

## BEST MANAGEMENT PRACTICES

### Chapter: 16 Online Soil Survey Information – Web Soil Survey (WSS)



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Soil information is used for a multitude of decisions including determining fertilizer rates, identifying soil characteristics linked to specific pest problems, identifying areas prone to moisture stress, and identifying areas with poor drainage. The purpose of this chapter is to provide a hands-on example on how to integrate Web Soil Survey (WSS) information into the decision process.

#### Introduction

In this rapidly changing world, technological advances (e.g., precision farming methods, smartphones, tablets, iPads, apps of various kinds, and Internet sources) allow resource managers to rapidly inventory the soil resource using the USDA-NRCS Web Soil Survey. Web Soil Survey (WSS) is a powerful, user-friendly search engine for obtaining modern, detailed soil survey information. The most recent WSS version 3.1 was released in December 2013. An online tutorial and written directions are available (Malo, 2008; 2012; 2013). Visual and tabular information can be obtained from WSS. The basic steps in using WSS include defining your area of interest, creating a soil map for the area of interest, exploring soil suitabilities, and developing a customized map.

#### Step 1 – Define Area of Interest (AOI)

The AOI is used by WSS to generate tabular and visual data for use in later steps. First, identify and define the AOI where information about a field, farm, or parcel of land is needed. The AOI can be located using the various Quick Navigation options or the Interactive Map option (Fig. 16.2) in the WSS navigation window or imported from a previous session. When using the Quick Navigation option, you can locate your AOI by entering any one of the following:

1. Local street address.
2. State and county identification.
3. Soil survey area.

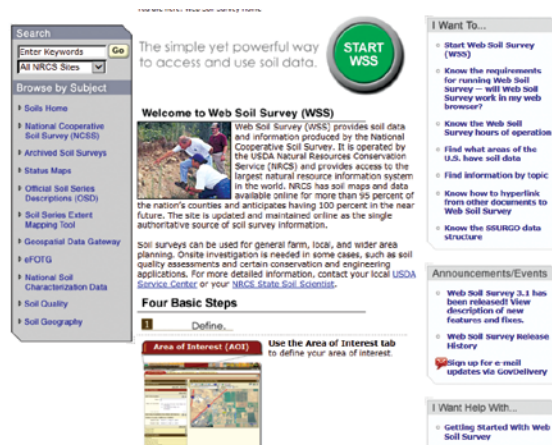


Figure 16.1 Web Soil Survey home page.  
([websoilsurvey.sc.egov.usda.gov](http://websoilsurvey.sc.egov.usda.gov))

4. Longitude and latitude.
5. Legal land description (PLSS – section, town, and range. Remember to select the proper Principal Meridian (PM), if needed, for your AOI. Use the drop-down menus in the program to assist you in picking the proper PM [Fig. 16.3]).
6. Other data sources such as the Bureau of Land Management Field Office (BLM), Defense Department Installation (DOD), US Forest Service (USFS), National Park Service (NPS), or Hydrologic Unit (HU) Code (8-digit code).

If you cannot use the Quick Navigation options, items 1-6 above, then use the Interactive Map on the home page (Fig. 16.2) to find your AOI.

Once the AOI has been located, the boundaries of the AOI need to be entered into the WSS application. Select one of the two boundary buttons. The left button allows you to identify the AOI boundaries using a rectangular box, while the right button allows you to use polygons (Fig. 16.3). Once the AOI has been outlined, double-click to electronically define and enter the AOI into WSS. After the AOI is defined and accepted, the area (in acres), availability of soil data/maps, and an aerial photo of the AOI are provided (Fig. 16.4).

## Step 2 – Create Soil Map for AOI

WSS allows users to view and print the soil map of the AOI selected. Answers to selected questions regarding the interactive map functions are available by going to [websoilsurvey.sc.egov.usda.gov](http://websoilsurvey.sc.egov.usda.gov) and clicking on Frequently Asked Questions (see Interactive Map section). Click on the Soil Map tab at the top of the WSS webpage to create a modern, detailed soil survey map (Fig. 16.5). The information available includes: the soil map and legend (tab on upper left side of image), the soil map unit (MU) name and symbol, number of acres of each soil MU, the percentage of AOI that each soil MU occupies, and tabular data for each MU. The tabular data (click on the MU name found in the AOI in the drop-down box on the left side of the Soil Map window, Fig. 16.6) includes:

1. MU setting – elevation, annual precipitation, average annual temperature, frost-free period (days), and farmland classification (e.g., prime or unique).
2. MU composition – lists all the major and minor soil units with their composition percentage.
3. Description of each major MU component (named in the MU name).
  - a. Setting for named series – landform, landscape position, slope shape (down and across), and parent material.
  - b. Typical profile horizon names, thicknesses, depths, and textures.
  - c. Selected soil properties and qualities – percent slope, restrictive layers, drainage class, permeability, depth to water table, flooding and ponding frequency, lime (calcium carbonate) content, salinity (electrical conductivity [EC]), sodium adsorption ratio (SAR), and profile plant available water holding capacity.
  - d. Interpretive groups – Land Capability Classification, Hydrologic Soil Group, Ecological Site (formerly Range Site), and Other Vegetative Groups (e.g., Forage Suitability Groups).
4. A brief description of each minor MU component – explains how the minor soil differs from the named major MU component(s).

If you would like to copy or include the soil map in a custom soil survey report, select the proper print tab in the upper right-hand corner of the window (Fig. 16.7). There are two options, Printable Version or Add to Shopping Cart. The Printable Version allows you to download a PDF of the soil map and associated documentation. The Add to Shopping Cart adds the soil map to a file and saves the file until you are done with your WSS session. The customized AOI web-based soil survey report, including the soil map with other maps and tables, can be printed. Note that when either the Printable Version or the Add to Shopping Cart button is selected, it will fade.

## Step 3 – Explore Soil Suitabilities/Limitations/Properties and Characteristics for AOI

Once the AOI is identified, the soil map is prepared and you can explore and assess the suitability and

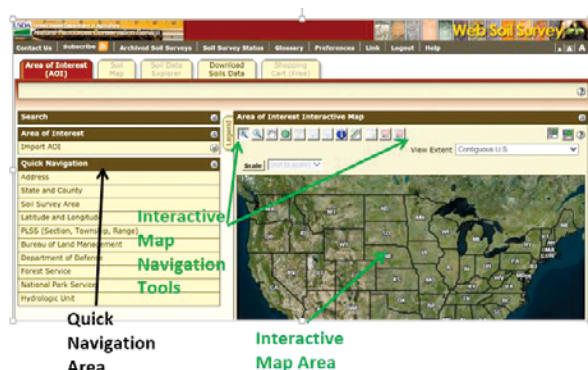


Figure 16.2 Web Soil Survey's AOI selection window, showing Quick Navigation and Interactive Map options.

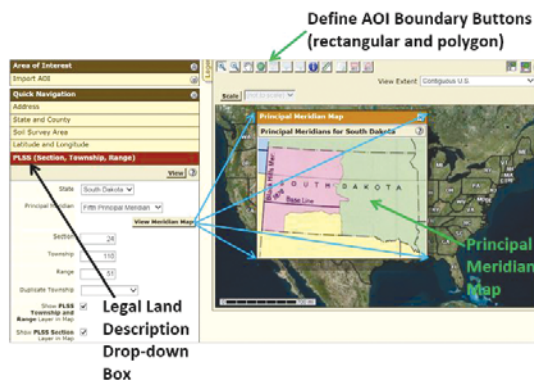


Figure 16.3 Using the WSS legal land description section in the Quick Navigation tool for locating AOI. The Principal Meridian drop-down box is located in center of the window. Example: Eastern South Dakota uses the Fifth Principal Meridian for legal land description.

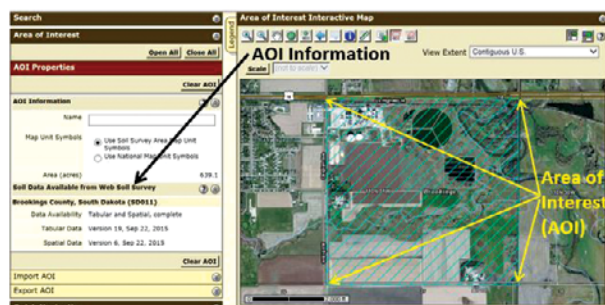


Figure 16.4 Web Soil Survey's AOI selection window with the AOI defined as the cross-hatched area.

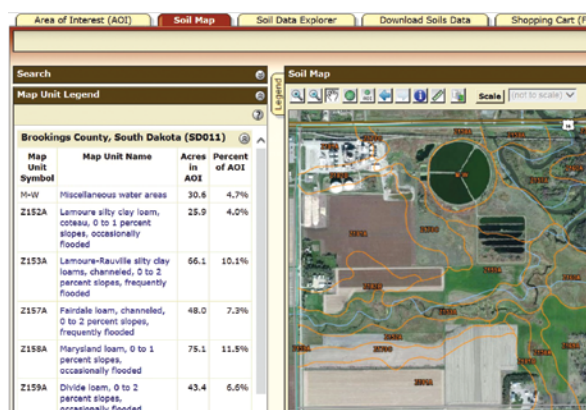


Figure 16.5 Web Soil Survey's Soil Map for the AOI information.

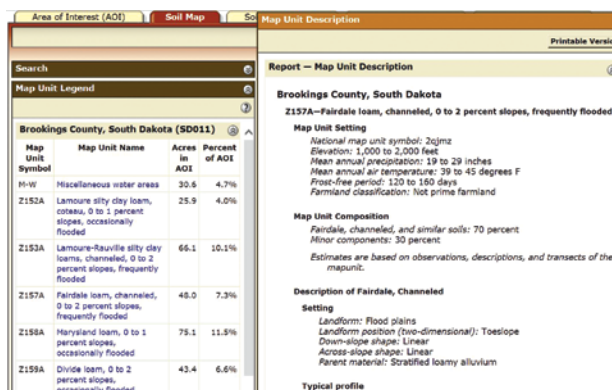


Figure 16.6 Sample WSS Map Unit Description, obtained by clicking on the Map Unit Name, e.g., Z157A, Fairdale loam.



Figure 16.7 Location of Printable Version tab and Add to Shopping Cart tab in upper right-hand corner of WSS window. The Printable Version tab creates a PDF file of the current window on the computer monitor and the Add to Shopping Cart tab stores the current window contents and associated information for later retrieval in a final report.

limitations of soils for selected uses. Maps and tables of selected soil physical/chemical properties and characteristics, as well as land productivity information, are available. Answers to selected questions on the Soil Data Explorer are available by going to [websoilsurvey.sc.egov.usda.gov](http://websoilsurvey.sc.egov.usda.gov) and clicking on Frequently Asked Questions (see the Soil Data Explorer section). To look at various soil properties, qualities, and uses (Suitabilities and Limitations), select the Soil Data Explorer tab at the top of the webpage (Fig. 16.8). A new window appears giving you the following options:

1. Intro to Soils (tutorial about soils and their use).
2. Suitabilities and Limitations for Use.
3. Soil Properties and Qualities.
4. Ecological Site Assessment.
5. Soil Reports.

Select the Suitabilities and Limitations for Use tab and a drop-down list appears on the left side of the webpage window (Fig. 16.8). If you click the Open All button, all the options for each category (e.g., Land Classifications, Sanitary Facilities, Vegetative Productivity, etc.) will be displayed. The categories of Land Classification, Land Management, Vegetative Productivity, Waste Management, and Water Management are most commonly used for agricultural production and management decisions. Crop-yield estimates can be obtained by using the actual crop-yield data for those states having actual crop-yield data or by using the Crop Productivity Index (CPI) data. In this paper, we will use the CPI data. The CPI values are assigned relative soil potential rankings (0-100) for intensive crop production. The CPI ratings are based on the following assumptions:

1. Adequate management.
2. Natural weather conditions (no irrigation).
3. Drainage installed where needed.
4. No frequent flooding in low-lying areas.
5. No leveling or terracing employed.
6. CPI values will remain constant with time.

The CPI rating map and tabular data are shown, respectively, in Figures 16.9 and 16.10. The potential corn yield can be estimated by multiplying soil-specific digital CPI by a specific crop high yield.

Example: Soil is Z181A – Brandt silty clay loam with CPI of 85.  
Brookings County, SD high corn yield estimate = 200 bu/a  
Estimated corn yield for Brandt soil =  $200 \text{ bu/a} \times (85/100) = 170 \text{ bu/a}$

For each soil suitability or limitation listed, the dominant condition within the soil mapping unit (MU), the dominant soil within a MU, all components of a MU, and weighted average of all components within a MU are available.

In addition to soil suitabilities and limitations for land use, there is a tab for Soil Properties and Qualities at the top of the webpage (Fig. 16.11). If the Soil Properties and Qualities tab is selected, a drop-down list with various categories (e.g., chemical, erosion, physical, and water) of soil properties and qualities appears on the left side of the window.

For each soil property or quality selected, you can look at the dominant condition within a soil mapping unit (MU), the dominant soil in a MU, all components of a MU, components of a certain percentage, or a weighted average of all components in a MU. You also can select the soil-depth range, e.g., surface, part of a profile, or all of a profile (Advanced Options, Fig. 16.12). Many different options are available for viewing soil property maps (Fig. 16.13) and tables (Fig. 16.14). The single-purpose maps, associated legends, description information, and other related materials can be printed by using the Printable Version tab or Add to Shopping Cart tab in the upper right-hand corner of the webpage window. Note that the tabs in the Add to Shopping Cart area fade when selected. When the report becomes large (> 8 MB), the NRCS will send you the report by email as a PDF file after it is created.



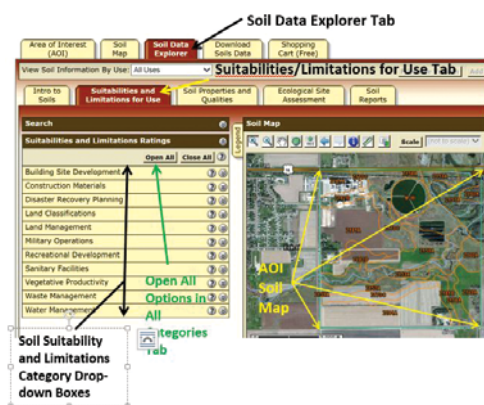


Figure 16.8 The WSS Suitabilities and Limitations for Use window with drop-down list on the left. If you want all options to be visible in the drop-down area, click the Open All button.

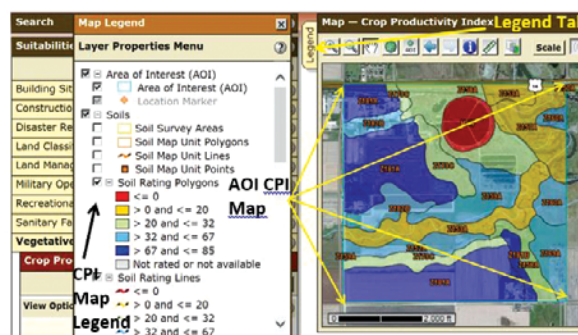


Figure 16.9 Sample WSS Soil Data Explorer window for the Suitabilities and Limitations for Use tab (Crop Productivity Index, CPI) for the AOI, right, and legend, left. Note: click the Legend tab to cause the suitability Map Legend to appear. To estimate a crop yield (e.g., corn) for each soil MU, multiply the top yield in the county by the CPI value.

Map unit symbol	Map unit name	Rating	Area in AOI	Percent of AOI
11-01	Nonirrigated water areas	0	38.6	4.9%
2232A	Lamoure silt clay loam, calcareous, 0 to 1 percent slopes, occasionally flooded	67	25.5	4.9%
2232B	Lamoure silt clay loam, calcareous, 0 to 2 percent slopes, frequently flooded	63	66.7	16.4%
2237A	Parade loam, calcareous, 0 to 2 percent slopes, frequently flooded	23	47.7	7.5%
2237B	Parade loam, calcareous, 0 to 2 percent slopes, occasionally flooded	32	75.9	13.9%
2239A	Erlebe loam, 0 to 2 percent slopes, occasionally flooded	54	43.1	6.7%
2239B	Harp, occasionally flooded calcareous, frequently flooded, calcareous, 0 to 2 percent slopes	65	23.1	3.9%
2239C	Fort Union, rarely flooded-siltstone, occasionally flooded, calcareous, 0 to 2 percent slopes	64	27.5	4.3%
2239D	Fort Union, rarely flooded-siltstone, occasionally flooded, calcareous, 0 to 2 percent slopes	27	11.3	1.9%
2239E	Brink silt clay loam, calcareous, 0 to 2 percent slopes	55	108.3	21.3%
2239F	Brink silt clay loam, calcareous, 2 to 6 percent slopes	77	18.0	1.9%
2239G	Erlebe silt loam, calcareous, 2 to 6 percent slopes	55	37.4	5.9%
2239H	Rauville silt clay loam, calcareous, 0 to 2 percent slopes, frequently flooded	11	8.4	0.1%
<b>Totals for Area of Interest</b>			<b>639.2</b>	<b>100.0%</b>

Figure 16.10 Sample WSS Soil Data Explorer yield table and descriptive information for Crop Productivity Index (CPI) map created in Figure 16.9. This information is located below (scroll down) the CPI map.

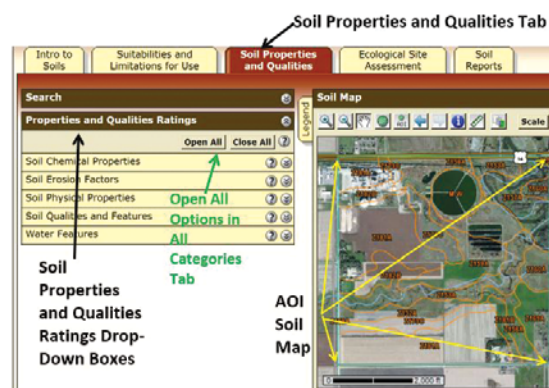


Figure 16.11 The WSS Soil Properties and Qualities window with drop-down list on the left. If you want all options to be visible in the drop-down area, click the Open All button.

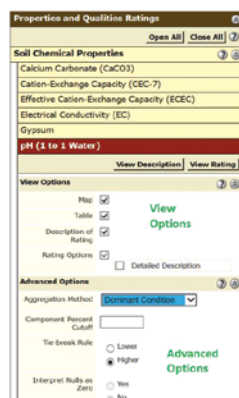


Figure 16.12 WSS View Options and Advanced Options in the drop-down list of the Soil Properties and Qualities window.

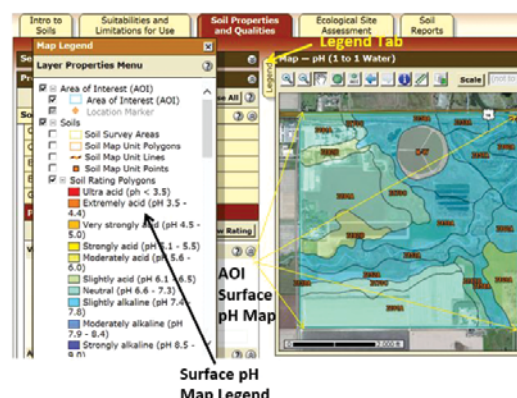


Figure 16.13 Sample WSS Soil Data Explorer window, showing the Soil Properties and Qualities tab and Surface Soil pH for the AOI, right, and Map Legend, left. Note: click the Legend tab to cause the Soil Property Map Legend to appear.

The fourth tab in the Soil Data Explorer window, Ecological Site Assessment, provides ecological site information (Fig. 16.15). This information includes an ecological site assessment map and associated tabular data for the AOI including MU name, MU components (percentage of MU), ecological site ID for each component, and detailed information about each ecological site.

The ecological site information for rangeland is available. For selected counties, ecological sites for pasture groups are also provided. The information given for a rangeland ecological site includes: a photo of the plant communities, a brief ecological site description and impacts of management on species (composition and abundance), and a transition diagram illustrating the impact of management on the plant communities in the ecological site (Fig. 16.16). Within each ecological site various plant communities are further explained (e.g., community description, management impacts, production total, species identification, species productivity, and plant growth curves) relative to the impact of management on plant communities in this ecological site.

In addition to the interpretive maps, tabular data for the AOI can be downloaded (Fig. 16.17). Tabular data is available when you use the Soil Reports tab in the Soil Data Explorer window. The many possible options for tabular data found in the drop-down menu are located on the left-hand side of the Soil Reports window. An explanation as to what is contained in each table can be viewed using the View Description tab or View Soil Report tab on the left side of the window. This information can be printed or saved using the Printable Version tab or Add to Shopping Cart tab (creates a composite report containing all the information you selected upon completion of your WSS session) in the upper right hand of the webpage window.

#### **Step 4 – Create Custom Soil Survey Report for Area of Interest (AOI)**

Electronically store and/or print the available data generated by the WSS session using the Shopping Cart and Checkout Option tabs. Answers to selected questions concerning data downloads and printable reports are available by going to [websoilsurvey.sc.egov.usda.gov](http://websoilsurvey.sc.egov.usda.gov) and clicking on Frequently Asked Questions (see the Data Downloads and Printable Maps and Reports sections).

After creating all the maps and tables needed and saving them to the Add to Shopping Cart tab, you need to click on the Shopping Cart tab at the top center of the webpage (Fig. 16.18). This option allows you to create your own customized detailed soil survey report. Review the Report Properties and report Table of Contents and make any additions or deletions you may need. When you are satisfied with the information in the Report Properties and the Table of Contents, select the Checkout Options tab (upper right-hand corner of window).

For small reports (< 8 MB), a Checkout Options box will appear and you will have the option to receive the report online during the current WSS session or having the report sent by email (receipt within 24 hours) to you.

#### ***Use and Limitation of Web Soil Survey (WSS) Information***

Web Soil Survey (WSS) information is useful in understanding how soils differ and will perform under various land-management systems. Examination of key soil-property and quality-attribute information can aid you in making management decisions.

You can manage soil resources more economically and with increased environmental sustainability using detailed WSS soil-survey data along with yield-monitor maps. Producers can integrate WSS data with yield-monitor and other collected on-site data (Reitsma and Malo, 2011). One key point to remember is that many soil maps in WSS were originally prepared at a scale of 1:20,000 and 1:24,000. As a result, the soil interpretations included inside a soil mapping-unit (MU) boundary have limitations.

The smallest delineation that can be shown on modern soil-survey maps in South Dakota, for example, is about 2 acres. Areas smaller than 2 acres are not shown on the map. Most soil MU descriptions include descriptions of these inclusions to let the user know that these other soils exist in the soil MU.

Tables - pH (1 to 1 Water) - Summary By Map Unit				
Summary by Map Unit - Brookings County, South Dakota (SD011)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2132A	Occasional water areas		25.6	4.0%
2133A	Lamoure silty clay loam, coteau, 0 to 1 percent slopes, occasionally flooded	7.6	23.5	4.0%
2133A	Lamoure-Raville silty clay loams, channelled, 0 to 2 percent slopes, frequently flooded	7.6	66.7	10.4%
2137A	Fertile loam, channelled, 0 to 2 percent slopes, frequently flooded	7.6	47.7	7.5%
2138A	Harvard loam, 0 to 1 percent slopes, occasionally flooded	7.8	75.9	11.9%
2139A	Divide loam, 0 to 2 percent slopes, occasionally flooded	7.7	43.1	6.7%
2150A	Horiz. occasionally flooded-Lamoure, frequently flooded, complex, 0 to 2 percent slopes	7.6	23.1	3.6%
2158A	Fertile, rarely flooded-Spottwood, occasionally flooded, loams, 0 to 2 percent slopes	6.4	27.5	4.3%
2173C	Sandwich-Siloa complex, 6 to 9 percent slopes	7.0	51.3	8.0%
2181A	Grand silty clay loam, coteau, 0 to 2 percent slopes	6.6	199.0	31.3%
2181B	Grand silty clay loam, coteau, 2 to 6 percent slopes	6.6	10.0	1.6%
2182B	Estaline silt loam, coteau, 2 to 6 percent slopes	6.4	37.4	5.8%
2200A	Raville muldy silty clay loam, ponded, 0 to 1 percent slopes, frequently flooded	7.9	0.4	0.1%
<b>Totals for Area of Interest</b>			<b>639.2</b>	<b>100.0%</b>

**Descriptions - pH (1 to 1 Water)**

Soil reaction is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion. In general, soils that are either highly alkaline or highly acid are likely to be very corrosive to steel. The most common soil laboratory measurement of pH is the 1:1 water method. A crushed soil sample is mixed with an equal amount of water, and a measurement is made of the suspension.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For the soil property, only the representative value is used.

Figure 16.14 Sample WSS Soil Data Explorer tab, showing soil properties and qualities ratings and descriptive information for surface pH for map created in Figure 16.13. This information is located below (scroll down) the pH map.

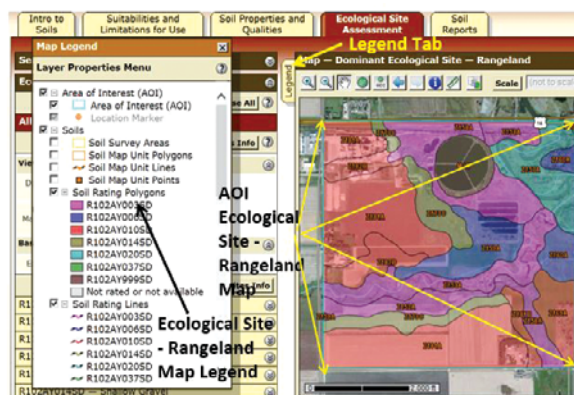


Figure 16.15 Sample WSS Soil Data Explorer window, showing Ecological Site Assessment tab (Dominant Ecological Site-Rangeland) for AOI, right, and Map Legend, left. Note: click the Legend tab to cause the Ecological Site - Rangeland Map Legend to appear.

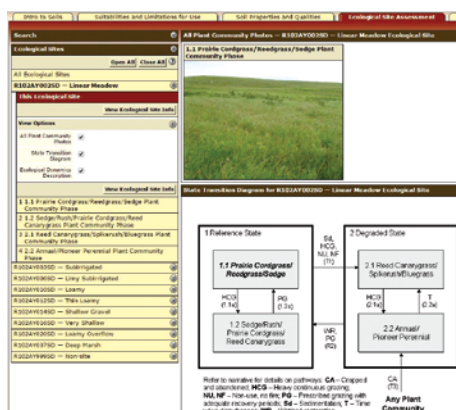


Figure 16.16 Sample WSS Soil Data Explorer Ecological Site Assessment information (Plant Community Transition Diagram) for selected ecological site (e.g., Linear Meadow) for AOI created in Figure 16.15. This information appears when each ecological site is selected in the left-hand set of drop-down boxes. The diagram on the left shows management impacts on native plant communities.

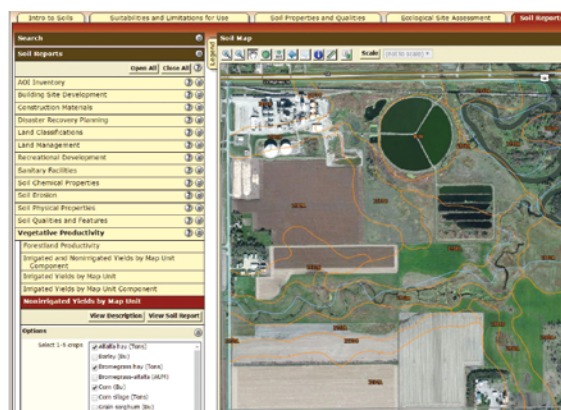


Figure 16.17 Sample WSS Soil Data Explorer window, showing Soil Reports tab with drop-down boxes on the left. If you want all options to be visible in the drop-down area, select the Open All button. Example: drop-down box for Non-irrigated Yields by Map Unit is shown. Selected crops for table creation are checked.



Figure 16.18 Sample WSS Soil Shopping Cart window with the Checkout Options tab selected (upper right-hand corner).



For intensive management of areas smaller than 2 acres, a more detailed soil map is needed. The soil MUs in WSS allow the user to develop field zones where sound management decisions can be made. With modern GPS, soil-survey data, yield-monitoring data, and scouting reports, it may be possible to increase profitability and reduce the impact of agriculture on the environment.

## Conclusions

This chapter outlines how to use Web Soil Survey (WSS) to obtain soil and land-attribute information. Samples of output and WSS 3.1 and a listing of other websites with valuable soil and natural resource information are provided (Table 16.1).

**Table 16.1 Online sources of soil and natural resources information. These locations are provided for the convenience of the reader, however, locations frequently change.**

Name	Information available	Web address (verified 25 June 2015)
Agricultural Research Service, USDA	Home page, research results and projects	<a href="http://www.ars.usda.gov/main/main.htm">http://www.ars.usda.gov/main/main.htm</a>
American Fact Finder (US Census Bureau)	Source of population, housing, economic, and geographic data by state, town, county, or zip code area	<a href="http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml">http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml</a>
Bureau of Land Management, USDOI	Home page, projects and activities	<a href="http://www.blm.gov/wo/st/en.html">http://www.blm.gov/wo/st/en.html</a>
California Soil Resource Lab	Soil survey data, soil web apps	<a href="http://casoilresource.lawr.ucdavis.edu">http://casoilresource.lawr.ucdavis.edu</a>
Canada Centre for Mapping and Earth Observation	General remote sensing information and educational materials	<a href="http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/9271">http://www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/9271</a>
Current Research Information System (CRIS)	Current agricultural research results and publications	<a href="http://cris.nifa.usda.gov/">http://cris.nifa.usda.gov/</a>
EROS Data Center (USGS)	Home page, satellite and aerial images, research projects and programs	<a href="http://eros.usgs.gov/">http://eros.usgs.gov/</a>
Google Maps/Google Earth	Various maps of US in 2 and 3 dimensions	<a href="http://maps.google.com/">http://maps.google.com/</a> <a href="https://www.google.com/earth/">https://www.google.com/earth/</a>
Federal Stats of US	Federal statistics for state, county, and city	<a href="http://fedstats.sites.usa.gov/">http://fedstats.sites.usa.gov/</a>
iGrow (SDSU Extension Service and ABS College)	Production and management information	<a href="http://extension.sdstate.edu">http://extension.sdstate.edu</a>
National Agricultural Statistics Service	Agricultural statistics for state and county	<a href="http://www.nass.usda.gov/">http://www.nass.usda.gov/</a>
National Institute of Food and Agriculture (NIFA)	USDA NIFA Home page and agricultural research information	<a href="http://nifa.usda.gov/">http://nifa.usda.gov/</a>
National Map Viewer (USGS)	Various kinds and scales of US maps	<a href="http://nationalmap.gov/viewer.html">http://nationalmap.gov/viewer.html</a>
NRCS – Field Office Technical Guide	Provide county specific scientific technical and reference information on soil, water, air, plant and animal conservation	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/</a>
NRCS – Hydric Soils	Hydric soils information	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/">http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/</a>
NRCS – Major Land Resource Areas (MLRAs)	Physiography, geology, climate, water resources, soils, biological resources, and kinds of land use	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook">http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook</a>
NRCS – National Soil Survey Handbook	Technical guide for soil survey projects and activities	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242">http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242</a>



**Table 16.1 Online sources of soil and natural resources information. These locations are provided for the convenience of the reader, however, locations frequently change.**

Name	Information available	Web address (verified 25 June 2015)
NRCS – National Range and Pasture Handbook	Procedures for the inventory, analysis, treatment, and management of grazing land resources	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/rangepasture/?cid=stelpddb1043084">http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/rangepasture/?cid=stelpddb1043084</a>
NRCS – National Centers	National NRCS Centers (e.g., Water + Climate, Soil Survey, Agroforestry, and others)	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/org/?cid=nrcs143_021411">http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/about/org/?cid=nrcs143_021411</a>
NRCS – National Water and Climate Center	Climate and water conservation planning information	<a href="http://www.wcc.nrcs.usda.gov/">http://www.wcc.nrcs.usda.gov/</a>
NRCS – Offices/Centers	State and county office location and address information	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/org/">http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/org/</a>
NRCS – Official Soil Series Descriptions	Detailed , official soil series descriptions for soils in US	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/home/?cid=nrcs142p2_053587">http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/home/?cid=nrcs142p2_053587</a>
NRCS – Soil Data Mart	Soil physical, chemical, and characterization data	<a href="http://ncsslabsdatamart.sc.egov.usda.gov/">http://ncsslabsdatamart.sc.egov.usda.gov/</a> <a href="http://sdmdataaccess.nrcs.usda.gov/">http://sdmdataaccess.nrcs.usda.gov/</a>
NRCS – Soil Health and Quality	Soil health/quality definition, assessment, management, resources, and publications	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/">http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/</a>
NRCS – Soil Survey Manual	Soil Survey Manual Publication	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054262">http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054262</a>
NRCS - Soils	Home page, soil classification, lab data	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/">http://www.nrcs.usda.gov/wps/portal/nrcs/site/soils/home/</a>
NRCS – Technical References	Website for manuals, technical guides, and references used by NRCS	<a href="http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/ref/">http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/ref/</a>
NOAA	Weather data, drought monitoring, current conditions	<a href="http://www.weather.gov/">http://www.weather.gov/</a>
Service Center Locator (USDA)	Service Center locator and contact information	<a href="http://offices.sc.egov.usda.gov/locator/app">http://offices.sc.egov.usda.gov/locator/app</a>
Site Specific Management Guide	Site specific management for agriculture	<a href="http://www.ipni.net/ssmg">http://www.ipni.net/ssmg</a>
Soil Orders	Images of 12 soil orders	<a href="http://soils.cals.uidaho.edu/soilorders/">http://soils.cals.uidaho.edu/soilorders/</a>
US Forest Service	Home page	<a href="http://www.fs.fed.us/">http://www.fs.fed.us/</a>
Web Soil Survey (WSS)	Detailed soil survey information	<a href="http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm">http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm</a>
World Reference Base for Land Resources	Soil classification and soil description for world - FAO	<a href="http://www.fao.org/soils-portal/soil-survey/soil-classification/world-reference-base/en/">http://www.fao.org/soils-portal/soil-survey/soil-classification/world-reference-base/en/</a>

## Abbreviations

1:1 – one part soil to 1 part water	MU – soil mapping unit
AOI – area of interest	NCCPI – National Commodity Crop Productivity Index
BLM – Bureau of Land Management	NIFA – National Institute of Food and Agriculture
CaCO <sub>3</sub> – calcium carbonate (lime)	NIMSS – National Information Management and Support System
CEC – cation exchange capacity	NOAA – National Oceanic and Atmospheric Administration
cm – centimeter	NPS – National Park Service
CRIS – Current Research Information System	NRCS – Natural Resources Conservation Service (formerly the SCS)
CPI – Crop Productivity Index	PAW – plant available water holding capacity
dS/m – deciSiemen per meter (measure of electrical conductivity)	Pct, pct – percent
EC – electrical conductivity (soil salinity measurement)	PDF – portable document format
EROS – Earth Resources Observation Satellite	pH – soil reaction
GIS – geographic information systems	PM – principal meridian
GPS – global positioning system	RUSLE2 – Revised Universal Soil Loss Equation
HU – hydrologic unit	SAR – sodium adsorption ratio
K factor – soil erodibility (soils inherent susceptibility to water erosion)	SCS – Soil Conservation Service (now the NRCS)
kml – keyhole markup language	T value – tolerable soil loss (maximum amount of soil loss by wind and water and not decrease long-term productivity)
Ksat – saturated soil hydraulic conductivity	USDA – United States Department of Agriculture
MLRA – Major Land Resource Area	USDOI – United States Department of Interior
MB – megabyte	USFS – United States Forest Service
meq/100g – milliequivalents per 100g (measure of cation exchange capacity), 1 meq/100g = 1 cmolc /kg	USGS – United States Geological Survey
mmhos/cm – millimhos per centimeter (measure of electrical conductivity), 1 mmhos/cm = 1 dS/m	WSS – Web Soil Survey
mm – millimeter	

## References and Additional Information

- California Soil Resource Lab. 2015. SoilWeb Apps. University of California - Davis Soil Resource Laboratory. University of California - Davis. Available at <http://casoilresource.lawr.ucdavis.edu/soilweb-apps/>. Accessed June 29, 2015.
- Reitsma, K.D., and D.D. Malo. 2011. Integration of USDA-NRCS web soil survey and site collected data. p. 81-100. In Clay, D.E., and J.F. Shanahan (eds). GIS Applications in agriculture: nutrient management for energy efficiency. CRC Press, Boca Raton, FL.
- Malo, D.D. 2013. Identifying Potential Iron Chlorosis Soils for Soybean Production (Chapter 19). p 137-166. In Clay, D.E., C.G. Carlson, S.A. Clay, L. Wagner, D. Deneke, and C. Hay (eds.). iGrow Soybeans: Best Management Practices for Soybean Production. iGrow. College of Agriculture and Biological Sciences, South Dakota State University. Box 2208. Brookings, SD 57007.
- Malo, D.D. 2012. Online Web Soil Survey (WSS) Information (Chapter 18). p. 139-164. In Clay, D.E., C.G. Carlson, and K. Dalsted (eds.). iGrow Wheat: Best Management Practices for Wheat Production. iGrow. College of Agriculture and Biological Sciences, South Dakota State University. Box 2208. Brookings, SD 57007.
- Malo, D.D. 2008. Online sources of basic soils information. Pp. 35-48. In Logsdon, S., D.E. Clay, D. Moore, and T. Tsegaye (eds). Soil science – step-by-step field analysis. Soil Science Society of America. Madison, WI.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available at <http://websoilsurvey.nrcs.usda.gov/>. Accessed June 29, 2015.

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Malo, Douglas. 2016. Chapter 16: Online Soil Survey Information – Web Soil Survey (WSS). In Clay, D.E., C.G. Carlson, S.A. Clay, and E. Byamukama (eds). iGrow Corn: Best Management Practices. South Dakota State University.

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