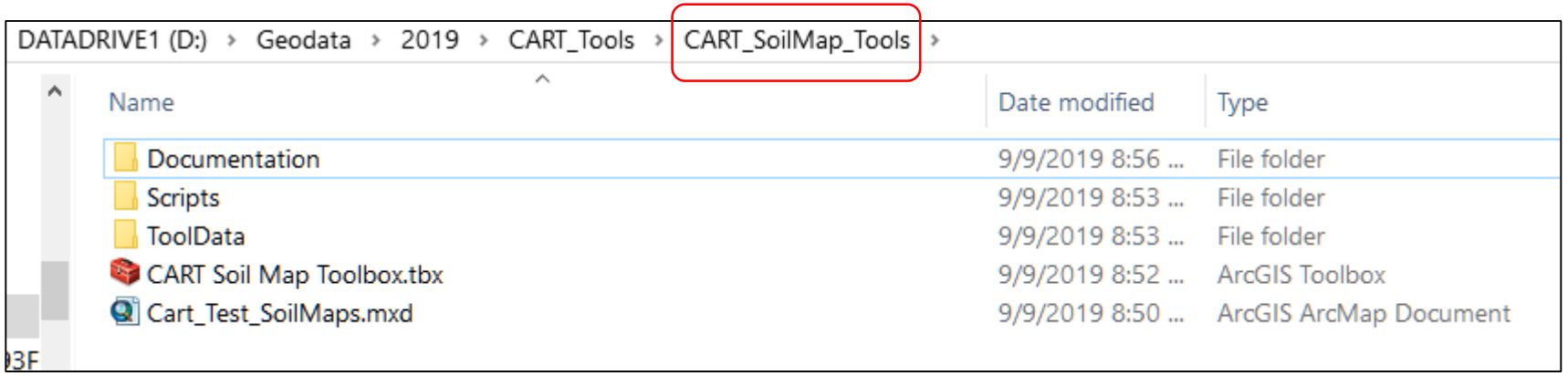
Installation of the CART Soil Map Tool

Installation is one-time-process that does not require Admin privileges. Upgrading to a newer version would involve removing the old folder and then downloading the replacement from the NRCS-GIS Sharepoint at:

NRCS-GIS SharePoint Tools-CART

Unzip the CART_SoilsMap_Tools zip file to a convenient location on a local hard drive. Make note of the location so that it can be found again later. The toolbox contents are self-contained within a folder named **CART_SoilMap_Tools**.

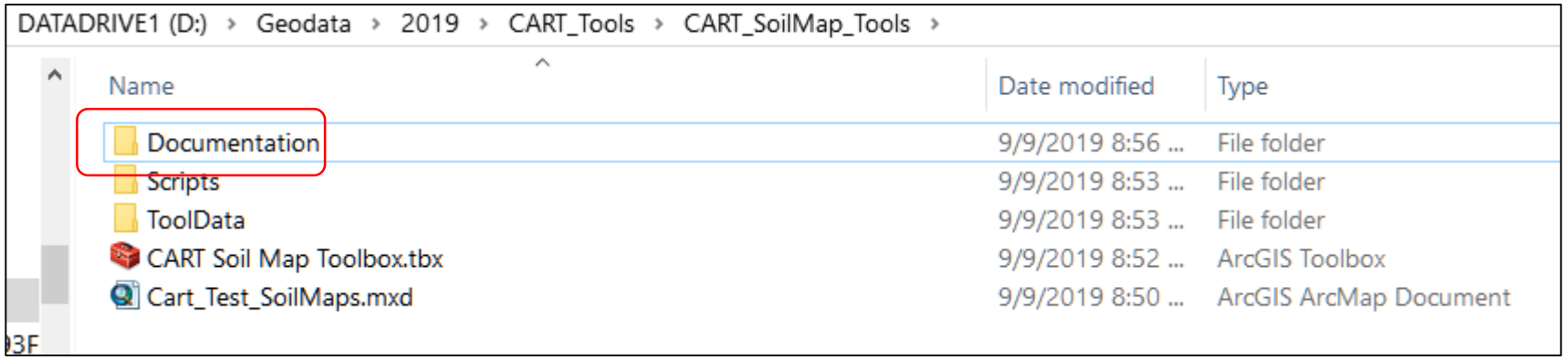
Contents of the CART Soil Map Tool

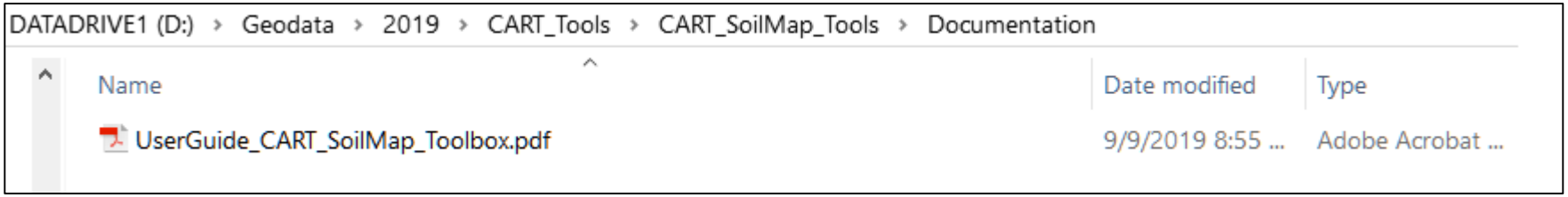


This is a fairly simple toolbox. It is based upon a pair of Python (2.7) scripts and currently does not use an ESRI AddIn. It uses the standard toolbox or '.tbx' file that can be added to the user's ArcToolbox collection in ArcMap. In the future this tool will be ported to ArcGIS Pro.

The CART_SoilMap_Tools folder has all the files needed to run the tool. The folder contents must remain intact because of interdependencies. Do not move the .tbx file to another location.

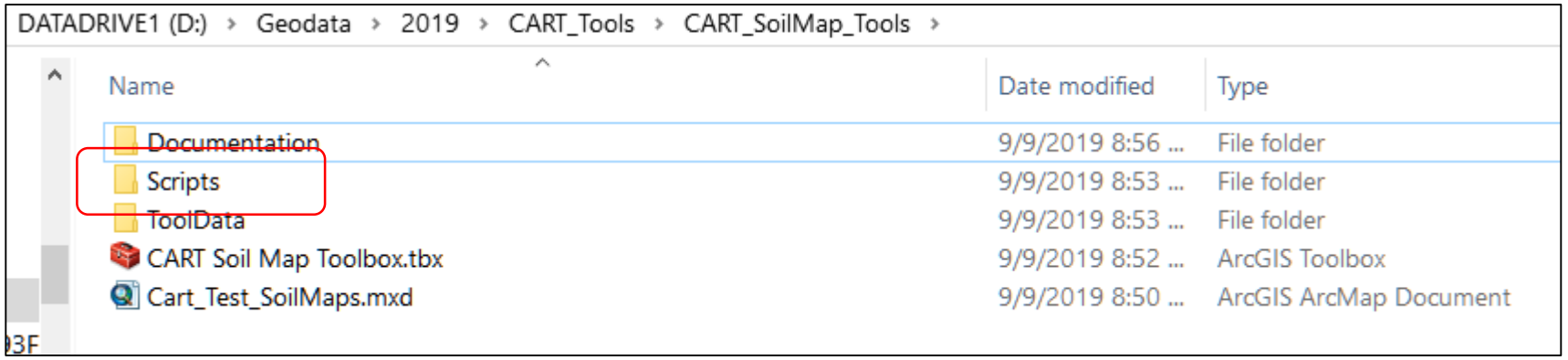
Contents of the CART Soil Map Tool (cont'd)

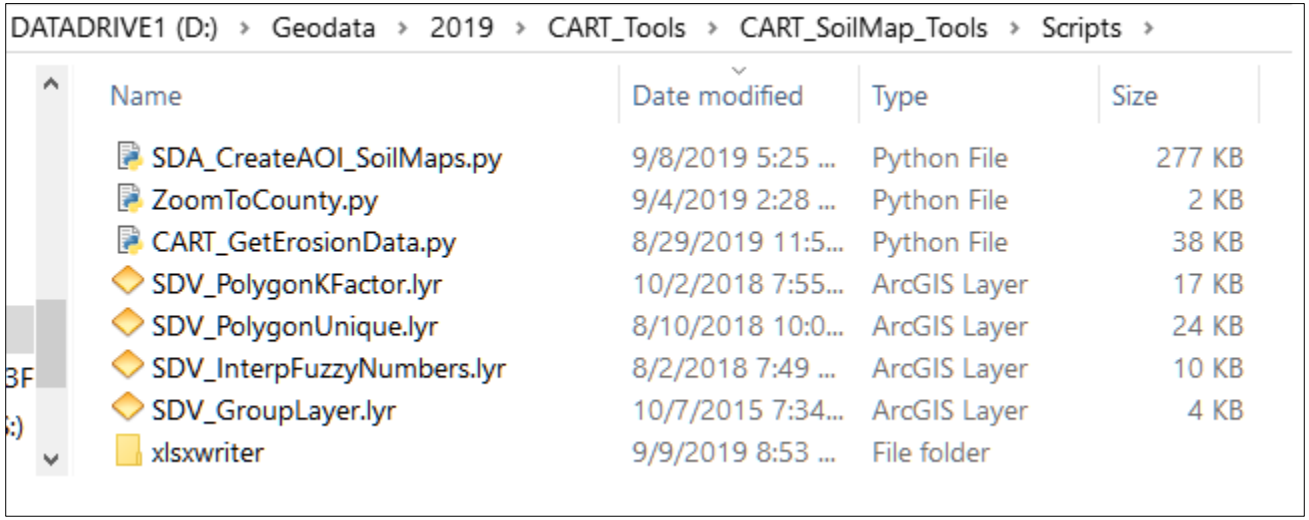




The Documentation subfolder contains the PowerPoint (PDF format) that you are looking at right now.

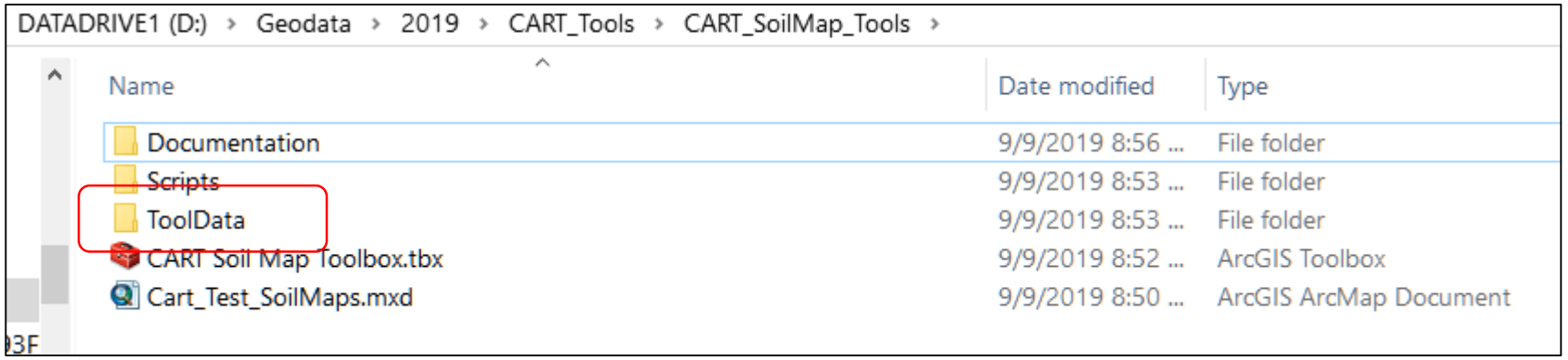
Contents of the CART Soil Map Tool (cont'd)

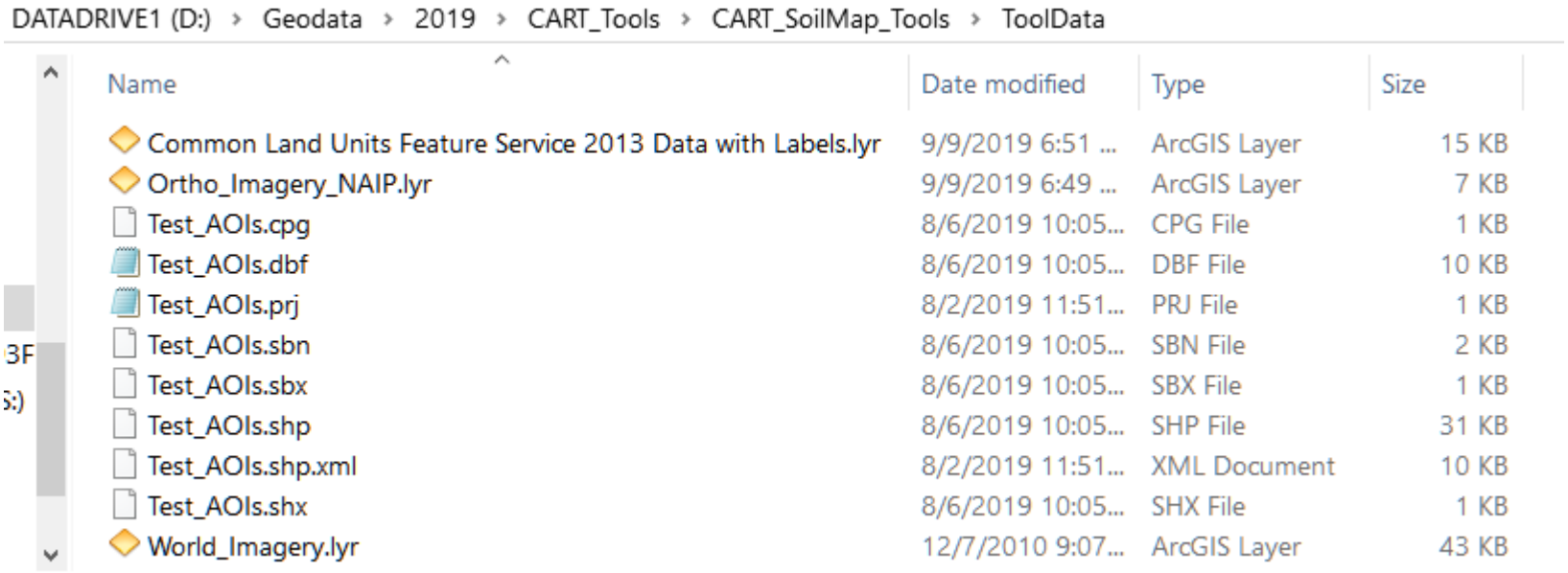




The Scripts subfolder contains the Python scripts and libraries needed for the tools.

Contents of the CART Soil Map Tool (cont'd)





The ToolData subfolder contains layer files for online web services including CLU.

Running the CART Soil Map Tool

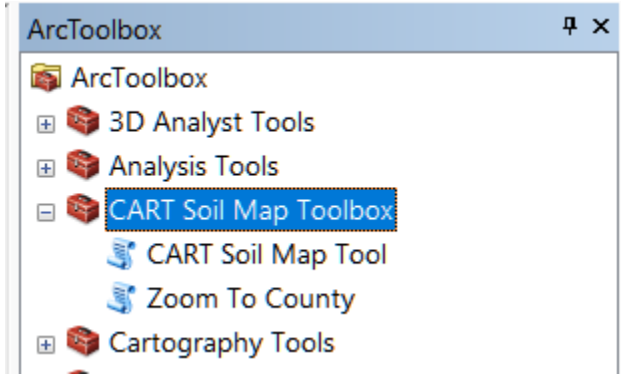
Five steps required to generate a series of CART soil maps

1. Open the Cart_Test_SoilMap.mxd. Please note. If you have problems opening the mxd, you can simply add the toolbox and even the layer files (Common Landunits and World Imagery .lyr) to your own ArcMap session. The background layers are all online, so initially it may take several seconds for the map to display. The layer files are located under *..\CART_SoilMap_Tools\ToolData*.
2. Begin by selecting a couple of the Common Land Unit polygo  serve as an area-of-interest. Use the Select Feature tool in ArcMap.
3. Please note, the Common Land Unit layer will not display below 1:50,000 scale.

Running the CART Soil Map Tool

Five steps required to generate a series of CART soil maps (cont'd)

3. If necessary, add the toolbox to ArcMap. Open the CART Soil Map tool. If you are unable to expand the CART SoilMap Toolbox because the little 'plus' button on the left is missing, please contact support (see last slide).
4. Select a valid land units layer from the first choice list. The layer must have at least one polygon selected (blue highlight) in order to run the tool. If a ⊗ is displayed, hover the mouse cursor over it to see the error message.



Running the CART Soil Map Tool

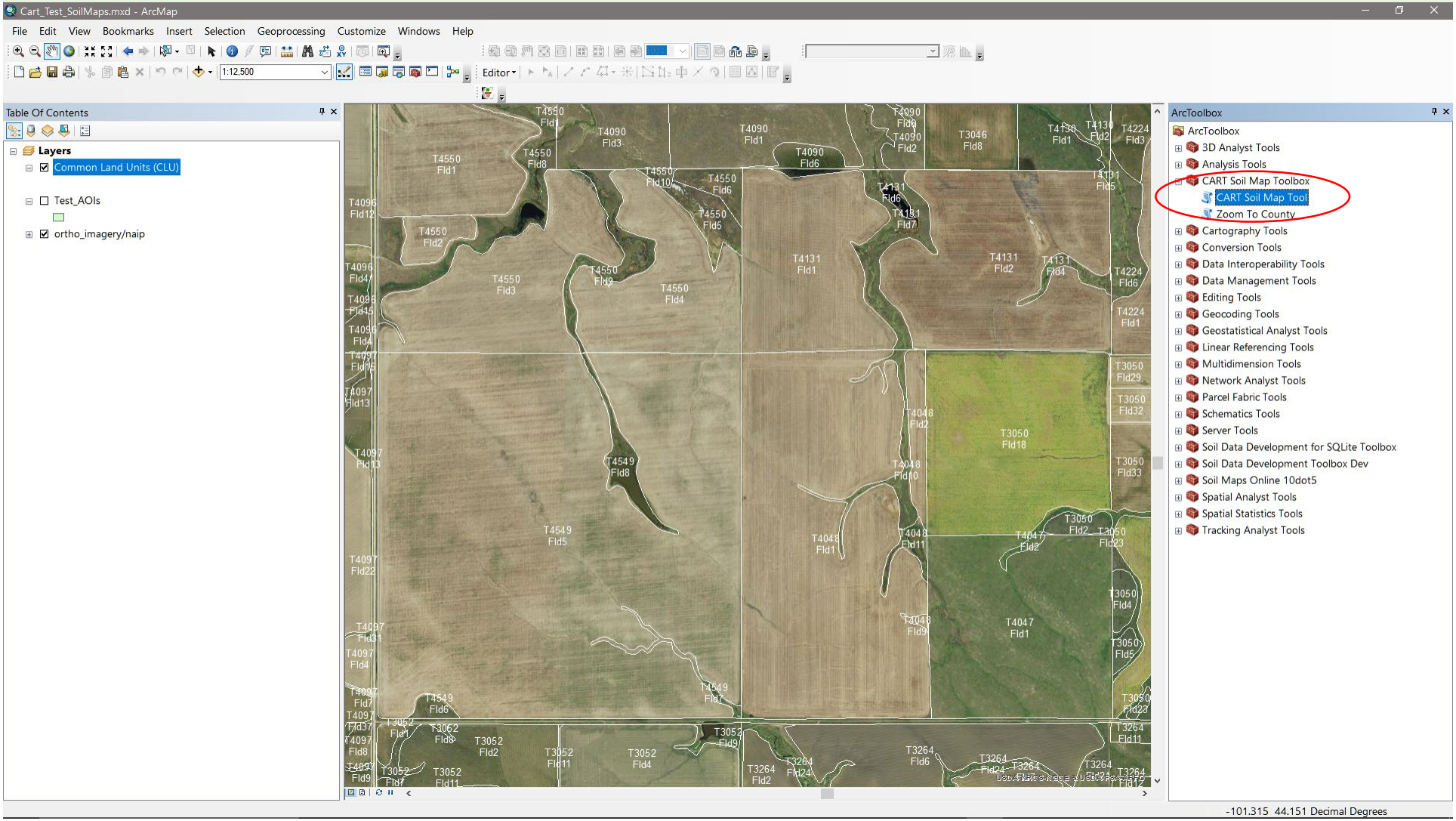
Five steps required to generate a series of CART soil maps (cont'd)

5. Set the output folder where the new geodatabase and other output data will be written. Output layers for the same land unit from previous runs may fail to overwrite until you quit out of ArcMap and start up again.

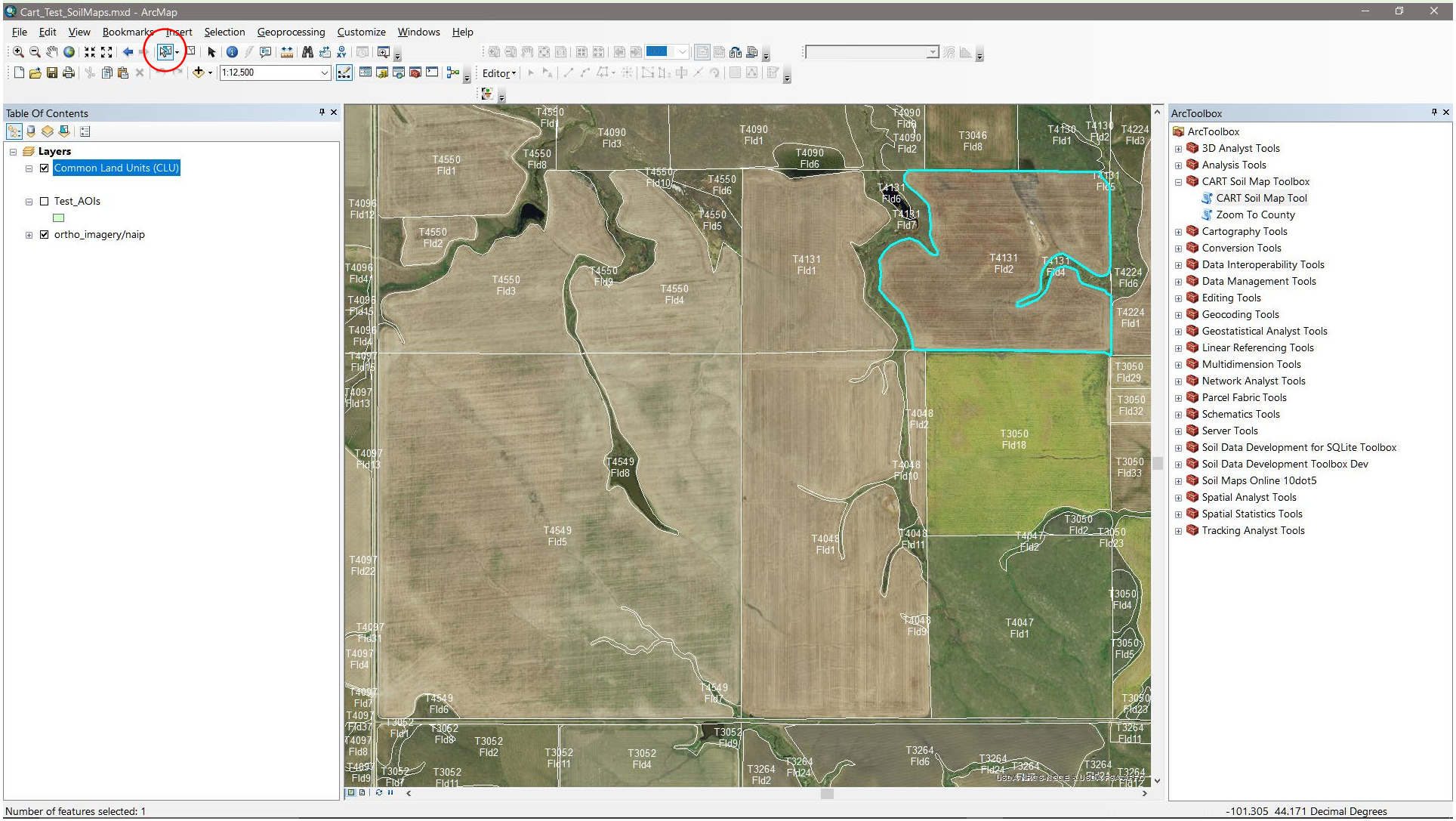
The following several slides illustrate the process and the tool output.

Contact information for assistance is on the final slide.

ArcMap project with imagery and 2013 CLU. The CART Soil Map Toolbox is highlighted.

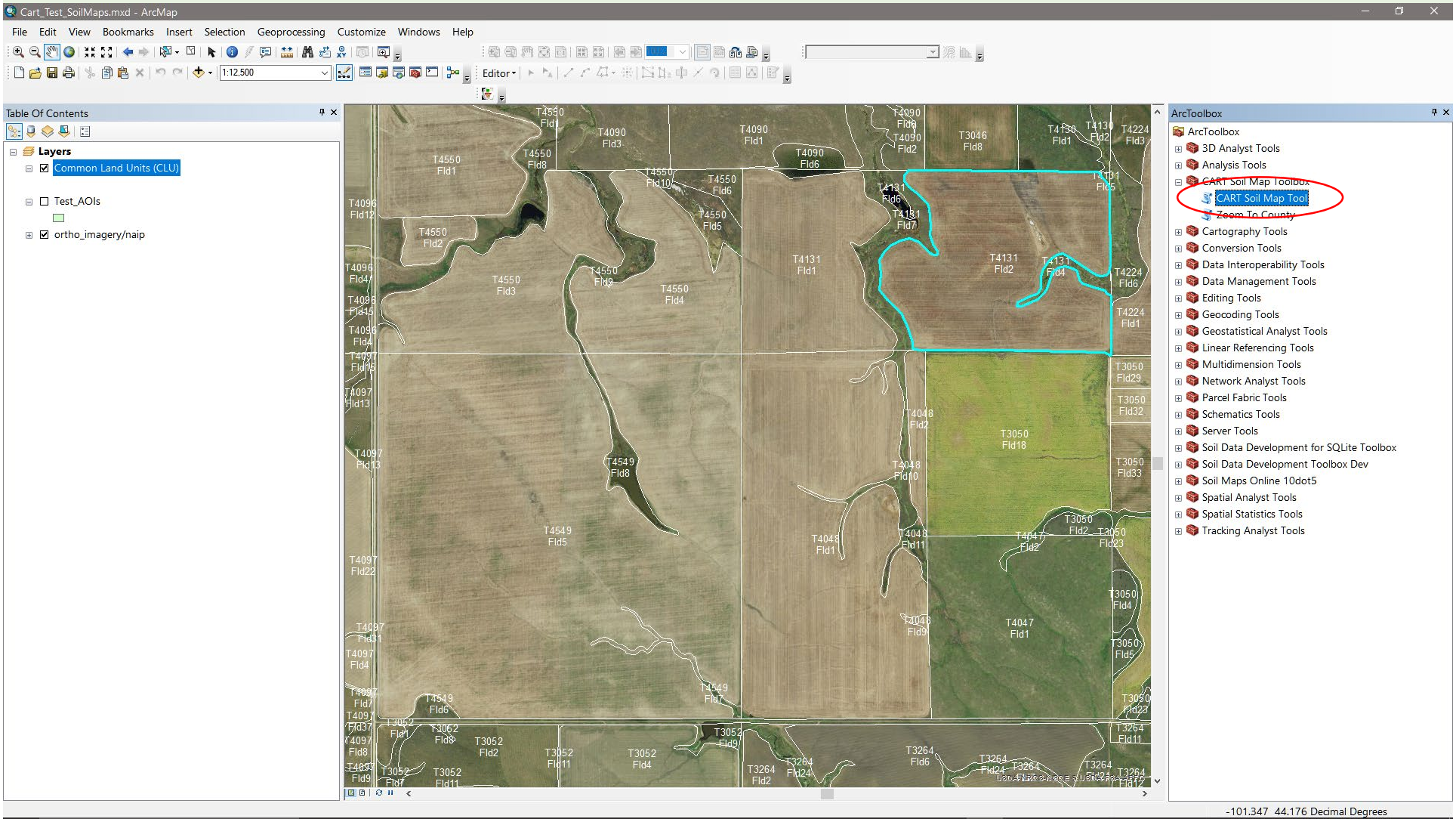


Select one or more land unit polygons on the map to be processed (Select Features Tool).



The shift-click method works best when selecting multiple CLU polygons.

Double-click the ‘CART Soil Map Tool’ to execute.

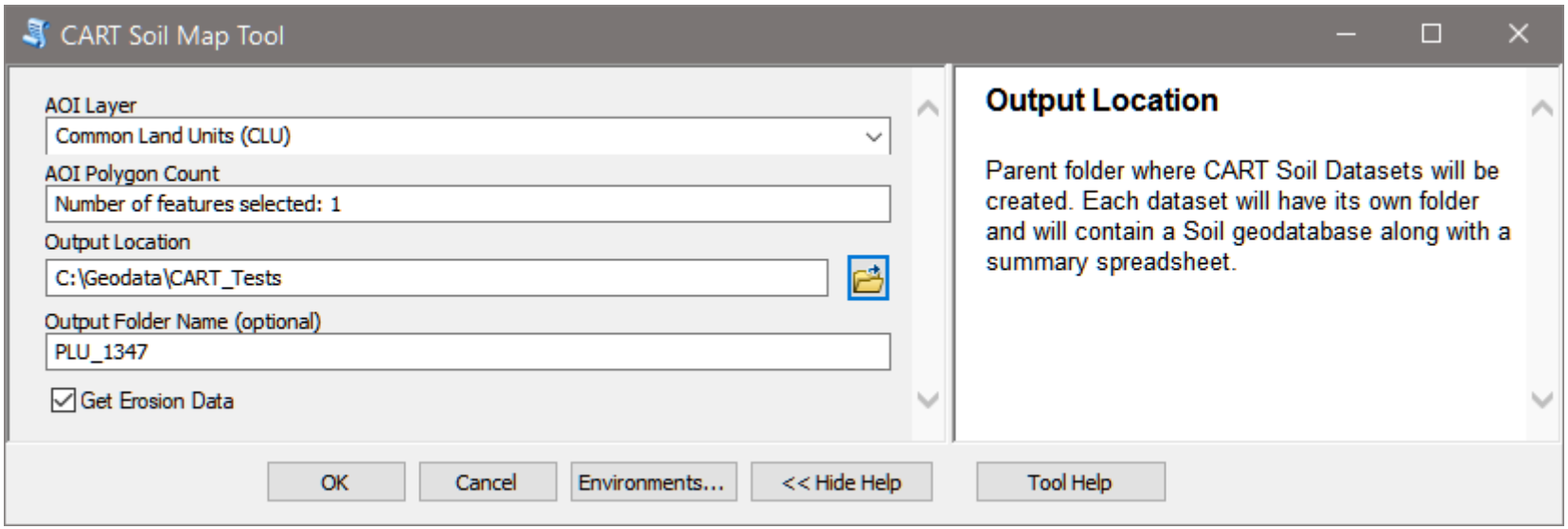


The CART Soil Map Tool menu…

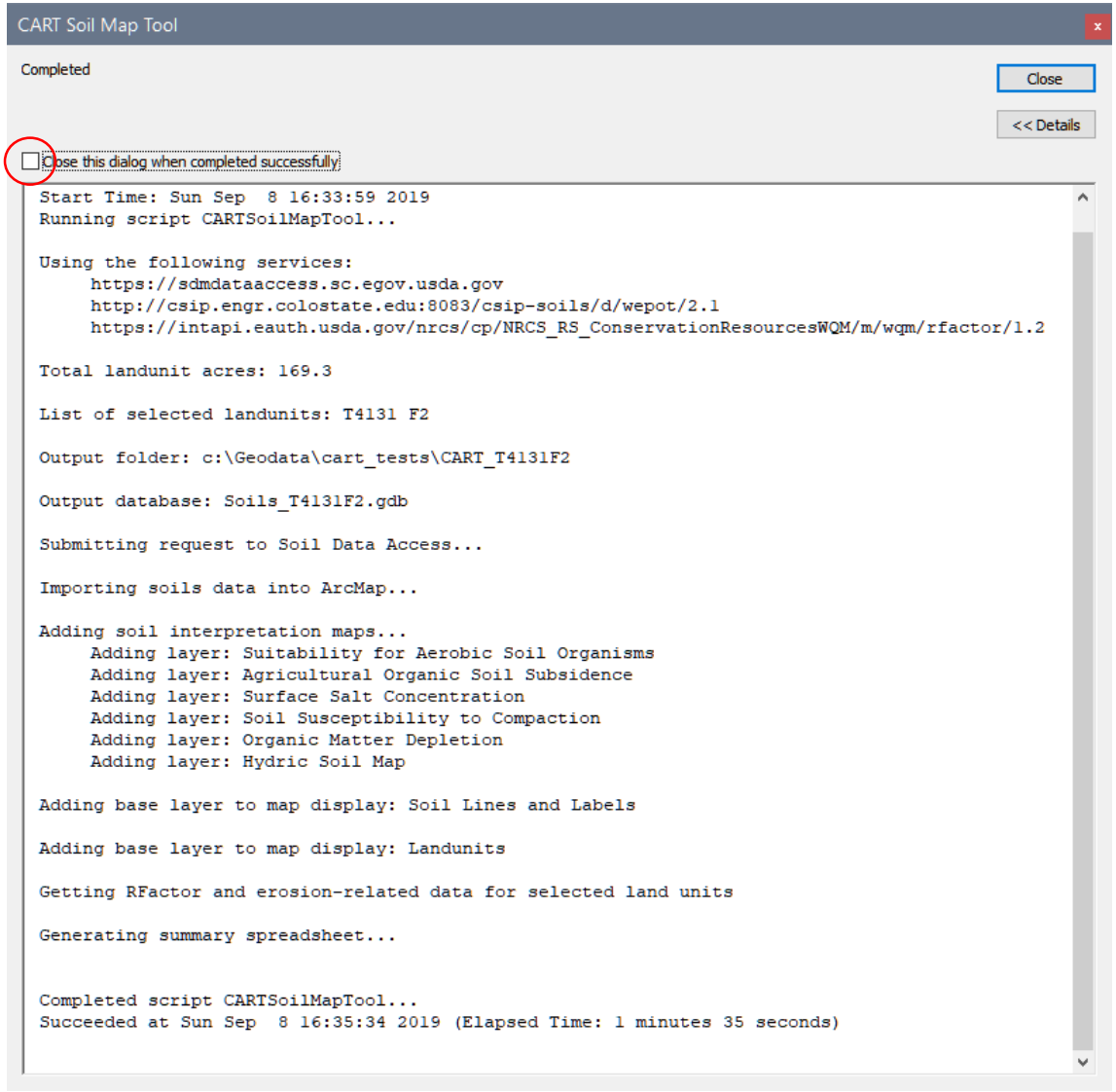
If the ‘Common Landunit’ layer is present in the ArcMap table of contents (TOC), it will automatically appear as the first choice for the AOI layer. The user can switch to another layer in ArcMap by clicking the down arrow on the right side of ‘AOI Layer’. Valid choices are any polygon map layer containing ‘PLU_*’ or ‘CLU_*’ attribute fields.

User may set the ‘Output Location’ to any folder. A local folder is recommended for the Output Location (as opposed to a network shared drive).

If an output folder name is specified, a folder by that name will be created; in this example PLU_1347. If no name is specified the folder will be created using the selected Tract and Fields.

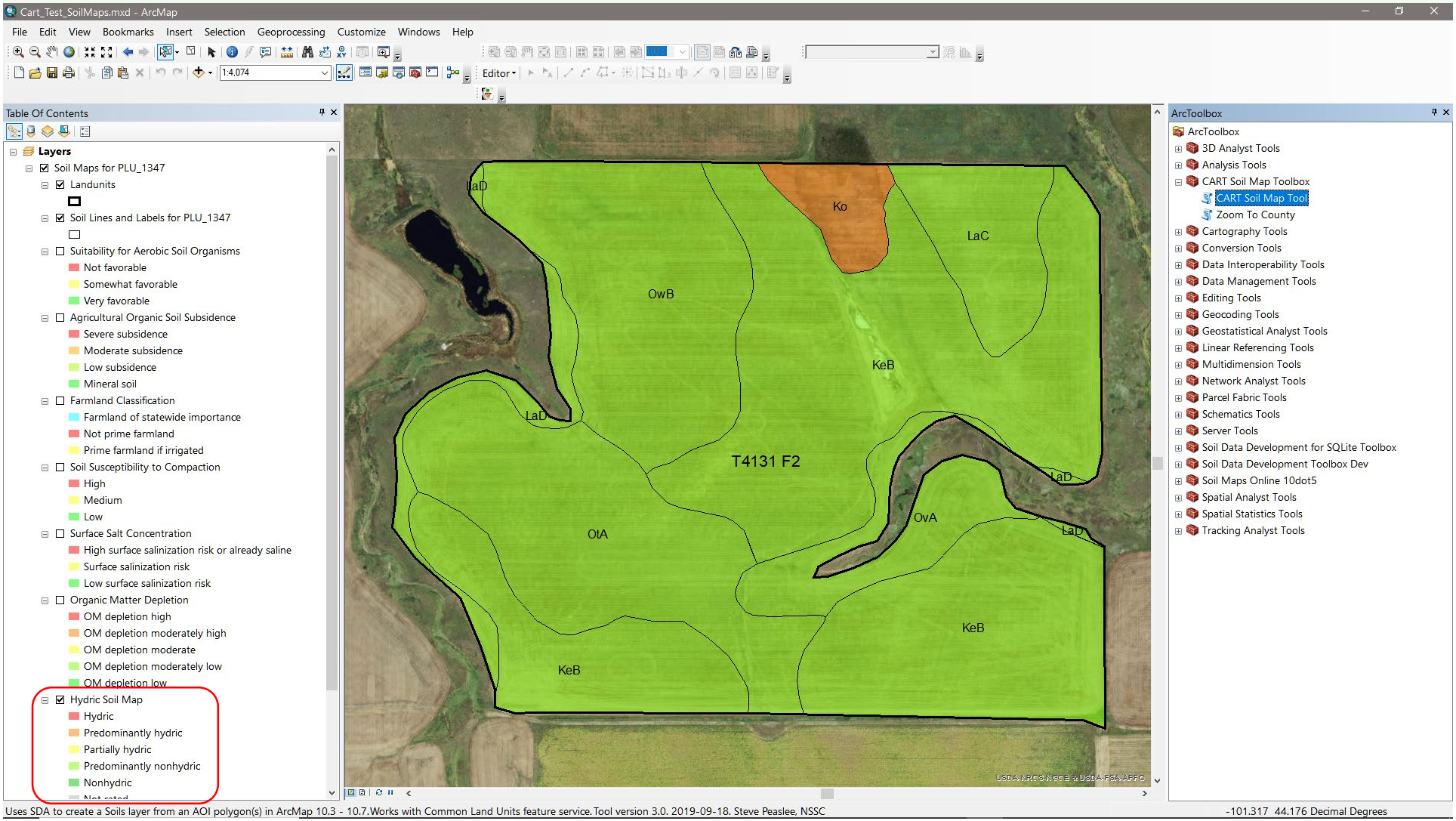


The tool window displays status messages and processing time.



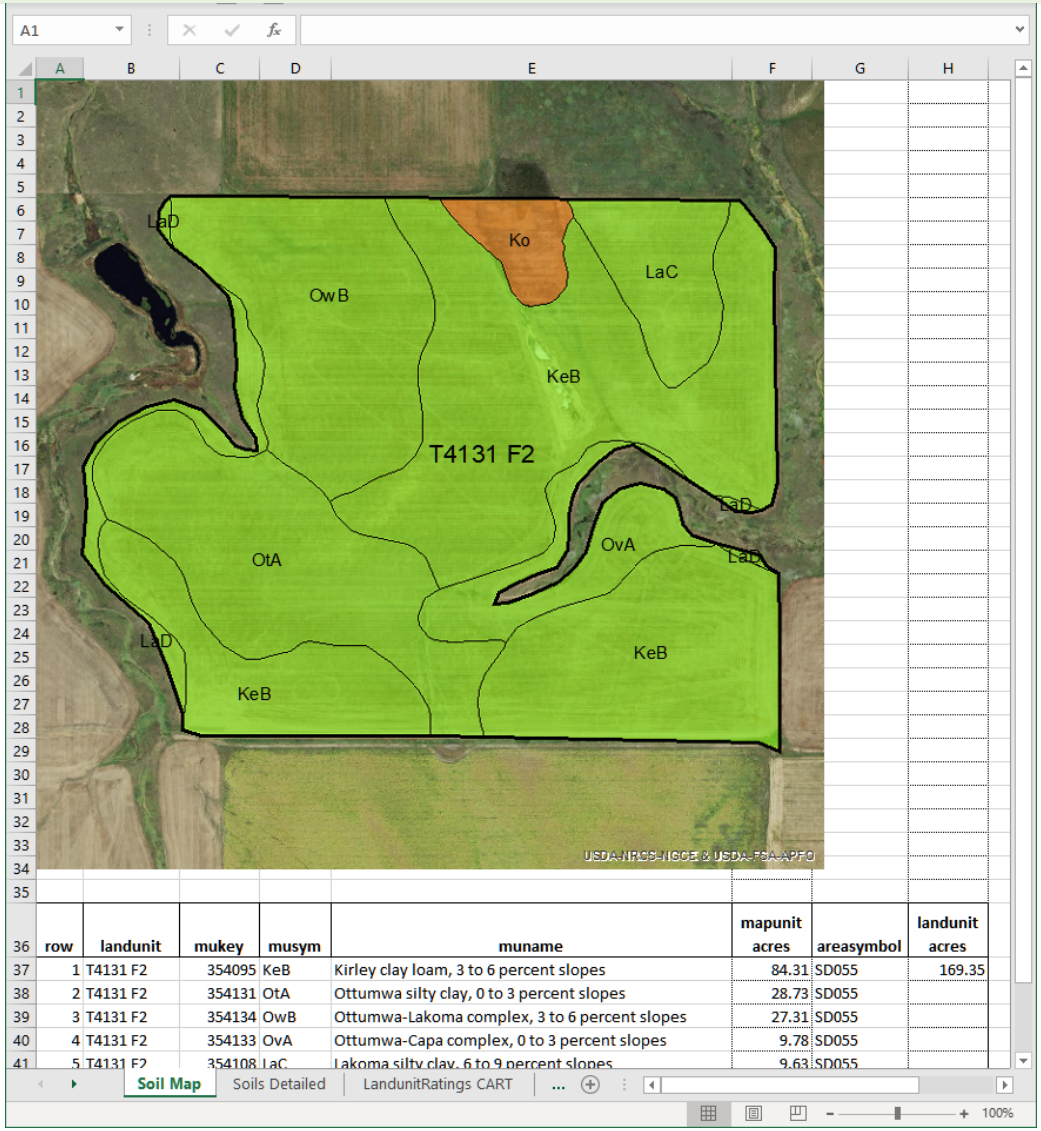
Uncheck the 'Close this dialog…' box and if necessary resize the tool window in order to see any warnings or error messages.

Upon completion, the tool will display the hydric soil map and a spreadsheet will also pop up.



A series of soil map layers are generated. Only the hydric map is displayed initially.

The spreadsheet has several worksheet tabs. The first sheet contains the soils map.

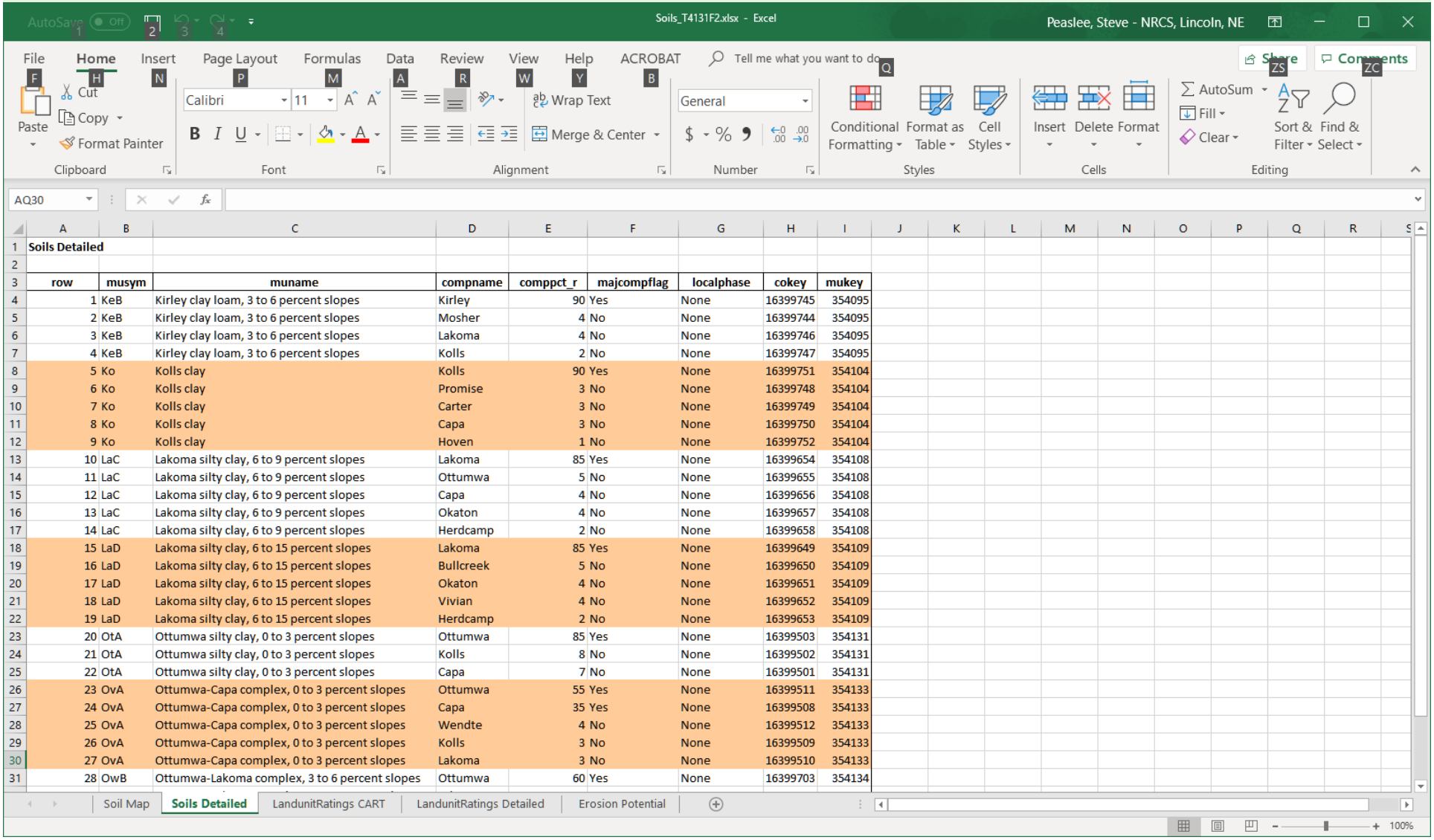


row	landunit	mukey	musym	muname	mapunit acres	areasymbol	landunit acres
1	T4131 F2	354095	KeB	Kirley clay loam, 3 to 6 percent slopes	84.31	SD055	169.35
2	T4131 F2	354131	OtA	Ottumwa silty clay, 0 to 3 percent slopes	28.73	SD055	
3	T4131 F2	354134	OwB	Ottumwa-Lakoma complex, 3 to 6 percent slopes	27.31	SD055	
4	T4131 F2	354133	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	9.78	SD055	
5	T4131 F2	354108	LaC	Lakoma silty clay, 6 to 9 percent slopes	9.63	SD055	

Soil Map | Soils Detailed | LandunitRatings CART

Soils are grouped and sorted by land unit and map unit acres.

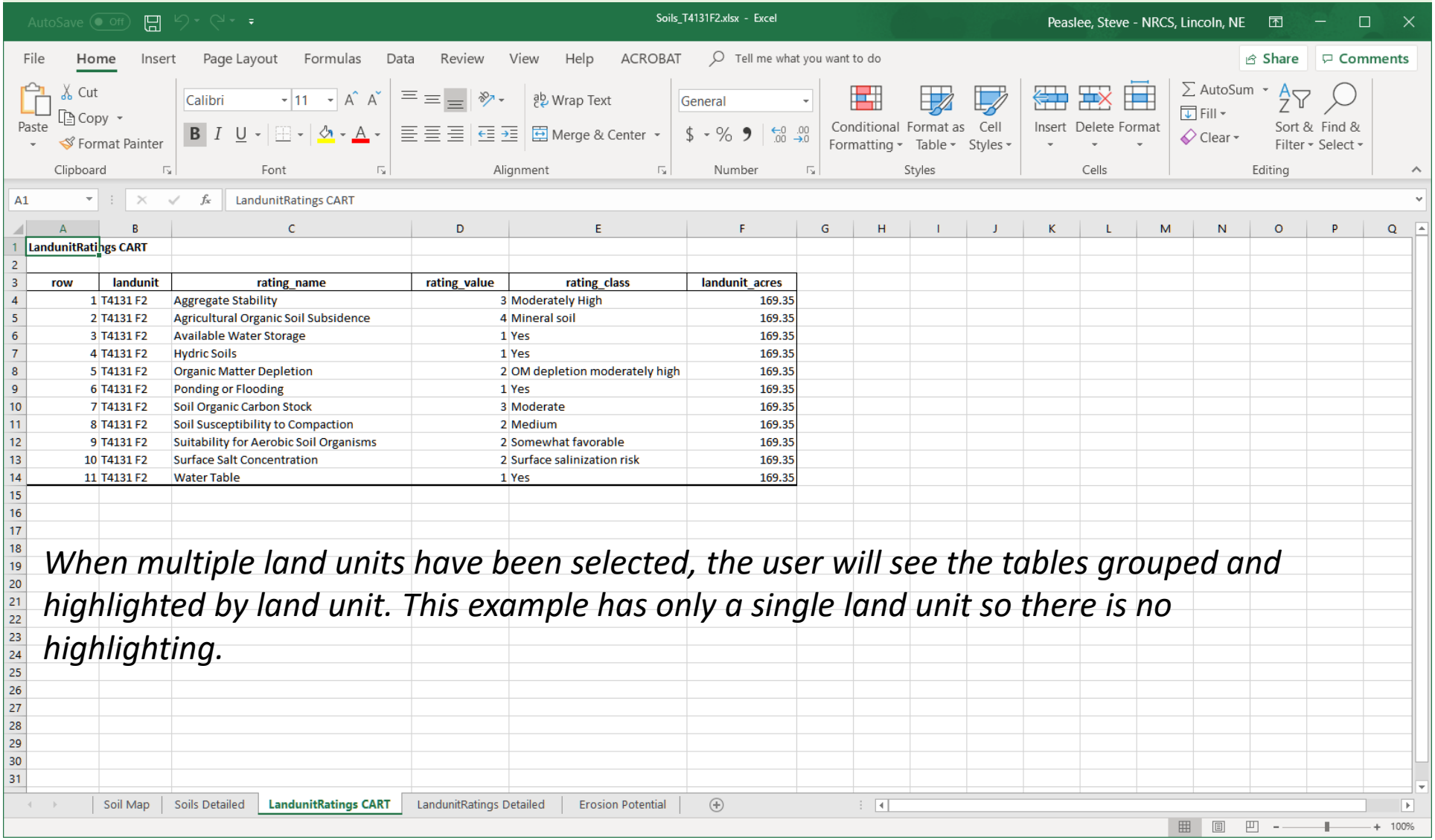
The ‘Soils Detailed’ sheet contains a table of soil mapunit-component information.



	A	B	C	D	E	F	G	H	I
1	**Soils Detailed**								
2									
3	**row**	**musym**	**muname**	**compname**	**comppct_r**	**majcompflag**	**localphase**	**cokey**	**mukey**
4	1	KeB	Kirley clay loam, 3 to 6 percent slopes	Kirley	90	Yes	None	16399745	354095
5	2	KeB	Kirley clay loam, 3 to 6 percent slopes	Mosher	4	No	None	16399744	354095
6	3	KeB	Kirley clay loam, 3 to 6 percent slopes	Lakoma	4	No	None	16399746	354095
7	4	KeB	Kirley clay loam, 3 to 6 percent slopes	Kolls	2	No	None	16399747	354095
8	5	Ko	Kolls clay	Kolls	90	Yes	None	16399751	354104
9	6	Ko	Kolls clay	Promise	3	No	None	16399748	354104
10	7	Ko	Kolls clay	Carter	3	No	None	16399749	354104
11	8	Ko	Kolls clay	Capa	3	No	None	16399750	354104
12	9	Ko	Kolls clay	Hoven	1	No	None	16399752	354104
13	10	LaC	Lakoma silty clay, 6 to 9 percent slopes	Lakoma	85	Yes	None	16399654	354108
14	11	LaC	Lakoma silty clay, 6 to 9 percent slopes	Ottumwa	5	No	None	16399655	354108
15	12	LaC	Lakoma silty clay, 6 to 9 percent slopes	Capa	4	No	None	16399656	354108
16	13	LaC	Lakoma silty clay, 6 to 9 percent slopes	Okaton	4	No	None	16399657	354108
17	14	LaC	Lakoma silty clay, 6 to 9 percent slopes	Herdcamp	2	No	None	16399658	354108
18	15	LaD	Lakoma silty clay, 6 to 15 percent slopes	Lakoma	85	Yes	None	16399649	354109
19	16	LaD	Lakoma silty clay, 6 to 15 percent slopes	Bullcreek	5	No	None	16399650	354109
20	17	LaD	Lakoma silty clay, 6 to 15 percent slopes	Okaton	4	No	None	16399651	354109
21	18	LaD	Lakoma silty clay, 6 to 15 percent slopes	Vivian	4	No	None	16399652	354109
22	19	LaD	Lakoma silty clay, 6 to 15 percent slopes	Herdcamp	2	No	None	16399653	354109
23	20	OtA	Ottumwa silty clay, 0 to 3 percent slopes	Ottumwa	85	Yes	None	16399503	354131
24	21	OtA	Ottumwa silty clay, 0 to 3 percent slopes	Kolls	8	No	None	16399502	354131
25	22	OtA	Ottumwa silty clay, 0 to 3 percent slopes	Capa	7	No	None	16399501	354131
26	23	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	Ottumwa	55	Yes	None	16399511	354133
27	24	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	Capa	35	Yes	None	16399508	354133
28	25	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	Wendte	4	No	None	16399512	354133
29	26	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	Kolls	3	No	None	16399509	354133
30	27	OvA	Ottumwa-Capa complex, 0 to 3 percent slopes	Lakoma	3	No	None	16399510	354133
31	28	OwB	Ottumwa-Lakoma complex, 3 to 6 percent slopes	Ottumwa	60	Yes	None	16399703	354134

Soils are grouped and highlighted by soil map unit and sorted by component percent.

The ‘LandunitRatings CART’ sheet will contain summary ratings for each landunit.

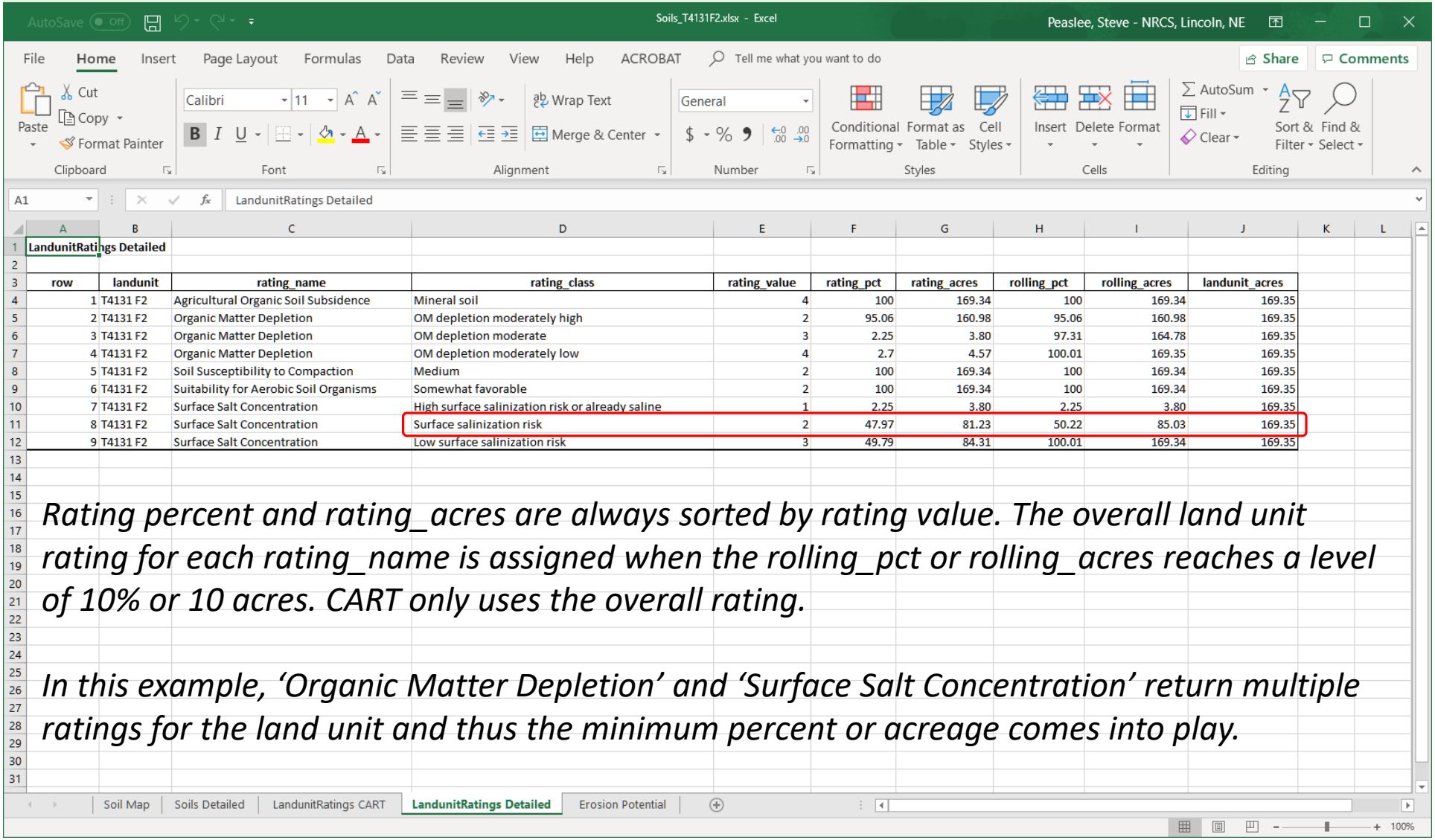


LandunitRatings CART

row	landunit	rating_name	rating_value	rating_class	landunit_acres
1	T4131 F2	Aggregate Stability	3	Moderately High	169.35
2	T4131 F2	Agricultural Organic Soil Subsidence	4	Mineral soil	169.35
3	T4131 F2	Available Water Storage	1	Yes	169.35
4	T4131 F2	Hydric Soils	1	Yes	169.35
5	T4131 F2	Organic Matter Depletion	2	OM depletion moderately high	169.35
6	T4131 F2	Ponding or Flooding	1	Yes	169.35
7	T4131 F2	Soil Organic Carbon Stock	3	Moderate	169.35
8	T4131 F2	Soil Susceptibility to Compaction	2	Medium	169.35
9	T4131 F2	Suitability for Aerobic Soil Organisms	2	Somewhat favorable	169.35
10	T4131 F2	Surface Salt Concentration	2	Surface salinization risk	169.35
11	T4131 F2	Water Table	1	Yes	169.35

When multiple land units have been selected, the user will see the tables grouped and highlighted by land unit. This example has only a single land unit so there is no highlighting.

The ‘LandunitRatings Detailed’ sheet will contain more detailed rating information.



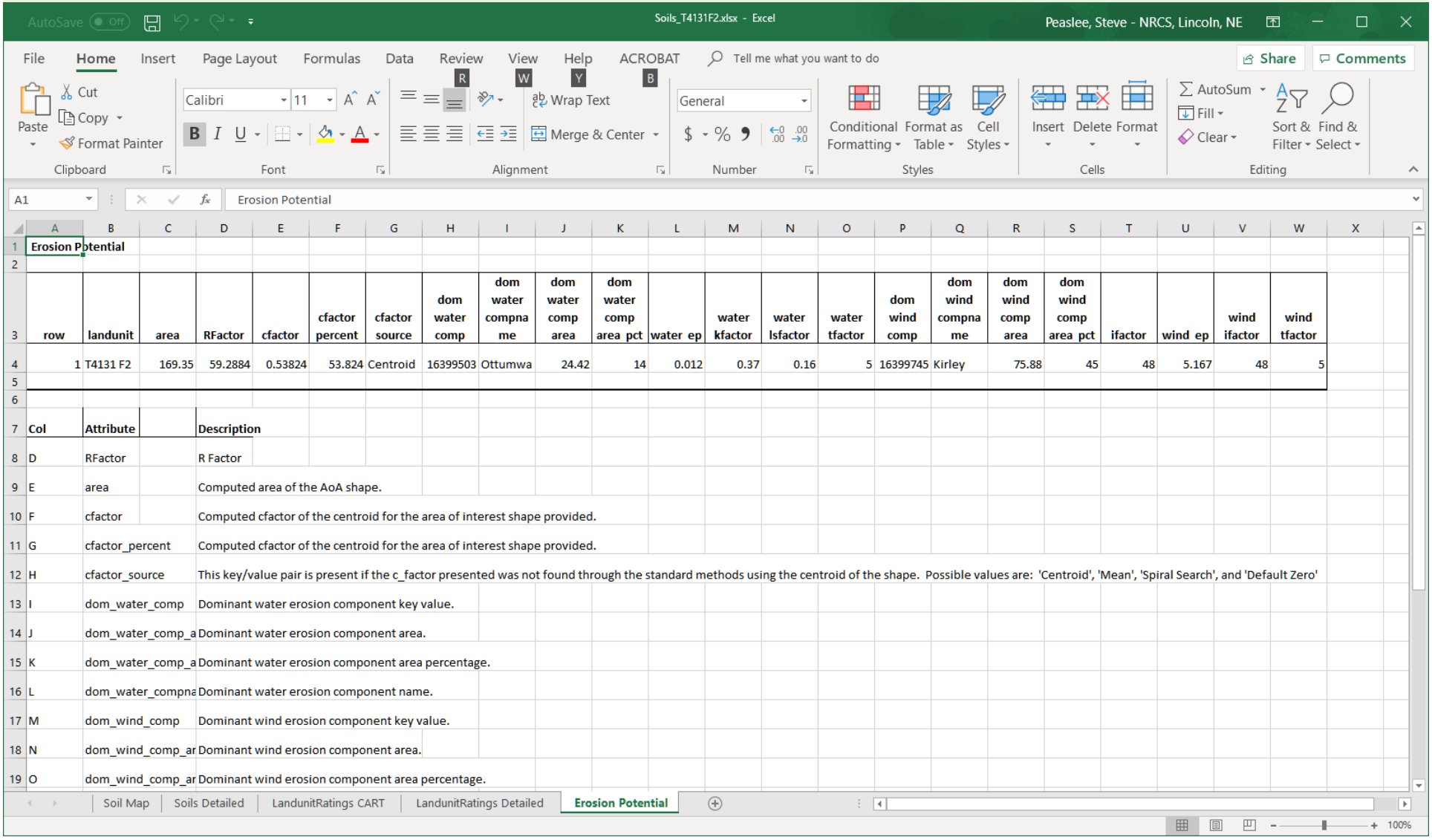
Soils_T4131F2.xlsx - Excel

row	landunit	rating_name	rating_class	rating_value	rating_pct	rating_acres	rolling_pct	rolling_acres	landunit_acres
1	T4131 F2	Agricultural Organic Soil Subsidence	Mineral soil	4	100	169.34	100	169.34	169.35
2	T4131 F2	Organic Matter Depletion	OM depletion moderately high	2	95.06	160.98	95.06	160.98	169.35
3	T4131 F2	Organic Matter Depletion	OM depletion moderate	3	2.25	3.80	97.31	164.78	169.35
4	T4131 F2	Organic Matter Depletion	OM depletion moderately low	4	2.7	4.57	100.01	169.35	169.35
5	T4131 F2	Soil Susceptibility to Compaction	Medium	2	100	169.34	100	169.34	169.35
6	T4131 F2	Suitability for Aerobic Soil Organisms	Somewhat favorable	2	100	169.34	100	169.34	169.35
7	T4131 F2	Surface Salt Concentration	High surface salinization risk or already saline	1	2.25	3.80	2.25	3.80	169.35
8	T4131 F2	Surface Salt Concentration	Surface salinization risk	2	47.97	81.23	50.22	85.03	169.35
9	T4131 F2	Surface Salt Concentration	Low surface salinization risk	3	49.79	84.31	100.01	169.34	169.35

Rating percent and rating_acres are always sorted by rating value. The overall land unit rating for each rating_name is assigned when the rolling_pct or rolling_acres reaches a level of 10% or 10 acres. CART only uses the overall rating.

In this example, ‘Organic Matter Depletion’ and ‘Surface Salt Concentration’ return multiple ratings for the land unit and thus the minimum percent or acreage comes into play.

The ‘Erosion Potential’ sheet contains data from the WEPOT and Rfactor services.



Erosion Potential

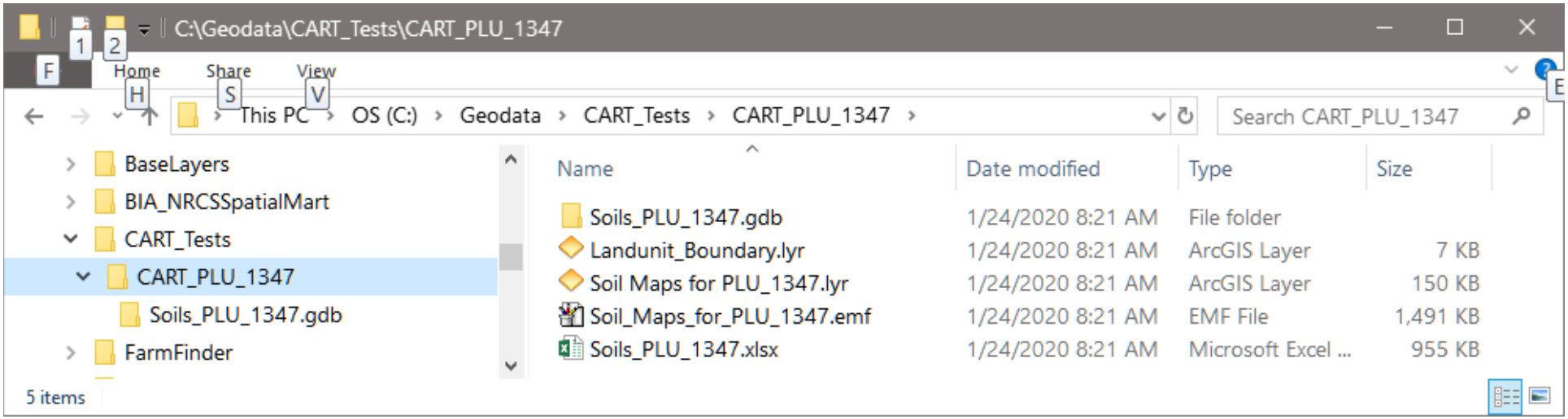
row	landunit	area	RFactor	cfactor	cfactor percent	cfactor source	dom water comp	dom water compname	dom water comp area	dom water comp area pct	water ep	water kfactor	water lsfactor	water tfactor	dom wind comp	dom wind compname	dom wind comp area	dom wind comp area pct	ifactor	wind ep	wind ifactor	wind tfactor
1	T4131 F2	169.35	59.2884	0.53824	53.824	Centroid	16399503	Ottumwa	24.42	14	0.012	0.37	0.16	5	16399745	Kirley	75.88	45	48	5.167	48	5

Col	Attribute		Description
D	RFactor		R Factor
E	area		Computed area of the AoA shape.
F	cfactor		Computed cfactor of the centroid for the area of interest shape provided.
G	cfactor_percent		Computed cfactor of the centroid for the area of interest shape provided.
H	cfactor_source		This key/value pair is present if the c_factor presented was not found through the standard methods using the centroid of the shape. Possible values are: 'Centroid', 'Mean', 'Spiral Search', and 'Default Zero'
I	dom_water_comp		Dominant water erosion component key value.
J	dom_water_comp_a		Dominant water erosion component area.
K	dom_water_comp_a		Dominant water erosion component area percentage.
L	dom_water_compna		Dominant water erosion component name.
M	dom_wind_comp		Dominant wind erosion component key value.
N	dom_wind_comp_ar		Dominant wind erosion component area.
O	dom_wind_comp_ar		Dominant wind erosion component area percentage.

The CART Soil Map tool will save all output data to the user specified folder.

Below is a screenshot of Windows File Explorer with an example of the types of data created by the tool. If the user does not specify an output The folder and most data files have the land unit identifier incorporated into the name.

The Soils geodatabase and .lyr files can be added to other ArcMap documents and even zipped up for distribution. All data paths are relative so keep the contents intact if the folder is moved.



Help!

In case of problems with installation/tool execution or if there are general questions, please contact: Steve Peaslee, National Soil Survey Center. steve.peaslee@usda.gov

The CART SoilMap ArcToolbox has been tested and should be compatible with all versions of ArcMap 10.5 through 10.7.1.

To obtain support, tool errors should be captured by highlighting all tool messages from the very first line in the tool window to the very last line. Copy-paste the text (using Ctrl-C) into an e-mail to support. If the tool window is small you may have to expand it or scroll to the top to make sure none of the text is missed. See slide 15 for an example of what the tool messages normally look like. Sending message text rather than a screenshot is preferred because it is easier to read and the full text will contain all the user-input parameters as well as the error message.

Periodic tool updates and documentation will be posted at: NRCS-GIS SharePoint Tools-CART

GitHub site for detailed documentation on CART SQL used: https://github.com/jneme910/CART