

Chapter 18: Online Web Soil Survey (WSS) Information



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The purpose of this chapter is to provide a hands-on example on how to integrate Web Soil Survey (WSS) information into your operation.

Introduction

In this rapidly changing world, technological advances allow us to inventory and understand soils in new and extremely useful ways. In past times, one would go to the county United States Department of Agriculture (USDA) – Natural Resources Conservation Service (NRCS) office and obtain detailed soils information from published soil surveys for a county or a selected geographic region.

Today you can obtain the same information, plus much more, online using the USDA-NRCS WSS website <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>, using a new application “SoilWeb: An Online Soil Survey Browser” that works with iPhone applications and Android OS smart phones <http://casoilresource.lawr.ucdavis.edu/drupal/node/902>. The WSS website is regularly updated with new options, features, and data (Fig. 18.1). Select the green button in the upper right side of the window to start the WSS application. The most recent WSS version 2.3 was released on July 25, 2011.

WSS is a powerful, user-friendly search engine for modern detailed soil survey information. The website has a detailed online tutorial to assist in using the WSS <http://websoilsurvey.nrcs.usda.gov/app/Help/FrequentlyAskedQuestions.htm#help>. There are other sources that provide additional WSS instructions (Malo 2008). This chapter provides basic information in how to obtain basic soil maps, soil productivity ratings, yields, and other soil information using WSS.

On-line sources of land and soils information

There are many sources of land and soil data available online. Table 18.1 shows a partial listing of useful websites for producers, agronomists, and natural resource managers. This table is not meant to be all-inclusive, but rather attempts to identify selected information sources.



Click here to start WSS

Figure 18.1. Web Soil Survey (WSS) home page.
<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>

Table 18.1. Online sources of soils and natural resources information. (continues on next page)

Name	Information Available	Web address (verified 28 July 2011)
Agricultural Research Service, USDA	Home page, research results and projects	https://www.ars.usda.gov/
American Fact Finder (U.S. Census Bureau)	Source of population, housing, economic, and geographic data by town, county, or zip code area	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml
Bureau of Land Management, USDOI	Home page, projects and activities	http://www.blm.gov/wo/st/en.html
California Soil Resource Lab	Soil Survey Data	http://casoilresource.lawr.ucdavis.edu/drupal/node/902
Canada Centre for Remote Sensing	General remote sensing information	http://ccrs.nrcan.gc/index_e.php
Current Research Information System (CRIS)	Current agricultural research results and publications	http://cris.nifa.usda.gov
EROS Data Center (USGS)	Home page, satellite and aerial images, research project and programs	http://eros.usgs.gov/
Google Maps/Google Earth	Various maps of U.S. in 2 and 3 dimensions	http://map.google.com/ http://www.google.com/earth/index.html
Map Stat of U.S.	Federal statistics maps for state, county, and city	http://www.fedstats.gov/qf/
National Agricultural Statistics Service	Agricultural statistics for state and county	http://nass.usda.gov/
National Information Management and Support System (NIMSS)	Agriculture research activities and projects in the state, region, and nation	http://nimss.umd.edu
National Institute of Food and Agriculture (NIFA)	Home page and agricultural research information	https://nifa.usda.gov/
National Map Viewer (USGS)	Various kinds and scales of U.S. maps	http://nationalmap.gov/viewers.html
NRCS – Field Office Technical Guide	Provide county specific scientific technical and reference information on soil, water, air, plant and animal conservation	http://nrcs.usda.gov/technical/efotg/
NRCS – Hydric Soils	Hydric soils information	http://soils.usda.gov/use/hydric/

Table 18.1. Online sources of soils and natural resources information.

Name	Information Available	Web address (verified 28 July 2011)
NRCS – Major Land Resource Areas (MLRAs)	Physiography, geology, climate, water resources, soils, biological resources, and kinds of land use	http://soils.usda.gov/survey/geography/mlra.index.html
NRCS – National Soil Survey Handbook	Technical guide for soil survey projects and activities	http://soils.usda.gov/technical/handbook
NRCS – National Range and Pasture Handbook	Procedures for the inventory analysis, treatment, and management of grazing land resource	http://soils.usda.gov/technical/publications/nrph.html
NRCS – National Centers	National NRCS Centers (e.g., Water + Climate, Soil Survey, Agroforestry, and others)	http://www.nrcs.usda.gov/about/organization/cent_inst.html
NRCS – National Water and Climate Center	Climate and water conservation planning information	http://www.wcc.nrcs.usda.gov/
NRCS – Offices/Centers	State and county office locations and address information	http://www.nrcs.usda.gov/about/organization/regions.html
NRCS – Official Soil Series Descriptions	Detailed, official soil series descriptions for soils in US	http://soils.usda.gov/technical/classification/osd/index.html
NRCS – Soil Data Mart	Soil physical, chemical, and characterization data	http://soildatamart.nrcs.usda.gov/
NRCS - Soil Quality	Soil quality definition, assessment, management, resources, and publications	http://soils.usda.gov/sqi/
NRCS – Soil Survey Manual	Soil Survey Manual Publication	http://soils.usda.gov/technical/manual
NRCS – Soils	Home page, soil classification, lab data	http://soils.usda.gov/
NRCS - Technical References	Web site for manuals, technical guides, and references used by NRCS	http://soils.usda.gov/technical/
NOAA	Weather data, drought monitoring, current conditions	http://www.weather.gov/
Service Center Locator (USDA)	Service Center locator and contact information	http://office.sc.egov.usda.gov/locator/app
Site Specific Management Guide	Site specific management for agriculture	http://www.ipni.net/e-catalog/SSMG/ssmg.htm
Soil Orders	Images of 12 soil orders	http://soils.cals.uidaho.edu/soilorders/
US Forest Service	Home page	http://www.fs.fed.us/
Web Soil Survey (WSS)	Detailed soil survey information	http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
World Reference Base for Land Resources	Soil classification and soil description for world – FAO	http://www.fao.org/nr/land/soils/soils/en/

Web Soil Survey

Web Soil Survey is widely used by farmers, ranchers, natural resource managers, and planners. This online interactive site is user friendly and is a powerful tool for both visual and tabular information. Please check the online requirements for WSS to make sure your computer system is configured to allow this interactive program to operate. <http://websoilsurvey.nrcs.usda.gov/app/Help/Requirements.htm>

This section will briefly describe how you can use WSS. Before selecting an Area of Interest (AOI), you need to make sure the WSS system has the modern soil survey data available for your county. Check the status of the soil data available by county by visiting the most recent status map at <http://soildatamart.nrcs.usda.gov/StatusMaps/SoilDataAvailabilityMap.pdf>.

There are three basic steps in using WSS.

1. Identify and define the AOI where you need to obtain detailed soil information. This area can be a field, farm, or parcel of land. The AOI in this program is limited to 10,000-acre size limit. Other questions dealing with the AOI and operation of WSS are available at <http://websoilsurvey.nrcs.usda.gov/app/Help/FrequentlyAskedQuestions.htm>.
2. Once the AOI is identified, the soils map is prepared and you can assess the suitability and 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.
3. Electronically store and/or print the available data generated by the WSS session using the Shopping Cart Tab and Check-out Option.

Step 1 – Define Area of Interest (AOI)

The first step in using WSS is to identify your AOI. The AOI is used by the WSS to generate tabular and visual data for use in later steps of the WSS. The AOI can be located either by using the various Quick Navigation options or the Interactive Map option (Fig. 18.2) in the WSS Navigation window. 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. Longitude and latitude.

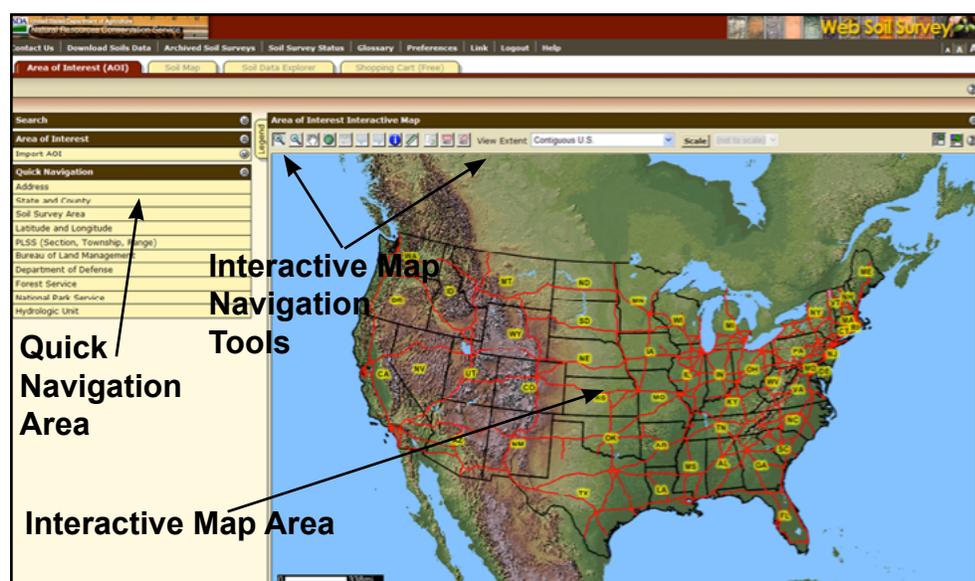


Figure 18.2. WSS Area of Interest selection window with quick navigation and interactive map options. <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

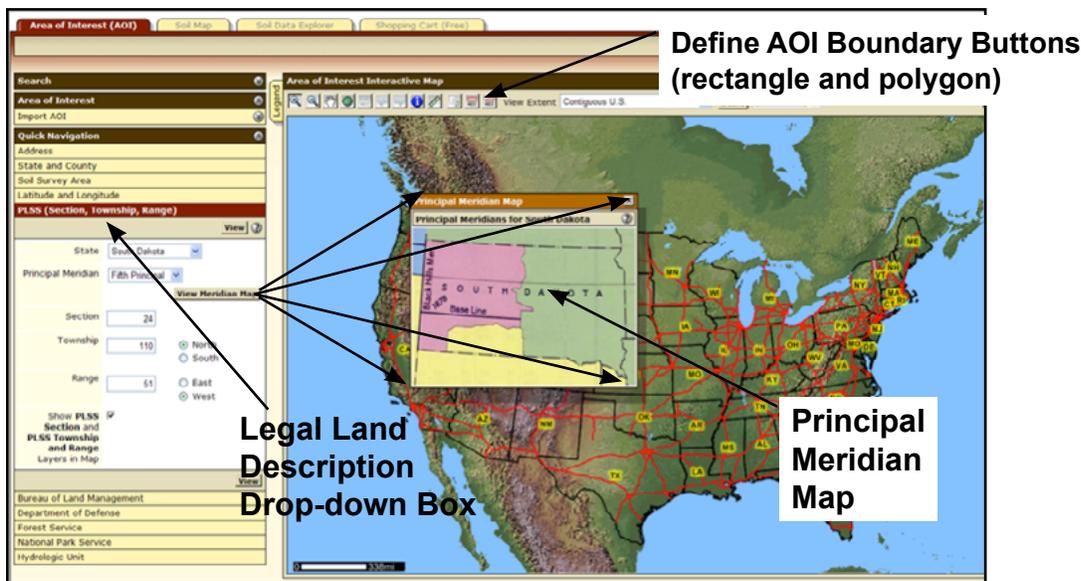


Figure 18.3. Using WSS legal land description quick navigation tool for locating area of interest (AOI). Principal Meridian drop-down box is located in center of the window. Example – Eastern South Dakota uses the Fifth Principal Meridian for legal land description.

4. Legal land description (section, town, and range). Remember to select the proper Principal Meridian (PM) for your AOI. Use the drop-down helps in the program to assist you in picking the proper PM (Fig. 18.3).
5. Other (Bureau of Land Management Field Office [BLM], Defense Department Installation [DOD], U.S. Forest Service [USFS], National Park Service [NPS], or Hydrologic Unit [HU] Code [8 digit code]).

Use the Interactive Map option on the entry page to find your AOI if you do not have information for one of the options (1-5) listed above.

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. 18.3). Once you have outlined the AOI, then double click to electronically define and enter the AOI into WSS. After the AOI is defined and accepted, the acres and availability of soils data/maps and an air photo of the AOI are given (Fig. 18.4).

Step 2a – Soils map for AOI

After completion of Step 1 (AOI defined), you then click on the Soil Map tab at the top of the WSS Web page to create a modern detailed soil survey map for the AOI (Fig. 18.5). The types of information available include: 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 dropdown box on the left side of the Soil Map window, Fig. 18.6) includes:

1. MU setting – elevation, annual precipitation, average annual temperature, and frost-free days.
2. MU composition – lists all the major and minor soil units with their composition %.
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. Selected soil properties and qualities – % slope, restrictive layers, drainage class, permeability, depth to water table, flooding and ponding frequency, lime (calcium carbonate content), salinity (EC), sodium adsorption ratio (SAR), and profile plant available water holding capacity.

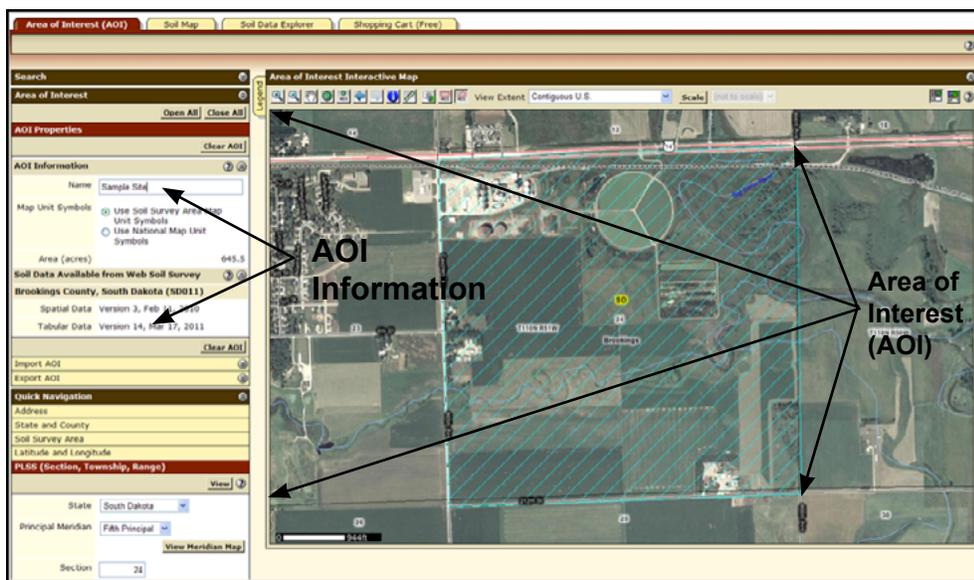


Figure 18.4. WSS Area of Interest (AOI) selection window with AOI defined (cross-hatched).

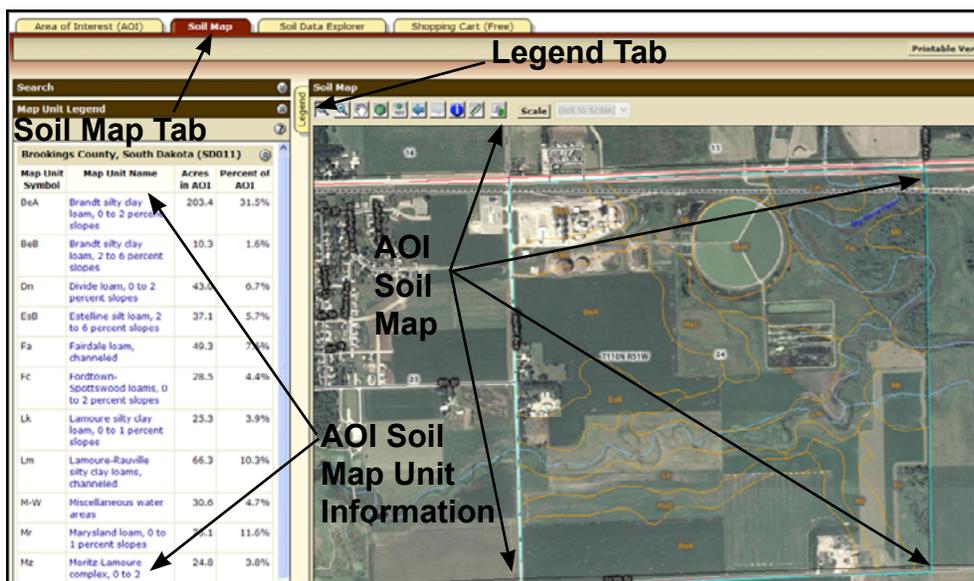


Figure 18.5. WSS Soil Map for Area of Interest (AOI) information.

- c. Interpretive groups – Land Capability Classification, Ecological Site (formerly Range Site), and Other Vegetative Groups (e.g., Forage Suitability Groups),
- d. Typical profile information (e.g., horizon depths and textures).
4. A brief description of each minor MU component to explain how the minor soil differs from the named major MU component(s).

If you would like a copy of the soil map 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. 18.7). There are two options, Printable Version or Add to Shopping Cart. The Printable Version option allows you to download a pdf version of just the soil map and associated documentation.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BeA	Brandt silty clay loam, 0 to 2 percent slopes	203.4	31.5%
BeB	Brandt silty clay loam, 2 to 6 percent slopes	10.3	1.6%
Dn	Divide loam, 0 to 2 percent slopes	43.0	6.7%
EsB	Estelline silt loam, 2 to 6 percent slopes	37.1	5.7%
Fa	Fairdale loam, channeled	49.3	7.6%
Fc	Fordtown-Spottswood loams, 0 to 2 percent slopes	28.5	4.4%
Lk	Lamoure silty clay loam, 0 to 1 percent slopes	25.3	3.9%
Lm	Lamoure-Rauville silty clay loams, channeled	13.3	2.0%
M-W	Miscellaneous water areas	30.6	4.7%
Mr	Marysland loam, 0 to 1 percent slopes	75.1	11.6%
Mz	Moritz-Lamoure complex, 0 to 2 percent slopes	24.8	3.8%
Rp	Rauville silty clay loam, ponded	0.9	0.1%

Map Unit Description

Report — Map Unit Description

Brookings County, South Dakota

BeA—Brandt silty clay loam, 0 to 2 percent slopes

Map Unit Setting
 Elevation: 1,000 to 2,000 feet
 Mean annual precipitation: 19 to 29 inches
 Mean annual air temperature: 39 to 45 degrees F
 Frost-free period: 120 to 160 days

Map Unit Composition
 Brandt and similar soils: 85 percent
 Minor components: 15 percent

Description of Brandt

Setting
 Landform: Outwash terraces
 Landform position (two-dimensional): Backslope
 Down-slope shape: Linear
 Across-slope shape: Linear
 Parent material: Loess over outwash

Properties and qualities
 Slope: 0 to 2 percent
 Depth to restrictive feature: More than 80 inches
 Drainage class: Well drained
 Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
 Depth to water table: More than 80 inches
 Frequency of flooding: None
 Frequency of ponding: None
 Calcium carbonate, maximum content: 20 percent
 Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
 Available water capacity: High (about 9.9 inches)

Interpretive groups
 Land capability (nonirrigated): 1
 Ecological site: Loamy (R102AY010SD)
 Other vegetative classification: Loam (G102AY100SD)

Typical profile
 0 to 9 inches: Silty clay loam
 9 to 35 inches: Silty clay loam
 35 to 48 inches: Silty clay loam
 48 to 60 inches: Stratified sand to very gravelly sand

Figure 18.6. Sample WSS map unit information (obtained by clicking on the soil mapping unit name, e.g., Brandt silty clay loam).

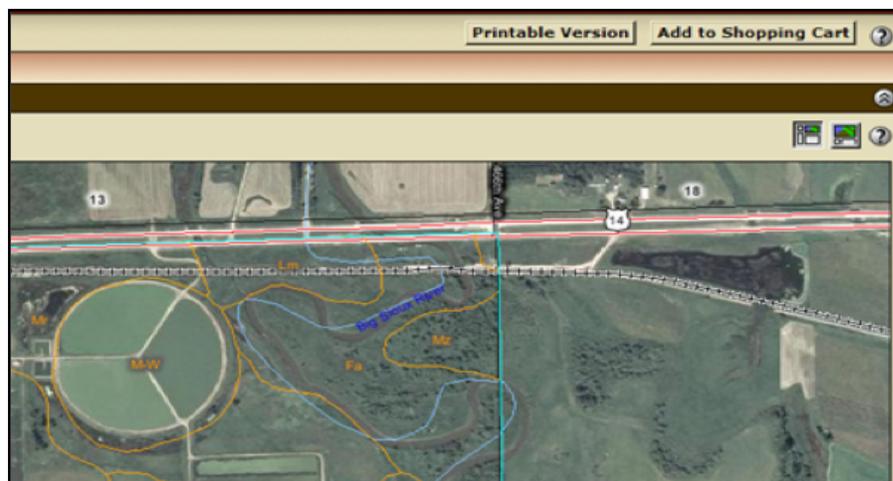


Figure 18.7. Location of Printable Version tab and Add to Shopping Cart tab in upper right-hand corner of WSS window. Printable Version tab creates a pdf file of the current window on the computer monitor and the Add to Shopping Cart tab stores the current window contents and associated information for later retrieval in a final report.

The Add to Shopping Cart option adds the soil map to a file and saves the file until you are done with your WSS session. You can then print out a customized Web-based soil survey report including the soil map with other maps and tables you need. Note that when either the Printable Version or the Add to Shopping Cart button is selected, it will fade.

Step 2b – Soil suitabilities/limitations/properties and characteristics for AOI

To look at various soil properties, qualities, and uses (Suitabilities and Limitations), select the Soil Data Explorer tab at the top of the Web page (Fig. 18.8). A new window appears giving you the options of:

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. A new series of dropdown tabs appears on the left side of the Web page window (Fig. 18.8). If you press the Open All tab, then all the options for each category (e.g., Land Classification, Sanitary Facilities, Vegetative Productivity, etc.) in the box will open.

The categories of Land Classification, Land Management, Vegetative Productivity, Waste Management, and Water Management are most commonly used for agricultural production and management decisions (Table 18.2).

Spring wheat yield data (rating map, legend and description) for the AOI can be seen in Figures 18.9 and 18.10. For each soil suitability or limitation listed, you can look at the dominant condition within a 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 can print/save a single purpose map, associated legend, description information, and other related materials by using the Printable Version tab or Add to Shopping Cart tab in the upper right hand of the Web page 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.

In addition to soil suitabilities and limitations for land use, there is a tab for Soil Properties and Qualities at the top of the Web page (Fig. 18.11). If you select this tab, a drop- down box with various categories (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 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. 18.12). Many different options are available for viewing maps (Fig. 18.13) and tables (Fig. 18.14 and Table 18.3).

For water table information, you can select the months when excess water is a problem. You can print and/or electronically save a single purpose map, associated legend, description information, and other related materials by using the Printable Version tab or Add to Shopping Cart tab in the upper right hand of the Web page window.

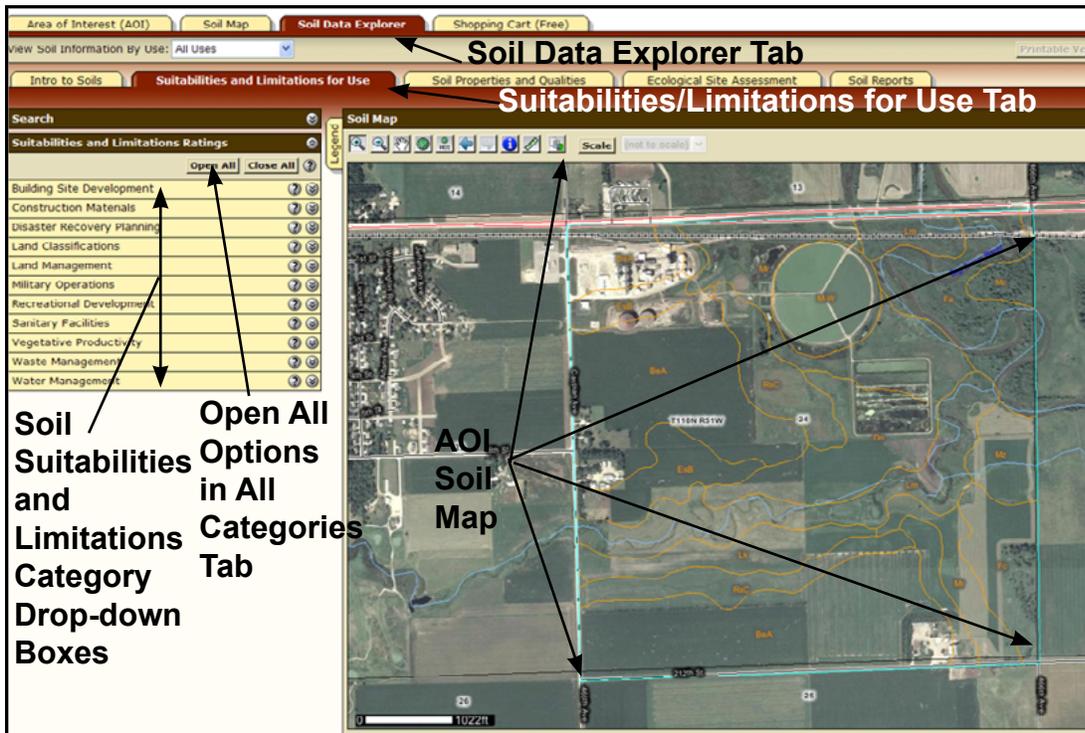


Figure 18.8. WSS suitabilities and limitations for use window with drop-down boxes on the left. If you want all options to be visible in the drop-down area, select the Open All tab.

Table 18.2. Selected WSS suitability and limitation category information available for agricultural purposes.

WSS Suitability/ Limitation Category*	Category Options*	Explanation/Examples
Land Classifications	Tree and Shrub Groups	Lists trees/shrubs best suited for MU
	Ecological Site ID and Name	Forage Suitability Groups and Rangeland Sites
	Farmland Classification	Identifies if land in prime farmland, land of state importance, land of local importance, unique land, or land not prime or of importance
	Hydric Rating	The components of each soil mapping unit are evaluated for hydric criteria and the map unit is designated as all hydric, partially hydric, not hydric, or unknown
	Dryland Land Capability Class and Subclass (irrigated where available)	Soil limitations for crop, grass (range), and timber production
	Soil Taxonomy Classification	Soil classification based on Soil Taxonomy
Land Management	Erosion Hazard (Off-Road, Off Trail)	Soil loss from off-road and off trail areas disturbance
	Erosion Hazard (Road, Trail)	Soil loss from unsurfaced roads and trails
	Fugitive Dust Resistance	Vulnerability of soil to go into suspension during a wind storm
	Potential for Fire Damage	Rating of potential fire damage to nutrient, physical, and biological soil properties/quality
	Soil Degradation Susceptibility	Susceptibility for soil degradation during disturbance on rangeland or woodland
	Soil Restoration Potential	Soil's inherent ability to recover from degradation (soil resilience)
	Suitability for Roads (Natural Surface)	Soil suitability for natural road surface
Sanitary Facilities	Septic Tank Absorption Fields	Soil between 24 to 60 inches evaluated for use in septic tank absorption fields
	Sewage Lagoon	Identify the soil feature and extent to which soils are limited by soil features impacting sewage lagoon construction and function
Vegetative Productivity	Crop Productivity Index	Relative ranking of soils based on intensive crop production potential (not crop specific)
	Forest Productivity	Tree Site Index and cubic feet of wood/acre/year
	Range Production	Amount of vegetation expected in favorable, normal, and unfavorable years in a well-managed area supporting a native plant community
	Yields of Irrigated Crops (by Component or Map Unit)	Crop yields for selected crops suited to a county are presented (e.g., alfalfa hay, barley, bromegrass hay, bromegrass-alfalfa hay, corn, corn silage, grain sorghum, oats, soybeans, spring wheat, sunflowers, and winter wheat)
	Yields of Non-Irrigated Crops (by Component or Map Unit)	Crop yields for selected crops suited to a county are presented (e.g., alfalfa hay, barley, bromegrass hay, bromegrass-alfalfa hay, corn, corn silage, grain sorghum, oats, soybeans, spring wheat, sunflowers, and winter wheat)
Waste Management	Manure and Food Waste Management	Soil properties and features rated based on their impact on agricultural waste management
Water Management	Excavated Ponds (Aquifer fed)	Soil suitability for excavated dugouts/pits to provide water from a groundwater aquifer/water table

**Please note that not all WSS Suitability/Limitation categories or all options within a category are listed in this table. Some items listed in this table may not be available in all counties and different items of local importance may be present.*

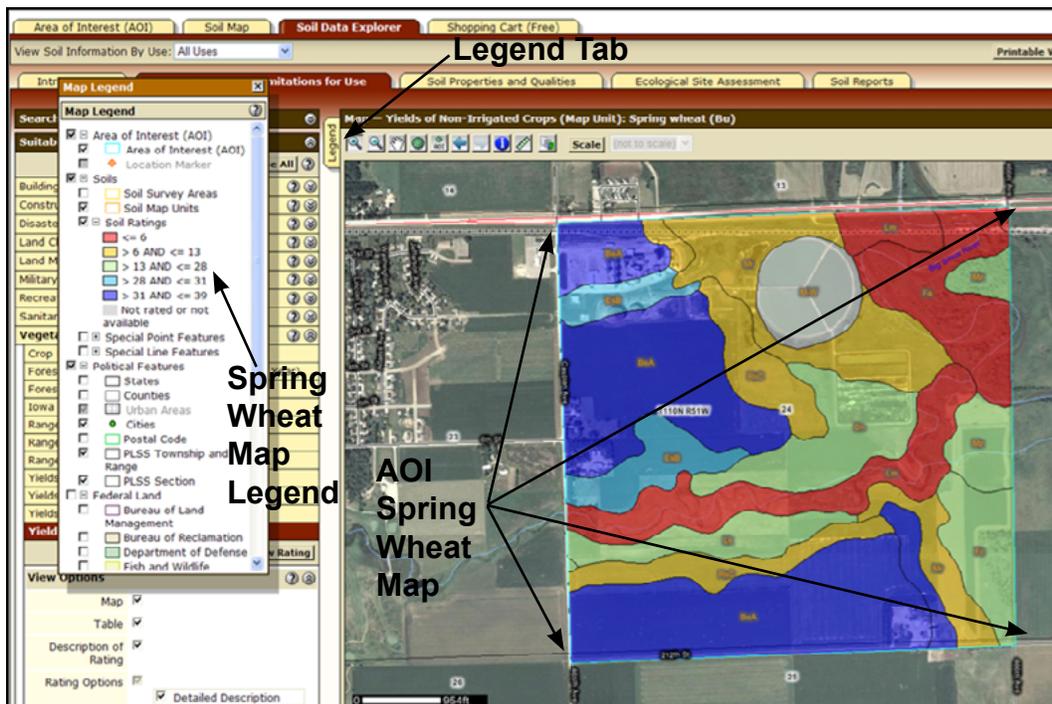


Figure 18.9. Sample WSS Soil Data Explorer window Suitabilities and Limitations for Use tab (estimated spring wheat yields (bu/a) for Area of Interest (AOI), right, and Legend on the left. Note: click the Legend tab to cause the suitability map legend to appear.

Tables — Yields of Non-Irrigated Crops (Map Unit): Spring wheat (Bu) — 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	
BeA	Brandt silty clay loam, 0 to 2 percent slopes	39.00	203.4	31.5%	
BeB	Brandt silty clay loam, 2 to 6 percent slopes	36.00	10.3	1.6%	
Dn	Divide loam, 0 to 2 percent slopes	20.00	43.0	6.7%	
EsB	Estelline silt loam, 2 to 6 percent slopes	31.00	37.1	5.7%	
Fa	Fairdale loam, channeled	6.00	49.3	7.6%	
Fc	Fordtown-Spottswood loams, 0 to 2 percent slopes	28.00	28.5	4.4%	
Lk	Lamoure silty clay loam, 0 to 1 percent slopes	26.00	25.3	3.9%	
Lm	Lamoure-Rauville silty clay loams, channeled	6.00	66.3	10.3%	
M-W	Miscellaneous water areas		30.6	4.7%	
Mr	Marysland loam, 0 to 1 percent slopes	13.00	75.1	11.6%	
Mz	Moritz-Lamoure complex, 0 to 2 percent slopes	26.00	24.8	3.8%	
Rp	Rauville silty clay loam, ponded	1.00	0.9	0.1%	
RSc	Renshaw-Sioux complex, 6 to 9 percent slopes	11.00	50.9	7.9%	
Totals for Area of Interest			645.5	100.0%	

Description — Yields of Non-Irrigated Crops (Map Unit)

These are the estimated average yields per acre that can be expected of selected nonirrigated crops under a high level of management. In any given year, yields may be higher or lower than those indicated because of variations in rainfall and other climatic factors.

In the database, some states maintain crop yield data by individual map unit component and others maintain the data at the map unit level. Attributes are included in this application for both, although only one or the other is likely to contain data for any given geographic area. This attribute uses data maintained at the map unit level.

The yields are actually recorded as three separate values in the database. A low value and a high value indicate the range for the soil component. A "representative" value indicates the expected value for the component. For these yields, only the representative value is used.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby areas and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for the selected crop. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Figure 18.10. Sample WSS Soil Data Explorer yield table and descriptive information for spring wheat map created in Figure 18.9. This information is located under (scroll down) the yield map.

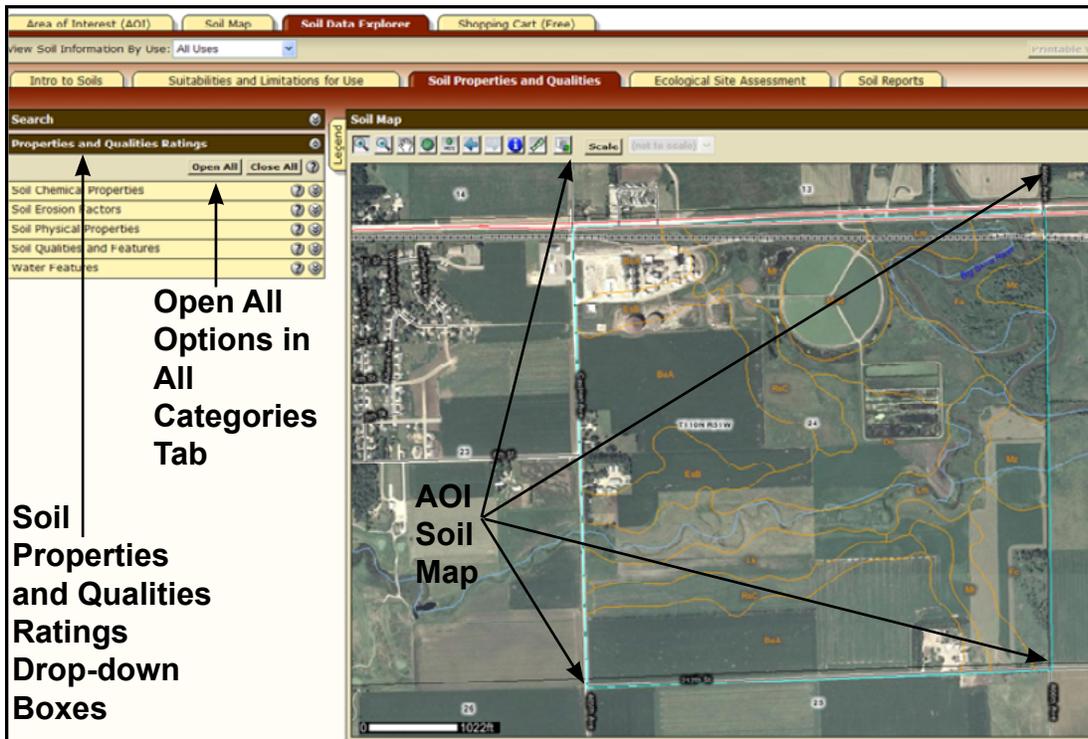


Figure 18.11. WSS Soil Properties and Qualities window with drop-down boxes on the left. If you want all options to be visible in the drop-down area, select the Open All button.

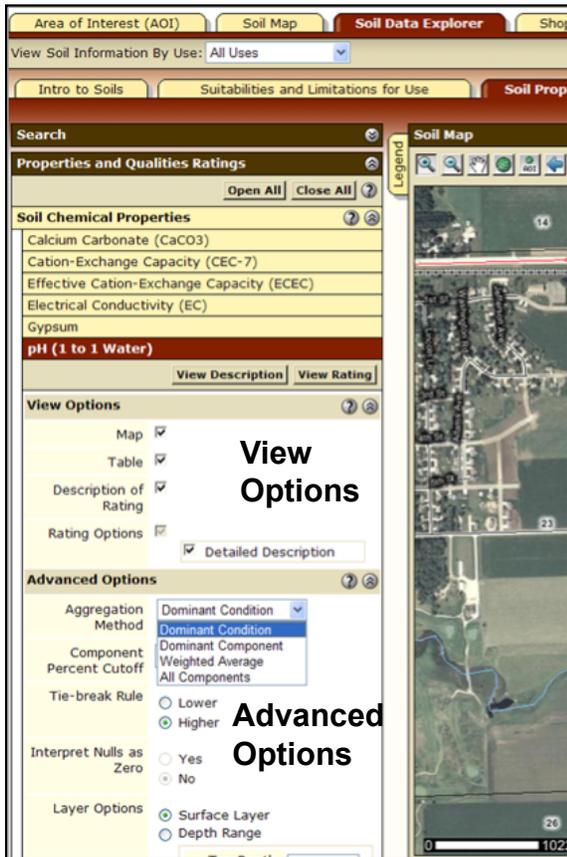


Figure 18.12. WSS View Options and Advanced Options for soil properties and qualities for drop-down boxes in Soil Properties and Qualities window.

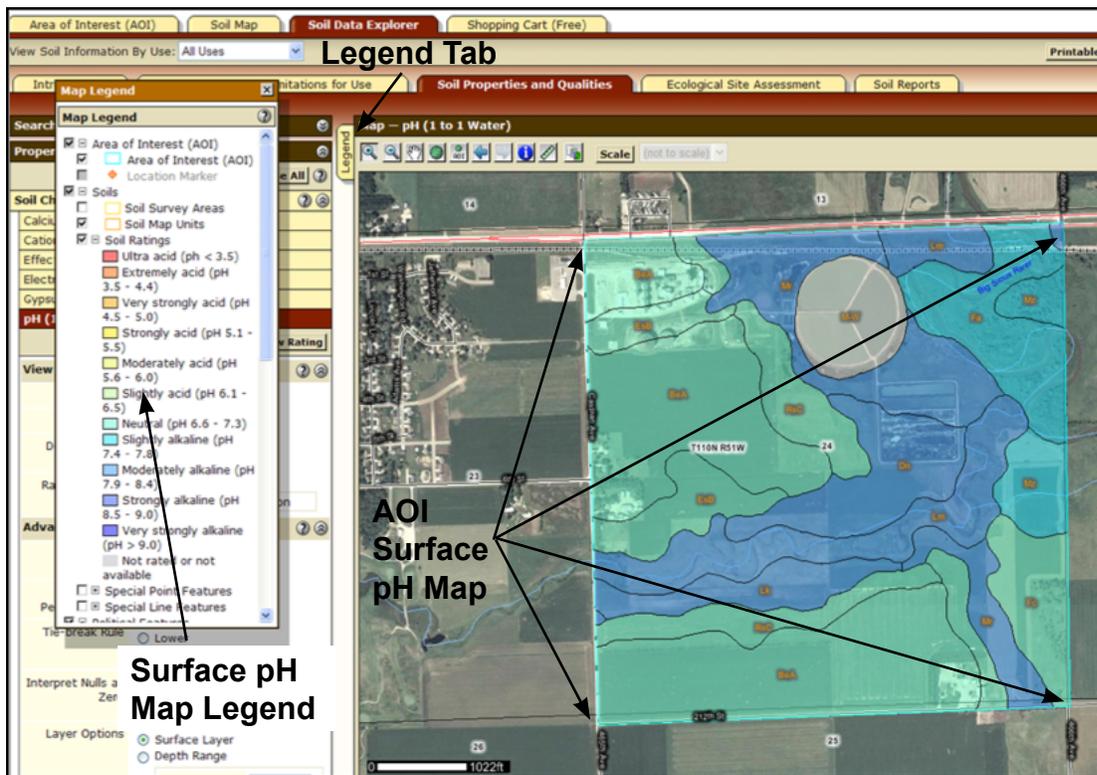


Figure 18.13. Sample WSS Soil Data Explorer window – Soil Properties and Qualities tab (Surface Soil pH) for Area of Interest (AOI), right, and Legend on the left. Note: click the Legend tab to cause the soil property map legend to appear.

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
BeA	Brandt silty clay loam, 0 to 2 percent slopes	6.7	203.4	31.5%
ReR	Brandt silty clay loam, 2 to 6 percent slopes	6.7	10.3	1.6%
Dn	Divide loam, 0 to 2 percent slopes	7.9	43.0	6.7%
EsB	Estelline silt loam, 2 to 6 percent slopes	6.7	37.1	5.7%
Fa	Fairdale loam, channeled	7.6	49.3	7.6%
Fc	Fordtown-Spottwood loams, 0 to 2 percent slopes	6.7	28.5	4.4%
Lk	Lamoure silty clay loam, 0 to 1 percent slopes	7.9	25.3	3.9%
Lm	Lamoure-Rauville silty clay loams, channeled	7.9	66.3	10.3%
M-W	Miscellaneous water areas		30.6	4.7%
Mr	Marysland loam, 0 to 1 percent slopes	8.2	75.1	11.6%
Mz	Moritz-Lamoure complex, 0 to 2 percent slopes	7.5	24.8	3.8%
Rp	Rauville silty clay loam, ponded	7.9	0.9	0.1%
RsC	Renshaw-Sioux complex, 6 to 9 percent slopes	7.0	50.9	7.9%
Totals for Area of Interest			645.5	100.0%

Description — 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 this soil property, only the representative value is used.

Figure 18.14. Sample WSS Soil Data Explorer soil properties and qualities ratings and descriptive information for surface pH for map created in Figure 18.13. This information is located under (scroll down) the pH map.

Table 18.3. Selected WSS soil properties and qualities information available for agricultural purposes.

WSS Soil Properties and Qualities Category*	Category Options*	Explanation/Examples
Soil Chemical Properties	Calcium Carbonate (CaCO ₃ - Lime)	Percent calcium carbonate by weight in the <2mm size fraction.
	Cation Exchange Capacity (CEC-7)	Total amount of extractable cations that can be held by soil at pH 7.
	Electrical Conductivity (EC)	Conductivity of a saturated paste extract (mmhos/cm) – measure of water soluble salt concentration in soils.
	Gypsum	Pct gypsum by weight in the <2 mm size fraction.
	pH (1:1 Water)	Measure of acidity and alkalinity using 1 part water and 1 part soil (weight basis).
	Sodium Adsorption Ratio (SAR)	Measure of the amount of sodium (Na ⁺) relative to the calcium + magnesium (Ca ²⁺ +Mg ²⁺) in a saturated soil paste extract.
Soil Erosion Factors	K Factor	Soil susceptibility to sheet and rill water erosion.
	T Value	Maximum tolerated amount of wind and water erosion without reducing productivity.
	Wind Erodibility Group/Index	Soil properties affecting soil susceptibility to wind erosion, index-numerical value indicating susceptibility to wind and water erosion.
Soil Physical Properties	Available Water Holding Capacity	Amount of plant available water in the 0-25, 0-50, 0-100, and 150 cm depths.
	Bulk Density	Soil bulk density at 15, 1/10, and 1/3 bars are used to calculate shrink-swell potential, plant available water holding capacity, total pore space, and other soil properties. The soil bulk density indicates the pore space available for water and roots.
	% Organic Matter	Organic matter is decomposed and decomposing plant and animal residue in the soil. Organic matter content is determined on the soil particles <2 mm and is % by weight.
	% Sand, % Clay, % Silt	The percent of each soil separate by weight <2 mm in diameter sized soil materials.
	Saturated Hydraulic Conductivity or permeability (K _{sat})	Transmission rate (ease) with which saturated soil pores allow water to move or pass through.
	Surface Texture	Representative soil textural class, plus any appropriate coarse fragment modifiers.
	Water Content at 1/3 and 15 bars	Volumetric water content at 1/3 bar (field capacity) and 15 bar (wilting point) are used to define plant available water (=1/3 - 15 bar).
Soil Qualities and Features	Depth to Any Soil Restrictive Layer	Depth to soil layer that significantly impedes root growth and/or water and air movement.
	Drainage Class	Frequency and duration of wet period that are expressed in the morphology of the soil.
Water Features	Depth to Water Table	Water table refers to a saturated zone in the soil present long enough (1 month or more) to cause significant changes in soil properties and management. User defines the months to use. Depths are determined based on observed water table measurements and based on the presence of redox features (gray colors) in the soil.
	Flooding Frequency	Temporary inundation caused by overflowing streams or runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in closed depressions (e.g., prairie potholes/wetlands, swamps, and marshes) is considered ponding rather than flooding.
	Ponding Frequency	Water standing in closed depressions (e.g., prairie potholes/wetlands, marshes, and others). Water is only lost through evaporation, transpiration, and deep percolation.

**Please note that not all WSS Properties and Qualities categories or all options within a category are listed in this table. Some items listed in this table may not be available in all counties and different items of local importance may be present.*

The fourth tab in the Soil Data Explorer window, Ecological Site Assessment, provides Ecological Site information (Fig. 18.15). This information includes an ecological site assessment map and associated tabular data for the AOI, viz., MU name, MU components (% of MU), and Ecological Site ID for each component, and detailed information about each ecological site (Fig. 18.16).

The ecological site information for rangeland is available. For selected counties, ecological sites for pasture groups are also given. The types of information given for a rangeland ecological site include: 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.18.17). 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 (Fig. 18.18).

In addition to the interpretive maps, you can also download tabular data for your AOI. Tabular data is available when you use the Soil Reports tab in the Soil Data Explorer window (Fig. 18.19, upper right-hand corner). 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 (Table 18.4 and Fig. 18.20). After the tabular data needed is selected, you can view an explanation of what each table contains by using the View Description tab or View Soil Report tab on the left side of the window.

You can print and/or save the tabular data, description information, and other related materials by 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 Web page window. The selected tables will be printed with interpretive maps and narrative information in the final custom soil survey report.

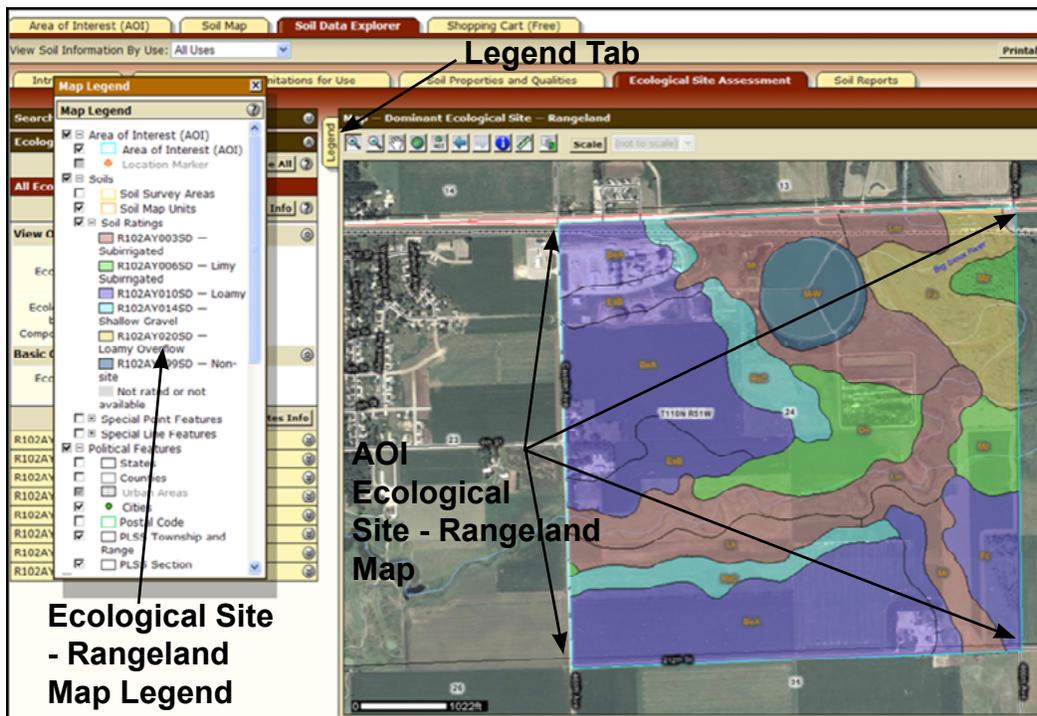


Figure 18.15. Sample WSS Soil Data Explorer window Ecological Site Assessment tab (Dominant Ecological Site-Rangeland) for Area of Interest (AOI), right, and Legend on left. Note: click the Legend tab to cause the Ecological Site - Rangeland map legend to appear.

Table — Ecological Sites by Map Unit Component — Rangeland					
Brookings County, South Dakota					
Map unit symbol	Map unit name	Component name (percent)	Ecological site	Acres in AOI	Percent of AOI
BeA	Brandt silty clay loam, 0 to 2 percent slopes	Brandt (85%)	R102AY0105D — Loamy	203.4	31.5%
		Estelline (8%)	R102AY0105D — Loamy		
		Goldsmith (5%)	R102AY0205D — Loamy Overflow		
		Badger (1%)	R102AY0205D — Loamy Overflow		
		Poinsett (1%)	R102AY0105D — Loamy		
BeB	Brandt silty clay loam, 2 to 6 percent slopes	Brandt (85%)	R102AY0105D — Loamy	10.3	1.6%
		Estelline (8%)	R102AY0105D — Loamy		
		Goldsmith (5%)	R102AY0205D — Loamy Overflow		
		Badger (1%)	R102AY0205D — Loamy Overflow		
		Poinsett (1%)	R102AY0105D — Loamy		
On	Divide loam, 0 to 2 percent slopes	Divide (85%)	R102AY0065D — Limy Subirrigated	43.0	6.7%
		Marysland, undrained (9%)	R102AY0035D — Subirrigated		
		Fordtown (3%)	R102AY0105D — Loamy		
		Renwash (2%)	R102AY0145D — Shallow Gravel		
		Castlewood, undrained (1%)	R102AY0025D — Linear Meadow		
EsB	Estelline silt loam, 2 to 6 percent slopes	Estelline (85%)	R102AY0105D — Loamy	37.1	5.7%
		Strayhoss (6%)	R102AY0105D — Loamy		
		Kranzburg (4%)	R102AY0105D — Loamy		
		Goldsmith (3%)	R102AY0205D — Loamy Overflow		
		Badger (1%)	R102AY0205D — Loamy Overflow		
		Renshaw (1%)	R102AY0145D — Shallow Gravel		
Fa	Fairdale loam, channeled	Fairdale, channeled (85%)	R102AY0205D — Loamy Overflow	49.3	7.6%
		Lamoure (13%)	R102AY0035D — Subirrigated		
		Rauville (2%)	R102AY0025D — Linear Meadow		
Fc	Fordtown Spottwood loams, 0 to 2 percent slopes	Fordtown (55%)	R102AY0105D — Loamy	28.5	4.4%
		Spottwood (30%)	R102AY0205D — Loamy Overflow		
		Divide (9%)	R102AY0065D — Limy Subirrigated		
		Renwash (4%)	R102AY0145D — Shallow Gravel		
		Allivar (1%)	R102AY0145D — Shallow Gravel		
		Marysland, undrained (1%)	R102AY0035D — Subirrigated		
Lk	Lamoure silty clay loam, 0 to 1 percent slopes	Lamoure (75%)	R102AY0035D — Subirrigated	23.3	3.9%
		Lowe (15%)	R102AY0035D — Subirrigated		

Figure 18.16. Sample WSS Soil Data Explorer ecological site assessment information for each Area of Interest soil mapping unit created in Figure 18.15. This information is located under (scroll down) the ecological site map.

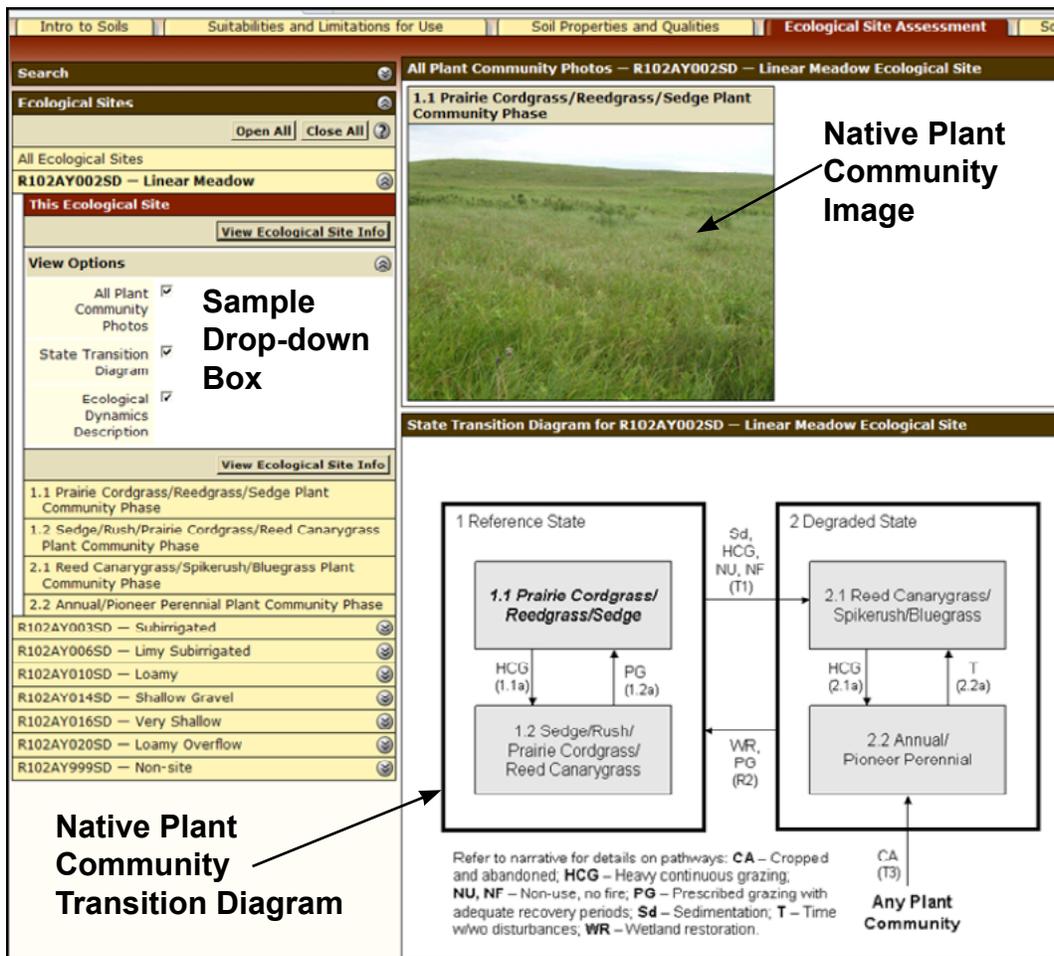


Figure 18.17. Sample WSS Soil Data Explorer ecological site assessment information (Plant Community Transition Diagram) for selected ecological site (e.g., Linear Meadow) for Area of Interest created in Figure 18.15. This information appears when each ecological site is selected in the left-hand set of drop-down boxes. The diagram on the left shows management impacts on native plant communities.

Native Plant Community Image

Native Plant Community Description

Native Plant Community Data Tables

1.1 Prairie Cordgrass/Reedgrass/Sedge Plant Community Phase

Description — 1.1 Prairie Cordgrass/Reedgrass/Sedge Plant Community Phase

This community evolved with grazing by large herbivores, occasional prairie fires, and relatively frequent flooding and can be found on areas that are properly managed with grazing and/or prescribed burning, and sometimes on areas receiving occasional short periods of rest. The potential vegetation is about 65 percent grasses, 20 percent grass-like species, 10 percent forbs, and 5 percent shrubs by dry weight. Prairie cordgrass is the dominant tall warm-season grass occupying this plant community. Reedgrasses are the dominant tall cool-season species. A variety of sedges and rushes occur throughout this community as well as fowl mangrass, switchgrass, reed canarygrass, plains bluegrass, and fowl bluegrass. Key forbs include broadfruit burreed, giant goldenrod, New England aster, Maximilian sunflower, white panicum aster, and cinqufoil.

This plant community phase is diverse, stable, and productive, and is well adapted to the Northern Great Plains. The high water table supplies much of the moisture for plant growth. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. Plant litter is properly distributed with very little movement off site and natural plant mortality is very low. The diversity in plant species allows for the variability of both the fluctuations of water table and reoccurring flooding. This is a sustainable plant community in terms of soil stability, watershed function, and biologic integrity.

Transitions or pathways leading to other plant communities are as follows:

- 1.1a — Heavy continuous grazing which includes herbivory at moderate to heavy levels at the same time of year each year without adequate recovery periods, or during periods of below normal precipitation when grazing frequency and intensity increases on these sites due to limited forage availability on adjacent upland sites will shift this community to the 1.2 Sedge/Rush/Prairie Cordgrass/Reed Canarygrass Plant Community Phase.

Tables — 1.1 Prairie Cordgrass/Reedgrass/Sedge Plant Community Phase

Annual Production (Lbs/Acre)

Plant Type	Low	Representative Value	High
Grass/Grasslike	5,070	5,408	5,750
Forb	270	800	1,280
Shrub/Vine	60	192	370
Totals	5,400	6,400	7,400

Plant Species Composition (Lbs/Acre)

Group	Plant Common Name	Grass/Grasslike	Plant Scientific Name	Annual Production Pounds Per Acre	
				Low	High
1:	Tall Cool-season Grasses			1280	2880

Figure 18.18. Sample WSS Soil Data Explorer ecological site assessment information (individual plant community–Prairie Cordgrass/Reedgrass/Sedge Phase) for selected ecological site (e.g., Linear Meadow) for Area of Interest created in Figure 18.15. This information appears when a specific plant community is selected from a particular ecological site in the drop-down boxes on the left hand side of the window.

Soil Reports Tab

AOI Soil Map

Soil Report Drop-down Box Options

Sample Drop-down Box

Select 1-5 crops

- Alfalfa hay (Tons)
- Barley (Bu)
- Bromegrass hay (Tons)
- Bromegrass-alfalfa (AUM)
- Corn (Bu)
- Corn silage (Tons)
- Grain sorghum (Bu)
- Oats (Bu)
- Soybeans (Bu)
- Spring wheat (Bu)
- Sunflowers (Lbs)
- Winter wheat (Bu)

Figure 18.19. Sample WSS Soil Data Explorer window 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 tab. Example – drop-down box for Non-irrigated Yields by map unit is shown. Selected crops for table creation are checked. AOI = Area of Interest.

Table 18.4. Selected tabular soils data available in the WSS Soil Reports tab folder.

WSS Soil Report Tabular Data Category*	Category Options*
AOI Inventory	Component Legend
	Map Unit Description
	Soil Interpretations
Building Site Development	Dwellings and Small Commercial Buildings
	Roads/Streets, shallow excavations, lawns and landscaping
Construction Materials	Source for sand and gravel
Land Classifications	Conservation Tree and Shrub Suitability Groups
	Hydric Soils
	Land Capability Classifications
	Prime and Important Farmland
	Taxonomic Classification of Soils
Land Management	Rangeland Fencing, Resistance to Fugitive Dust
	Rangeland Site Description and Fire Damage Susceptibility
	Rangeland Tillage, Compaction Resistance and Soil Restoration
Sanitary Facilities	Sewage Disposal (e.g., septic systems and sewage lagoons)
Soil Chemical Properties	Cation exchange capacity (CEC), pH, lime (CaCO ₃), gypsum, salinity, and sodium adsorption ratio (SAR)
Soil Erosion	Attributes for RUSLE2 Equation (estimate soil erosion rates)
	Windbreaks and environmental plantings
Soil Physical Properties	Engineering soil properties, particle size and coarse fragment content, % sand, % silt, % clay, bulk density, saturated hydraulic conductivity, plant available water holding capacity, % organic matter, erosion factors, linear extensibility (shrink/swell), wind erodibility group and index
Soil Qualities and Features	Restrictive layers (depth and type), frost action, corrosion (steel and concrete)
Vegetative Productivity	Crop yields for major and adapted crops (e.g., alfalfa hay, barley, bromegrass hay, bromegrass alfalfa hay, corn, corn silage, grain sorghum, oats, soybeans, spring wheat, sunflowers, and winter wheat)
	Rangeland productivity and plant composition
Waste Management	Agricultural disposal of manure, food processing waste, and sewage sludge
	Large animal carcass disposal
Water Features	Hydrologic group, surface runoff, water table (depth and duration), flooding (duration and frequency), ponding (duration and frequency)
Water Management	Irrigation (general, sprinkler, surface)
	Ponds (reservoirs and aquifer-fed excavated ponds) and Embankments (dikes, levees)

**Please note that not all WSS Properties and Qualities categories or all options within a category are listed in this table. Some items listed in this table may not be available in all counties and different items of local importance may be present.*

Brookings County, South Dakota						
Map symbol and soil name	Land capability	Alfalfa hay Tons	Corn Bu	Soybeans Bu	Spring wheat Bu	Winter wheat Bu
BeA—Brandt silty clay loam, 0 to 2 percent slopes		3.50	94	34	39	42
Brandt	1					
BeB—Brandt silty clay loam, 2 to 6 percent slopes		3.30	85	31	36	39
Brandt	2e					
Dn—Divide loam, 0 to 2 percent slopes		2.50	73	23	28	30
Divide	3s					
EsB—Estelline silt loam, 2 to 6 percent slopes		2.70	60	22	31	34
Estelline	2e					
Fa—Fairdale loam, channeled		0.40	38	14	6	6
Fairdale, channeled	6w					
Fc—Fordtown-Spottswood loams, 0 to 2 percent slopes		2.90	65	24	28	32
Fordtown	2s					
Spottswood	2s					
Lk—Lamoure silty clay loam, 0 to 1 percent slopes		1.30	76	23	26	27
Lamoure	3w					
Lm—Lamoure-Rauville silty clay loams, channeled		0.30	35	11	6	4
Lamoure, channeled	6w					
Rauville	6w					
M-W—Miscellaneous water areas		—	—	—	—	—
Miscellaneous water	—					
Mr—Marysland loam, 0 to 1 percent slopes		0.40	50	15	13	8
Marysland, undrained	4w					
Mz—Moritz-Lamoure complex, 0 to 2 percent slopes		2.00	78	24	26	27
Moritz	2s					
Lamoure	4w					
Rp—Rauville silty clay loam, ponded		0.00	5	2	1	0
Rauville	8w					
RsC—Renshaw-Sioux complex, 6 to 9 percent slopes		1.40	14	5	11	13
Renshaw	4e					
Sioux	6s					

Figure 18.20. Sample WSS Soil Data Explorer window Soil Reports table. Example created based on Figure 18.19. Yields are long-term yields with average management and average weather conditions.

Step 3. Creation of Custom Soil Survey Report for AOI

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 Web page (Fig. 18.21). 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 Check Out 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. The report (Fig. 18.22) is in pdf format and requires the current version of Adobe Acrobat Reader <http://get.adobe.com/reader/> to open the file.

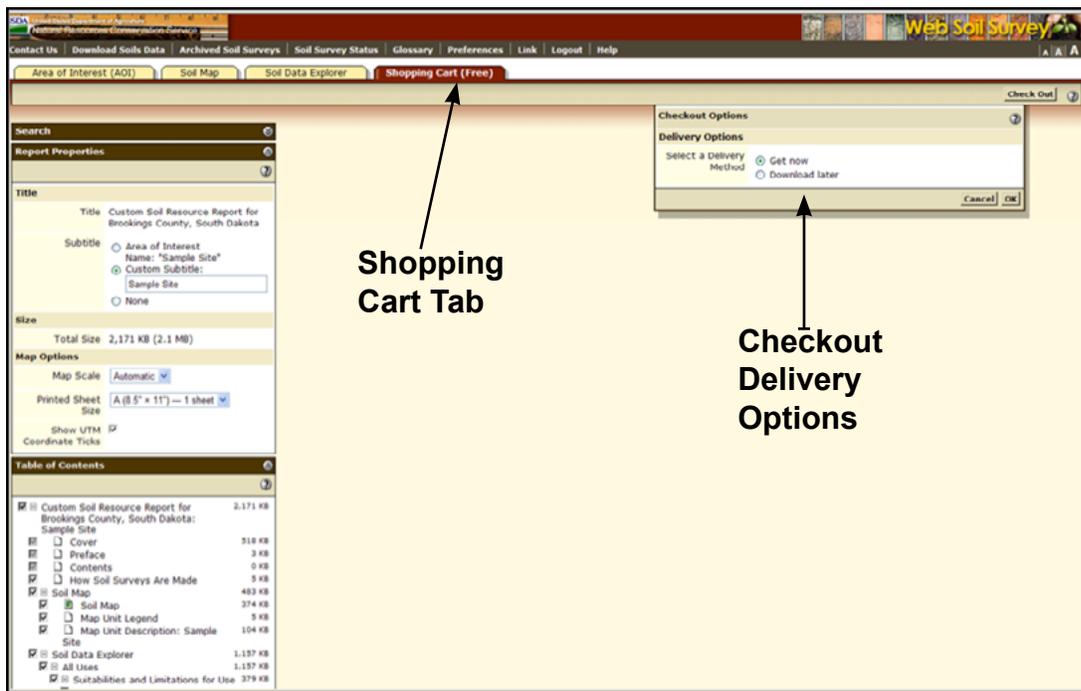


Figure 18.21. Sample WSS Soil Shopping Cart window with the Checkout tab selected (upper right-hand corner).

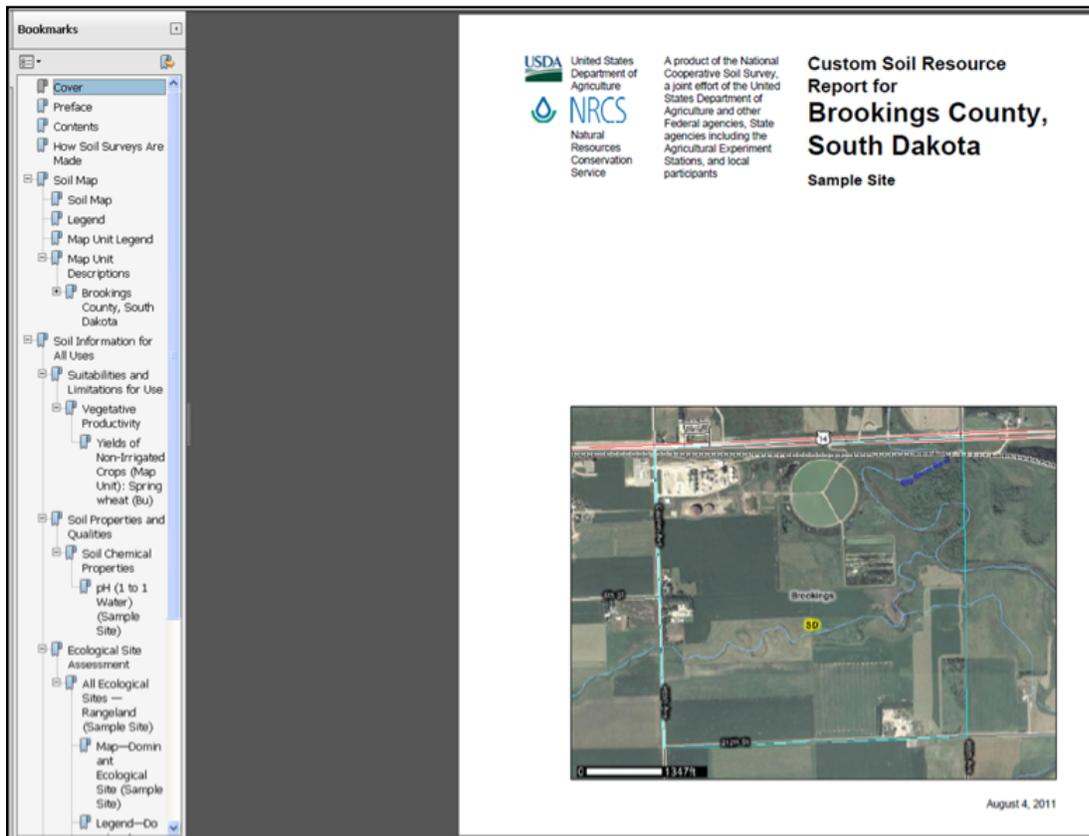


Figure 18.22. Sample WSS Report window. Report can be saved on your computer in pdf format for later use.

Use and limitation of WSS information

WSS information is useful in understanding how soils differ and will perform under various land management systems. Examination of key soil properties and quality attribute information can aid you in making seeding, fertility, pest management, water/erosion conservation, tillage, and other crop-related management decisions.

Along with yield monitor maps, you can more economically and environmentally manage soil resources using the WSS detailed soil survey data. 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 the soil maps in WSS were originally prepared at a scale of 1:20,000 and 1:24,000 for most of South Dakota. As a result, the soil interpretations included inside a soil mapping unit boundary have limitations because of the mapping scale.

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

For intensive management of areas smaller than two acres in size, a more detailed soil map is needed. The soil MUs in WSS allows 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.

Conclusion

This chapter outlines how to use WSS to obtain soil and land attributes for making land- use and management decisions. Samples of output and WSS 2.3 web site use are presented to demonstrate the potential and capabilities of WSS 2.3. In addition, a listing of other websites with valuable soil and natural resource information is given.

There are numerous useful, credible, and user-friendly web sites providing soil and natural resource information. Explore the sites and see the incredible wealth of information available to you online.

Abbreviations used in this chapter

<i>1:1</i>	– one part soil to one part water
<i>AOI</i>	– area of interest
<i>BLM</i>	– Bureau of Land Management
<i>CaCO₃</i>	– calcium carbonate (lime)
<i>CEC</i>	– cation exchange capacity
<i>cm</i>	– centimeter
<i>CRIS</i>	– Current Research Information System
<i>dS/m</i>	– deciSiemen per meter (measure of electrical conductivity)
<i>EC</i>	– electrical conductivity (soil salinity measurement)
<i>EROS</i>	– Earth Resources Observation Satellite
<i>GIS</i>	– geographic information system
<i>GPS</i>	– global positioning system
<i>HU</i>	– hydrologic unit
<i>K factor</i>	– soil erodibility (soils inherent susceptibility to water erosion)
<i>K_{sat}</i>	– saturated soil hydraulic conductivity
<i>MLRA</i>	– Major Land Resource Area
<i>MB</i>	– megabyte
<i>mmhos/cm</i>	– millimhos per centimeter (measure of electrical conductivity), 1 mmhos/cm = 1 dS/m
<i>mm</i>	– millimeter
<i>MU</i>	– soil mapping unit
<i>NIFA</i>	– National Institute of Food and Agriculture
<i>NIMSS</i>	– National Information Management and Support System
<i>NOAA</i>	– National Oceanic and Atmospheric Administration
<i>NPS</i>	– National Park Service
<i>NRCS</i>	– Natural resources Conservation Service (formerly the SCS)
<i>PAW</i>	– plant available water holding capacity
<i>Pct, pct</i>	– percent
<i>pdf</i>	– portable document format
<i>pH</i>	– soil reaction
<i>PM</i>	– principal meridian
<i>RUSLE2</i>	– Revised Universal Soil Loss Equation
<i>SAR</i>	– sodium adsorption ratio
<i>SCS</i>	– Soil Conservation Service (now the NRCS)
<i>T value</i>	– tolerable soil loss (maximum amount of soil loss by wind and water and not decrease long-term productivity)
<i>USDA</i>	– United States Department of Agriculture
<i>USDOJ</i>	– United States Department of Interior
<i>USFS</i>	– United States Forest Service
<i>USGS</i>	– United States Geological Survey
<i>WSS</i>	– Web Soil Survey

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Office of the Assistant Secretary for Civil Rights
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Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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