



Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

Introduction to Soil Survey and Utilizing Web Soil Survey



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FARM PRODUCTION AND CONSERVATION
FSA | NRCS | RMA | Business Center

Five Soil Forming Factors

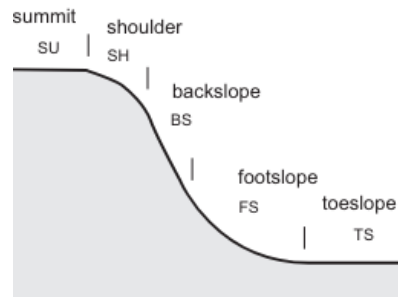
Climate

Organisms

Time



Topography

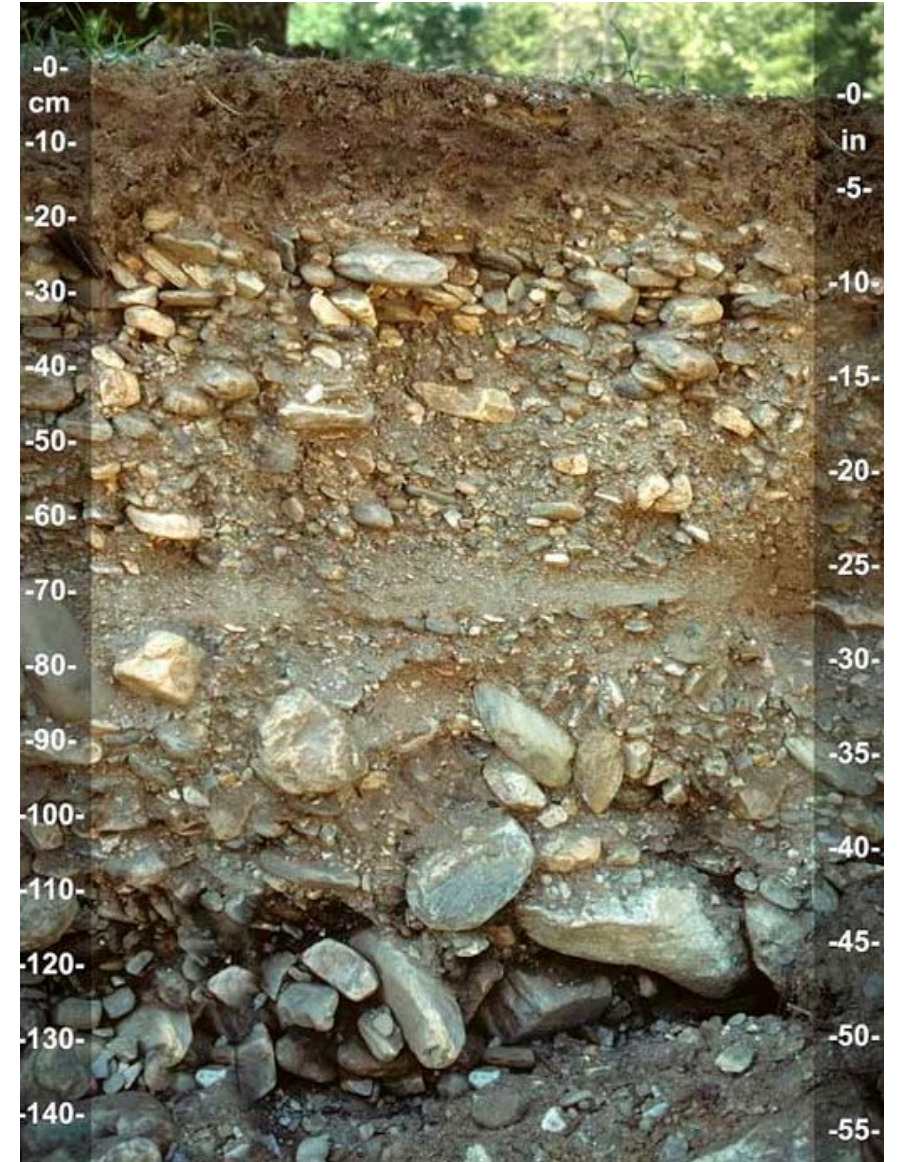


Parent material

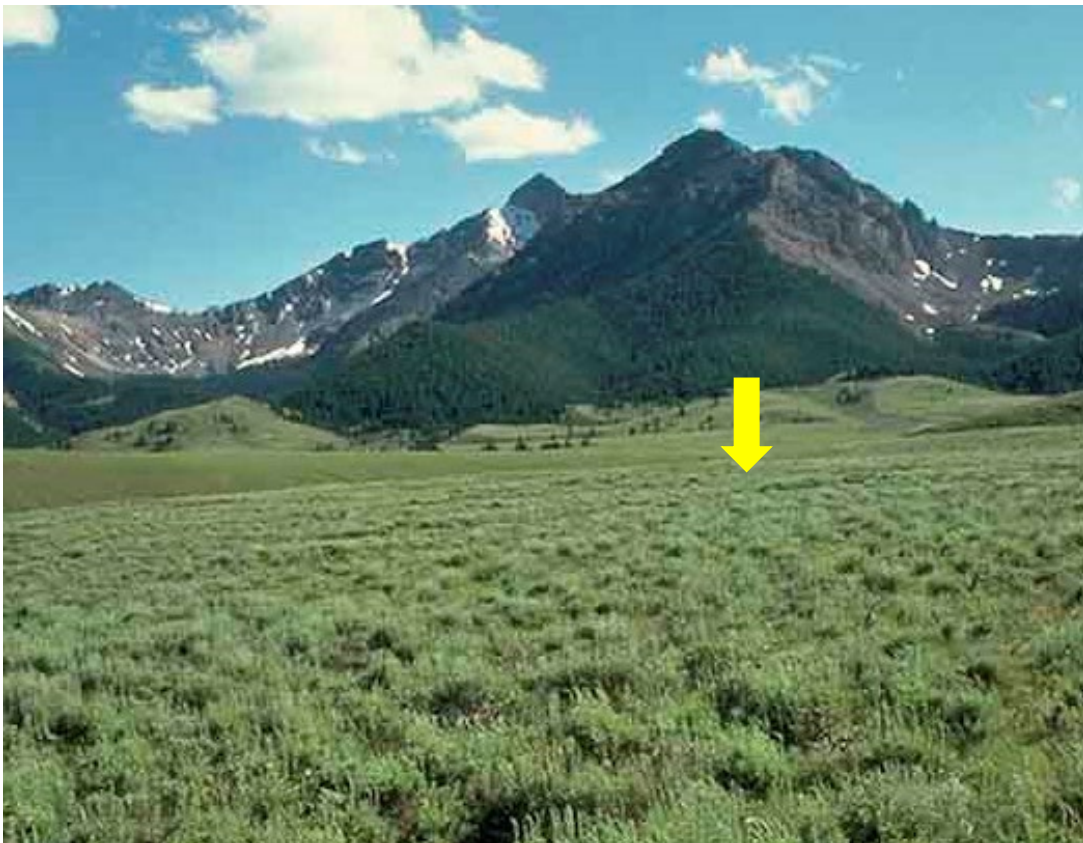
Five Factors in Action: Example



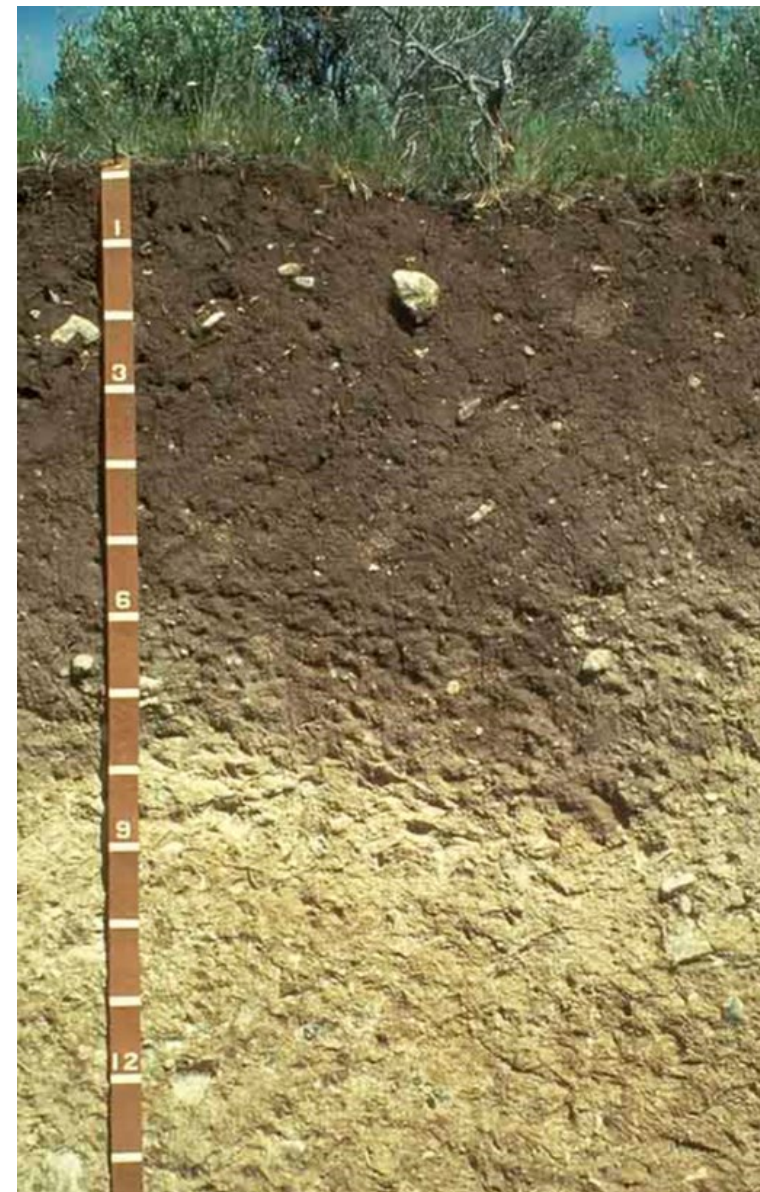
Parent Material?
Time?
Topography?



Five Factors in Action; Example 2



Climate?
Organisms?
Topography?
Time?



Five Factors Influence Soil Morphology and Properties

Morphology (appearance)

Color
Texture
Coarse Fragments
Structure
Roots and Pores
Special Features
(restrictions, redoximorphic
features...)

Properties (quantitative)

Organic Matter Content
Cation-Exchange-Capacity (CEC) pH
Depth to Restriction
Depth to Water Table
Flooding and Ponding
Rock Fragments
Landform Position
Slope and Aspect

Know your soil!

- Successful soil management requires informed decisions.
- Look at the landscape. Find a representative point. Dig a hole.
 - What do you see?
 - Soil color, texture, structure?
 - Soil health indicators?
 - Management issues?
- Get a soil test
 - Lab analysis
 - Soil chemical properties
- **Web Soil Survey**
 - Free!
 - Compare soil mapping to your observations



What is a Soil Survey?

- Comprehensive resource inventory accounting for multiple earth systems:
 - Climate, hydrology, landform, parent material, geology, ecology, soil types and properties
- Modern soil surveys consist of 3 products:
 1. Spatial Product: The “soil map”
 - Delineations of soil map units
 2. Tabular Product: Data created, stored, and managed within the NASIS database
 - Map Unit Data: Geographic and climatic parameters and soil components comprising the map unit
 - Soil Component Data: Soil type, classification, ranges of physical, chemical, and morphological properties
 - Tabular data is geo-encoded into the spatial product and drives interpretations
 3. Interpretations: Scientific models based on soil and site properties
 - Suitabilities and limitations for specific management practices
 - Land classifications and ratings
 - Summary reports of general soil property categories (soil health, physical properties, water features, etc)
- Web Soil Survey: The platform in which soil surveys are published and accessible

How Are Soil Surveys Made?

1. Legend and Map Unit Design:

- Identify relevant classes and combinations of classes of the 5 soil forming factors
- “relevant” = influential to soil classification, land use, ecology, interpretations, etc.

2. Spatial:

- Utilize LiDAR, Ortho-imagery, and spatial derivatives to delineate map unit concepts

3. Field Work:

- Observe and document site and soil properties at representative locations within map unit delineations
- Determine the soil component(s) that will comprise the map unit
- Confirm accuracy of soil map unit lines

4. Refine:

- Repeat steps 1-3 to refine and improve the product

5. Quality Assurance and Publication

Map Unit Design Example; Olympic National Park

CLIMATE

Temperature

Isomesic

Mesic

Frigid

Cryic

Moisture

Udic

Udic-Dry

TOPOGRAPHY

Landscape

Mountains

River Valley

Glacial Hills

Landform

Alluvial Terrace

Outwash Terrace

Cirque

Ridge

Valley Wall

Colluvial Apron

PARENT MATERIAL

Geology

Meta-sedimentary

Basalt

Glacial Outwash

Source

Alluvial

Colluvial

Residual

Glacial

BIOTA

Vegetation Community

Mesic Forest

Mesic Moist Forest

Floodplain Forest

Frigid Forest

Frigid Moist Forest

Temperate Wet Meadow

Low Cryic Forest

High Cryic Forest

Subalpine Shrubland

Subalpine Meadow

Cryic Moist Meadow

TIME

Geologic

Quaternary Sediment

Quaternary Glacial

Tertiary Meta-sedimentary

Disturbance

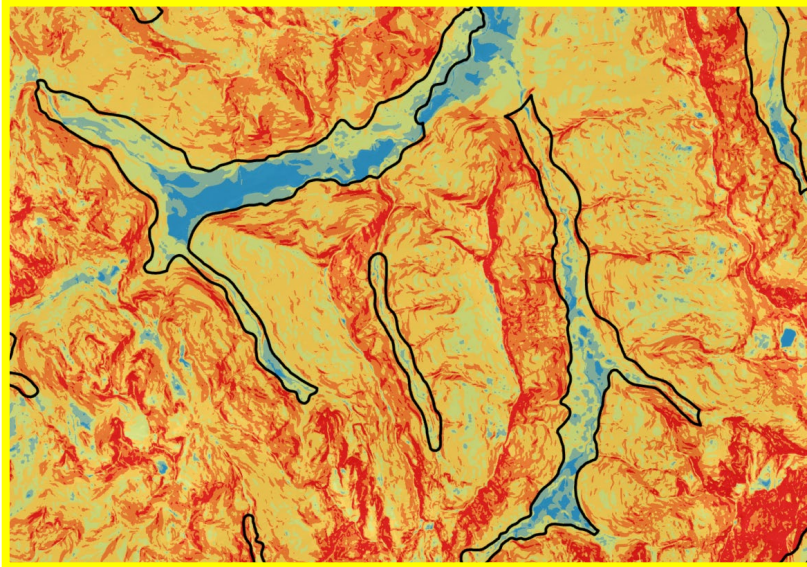
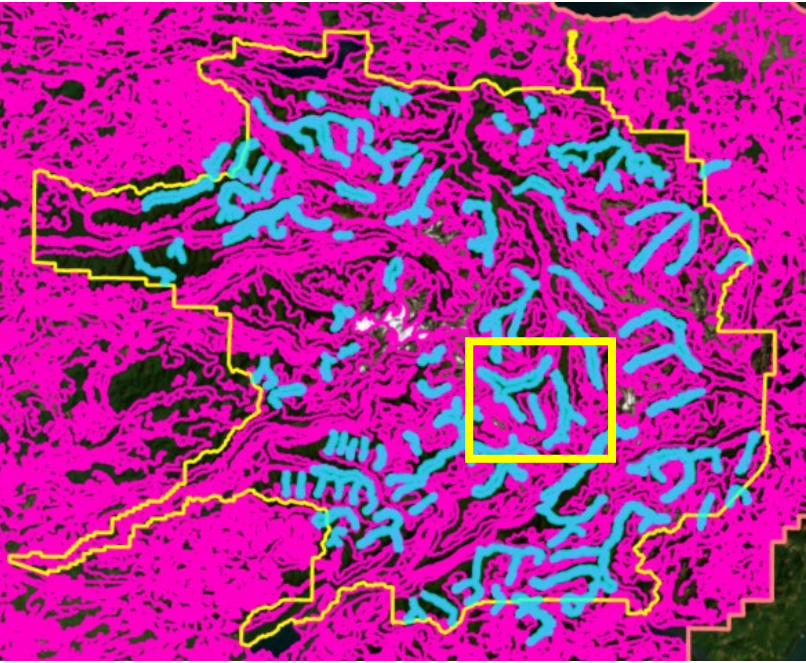
Frequent Flood

Occasional Flood

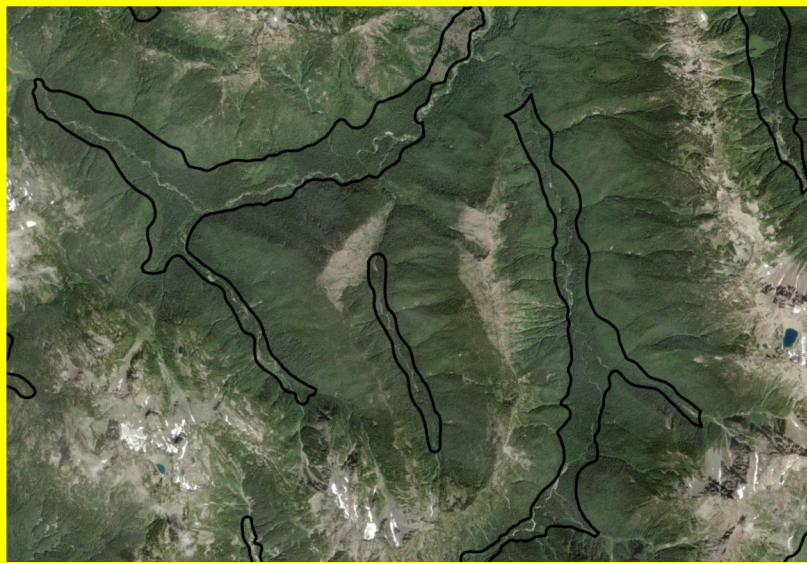
Rare Flood

No Flood

Example; Olympic National Park



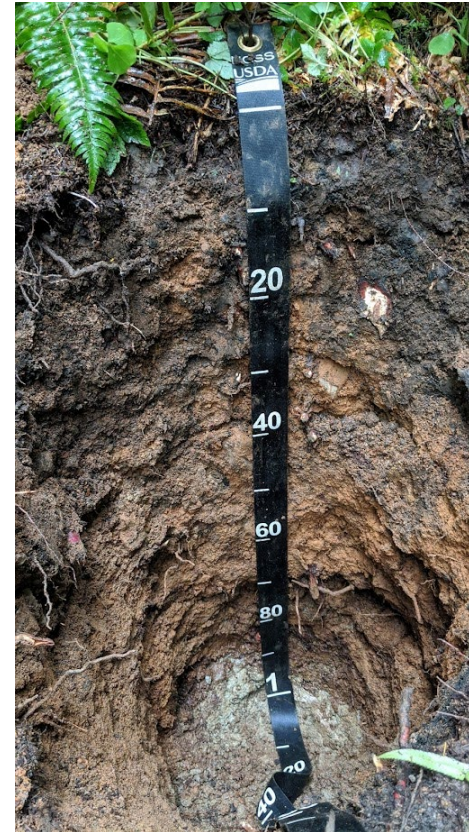
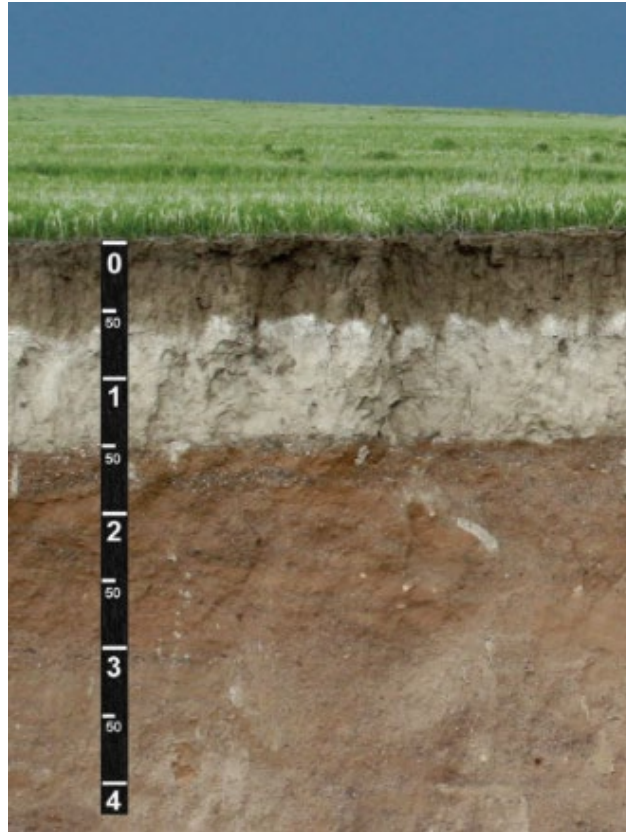
MUSYM	MU NAME	COMPONENT	Series	%
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	Bonjonpass-Skookumcreek-Lapoetcreek complex, 0 to 65 percent slopes		
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	loamy-skeletal, isotic, frigid andic haplorthods	Bonjonpass	30
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	loamy-skeletal, isotic, frigid andic dystrodepts	Skookumcreek	30
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	coarse loamy, mixed, active, frigid typic dystrodepts	Lapoetcreek	15
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	loamy skeletal, isotic, frigid typic humaquepts	Mountscott	10
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	typic humaquepts	h taxa	5
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	rubble land		5
6320	F/U Colluvial Aprons w/ stream/drainage, 0 to 65 percent slopes	Water		5



Soil Survey Data for Management Planning

Influential Soil and Site Properties

- Texture
- Temperature
- Moisture
- Impermeable Layers
- Hydraulic Conductivity
- Bulk Density
- Organic Matter Content
- Depth Class
- Drainage Class
- Water Table
- Inundation
- Rock Fragments
- CEC
- pH
- Slope
- Many more . . .



Web Soil Survey

Overview and Objectives

Typical Web Soil Survey Session

- Navigating to Web Soil Survey (WSS)
- Setting your area of interest (AOI)
- Accessing your soil map
- Understanding the map unit description
- Accessing interpretations and reports
 - Selecting correct methods and rating criteria
- Compiling maps, interpretations, and reports and “checking out”

Starting Web Soil Survey

- A simple Google search, or following the link below will get you to the WSS home page:
 - <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>
- Click the large green “START WSS” button to begin.



Selecting Area of Interest

USDA United States Department of Agriculture
Natural Resources Conservation Service

Contact Us | Subscribe | Archived Soil Surveys | Soil Survey Status | Glossary | Preferences | Link | Logout | Help

Web Soil Survey

Area of Interest (AOI) | Soil Map | Soil Data Explorer | Download Soils Data | Shopping Cart (Free)

Search

Area of Interest

Import AOI

Quick Navigation

Address

State and County

Soil Survey Area

Latitude and Longitude or Current Location

PLSS (Section, Township, Range)

Bureau of Land Management

Department of Defense

Forest Service

National Park Service

Hydrologic Unit

Area of Interest Interactive Map

View Extent: Contiguous U.S. | Scale: (not to scale)

Selecting Area of Interest (AOI) – Navigation Tools

Search

Area of Interest

Import AOI

Quick Navigation

Address

State and County

View ?

State Washington

County (optional) Grays Harbor

View

Soil Survey Area

Latitude and Longitude or Current Location

PLSS (Section, Township, Range)

Bureau of Land Management

Department of Defense

Forest Service

National Park Service

Hydrologic Unit

Area of Interest Interactive Map

View Extent Contiguous U.S. Scale (not to scale)

↑ Select and use these tools to zoom and pan

↑ Search options for selecting AOI

Selecting Area of Interest – Final Step

Area of Interest (AOI)

Soil Map

Soil Data Explorer

Download Soils Data

Shopping Cart (Free)

Search

Area of Interest

Import AOI

Quick Navigation

Address

State and County

View

State Washington

County (optional) Grays Harbor

View

Soil Survey Area

Latitude and Longitude or Current Location

PLSS (Section, Township, Range)

Bureau of Land Management

Department of Defense

Forest Service

National Park Service

Hydrologic Unit

Area of Interest Interactive Map

View Extent Contiguous U.S.

Scale (not to scale)

Select to draw polygon around your desired AOI

Selected AOI Will Be Shaded with Blue Stripes

Area of Interest (AOI)

Soil Map

Soil Data Explorer

Download Soils Data

Shopping Cart (Free)

Search

Area of Interest

Open All

Close All

AOI Properties

Clear AOI

AOI Information

Name

Map Unit Symbols

☒ Use Soil Survey Area Map Unit Symbols

☐ Use National Map Unit Symbols

Area (acres)

586.5

Soil Data Available from Web Soil Survey

Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington (WA627)

Data Availability

Tabular and Spatial, complete

Tabular Data

Version 15, Sep 12, 2018

Spatial Data

Version 6, Nov 9, 2017

Clear AOI

Import AOI

Export AOI

Quick Navigation

Address

State and County

View

State

Washington

County (optional)

Grays Harbor

View

Soil Survey Area

Latitude and Longitude or Current Location

PLSS (Section, Township, Range)

Area of Interest Interactive Map

Legend

View Extent

Contiguous U.S.

Scale

1:7,920

± 1 %

Viewing the Soil Map

Area of Interest (AOI)

Soil Data Explorer

Download Soils Data

Shopping Cart (Free)

Printable Version

Add to Shopping Cart

Search

Map Unit Legend

Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington (WA627)

Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington (WA627)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
28	Centralia loam, 8 to 30 percent slopes	7.5	1.3%
169	Water	7.4	1.3%
1200	Water-Riverwash complex, 0 to 5 percent slopes	23.8	4.1%
1201	Water-Fluvaquents complex, 0 to 3 percent slopes	5.6	0.9%
1202	Xerofluvents, 0 to 15 percent slopes	4.1	0.7%
1210	Roundtree loam, 0 to 5 percent slopes	3.1	0.5%
1211	Fordprairie-Roundtree complex, 0 to	17.2	2.9%

Soil Map

Scale

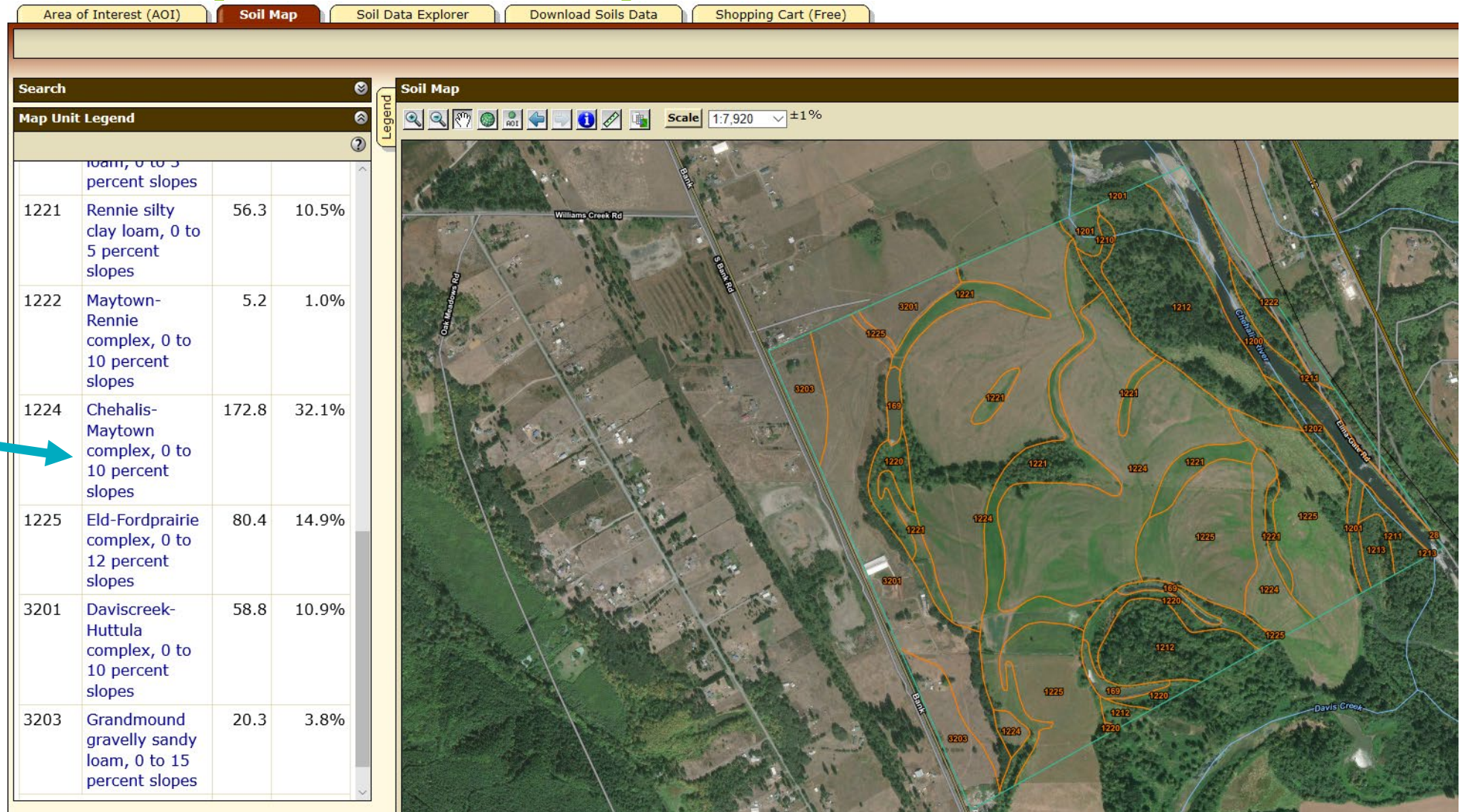
1:7,920

±1%

- **Map unit definition: Areas defined and named the same in terms of their soil components**
- **A map unit can contain more than one soil (component) in it.**
- **The map unit description provides details about the different soil components and their likely locations (landform or geomorphic position) within the map unit.**



Map Unit Description



The map unit name contains a hot link to the map unit description



Understanding the Map Unit Description

Map Unit Name

Component Name

Map Unit Description
Printable Version

Report — Map Unit Description

Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington

1224—Chehalis-Maytown complex, 0 to 10 percent slopes

Map Unit Setting

National map unit symbol: 2w94n
Elevation: 20 to 180 feet
Mean annual precipitation: 47 to 71 inches
Mean annual air temperature: 50 to 52 degrees F
Frost-free period: 150 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chehalis and similar soils: 55 percent
Maytown, frequently flooded, and similar soils: 30 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chehalis

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear, convex
Parent material: Alluvium

Typical profile

Ap1 - 0 to 5 inches: silt loam
Ap2 - 5 to 20 inches: silt loam
Bw1 - 20 to 28 inches: silty clay loam
Bw2 - 28 to 48 inches: silty clay loam
Bw3 - 48 to 59 inches: loam

Properties and qualities

Slope: 0 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 2.13 in/hr)
Depth to water table: About 47 to 79 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Forage suitability group: Soils with Few Limitations (G002XS501WA)
Hydric soil rating: No

Overview of map unit

Typical component percentages

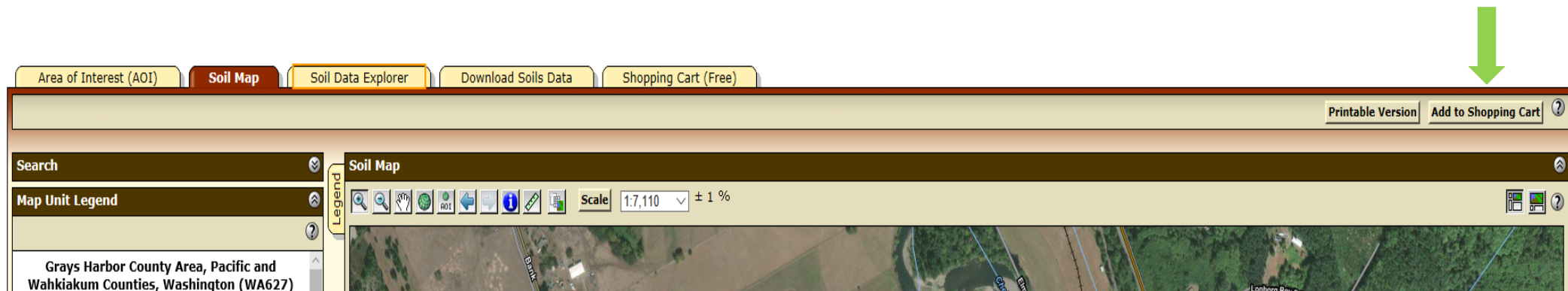
Where on the landform
will I likely find this soil?

Component Information

Good comparisons
for ground truthing

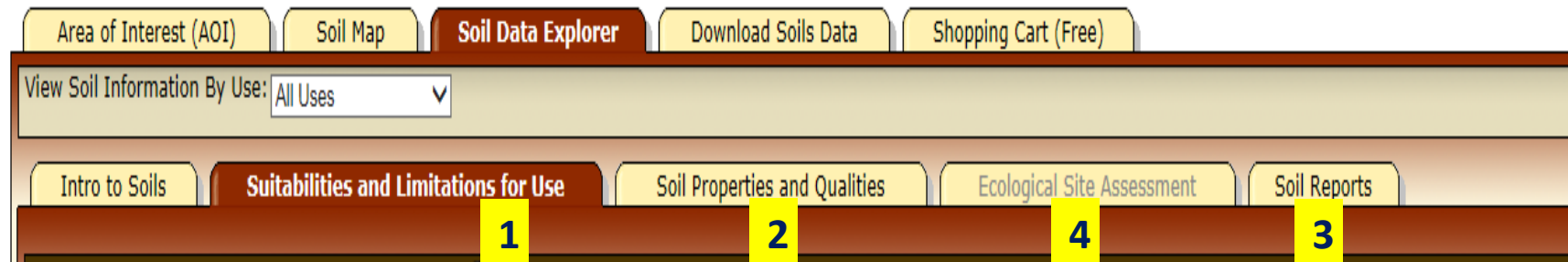
Compiling Soils Data

- Soil maps, map unit descriptions, and soil reports and interpretations can be a valuable reference for the field and for future planning purposes
- Choose reports and interpretations relevant to the current and proposed land uses and management practices
- Useful reports can be compiled into a single document by clicking the “Add to Shopping Cart” button (don’t worry, it’s free)





Types of Soil Information Available



1. **Suitabilities and Limitations for Use:** Produces map and report for single interpretations.
Ex: Forest Productivity (tree site index)
2. **Soil Properties and Qualities:** Produces map and report for single property. Ex: Depth to Water Table
3. **Soil Reports:** Produces report and tables (no map) containing multiple soil properties and interpretations.
Ex: Hydric Soils
4. **Ecological Sites:** Characterization of ecological community correlated to each soil component in the survey
 - Most ES data for WA State is still in draft status and not yet available to the public

Example: Forest Productivity

Area of Interest (AOI)

Soil Map

Soil Data Explorer

Download Soils Data

Shopping Cart (Free)

View Soil Information By Use: All Uses

Intro to Soils

Suitabilities and Limitations for Use

Soil Properties and Qualities

Ecological Site Assessment

Soil Reports

Search

Suitabilities and Limitations Ratings

Open All Close All ?

Building Site Development ?

Construction Materials ?

Disaster Recovery Planning ?

Land Classifications ?

Land Management ?

Military Operations ?

Recreational Development ?

Sanitary Facilities ?

Soil Health ?

Vegetative Productivity ?

Crop Productivity Index ?

Forest Productivity (Cubic Feet per Acre per Year) ?

Forest Productivity (Tree Site Index) ?

Iowa Corn Suitability Rating CSR2 (IA) ?

Minnesota Crop Productivity Index ?

Prod Index - Alfalfa Hay - Palouse, Northern Rocky Mtns (WA) ?

Prod Index - Grass Hay - Palouse, Northern Rocky Mtns (WA) ?

Prod Index - Small Grains - Palouse Prairies (WA) ?

Legend

Soil Map

Scale (not to scale)

Example: Tree Site Index

Forest Productivity (Tree Site Index)

[View Description](#)
[View Rating](#)

View Options

Map

☒

Table

☒

Description of Rating

☒

Rating Options

☒

☐

Detailed Description

Basic Options

Tree

Douglas-fir

King 1966 (795)

Advanced Options

Aggregation Method

Dominant Condition

Component Percent Cutoff

Tie-break Rule

☐ Lower

☒ Higher

Interpret Nulls as Zero

☐ Yes

☒ No

[View Description](#)
[View Rating](#)

- Set options
- Click View Rating

Setting Advanced Options: Aggregation Method

- **Recommend using Dominant Condition unless you are certain you are working with the Dominant Component**
- **Why? Example: Map unit composition =**
 - Soil A (poorly drained) = 30%
 - Soil B (poorly drained) = 30%
 - Soil C (well drained) = 40%
- **Dominant Component will base interpretation off of Soil C data**
- **Dominant Condition will base interpretation off of Soil A and B data**
- **Weighted Average is generally not recommended**
 - Will produce a result not representative of any of the individual components

Forest Productivity (Tree Site Index)

View Description

View Rating

View Options

Map

Table

Description of Rating

Rating Options

☒

☒

☒

☒

☐ Detailed Description

Basic Options

Tree

Douglas-fir

King 1966 (795)

Advanced Options

Aggregation Method

Component Percent Cutoff

Tie-break Rule

Interpret Nulls as Zero

Dominant Condition

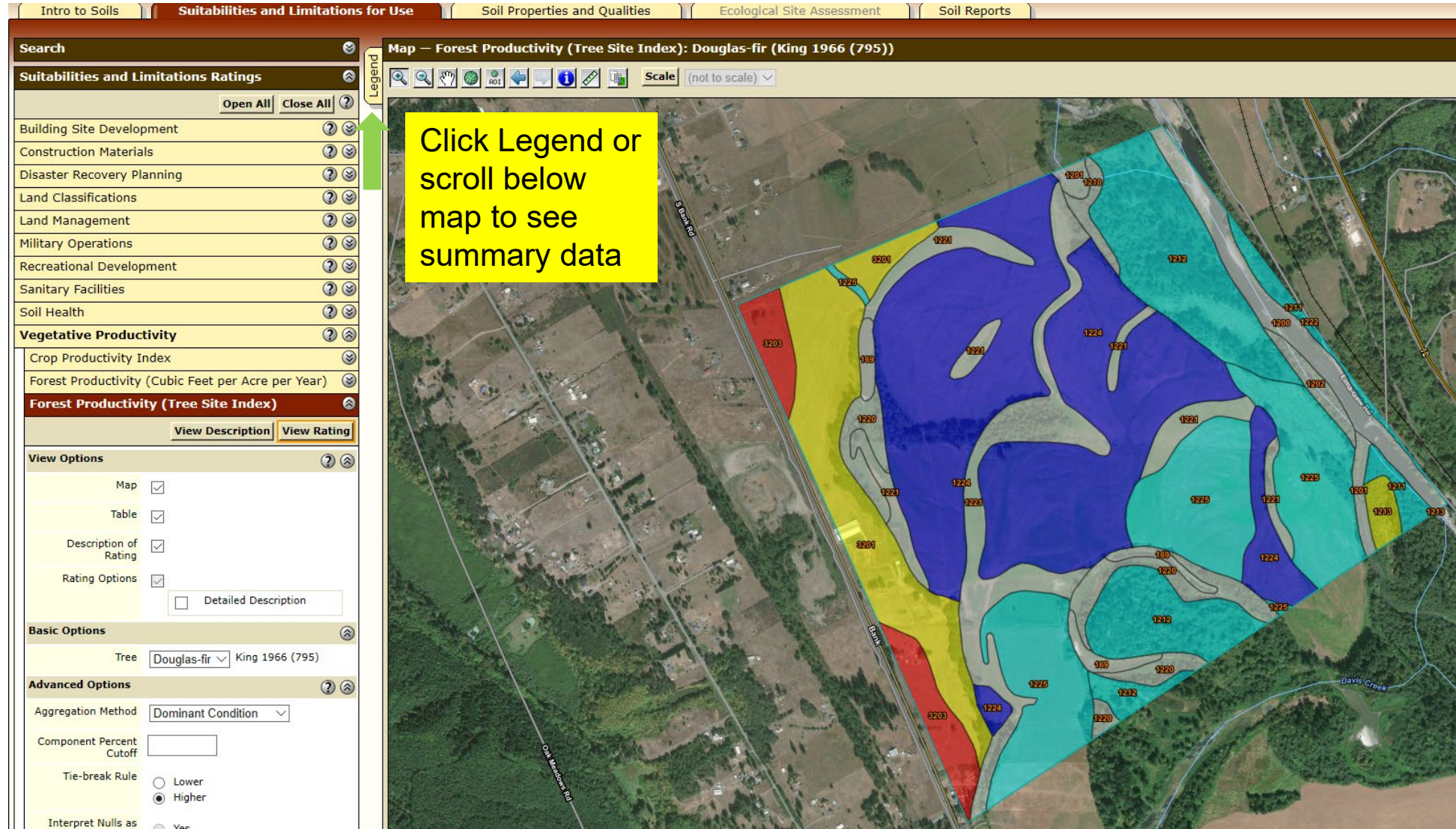
☐ Lower
 ☒ Higher

☐ Yes
 ☒ No

View Description

View Rating

Example: Tree Site Index – Map



Example: Tree Site Index – Table

Tables — Forest Productivity (Tree Site Index): Douglas-fir (King 1966 (795)) — Summary By Map Unit				
Summary by Map Unit — Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington (WA627)				
Summary by Map Unit — Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington (WA627)				
Map unit symbol	Map unit name	Rating (feet)	Acres in AOI	Percent of AOI
169	Water		7.4	1.4%
1200	Water-Riverwash complex, 0 to 5 percent slopes		19.2	3.6%
1201	Water-Fluvaquents complex, 0 to 3 percent slopes		4.8	0.9%
1202	Xerofluvents, 0 to 15 percent slopes		4.1	0.8%
1210	Roundtree loam, 0 to 5 percent slopes		3.1	0.6%
1211	Fordprairie-Roundtree complex, 0 to 10 percent slopes	120	8.7	1.6%
1212	Scatter-Fordprairie-Roundtree complex, 0 to 12 percent slopes	120	67.1	12.7%
1213	Elma-Fordprairie complex, 0 to 12 percent slopes	115	3.8	0.7%
1220	Salzer silty clay loam, 0 to 3 percent slopes		20.2	3.8%
1221	Rennie silty clay loam, 0 to 5 percent slopes		57.5	10.9%
1222	Maytown-Rennie complex, 0 to 10 percent slopes	120	0.0	0.0%
1224	Chehalis-Maytown complex, 0 to 10 percent slopes	130	170.3	32.3%
1225	Eld-Fordprairie complex, 0 to 12 percent slopes	120	87.1	16.5%
3201	Daviscreek-Huttula complex, 0 to 10 percent slopes	115	54.9	10.4%
3203	Grandmound gravelly sandy loam, 0 to 15 percent slopes	108	18.9	3.6%
Totals for Area of Interest			527.1	100.0%
Description — Forest Productivity (Tree Site Index)				
The "site index" is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands.				
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 attribute, only the representative value is used.				
Rating Options — Forest Productivity (Tree Site Index): Douglas-fir (King 1966 (795))				
Units of Measure: feet				
Tree: Douglas-fir				
Site Index Base: King 1966 (795)				
Aggregation Method: Dominant Condition				
Component Percent Cutoff: None Specified				
Tie-break Rule: Higher				
Interpret Nulls as Zero: No				

Scroll below
map to view
summary tables

Useful Interpretations and Reports (Where to Find Them)

- **Suitabilities and Limitations for Use**
 - Land Classifications
 - Ecological Site ID, Hydric Rating by Map Unit, Conservation Tree and Shrub Group, Farmland Classification
 - Land Management
 - Fencing, Suitability for Roads, Suitability for Log Landings, Harvest Equipment Operability, Soil Rutting Hazard
 - Vegetative Productivity
 - Forest Productivity (tree site index), Range Production
- **Soil Properties and Qualities**
 - Soil Qualities and Features
 - Depth to Restrictive Layer, Drainage Class
 - Soil Physical Properties
 - Available Water Capacity, Organic Matter, Bulk Density, Texture
 - Water Features
 - Depth to Water Table, Flooding Frequency, Ponding Frequency
- **Soil Reports**
 - Land Classifications
 - Hydric Soils, Land Capability Class, Forage Suitability Groups
 - Water Features
 - Water Features, Hydrologic Soil Group and Surface Runoff

Example: Hydric Soils Report (1 of 2)

Intro to Soils
Suitabilities and Limitations for Use
Soil Properties and Qualities
Ecological Sites
Soil Reports

Search

Soil Reports

[Open All](#)
[Close All](#)

AOI Inventory

Building Site Development

Construction Materials

Disaster Recovery Planning

Land Classifications

Hydric Soils

[View Description](#)
[View Soil Report](#)

Options

This report has no options.

[View Description](#)
[View Soil Report](#)

Land Capability Classification

NCCPI Overall

Prime and other Important Farmlands

Taxonomic Classification of the Soils

Land Management

Recreational Development

Sanitary Facilities

Soil Chemical Properties

Soil Erosion

Soil Map

Scale (not to scale)

Legend



Example: Hydric Soils Report (2 of 2)

Report — Hydric Soils				
Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington				
Map symbol and map unit name	Component	Percent of map unit	Landform	Hydric criteria
1200—Water-Riverwash complex, 0 to 5 percent slopes				
	Riverwash	20	—	4
	Fluvaquents	5	Overflow stream channels	2, 3, 4
1201—Water-Fluvaquents complex, 0 to 3 percent slopes				
	Fluvaquents	30	Depressions, overflow stream channels	2, 3, 4
1202—Xerofluvents, 0 to 15 percent slopes				
	Fluvaquents	10	Overflow stream channels	2, 3, 4
1210—Roundtree loam, 0 to 5 percent slopes				
	Roundtree	80	Depressions, overflow stream channels	2, 3
1211—Fordprairie-Roundtree complex, 0 to 10 percent slopes				
	Roundtree	20	Depressions, overflow stream channels	2, 3
1212—Scatter-Fordprairie-Roundtree complex, 0 to 12 percent slopes				
	Roundtree	15	Depressions, overflow stream channels	2, 3

Aggregating Final Report – “Checking Out”

The screenshot shows the Web Soil Survey interface. At the top, there's a navigation bar with links: Contact Us, Subscribe, Archived Soil Surveys, Soil Survey Status, Glossary, Preferences, Link, Logout, and Help. Below this is a secondary navigation bar with tabs: Area of Interest (AOI), Soil Map, Soil Data Explorer, Download Soils Data, and Shopping Cart (Free). The Shopping Cart tab is currently selected. On the left side, there's a sidebar with sections: Search, Report Properties, Title, Subtitle, Map Options, and Table of Contents. The Title section shows a report for Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington. The Subtitle section has radio buttons for 'Area of Interest Name: (none defined)', 'Custom Subtitle:', and 'None' (which is selected). The Map Options section includes a dropdown for Map Scale (Fit to page), a dropdown for Printed Sheet Size (A portrait (8.5" x 11") — 1 sheet), and a checkbox for Show UTM Coordinate Ticks (checked). On the right side, a Checkout Options dialog box is open, showing Delivery Options with radio buttons for 'Get now' (selected) and 'Download later'. The dialog box has 'Cancel' and 'OK' buttons. A green arrow points from the 'Check Out' button in the top right corner of the Shopping Cart tab to the 'Check Out' button in the dialog box. Another green arrow points from the 'Check Out' button in the dialog box to the 'OK' button.

At end of session select the Shopping Cart tab, and then click the “Check Out” button to download your comprehensive report

Concluding Statements

1. Soil survey products are guides, not gospel.

1. Soil survey maps, interpretations, and reports are great references points, but they are not always perfect.
2. Soil surveys are a snapshot in time and are not site-specific.
3. Understanding the map unit composition and map unit description is critical.
4. On site observations are always necessary. You must ground truth!

2. What if the soil map and your on-site observations are strongly contrasting?

1. Review the map unit description. Check to see if your observations resemble any minor component in the map unit.
2. Contact NRCS State Soil Scientist or local Resource Soil Scientist to discuss the situation.



Questions?

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Link to Web Soil Survey



<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>