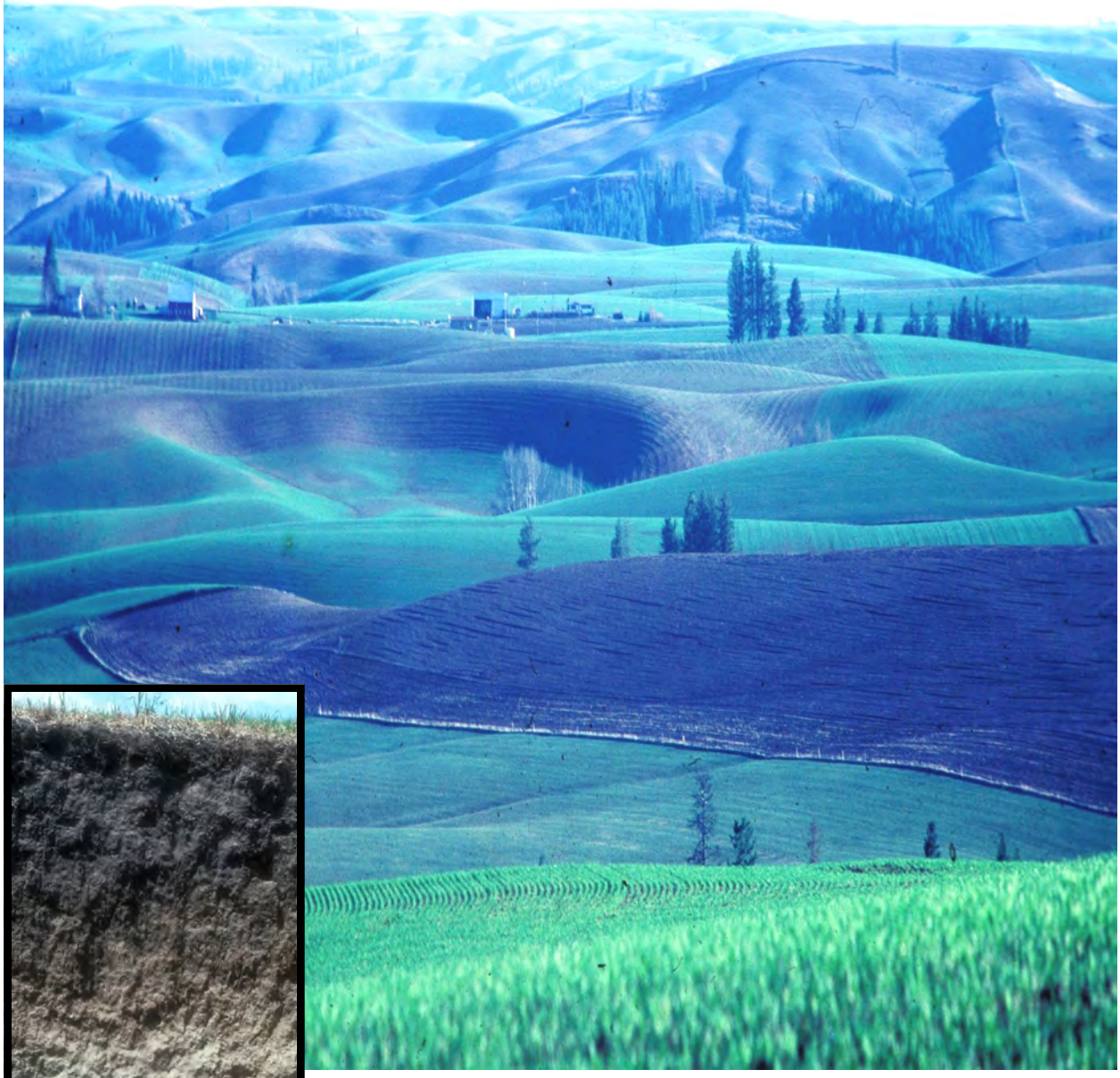
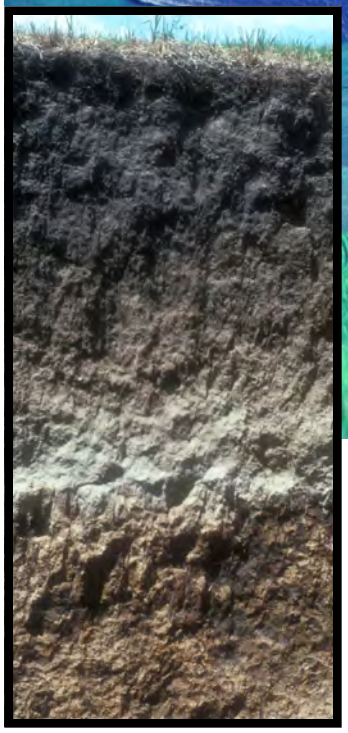
WASHINGTON SOIL ATLAS





KARL W. HIPPLE

The *Washington Soils Atlas* features many soils from throughout Washington State. It has been prepared to assist readers develop an understanding about the variability of Washington soils and as an aid to further the reader's knowledge of soils.

The soils included in this atlas, were selected from several hundred different soils which have been identified and mapped in Washington State. Each of the soils have characteristics that make it a unique soil individual much like each person is a unique individual.

The intent of this atlas is to present some of the different soils mapped and correlated in Washington and to demonstrate how their unique characteristics impact their use and management. Both physical and chemical properties have dramatic impacts on a soil's use and/or management. This atlas only presents brief comments regarding their limitations that impact management but much more information is available from the Natural Resources Conservation Service. Complete information on the soils in Washington State is available online using the Web Soil Survey tool at:

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

A brief section on soil formation is also included and it explains facts regarding the soil forming factors and how individual soils form. Again, most soil survey reports contain sections that explain in more detail the formation of soils that are mapped in each soil survey area.

Roylene Rides at the Door
State Conservationist
NRCS Washington

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public ass instance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

ACKNOWLEGEMENTS

This book, the *Washington Soils Atlas*, is the result of a long-term project by the cooperators of the Washington State National Cooperative Soil Survey (WA NCSS) partnership. The WA NCSS partnership is formed of federal, regional, state, and local agencies and institutions. The partnership works together to investigate, document, inventory, classify, and interpret soil resources in Washington State and to assist users develop, interpret and use standard or custom products made from soil survey data.

The *Washington Soils Atlas* was conceived and endorsed by partnership members in 2001 at the WA NCSS Annual Planning Conference hosted by Washington NRCS in Spokane, WA. This agreement quickly resulted in the publication of several yearly planning guides or calendars (2001, 2002, 2003, 2004, 2005, and 2006). Each yearly planning guide or calendar focused on presenting photographs of soil profiles and landscapes plus a small amount of additional related information to introduce and educate a wide variety of users on the topic of the value and critical importance of Washington State's soil resources.

The Washington Natural Resources Conservation Service provided overall project leadership but because of routine employee transfers and priority shifts, this project slowed and finally stopped in 2006. WA NCSS cooperators that provided funding for publication and distribution of the planning guides are: USDA US Forest Service (USFS), USDA Natural Resources Conservation Service (NRCS), Washington State University (WSU), and the Washington Society of Professional Soil Scientists (WSPSS).

The project was re-invigorated by the NRCS IN 2011 to develop the previously existing materials into a completed final product. This *Washington Soils Atlas* is that product and the NRCS wishes to again thank the WA NCSS cooperators and individual soil scientists, both active and retired, who assisted in these efforts.

I would like to also recognize and acknowledge all of the soil scientists who have mapped soils in Washington State over the years. It is their hard work and skillful data collection that have made these invaluable data available to Washington State residents and others throughout the world. It also enables the dispersion of this information to a wide variety of customers throughout the state and the world. A small number of soil scientists have also collected the photographs that are contained in the *Washington Soils Atlas*. Without the exemplary efforts of this group of soil scientists the extremely valuable data of the Washington NCSS database would not exist or be available to produce excellent customer products and services.

ABOUT THE AUTHOR

Dr. Karl W. Hipple was born and raised on a small dairy farm in northwestern Pennsylvania. He is a Viet Nam era Navy veteran. He obtained a B.S. degree in Secondary Education with an emphasis in Biology and Physical Science from Old Dominion University in Norfolk, Virginia in 1972. He obtained M.S. and PhD degrees from the University of Idaho in Moscow, Idaho in 1976 and 1981 respectively.

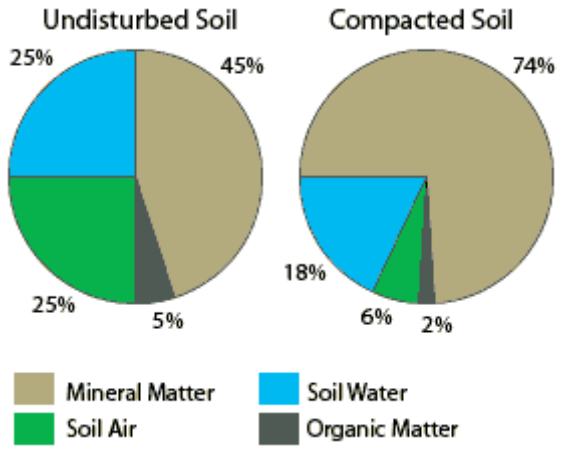
He worked as a soil scientist for the Idaho Soil Conservation Commission (1981) and the Natural Resources Conservation Service (formerly Soil Conservation Service) from 1982 until he retired in 2010. He held the following positions: 1) Soil Scientist, Latah County Idaho Soil Survey, Moscow, ID; 2) Soil Scientist, Lewis, Nez Perce and Western Half of Clearwater Counties, Idaho Soil Survey, Orofino, ID; 3) Soil Survey Project Leader, Custer and Lemhi Counties Idaho Soil Survey, Salmon, ID; 4) Soil Survey Project Leader, Butte County, Idaho, Salmon, ID; 5) Washington State Soil Correlator, Spokane, WA; 6) Washington State Soil Survey Database Manager and Manuscript Editor, Spokane, WA; 7) Washington State Soil Scientist, Spokane, WA; and 8) National Leader Soil Survey Interpretations at National Soil Survey Center in Lincoln, NE. He served as Chairman of the National Technical Committee for Hydric Soils from 2002 until 2008 and Acting Director, National Soil Survey Center from January 2009 until August 2009.

INTRODUCTION

This *Washington Soils Atlas* is designed to present information about Washington State soils in an organized format to a nontechnical audience. The intention is to assist readers understand the importance of soil. Soil is a vital natural resource to residents of Washington because it serves numerous functions that assist residents to live and to earn an income. It also produces food and fiber for populations of the world.

Soil serves to regulate, partition, and filter air and water. It supports the projects built into and onto it and serves as a building material for other projects. Soil nourishes the plants that produce food and fiber for animal and human consumption. The soil assists in decomposing and recycling organic materials, and it preserves natural and cultural history. Therefore, soil is complex and it is also a fundamental material for all life.

Soil, in its usual state, is made up of about 25 percent air, 25 percent water, 5 percent organic matter, and 45 percent mineral matter. When compacted those percentages change and hence so do the soil's properties. When compacted, water intake is reduced, there is less air for plant use, and because water can't infiltrate, soil erosion increases. It is important to take care of Washington's soil resources.



The soils presented in this atlas were selected from several hundred soil series recognized, mapped, and correlated in Washington State. Each of the soil series has a distinctive set of characteristics that make it a unique individual just as each person is a unique individual. The selected group of soils represents most of the unique soil features that occur within Washington. This was done because it is impractical to demonstrate each mapped and correlated Washington soil but the soils of this atlas can represent all Washington State soils. Soil series are named after geologic formations, geographic locations, and some soil names are "coined" or made up by soil scientists who describe, map, and correlate soils from within the National

Cooperative Soil Survey (NCSS) program. Soil series are correlated by NCSS soil scientists so that anywhere a particular soil individual occurs it is identified and called by the same name.

Photographs of the soils show the various layers or soil horizons and they also show a representative landscape where each soil series occur. Along the left side of each soil profile is a scale in inches. Along the right side of each soil profile are labeled the major genetic horizons of the soil using letters and numbers. These letters and numbers are used by soil scientists to show the soil forming process that has taken place in the development of each soil horizon.

The genetic soil horizons have been simplified for this atlas. As one can easily see in the photographs, each "A" horizon and each "B" horizon do not look alike. The soil scientist who described these soil profiles, used knowledge gained in university studies and experience gained from identifying, describing, mapping, and correlating soil in many locations in Washington State or other states to help determine how each horizon has developed from the original soil parent material. The soil horizon designators are useful in making comparisons among soils. A brief discussion or definition of each genetic soil horizon designator is found in the glossary of this atlas. The subscript identifiers are defined in Appendix 1 of this atlas. Appendix 2 provides a map and brief description of the Land Resource Regions in Washington.

The glossary terms may be helpful to assist users to understand certain words that are used to describe each soil. The definitions have been simplified to help more users understand them. More detailed definitions and information can be found in soil survey documents and publications like the *Soil Survey Manual* (http://soils.usda.gov/technical/manual/) and *Soil Taxonomy* (http://soils.usda.gov/technical/classification/taxonomy/) .

All soils are classified according to a recognized national system (*Soil Taxonomy*). This taxonomic classification system was developed to classify the hundreds of thousands of soils that occur in the world. It is a dynamic system that can be adjusted or added to when new kinds of soils are recognized that don't fit the current system. The soil classification system resembles the systems that are used for classifying plants and animals. The soil classification system is mainly used by soil scientists to identify a soil individual, compare one soil to another, and to group soils together that have similar properties and uses.

Other information that is included for each soil series is the soil classification at the family level. It includes several items which describe soil depth, drainage class, parent material, arrangement of soil horizons, and other information. Also included is information on climate, topography, elevation, natural plant community, soil use(s), and management considerations. Management considerations are based on soil properties that impact the soil's use. In many cases, mitigation measures must be used to modify the soil to make use of it for a specific purpose. A map that shows where the soil series is located within the state is also included for each soil series. A link is also provided for the official soil series description that is maintained for each soil series in the NCSS database.

SOIL FORMATION

Soil forms layers or horizons, roughly parallel to the earth's surface, in response to five soil forming factors. The whole soil, from the surface to the lower depths, develops naturally as a result of these five factors. The five factors are: 1) parent material, 2), relief or topography 3) organisms (including humans), 4) climate, and 5) time. If a single parent material is exposed to different climates then a different soil individual will form. If any one of the five factors is changed but the remaining four factors remain the same, a new soil will form. This is called "soil genesis".

It is thought that roughly 95 percent of the world's soils have been moved or transported to their present location. Only 5 percent of the world's soils are "residual soils" or soils that formed in place from the existing parent material. However, there are other differences in soils that are determined by whether a soil is formed in mineral material (sand, silt, and clay) or whether a soil formed in organic material (plant and/or animal matter that is in various stages of decay and decomposition). Soils that formed in dominantly organic material are classified as Histosols according to *Soil Taxonomy*. Parent material contributes both chemical and physical properties to an individual soil.

PARENT MATERIAL

Geologic events have provided Washington with a wide variety of parent materials. In more recent times, many of us are familiar with blowing dust (loess) and volcanic ash from the eruption of Mount St. Helens in 1980. These are two of the parent materials that contribute to Washington State's soils. Probably the most common parent material which covers almost all of the land surfaces in Washington is volcanic ash from numerous eruptions of the Cascade Mountains in the western United States. The volcanic ash is very common either by itself on the surface (volcanic ash mantles) or mixed with other material in surface horizons. Volcanic ash has very specific properties such as very light weight, capacity to hold large amounts of water, and susceptibility to compaction by vehicles when it is wet. These are some factors that influence soil genesis in Washington State.

There are also many rock formations in Washington so there are many kinds of rocks in Washington soils. Examples are granite, schist, limestone, basalt, tuff, and many others. Glaciers from the highest mountains in Washington and from north of Washington in Canada have ground up many kinds of rocks and pushed glacial till

along the earth's surface and commonly deposited it far from the source and creating yet another kind of parent material.

Water has transported and deposited large quantities of material in all parts of the state which has created another kind of parent material. Slower flowing water carries particles such as sand, silt, clay, and tiny rocks downstream until the water slows enough that the materials drop out of the water and form sediments that become parent material. Fast-moving water carries gravel and cobblestones from a wide variety of rock formations downstream and deposits them in various locations to form another kind of parent material. Material that has been transported by water is called alluvium.

Swampy areas or old lakes collect dead and/or dying plants and animals to form peat which is also a parent material. Peat deposits, protected from decay by being saturated with water, form the organic soils (Histosols). They may contain small amounts of mineral matter like sand, silt, and clay. These low-lying areas commonly collected volcanic ash when it was deposited from the air and when it was washed off adjoining uplands.

It is thought that about 70 to 75 percent of the earth's crust is made up of sedimentary rocks and the remaining 25 to 30 percent is made up of igneous rocks and glacial materials. Coarse-grained igneous rocks such as granite weather to sandy types of materials thus soils that formed from these kinds of rocks have a sandy texture. Fine-grained sedimentary rocks such as siltstone and shale weather to finer textured materials; thus soils that formed from these types of rock are more clayey.

All of the different kinds of parent material have been subjected, in varying degrees, to the other four soil forming factors. All five of the soils forming factors are acting at the same time at different rates of speed and with different degrees of efficiency.

TOPOGRAPHY

Very few Washington landscapes are flat. Most of them exhibit some relief or topography related to the type of landform that they occupy. A landscape location 1) has an elevation either above or below another part of the landscape, 2) has a distinct shape (convex, concave or linear), 3) faces a specific compass direction, and 4) is only one component of the landscape. These factors influence drainage, runoff, deposition, and erosion as well as the collection of solar energy.

The most common flat landscapes are those in wide valleys along rivers. The soils in these areas typically are poorly drained or moderately well drained and have very limited runoff. During floods, soil material commonly is deposited in these landscape

positions and erosion generally is not a concern. Erosion from surrounding slopes also results in additional depositions of soil material on the valley bottoms. These landscapes are often cooler because of cold air drainage from higher surrounding areas. Livestock often over-use these areas which results in compaction of the surface soil.

South-facing slopes (south aspects) are warmer and dry out faster because they receive more solar heat than north-facing slopes (north aspects). This affects soil genesis because the warmer temperatures speed up most chemical reactions and increases the evaporation of water from the soil profiles. The drier nature of south aspects, results in production of different natural plant communities than those on the more moist north aspects. The shape and aspect of the topography also contributes to how the slope disperses water. Concave-shaped slopes tend to concentrate water which causes more erosion and runoff. Convex-shaped slopes tend to disperse water more uniformly. Concave positions in flatter landscapes tend to collect water and these soils are more poorly drained and may have a water table near the surface.

CLIMATE

Washington's climate, like its topography, varies greatly from place to place. In fact, soil climate changes quite rapidly in very short distances. Annual precipitation varies from about 7 inches in parts of the Columbia Basin to more than 300 inches in the Olympic Rainforest. Some areas in Washington receive very little snowfall and other areas receive many feet of snow in winter. Accumulation of snow in winter and melting of snow during the spring and summer provides runoff water in areas where precipitation is low. Great differences in temperature and in the number of frost free days also occur across Washington.

Temperature changes with increases and decreases in elevation and it also changes with aspect. Moisture and temperature differences are also evident in soil genesis also. Climate directly and indirectly effects soil formation. Less development occurs in drier areas because as water quickly moves into and through a soil it increases the rate of weathering of soil materials. For example, soluble materials such as organic matter, clay, and calcium carbonate and other salts are moved downward in a soil profile and sometimes out of a soil profile if enough water is available. In general terms, the depth at which soluable material occurs in a soil profile indicates the amount of water that the soil individual receives. Thus a record of the average annual precipitation and average annual soil temperature on each site is important.

The amount of moisture within a soil profile also impacts the soil pH. Soil pH is a determining factor in the kinds of plants that can grow on a soil. It also affects the availability of other nutrients that plants need to grow.

If a soil is wet, soil characteristics illustrate that fact. Soils that have a water table that moves upward and downward during different times of the year contain mottles (rusty spots) or what soil scientists call “redoximorphic features” that are similar to spots that form on a shovel that is left out in the rain. These yellowish and orange “rusty spots” help soil scientists determine where a water table occurs in a soil. Most of these wet soils in Washington are in depressions or along rivers and streams. Soil wetness is a concern for many uses unless the soil can be drained. When a soil is “too wet” there is also very little if any room for air in the soil profile. Many kinds of plants and animals are not able to live on or in these soils because of the lack of soil air. However, there are plants that have adapted to life on wet soils and these plants help a soil scientist identify wet soils.

ORGANISMS

Both living plants and animals (including humans) affect natural soil formation. The kinds of plants that grow on a soil impact the kind of plant residue that form and is incorporated into the soil. Surface soil horizons are most affected by the kinds of plants that grow on a site. Needles, twigs, leaves, stems, and roots of plants are incorporated into the soil and broken down by the different kinds of organisms that live in the soil. In Washington, soils that have darker surface horizons generally have more organic matter than do those that have a lighter- colored surface horizon. Different kinds of plants produce materials that are acidic and others produce material that is alkaline. This too changes the kind of soil that form on a site.

Micro-organisms in the soils in Washington vary according to the kinds of plants that grow on the site, and the kinds of plants are impacted by precipitation, temperature, and soil pH. Micro-organisms are present in all soils, and they occur in extremely large numbers. One teaspoon of soil contains many millions of tiny, microscopic microorganisms. These organisms assist in the breakdown of soil parent material, organic matter, and other weathering products contained in the soil. They also produce substances that help plants absorb nutrients and water from the soil.

Other organisms such as worms that burrow into the soil create little channels that assist in the movement of water and air into and through soil. Burrowing animals such as voles, moles, and ground squirrels mix the soil as they dig homes which also helps to move water and air into the soil profile.

In Washington, it is obvious that dry soils support certain natural plants and wetter soils support different natural plants. For example, soils in the Columbia Basin (central Washington) are some of the driest in Washington. Some of these soils only receive about 7 to 10 inches of precipitation annually. Grasses such as bluebunch wheatgrass

and Idaho fescue and Wyoming big sagebrush can grow successfully in dry areas. Few trees grow in these areas except along rivers and streams.

As soils receive more precipitation, a certain pattern of plants occur. In dry forest areas, ponderosa pine trees grow along with specific natural understory plants. The next wetter forest zone is the Douglas-fir zone and it too has a certain group of natural understory plants that grow with it. Western red cedar, Sitka spruce, noble fir and other tree species grow along with their specific natural understory plants in the wetter and colder areas in Washington. Climate plays a huge role in soil formation in Washington and it also contributes to the several thousand kinds of soil that are identified, mapped, and correlated inside Washington States' boundaries.

TIME

Time is the last of the five soil forming factors to consider. However, this does not mean that it is not important. Washington landscapes, and the soils developing on them, are products of dynamic on-going soil-forming processes. Time is just as important as each of the other soil forming factors. Time, in the way most humans think of it for soil forming processes and soil landscape development is relatively long. In geologic time, many of the soil-forming processes and landscapes that result from weathering are relatively temporary. Geologically speaking, landscapes are continually building and degrading throughout time. It takes time for all things to happen even though some things are now measured in nanoseconds.

Young soils are usually easy to recognize because they have little or weak soil horizon development and the horizons commonly are indistinct. The soil parent material and the intensity of weathering have not yet produced highly visible evidence such as clay or carbonate movement and deposition which form subsoil horizons. Normally, soil scientists think of soil development in terms of soil age. Older soils have more and stronger horizon development than do younger soils. Young soils are weakly developed and have indistinct soil horizons while older (mature) soils are strongly developed and have well defined soil horizons.

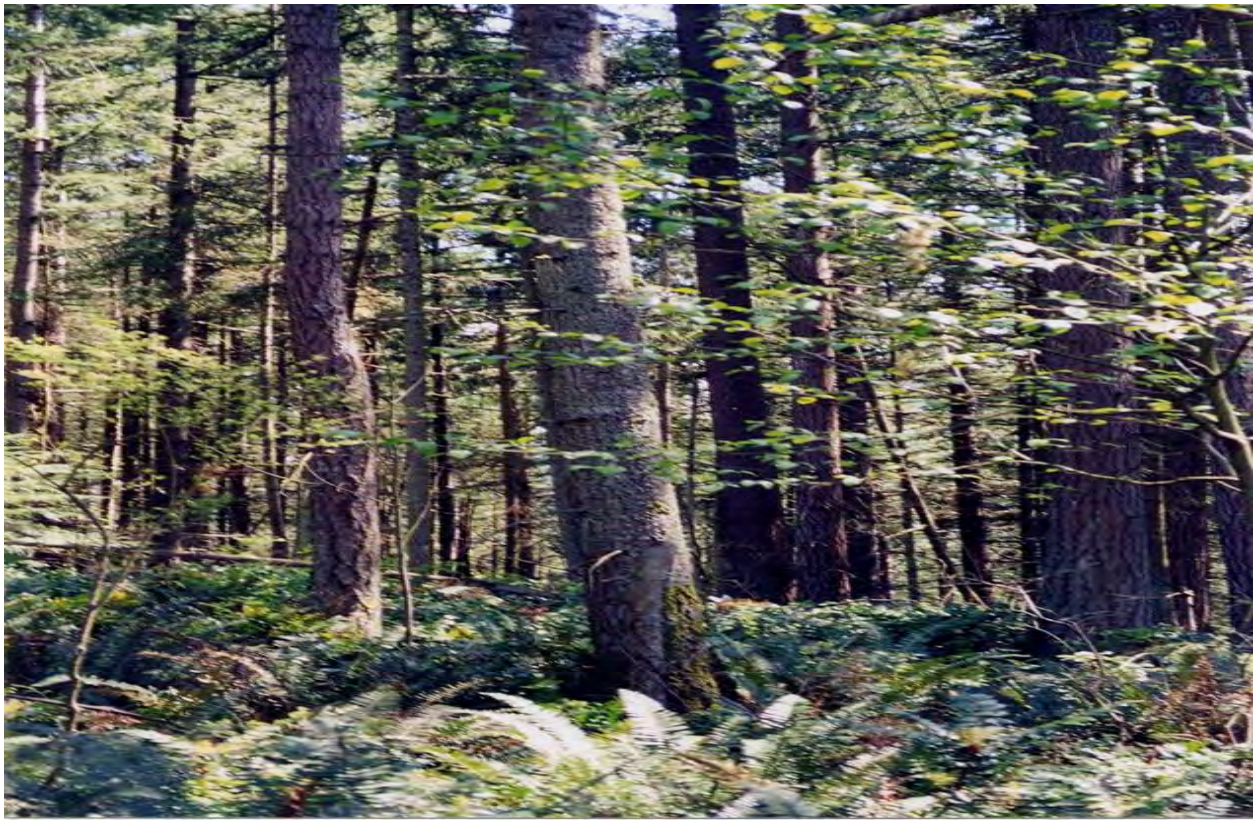
One of the first processes to occur during soil formation is the movement of organic matter into the surface of a soil giving it a characteristic dark color. An often asked question is, "How long does it take to form an inch of topsoil?" This question has many different answers but most soil scientists agree that it takes at least 100 years and it varies depending on climate, vegetation, and other factors.

In a wet, hot climate soil horizons will form fairly quickly compared to those in cold, dry environments. Therefore, soils in cold, dry climates develop rather slowly in

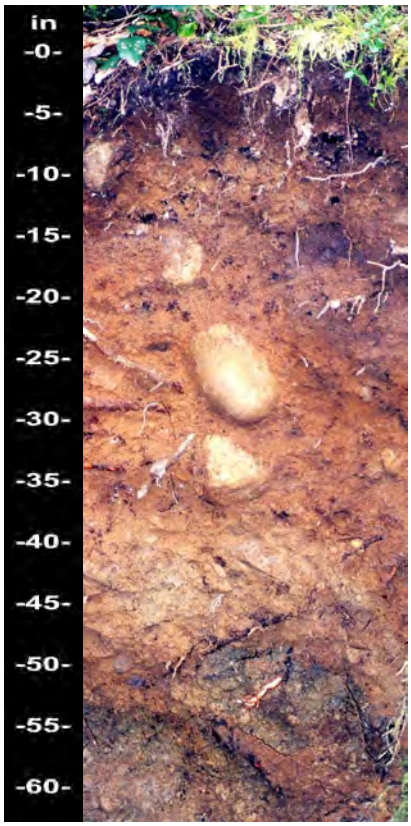
comparison. It is not just the amount of time that determines the degree of soil development but also the parent material, climate, vegetation, and intensity of soil-forming factors during that time that ultimately determine soil development.

Washington State has a variable environment for soil development. Elevation ranges from 0 feet (sea level) at the shore of the Pacific Ocean to more than 14,000 feet at the summit of Mount Rainier in Pierce County and the average annual precipitation ranges from about 6 inches to more than 300 inches. Geologic formations and their rock types are also highly variable in composition as well as in age. Several thousand soil series are identified, mapped, and correlated in Washington State so soil variability is huge. Very few soils are suited to all uses without some kind of modification. Washington soils are a substantial resource supporting Washington's economy through farming, ranching, recreation, and timber production. The soil-forming factors have produced a fascinating number of soil individuals in Washington for our use. It is important that we use them wisely and responsibly so that future generations can do the same.

ALDERWOOD SERIES



Alderwood soils are in the foreground

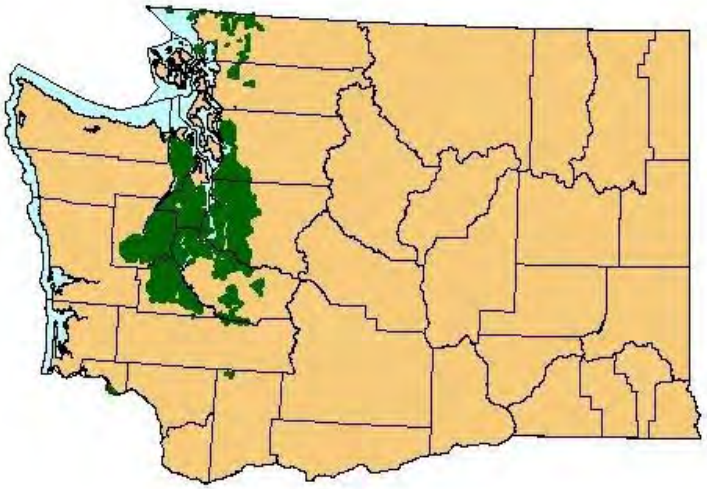


A

Bw

2Bg

2Cd



Location of Alderwood soils

ALDERWOOD SERIES

Land Resource Region A

Parent material: Glacial till

Extent: Extensive

Climate: Average annual precipitation is about 40 inches, and average annual soil temperature is about 50 degrees F. The marine climate is characterized by cool, dry summers and mild, wet winters.

Depth: 20 to 40 inches to a dense layer

Drainage: Moderately well drained

Average frost-free period: 180 to 220 days

Elevation: 0 (sea level) to 800 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development.

Family classification: Loamy-skeletal, isotic, mesic Vitrandic Dystroxerepts

Alderwood soils are on foothills and valleys in Jefferson, King, Mason, Pierce, Snohomish, and Thurston Counties, Washington.

Uses: Timber production, hayland, pastureland, crop production, wildlife habitat, and urban uses.

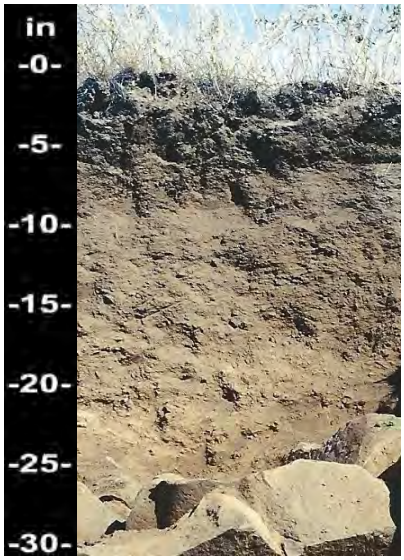
Cultivated areas are used to produce grapes, fruit crops, small grain, and hay. Natural vegetation is Douglas-fir, western red cedar, western hemlock, and red alder. Understory is Oregon grape, western brackenfern, western swordfern, and red huckleberry.

Management considerations: Alderwood soils have a perched water table is at 18 to 36 inches at times from January to March in most years. The dense layer at 20 to 40 inches restricts roots and limits water movement. The seasonally high water table must be considered when managing these soils.

The official soil series descriptions is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/A/ALDERWOOD.html

ANDERS SERIES

Anders soils are in areas between the rock outcrops



A

AB

Bw

2R

Location of Anders soils

ANDERS SERIES

Land Resource Region B

Parent Material: Wind-blown silts (loess) that includes small amounts of volcanic ash over hard basalt bedrock

Extent: Moderately extensive

Climate: Average annual precipitation is about 14 inches, and average annual soil temperature is about 48 degrees. The climate is characterized by hot, dry summers and cool, moist winters.

Depth: 20 to 40 inches to hard bedrock

Drainage: Well drained

Average frost-free period: 90 to 150 days

Elevation: 600 to 2,700 feet

Soil order: Mollisols - grassland soils that have dark-colored surfaces and high natural fertility

Family classification: Coarse-loamy, mixed, superactive, mesic Typic Haploxerolls

Anders soils occur on plateaus, benches, and on channeled scablands in Washington and Oregon. In Washington they are in Whitman, Adams, Lincoln and Grant Counties. In Oregon, they are in Sherman County, Oregon.

Uses: Crop production, livestock grazing, recreation, and wildlife habitat.

Cultivated areas are used to produce wheat, barley, and peas and lentils. Native vegetation is grasses like Idaho fescue and bluebunch wheatgrass.

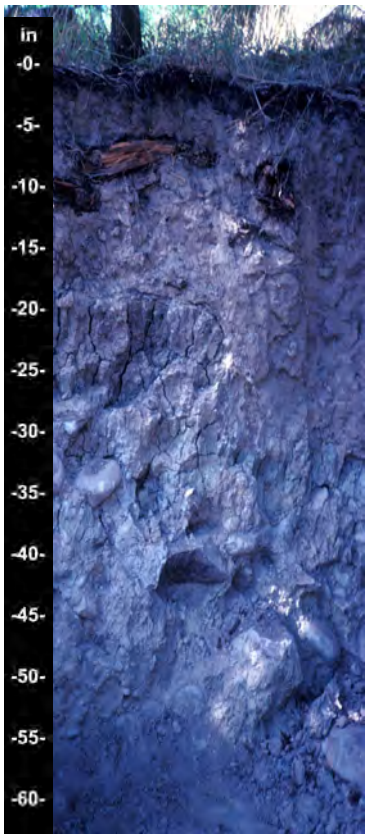
Management considerations: Anders soils have hard basalt bedrock at 20 to 40 inches below the surface. This limits water movement and root penetration. This limits management that requires excavation.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/A/ANDERS.html

Anders soils are in the area of eastern Washington called the “channel scablands”.

BEARRUN SERIES

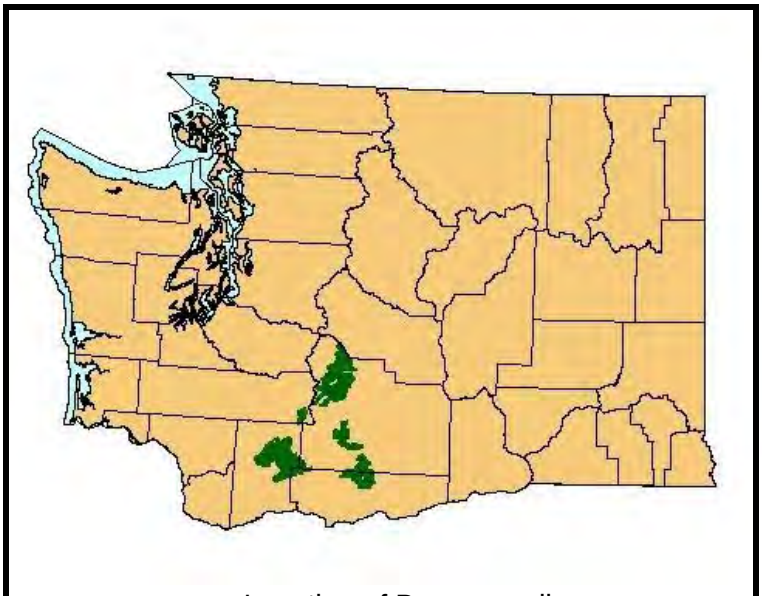
Bearrun soils are on unstable sloping areas



A

2Bw

3Bt



Location of Bearrun soils

BEARRUN SERIES

Land Resource Region B

Parent material: Colluvium from basalt with a mantle of volcanic ash

Extent: Small extent

Climate: Average annual precipitation is about 40 inches, and average annual soil temperature is about 44 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 inches or more

Drainage: Well drained

Average frost-free period: 40 to 100 days

Elevation: 2,150 to 4,900 feet

Soil order: Alfisols - strongly weathered soils with zones of clay accumu**lation**

Family classification: Fine, mixed, active, frigid Vitrandic Palexeralfs

Bearrun soils are on unstable, hummocky mountain slopes with sag ponds in Klickitat, Lewis, Skamania and Yakima Counties, Washington. .

Uses: Timber production, recreation, wildlife habitat, and livestock grazing.

Natural vegetation is Douglas fir, ponderosa pine, and grand fir. Understory is elk sedge and pinegrass

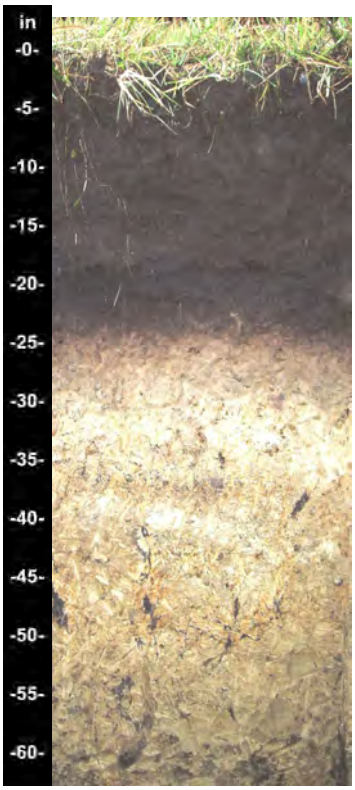
Management considerations: Bearrun soils have high clay content in the subsoil that shrink and swell when wetted and dried. Landscapes on steep slopes are very unstable when saturated with water in winter and spring. Water perches in the profile above the 3Bt horizon. Slope stability is a limitation for timber management.

Laboratory data is available from the National Soil Survey Laboratory; pedon number 92P-23, sample number S91WA-077-008.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BEARRUN.html

BOZARTH SERIES

Bozarth soils are in the foreground



A

E

2Bg

Location of Bozarth soils

BOZARTH SERIES

Land Resource Region A

Parent material: Wind-blown sands over dense glaciomarine sediments

Extent: Small extent

Climate: Average annual precipitation is about 22 inches, and average annual soil temperature is about 50 degrees F. The climate is characterized by warm, dry summers and mild, moist winters.

Depth: 20 to 40 inches to a dense layer

Drainage: Somewhat poorly

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 70 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Coarse-loamy, mixed, superactive, mesic Aquultic Haploxerolls

Bozarth soils are on sand dunes on glacial outwash plains in Island County, Washington. They may occur in other areas along Puget Sound.

Uses: Home sites, crop production, and livestock grazing.

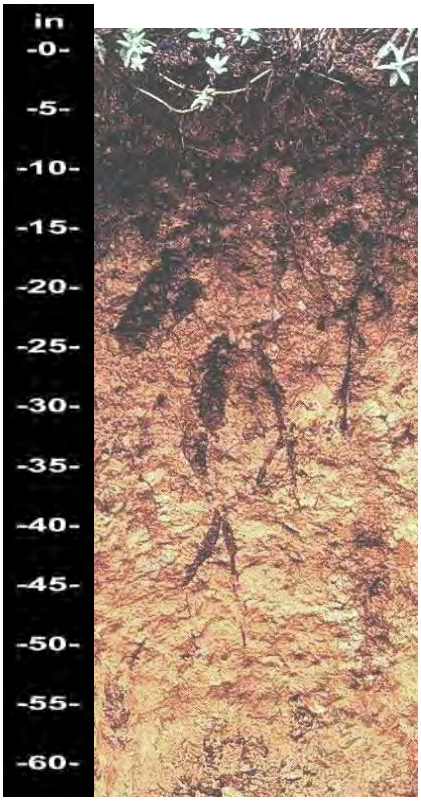
Cultivated areas are used to produce small grains, pasture, and hay. Natural vegetation is Douglas-fir and Oregon white oak. Understory is wild rose, western brackenfern, trailing blackberry, common snowberry, Oregon grape, and oceanspray.

Management considerations: Bozarth soils have a high water table at 10 inches below the surface from December through February and some areas are occasionally ponded (water on the surface) from December to March. The seasonally high water table must be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BOZARTH.html

CALAWAH SERIES

Calawah soils are in the foreground



A

AB

Bw

Location of Calawah soils

CALAWAH SERIES

Land Resource Region A

Parent material: Wind-blown silt (loess) over glacial outwash

Extent: Moderately extensive

Climate: Average annual precipitation is about 100 inches, and average annual soil temperature is about 48 degrees F. The climate is a mild marine climate characterized by cool, moist summers and cool, wet winters.

Depth: 60 inches or more

Drainage: Well drained

Average frost-free period: 180 to 222 days

Elevation: 20 to 1,200 feet

Soil order: Andisols - soils formed from the weathering of volcanic materials

Family classification: Medial, ferrihydritic, isomesic Typic Fulvudands

Calawah soils are on terraces and terrace escarpments in Clallam, Grays Harbor, and Jefferson Counties, Washington.

Uses: Timber production and wildlife habitat

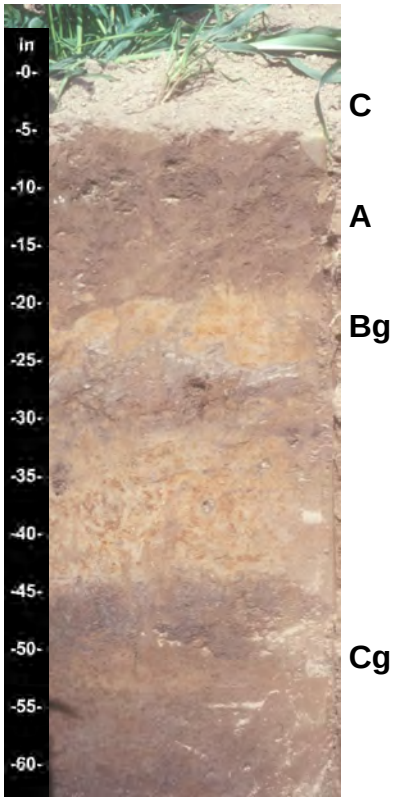
The natural vegetation is western hemlock, western redcedar, Pacific silver fir, red alder, and Sitka spruce. With understory vegetation of salal, several species of huckleberries, vine maple, blackberry, deer fern, western Swordfern and Oregon oxalis.

Management considerations: Steep slopes in some areas limits forest management opportunities. This soil has few limitations for many uses.

The official soil series description is online at
http://soilseries/sc/egov/usda.gov/OSD_Docs/C/CALAWAH.html

CAPLES SERIES

Caples Soils are in the foreground



Location of Caples soils

CAPLES SERIES

Land Resource Region A

Parent material: Alluvium

Extent: Small extent

Climate: Average annual precipitation is about 45 inches, and average annual soil temperature is about 52 degrees F. The climate is characterized by warm, dry summers and cool , moist winters.

Depth: 60 inches or more

Drainage: Somewhat poorly drained

Average frost-free period: 165 to 195 days

Elevation: 0 to 40 feet

Soil order: Inceptisols - Young soils with weakly expressed soil development

Family classification: Fine, mixed, superactive, nonacid, mesic Fluvaquentic Endoaquepts

Caples soils are on floodplains and low terraces in Cowlitz County, Washington.

Uses: When drained, it is used for crop production,

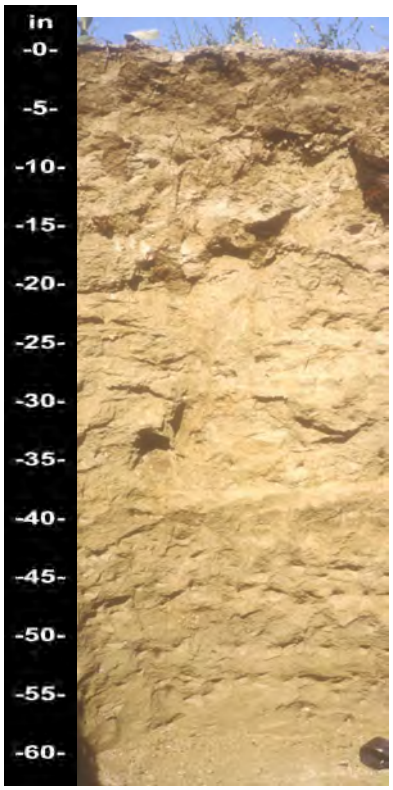
Cultivated areas are used to produce row crops, small grain, hay, pasture, bulbs, strawberries, and cane fruit. Natural vegetation is western redcedar, red alder, black cottonwood, and bigleaf maple. Understory vegetation is vine maple and willow.

Management considerations: Caples soils are on flat areas and have restricted infiltration and water ponds on the surface at times. A seasonal water table occurs at 18 to 30 inches below the surface from November to April and should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CAPLES.html

CEDONIA SERIES

Cedonia Soils are on the undulating hills in the foreground



A

Bk

C

Location of Cedonia soils

CEDONIA SERIES

Land Resource Region E

Parent material: Glacial lake sediments with wind-blown silt (loess) and volcanic ash mixed in the upper part

Extent: Moderately extensive

Climate: Average annual precipitation is about 18 inches, and average annual soil temperature is about 45 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 inches or more

Drainage: Well drained

Average frost-free period: 100 to 135 days

Elevation: 1,300 to 2,700 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development

Family classification: Fine-silty, mixed, superactive, mesic Vitrandic Haploxerepts

Cedonia soils are on lake terraces and terrace breaks in Ferry, Spokane, and Stevens Counties, Washington.

Uses: Crop production, hayland, pastureland, and timber production.

Cultivated areas are used to produce small grains, alfalfa and native grass hay. Natural vegetation is Douglas-fir and western larch. Understory is pinegrass, snowberry, mallow ninebark, and bluebunch wheatgrass.

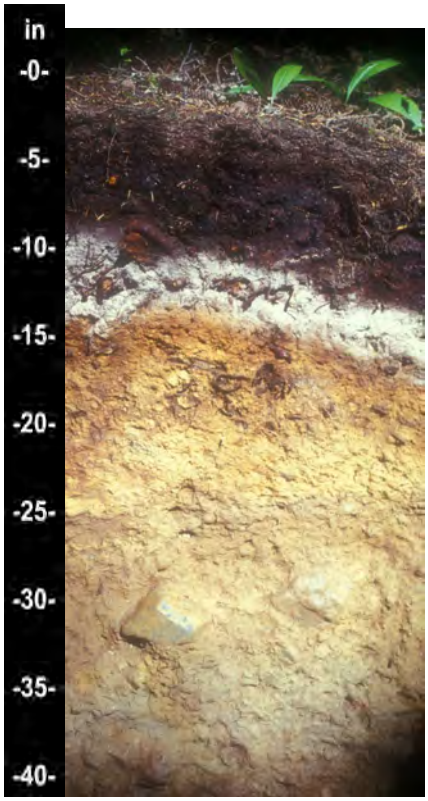
Management considerations: The surface mixture of loess and volcanic ash makes these soils susceptible to water erosion when they are on steep slopes and left without vegetation cover.

Partial laboratory data is available for the Cedonia series at the National Soil Survey Laboratory, Lincoln, NE. Pedon number 85P894, sample number S85WA019-002

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CEDONIA.html

CHINKMIN SERIES

Chinkmin soils are on the north-facing slopes of the mountain ridges



O

E
2Bhs
2Bs

3Bqm

Location of Chinkmin soils

CHINKMIN SERIES

Land Resource Region A

Parent material: Colluvium from glacial till, volcanic ash, and pumice above dense glacial till.

Extent: Extensive

Climate: Average annual precipitation is about 100 inches, and average annual soil temperature is about 40 degrees F. The climate is characterized by cool, dry summers and cold, wet winters.

Depth: 20 to 40 inches to cemented layer

Drainage: Moderately well drained

Average frost-free period: 50 to 100 days

Elevation: 2,500 to 6,000 feet

Soil order: Spodosols - Acid soils of cold, wet coniferous forests that have distinct grayish and reddish brown subsoils.

Family classification: Medial-skeletal, amorphic Andic Duricryods

Chinkmin soils are in cirques, valleys, and on lateral moraines in mountains in King, Pierce, Chelan, Okanogan, Kittitas, Snohomish, Skagit, and Whatcom Counties, Washington (mountains of north-central Washington).

Uses: Timber production, wildlife habitat, and watershed (store water as snowpack in winter for summer use).

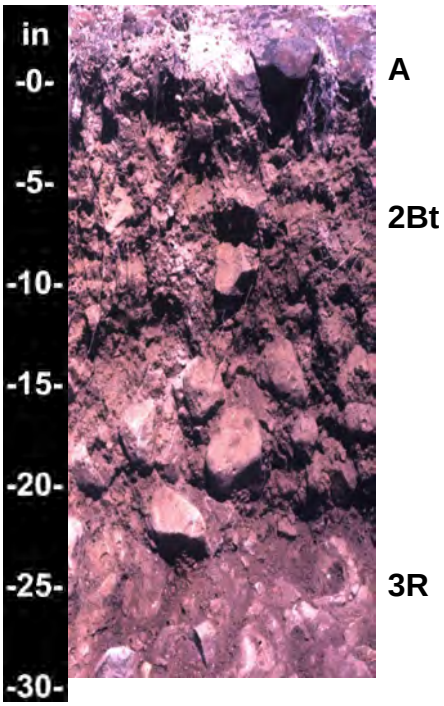
Natural vegetation is Pacific Silver fir, noble fir, western hemlock, Douglas fir, Alaska cedar, mountain hemlock and subalpine fir. Understory includes huckleberry , snowberry, salmonberry, dogwood, white rhododendron, Cascades azalea, heather, and Sitka mountain ash.

Management considerations: A dense cemented layer occurs at 20 to 40 inches below the soil surface which limits water movement and root penetration. Steep slopes in many areas impact forest management.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CHINKMIN.html

CLERF SERIES

Clerf soils are on the ridge slope in the foreground



Location of Clerf soils

CLERF SERIES

Land Resource Region B

Parent material: Residuum and colluvium from basalt with small amounts of wind-blown silt (loess)

Extent: Moderately extensive

Climate: Average annual precipitation is about 11 inches, and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cold, moist winters.

Depth: 20 to 40 inches to bedrock

Drainage: Well drained

Average frost-free period: 130 to 170 days

Elevation: 1,700 to 2,900 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Clayey-skeletal, smectitic, mesic Aridic Palexerolls

Clerf soils are on hills and ridges in Kittitas and Yakima Counties, Washington.

Uses: Livestock grazing and wildlife habitat

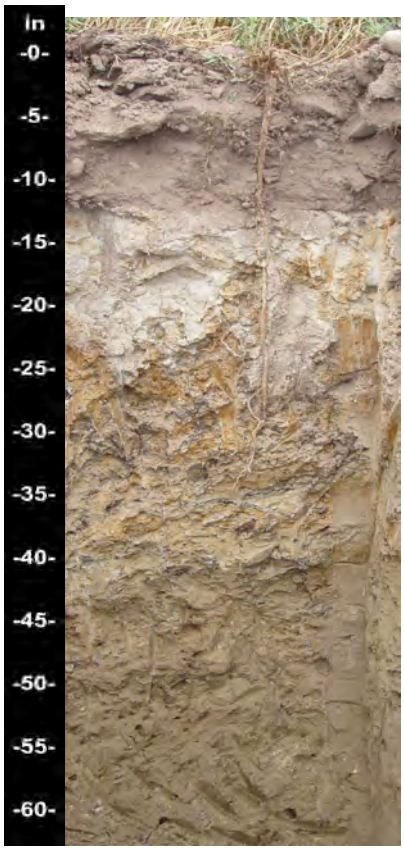
Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, Wyoming big sagebrush and arrowleaf balsamroot.

Management considerations: Bedrock at 20 to 40 inches limits soil water holding Capacity, water movement, and root penetration. Steep slopes and high clay content limit management opportunities.

The official soils series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CLERF.html

COUPEVILLE SERIES

Coupeville soils are in the flat area in the foreground.



A

2E

2Btg

2Cd

Location of Coupeville soils

COUPEVILLE SERIES

Land Resource Region A

Parent material: Glacial deposits

Extent: Small extent

Climate: Average annual precipitation is about 30 inches, and average annual soil temperature is 50 to 52 degrees F. e climate is characterized by warm, dry summers and cool, moist winters

Depth: 60 inches or more

Drainage: Poorly drained

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 300 feet

Soil order: Mollisols - grassland soils that have a dark-colored surfaces and high natural fertility

Family classification: Fine-loamy, mixed, superactive, mesic Argiaquic Argialbolls

Coupeville soils are in drainageways and valleys on glacial drift plains in San Juan and Island Counties, Washington. They likely also are in other areas around the Puget Sound in Washington.

Uses: Crop production, forage production, livestock grazing, and wildlife habitat.

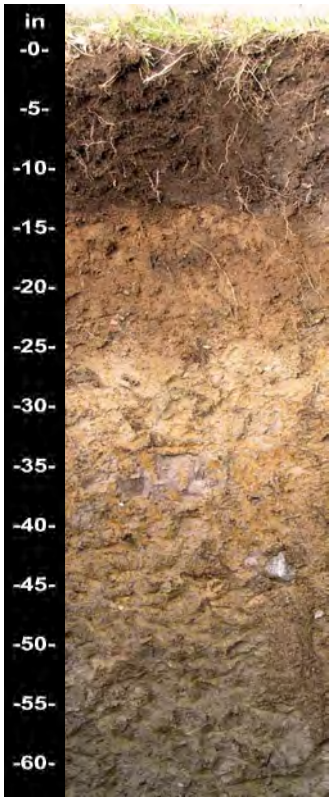
Cultivated areas are used to produce wheat, oats, barley, and alfalfa, and vegetables for seed and produce. The natural vegetation is Sitka spruce, red alder, lodgepole pine, salmonberry, blackberry, elderberry, swordfern, and sedges.

Management considerations: Coupeville soils have a high water table at or near the surface in fall, winter, and spring; water ponds on the surface for long durations from December through March and for brief durations in October, November, and April. The seasonally high water table should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/COUPEVILLE.html

COVELAND SERIES

Coveland Soils are in the foreground



A1

A2

E

2Btg

2Cd

Location of Coveland soils

COVELAND SERIES

Land Resource Region A

Parent material: Glacial materials over glaciomarine deposits

Extent: Small extent

Climate: Average annual precipitation is about 31 inches, and average annual soil temperature is about 48 degrees F. The climate is characterized by warm, dry summers and mild, moist winters.

Depth: 40 to 60 inches to a dense layer

Drainage: Somewhat poorly drained

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 300 feet

Soil order: Alfisols - strongly weathered soils with zones of clay accumulation

Family classification: Fine-loamy, mixed, superactive, mesic Aquic Haploxeralfs

Coveland soils are in valleys and glacial outwash plains in Island, San Juan, and Skagit Counties, Washington.

Uses: Forage crop production, livestock grazing, and timber production.

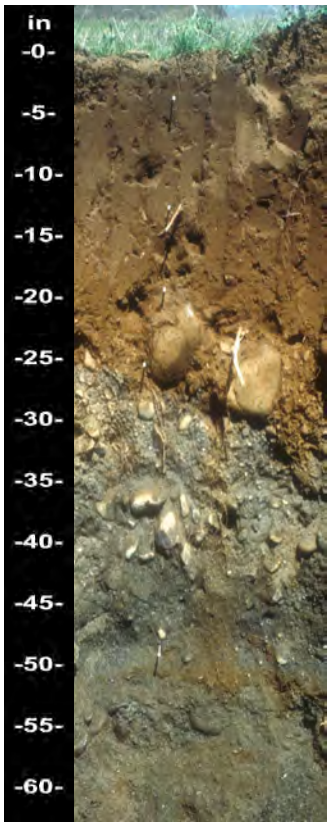
Cultivated areas are used for producing hay. Natural vegetation includes western redcedar, Douglas-fir, grand fir, and lodgepole pine. Understory vegetation includes red alder, snowberry, trailing blackberry, salmonberry, stinging nettle, Swordfern, and bracken fern.

Management considerations: This soil has a perched water table at 12 to 20 inches during November to May each year. These soils also are subject to ponding. The seasonally high water table should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/C/COVELAND.html

DALLESPORT SERIES

Dallesport soils are on terraces along the river



A

Bw

2BC

3C

Location of Dallesport soils

DALLESPORT SERIES

Land Resource Region B

Parent material: Wind-blown sediments over alluvial sand and gravel

Extent: Small extent

Climate: Average annual precipitation is about 13 inches, and average annual soil temperature is about 53 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 inches or more

Drainage: Somewhat excessively drained

Average frost-free period: 130 to 150 days

Elevation: 150 to 1,200 feet

Soil order: Mollisols - grassland soils with dark –colored surfaces and high natural fertility

Family classification: Sandy-skeletal, mixed, superactive, mesic Typic Haploxerolls

Dallesport soils are on terraces and terrace escarpments in Asotin and Klickitat Counties, Washington.

Uses: Livestock grazing, pastureland, and irrigated crop production.

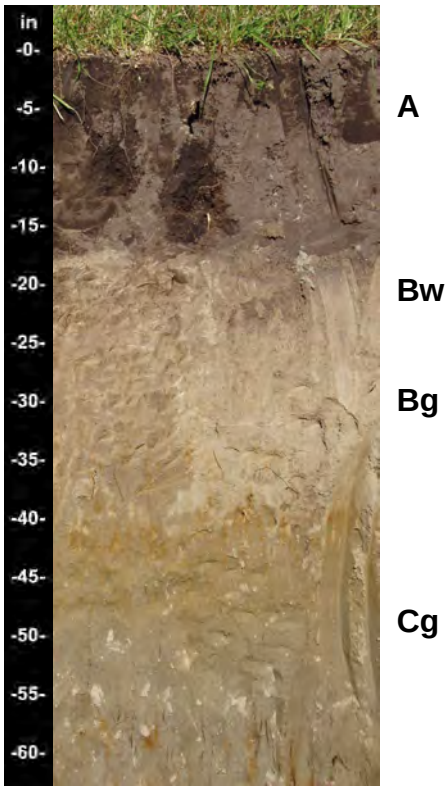
Cultivated areas are used to produce small grain crops. Natural vegetation includes bluebunch wheatgrass, lupine, Idaho fescue, Sandberg bluegrass, and arrowleaf balsamroot.

Management considerations: Dallesport soils have coarse textures in the lower horizons which limits water holding capacity and root development. Large stones in the lower profile may limit some uses.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/D/DALLESPORT.html

EBEYS SERIES

Ebeys soils are in the green-colored area



Location of Ebeys soils

EBEYS SERIES

Land Resource Region A

Parent material: Wind-blown and glacially deposited sands

Extent: Small extent

Climate: Average annual precipitation is about 22 inches, and the average annual soil temperature is about50 degrees F. The climate is characterized by warm, moist summers and cool, wet winters.

Depth: 60 inches or more

Drainage: Moderately well drained

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 25 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Sandy, isotic, mesic Aquulatic Haploxerolls

Ebeys soils are on sand dune remnants and plains in San Juan County, Washington.

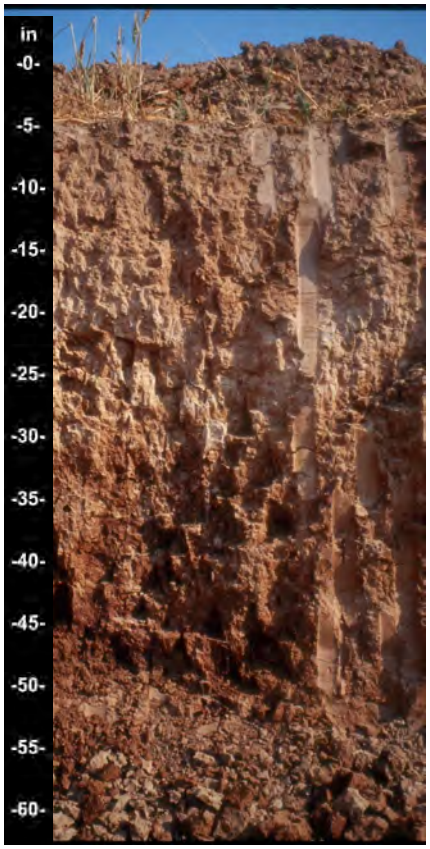
Uses: Crop production, livestock grazing, and wildlife habitat. Common crops include wheat, oats, barley, alfalfa, and vegetables for produce and for seed. The natural vegetation is scattered Oregon white oak and Douglas-fir. Understory is prairie grasses, western brackenfern, camas, chocolate lily, common snowberry, and trailing blackberry.

Management considerations: Ebeys soils have a water table at about 40 inches from December to February and this water should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/E/EBEYS.html

FREEMAN SERIES

Freeman soils are on gentle slopes in convex positions



A

Bt

2Bt

Location of Freeman soils

FREEMAN SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) of different ages with small amounts of volcanic ash mixed into the surface

Extent: Moderately extensive

Climate: Average annual precipitation is about 23 inches, and average annual soil temperature is about 46 degrees F. The climate is characterized by warm, dry summers and cool, wet winters

Depth: 60 inches or more

Drainage: Moderately well drained

Average frost-free period: 100 to 130 days

Elevation: 2,400 to 2,800 feet

Soil Order: Alfisols - strongly weathered soils with zones of clay accumulation

Family classification: Fine-silty, mixed, superactive, mesic Aquandic Palexeralfs

Freeman soils are on undulating to rolling hills in Spokane County, Washington, and they may also be in northern Idaho.

Uses: Crop production and livestock grazing. Cultivated areas are used to produce small grains, alfalfa, and grass. Natural vegetation is ponderosa pine and scattered Douglas-fir with grasses and shrubs, but most areas have been cleared.

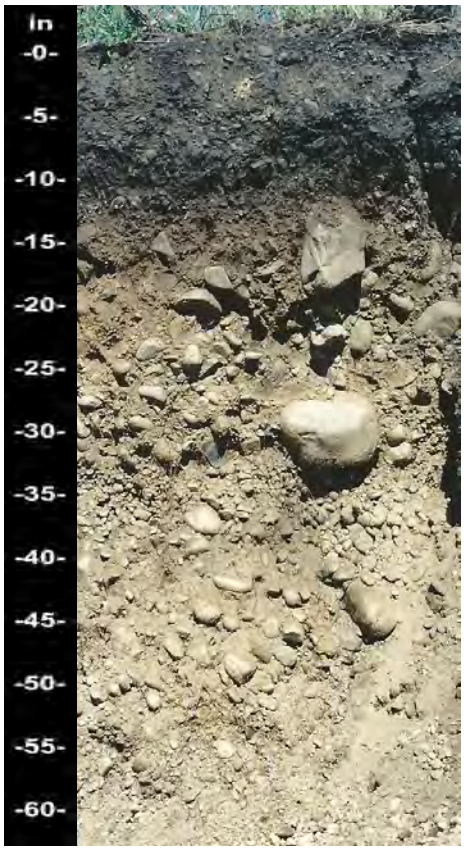
Management considerations: A seasonal perched high water table occurs at 15 to 20 inches below the surface from January through April in most years. Clay in the Freeman soils shrink and swell when wetted and dried which limits management..

Laboratory data are available at: Spokane County, Washington SOI-WA-063-002; NSSL, Lincoln, NE. Pedon number is 02N0113.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/F/FREEMAN.html

GARRISON SERIES

Garrison soils occur on the flat urbanized area



A

2B

2C

Location of Garrison soils

GARRISON SERIES

Land Resource Region E

Parent material: Glacial outwash with minor amounts of volcanic ash in the upper part

Extent: Moderate extent

Climate: Average annual precipitation is about 21 inches, and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cool, moist winters

Depth: 60 inches or more

Drainage: Somewhat excessively drained

Average frost-free period: 120 to 170 days

Elevation: 1,400 to 2,800 feet

Soil order: Mollisols - grassland soils that have a dark-colored surfaces and high natural fertility

Family classification: Loamy-skeletal, mixed, superactive, mesic Vitrandic Haploxerolls

Garrison soils are in Washington and Idaho. In Washington, they are on outwash terraces and terrace escarpments in Okanogan, Stevens, and Spokane Counties. In Idaho, they are in Kootenai County.

They are used for irrigated and nonirrigated crop production, urban development, livestock grazing, and timber production. Cultivated areas are used to produce alfalfa, grass seed, and small grains. Natural vegetation is scattered ponderosa pine, shrubs, and grasses.

Management considerations: Garrison soils have low water holding capacity because of the rock content but otherwise this soil has few limitations for most uses.

Garrison soils occur above the aquifer that supplies drinking water to the urban areas of Spokane and Spokane Valley, Washington and Post Falls and Coeur d'Alene, Idaho.

The official soil series description is available at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/G/GARRISON.html

GREHALEM SERIES

Grehalem soils are in foreground.

A

C1

C2

Location of Grehalem soils

GREHALEM SERIES

Land Resource Region A

Parent material: Alluvium

Extent: Moderately extensive

Climate: Average annual precipitation is about 115 inches, and average annual soil temperature is about 50 degrees F. The climate is characterized by cool, moist summers and wet, cool winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 180 to 220 days

Elevation: 0 (sea level) to 100 feet

Soil order: Entisols - young soils with very limited weathering and horizon development

Family classification: Fine-loamy, isotic, nonacid, isomesic Typic Udifluvents

Grehalem soils are in floodplains in Grays Harbor, Pacific, and Wahkiakum Counties, Washington.

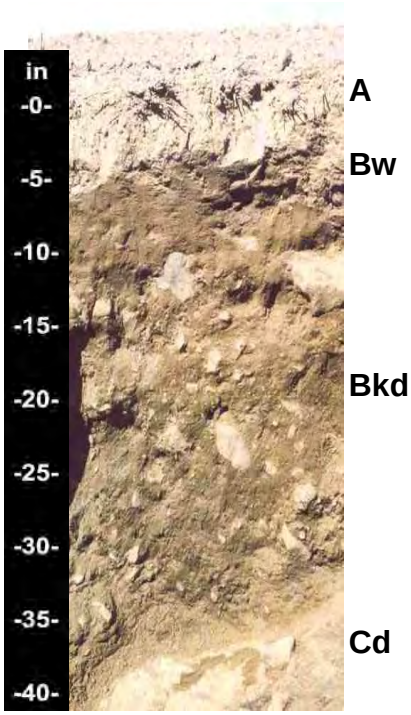
Uses: Hayland, pastureland, and crop production. They are used to produce silage crops. Natural vegetation is maple, red alder, and western hemlock with a dense understory of shrubs.

Management considerations: Grehalem soils are subject to annual flooding from stream overflow during spring. Flooding potential should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/G/GREHALEM.html

HEYTOU SERIES

Heytou soils are on the flat area in the foreground



Location of Heytou soils

HEYTOU SERIES

Land Resource Region B

Parent material: Glacial till mixed with wind-blown silt (loess) in the upper part

Extent: Extensive

Climate: Average annual precipitation is about 11 inches, and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 20 to 40 inches to dense glacial till

Drainage: Well drained

Average frost-free period: 130 to 180 days

Elevation: 1,000 to 3,000 feet

Soil order: Mollisols - grassland soils that have dark-colored surfaces and high natural fertility

Family classification: Loamy-skeletal, mixed, superactive, mesic Calcidic Haploxerolls

Heytou soils are on plains in Douglas County, Washington.

Uses: Livestock grazing and crop production.

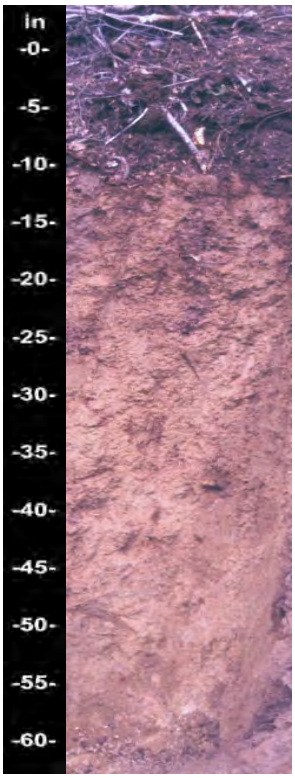
Cultivated areas are used for small grain production. Natural vegetation is bluebunch wheatgrass, needandthread, buckwheat, arrowleaf balsamroot, phlox and Wyoming big sagebrush.

Management considerations: Heytou soils are subject to both wind and water erosion when on steep slopes because the loess surface. The dense layer at 20 to 40 inches restricts root development and water movement. It also reduces water holding capacity.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/H/HEYTOU.html

ILWACO SERIES

Ilwaco soils are on the ridges in the foreground



O

A

Bw1

Bw2

Location of Ilwaco soils

ILWACO SERIES

Land Resource Region A

Parent material: Weathered siltstone, sandstone, and conglomerate

Extent: Small extent

Climate: Average annual precipitation is about 90 inches, and average annual soil temperature is about 48 degrees F. The marine climate is characterized by cool, dry summers and cool, wet winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 160 to 220 days

Elevation: 0 (sea level) to 1,200 feet

Soil order: Andisols - these soils formed in materials that weather to have properties of volcanic soils.

Family classification: Medial, ferrihydritic, isomesic Typic Fulvudands

Ilwaco soil are on uplands in Clallam and Grays Harbor, Counties, Washington.

Uses: Tiber production, wildlife habitat, recreation and watershed (storing water for summer use). Natural vegetation includes western hemlock, Sitka spruce, western redcedar, and red alder. Understory vegetation is mainly Swordfern, salal, red huckleberry, salmonberry, blackberry, red elderberry, and vine maple.

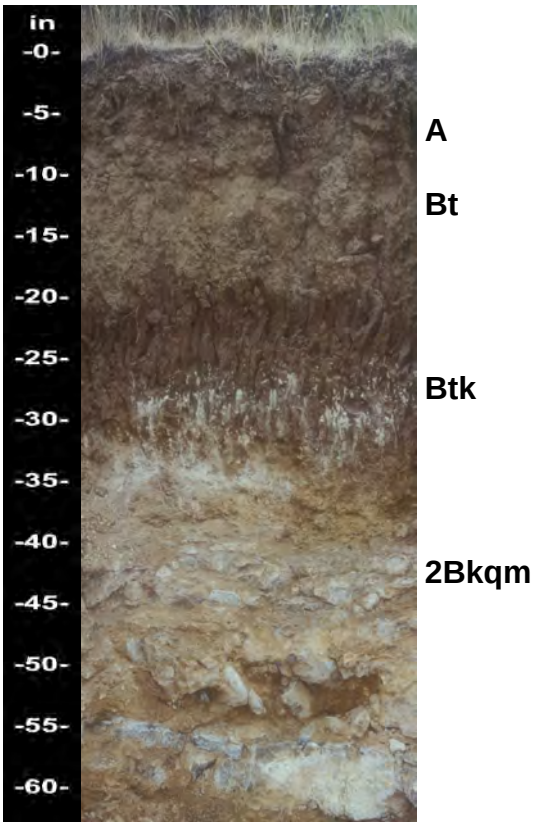
Management considerations: Steep slopes limit timber management in some areas. Timber harvest should be completed when soils are dry.

Laboratory data is available from the National Soil Survey Laboratory in Lincoln, Nebraska. Pedon number S77WA-25-5

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/I/ILWACO.html

MANASTASH SERIES

Manastash soils are in the foreground



Location of Manastash soils

MANASTASH SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) and alluvium

Extent: Small extent

Climate: Average annual precipitation is about 11 inches, and average annual soil temperature is about 48 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 20 to 40 inches to a cemented layer (duripan)

Drainage: Well drained

Average frost-free period: 130 to 170 days

Elevation: 1,500 to 2,900 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Fine, smectitic, mesic, Abruptic Argiduridic Durixerolls

Manastash soils are on fan and terrace remnants in Kittitas and Yakima Counties, Washington

Uses: Livestock grazing, wildlife habitat, and irrigated crop production. Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Wyoming big sagebrush.

Cultivated areas are used to produce small grains and hay.

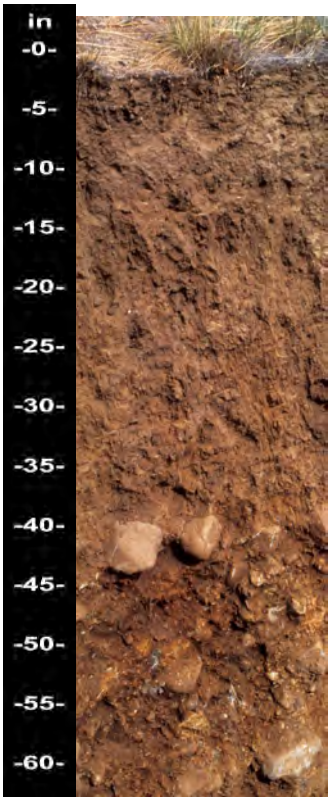
Management considerations: The cemented layer at 20 to 40 inches below the surface restricts root development and water movement. The large amount of clay in the Bt and Btk horizons shrink and swell when wetted and dried. This impacts the development of septic facilities and building foundations.

Laboratory data are available for Manatash soils at the National Soil Survey Laboratory in Lincoln, Nebraska. Samples S92WA03712 and S88WA037009.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/M/MANASTASH.html

MENDIAN SERIES

Mendian Soils are located on the terrace with the hay shed



A

Bt

2Btb

3Btb

Location of Mendian soils

MENDIAN SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) and glacial outwash

Extent: Small extent

Climate: Average annual precipitation is about 14 inches, and average annual soil temperature is about 48 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 130 to 150 days

Elevation: 1,650 to 1, 850 feet

Soil order: Mollisols - grassland soils with dark–colored surfaces and high natural fertility.

Family classification: Fine-loamy, mixed, superactive, mesic Ultic Argixerolls

Mendian soils are on terraces in Kittitas County, Washington.

Uses: Livestock grazing, wildlife habitat and irrigated crop production.

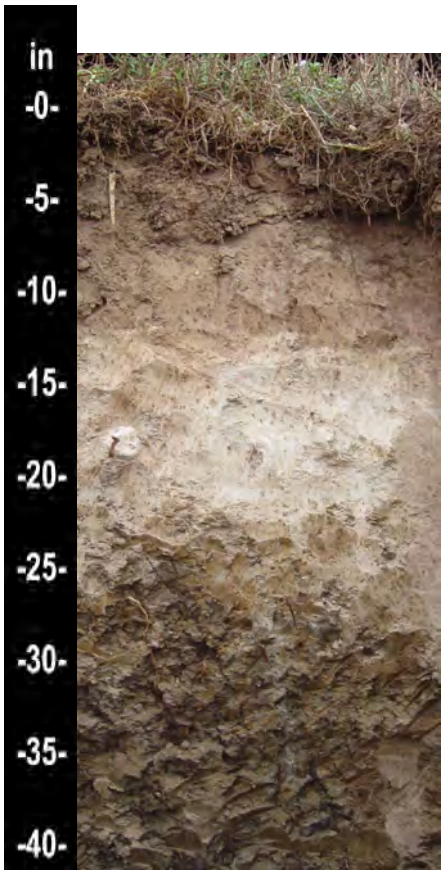
Cultivated areas are used for producing hay.

Management considerations: Mendian soils have high amounts of clay in the lower profile which shrink and swell as the soil profile wets and dries. This limits management opportunities.

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/M/MENDIAN.html

MITCHELLBAY SERIES

Mitchellbay soils are on the gently sloping area in the foreground



A

Bw

E

Btg

Cd

Location of Mitchellbay soils

MITCHELLBAY SERIES

Land Resource Region A

Parent Material: Glacial drift over dense glaciomarine deposits

Extent: Moderately extensive

Climate: Average annual precipitation is about 25 to 40 inches, and average annual soil temperature is about 48 to 50 degrees F. The climate is characterized by warm dry summers and mild moist winters.

Depth: 20 to 40 inches to a dense layer

Drainage: Somewhat poorly drained

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 500 feet

Soil order: Alfisols - strongly weathered soils with zones of clay accumulation.

Family classification: Fine-loamy, mixed, superactive, mesic Aquultic Haploxeralfs

Mitchellbay soils are in valleys and glacial drift plains in San Juan County, WA. They may also occur in other areas around Puget Sound. Natural vegetation consists of western redcedar, bigleaf maple, Douglas-fir and grand fir. Swordfern, deerfern, stinging nettle, and snowberry are in the understory.

Uses: Timber production. Most areas have been cleared and are used for pasture, forage crop production, and forestry.

Management considerations: Mitchellbay soils have restricted drainage, high water table, and dense layers in lower profile. Soil wetness limits management opportunities.

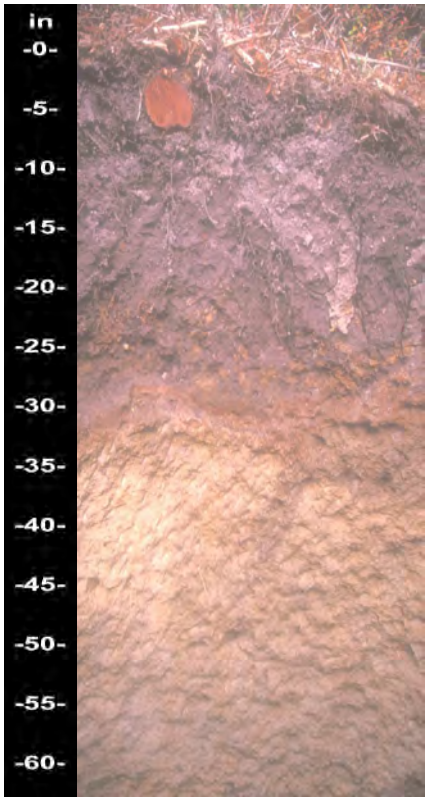
A seasonal perched water table occurs at 9 or 10 inches to 20 inches below the surface most of the time. The lower horizons have restricted water movement and are dense, hard to excavate, and restrict drainage.

Laboratory data are available for this soil: National Soil Survey Laboratory pedon number 03N0236.

The Official Soil Series Description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/M/MITCHELLBAY.html

MOCLIPS SERIES

Moclips soils are on the flat area in the foreground

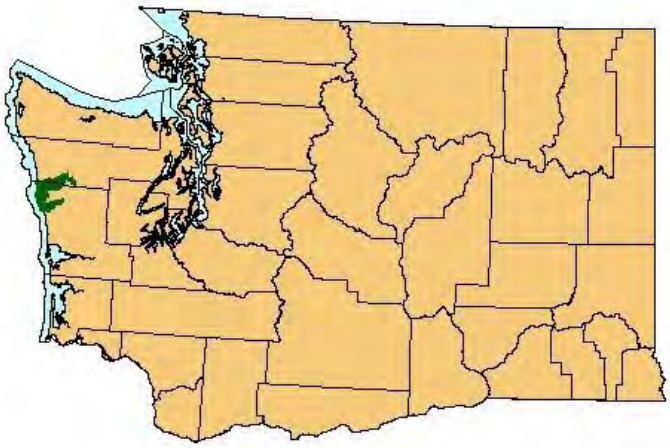


A

Bsm

Bg

2Cg



Location of Moclips soils

MOCLIPS SERIES

Land Resource Region A

Parent material: Glacial lake deposits over glacial outwash.

Extent: Moderately extensive

Climate: Average annual precipitation is about 100 inches, and average annual soil temperature is about 48 degrees F. The climate is characterized by cool, moist summers and cool, wet winters.

Depth: 12 to 20 inches to a cemented layer

Drainage: Poorly drained

Average frost-free period: 180 to 220 days

Elevation: 50 to 750 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development.

Family classification: Loamy, mixed, superactive, isomesic, shallow Placic Petraquerts

Moclips soils are on glacial outwash terraces in areas of the Olympic Peninsula in Washington State (Grays Harbor County and the Quinault Indian Reservation). Vegetation is mainly shore pine, Sitka spruce, western red cedar and western hemlock. The understory is Salmonberry, ferns and evergreen and red huckleberries.

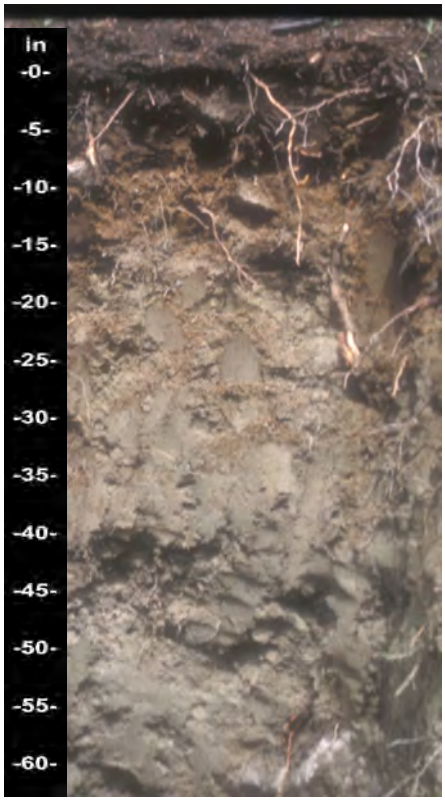
Uses: Timber production and wildlife habitat.

Management considerations This soil has a cemented horizon above 12 inches below the surface and these soils are saturated to the surface from March to May. Water movement is restricted in the lower profile. The perched water table should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/M/MOCLIPS.html

MYERSCREEK SERIES

Myerscreek soils are in the foreground



2A

2Bw

3Cd

Location of Myerscreek soils

MYERSCREEK SERIES

Land Resource Region E

Parent material: Glacial till with a mantle of volcanic ash

Extent: Moderate extent

Climate: Average annual precipitation is about 30 inches, and average annual soil temperature is about 39 degrees F. The climate is characterized by cool, dry summers and cold, wet winters.

Depth: 20 to 40 inches to a dense layer

Drainage: Well drained

Average frost-free period: 60 to 90 days

Elevation: 3,400 to 6,800 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development

Family classification: Loamy-skeletal, isotic Haploxerandic Haplocryepts

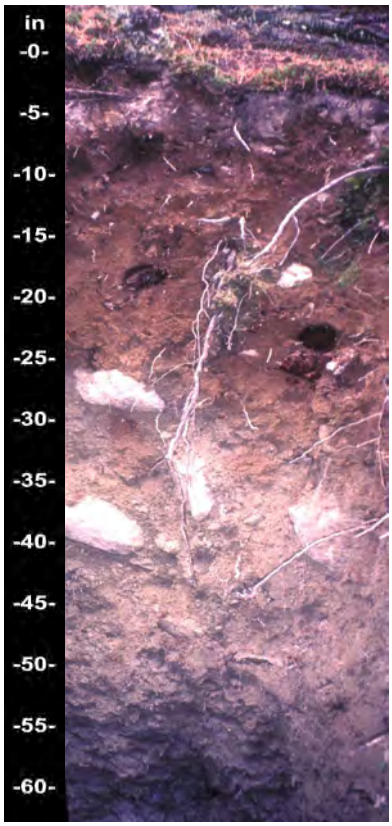
Myerscreek soils are on moraines and on glaciated mountains in Washington and Montana. In Washington they are in Ferry and Okanogan Counties. In Montana, they are in Beaverhead County. They are used for timber production, livestock grazing, recreation, wildlife habitat and watershed (storing water for summer use). The natural vegetation is subalpine fir, western hemlock, Douglas-fir, and Englemann spruce. The understory vegetation is grouse blueberry and mountain huckleberry.

Management considerations: A dense layer occurs at 20 to 40 inches which limits water storage and root penetration and steep slopes impact forest harvest management.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/M/MYERSCREEK.html

NEVINE SERIES

Nevine soils are on the slope in the foreground



O
A

Bw

2C

2Cd

Location of Nevine soils

NEVINE SERIES

LRR E

Parent material: Volcanic ash over glacial till

Extent: Extensive

Climate: Average annual precipitation is about 20 inches, and average annual soil temperature is about 43 degrees F. The climate characterized by warm, dry summers and cool, moist winters.

Depth: 20 to 40 inches to a dense layer

Drainage: Well drained

Average frost-free period: 85 to 120 days

Soil order: Andisols - soils formed by the weathering of volcanic materials

Family classification: Ashy over loamy-skeletal, glassy over isotic, frigid Typic Vitrixerands

Nevine soils are on moraines, foothills, and mountains in Washington and Montana. They are in Okanogan and Ferry Counties, Washington. They are in Sanders County, Montana. Vegetation is Douglas fir and lodgepole pine. Understory vegetation is mallow ninebark, common snowberry, elksedge, and pinegrass.

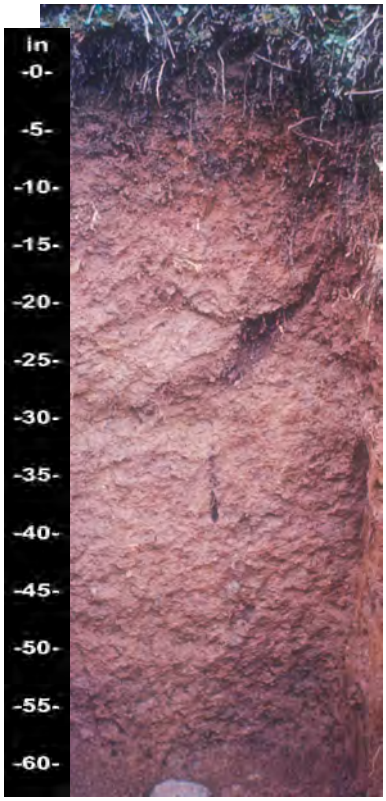
Uses: Timber production, livestock grazing, and small areas have been cleared and are used for cropland.

Management considerations: A dense layer occurs at 20 to 40 inches below the surface which restricts water movement and root development. Timber harvest should be completed when the soils are dry so the surface layers are not compacted.

The official soil series description is online at:
http://soilseries.sc.egov.usda.gov/OSD_Docs/N/NEVINE.html

OLYMPIC SERIES

Olympic soils are in the foreground



A

Bt

Location of Olympic soils

OLYMPIC SERIES

Land Resource Region A

Parent material: Residuum and colluvium weathered from basalt

Extent: Extensive

Climate: Average annual precipitation is about 60 inches, and average annual soil temperature is about 52 degrees F. The marine climate is characterized by cool, dry summers and mild, wet winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 150 to 200 days

Elevation: 200 to 2,000 feet

Soil order: Ultisols - highly weathered soils with the base elements leached out

Family classification: Fine, mixed, active, mesic Xeric Palehumults

Olympic soils are on tops of foothills and mountains in Clark, Cowlitz, Grays Harbor, Thurston, and Wahkiakum Counties, Washington. Natural vegetation is Douglas-fir, red alder, western hemlock, western red cedar, and bigleaf maple. Understory is salal, vine maple, western Swordfern, Oregon-grape, western bracken-fern, huckleberry and trailing blackberry.

Uses: Timber production

Management considerations: Steep slopes in some areas impact forest management.

Laboratory data are available form the National Soil Survey Laboratory. Sample Numbers: S72WA-21-1, S72WA-21-2, S72WA-21-3, S84WA-015-001, and S84WA015-006

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/O/OLYMPIC.html

PALOUSE SERIES

Palouse soils occur on south-facing slopes

A

AB

Bw

Location of Palouse soils

PALOUSE SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) and small amounts of volcanic ash.

Extent: Extensive

Climate: Average annual precipitation is about 21 inches, and average annual soil temperature is about 48 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 100 to 160 days

Elevation: 1,600 to 4,500 feet

Soil order: Mollisols - grassland soils that have a dark-colored surface layers and high fertility.

Family classification: Fine-silty, mixed, superactive, mesic, Pachic Ultic Haploxerolls

Palouse soils occur on hills in Washington, Idaho, and Oregon. They are in Walla Walla, Columbia, Garfield, Whitman and Spokane Counties, Washington. They are in Union and Umatilla Counties, Oregon. They are in Latah, Benewah, and Nez Perce Counties, Idaho.

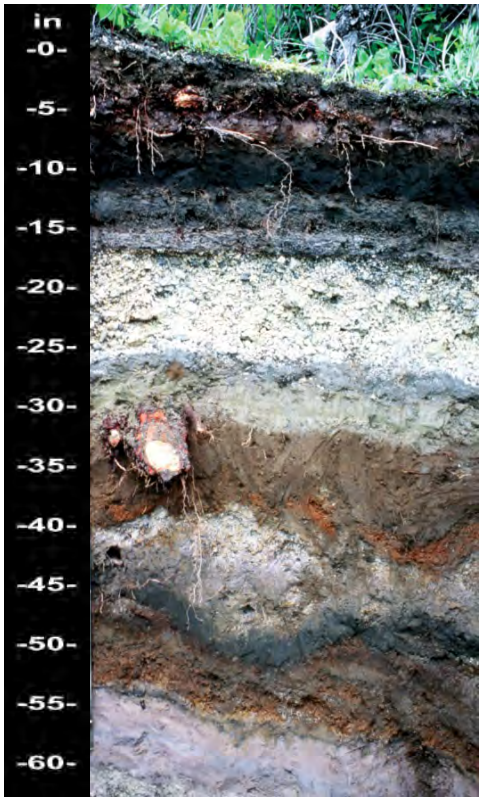
Uses: They are used mainly for crop production. They produce small grains, peas, lentils, alfalfa, and some areas are used to produce grasses for hay and pasture. Natural vegetation is prairie grasses like Idaho fescue, bluebunch wheatgrass and bluegrass. Arrowleaf balsamroot, snowberry and wild rose are also common. Areas of natural vegetation are extremely scarce because of farming pressures.

Management considerations: Steep slopes and volcanic ash in surface layers make Palouse soils susceptible to water erosion.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PALOUSE.html

PELEE SERIES

Pelee soils occur in the foreground



Location of Pelee soils

PELEE SERIES

Land Resource Region A

Parent material: Air deposited, stratified volcanic ash and pumice

Extent: Small extent

Climate: Average annual precipitation is about 135 inches, and average annual soil temperature is about 39 degrees F. The climate is characterized by cool, moist summers and cold, wet winters.

Depth: 60 inches or more

Drainage: Well drained

Average frost-free period: 75 to 90 days

Elevation: 2,800 to 4,500 feet

Soil order: Andisols - soils formed from the weathering of volcanic materials

Family classification: Ashy over pumiceous or cindery, glassy Typic Vitricryands

Pelee soils are on mountain slopes and ridge tops in Skamania, Lewis, Pierce, and Yakima Counties, Washington. Natural vegetation is Douglas-fir, Pacific silver fir, western hemlock, and western red cedar. Understory is vine maple, willow, huckleberry, and western brackenfern.

Uses: Timber production, recreation, wildlife habitat and watershed (store snow pack for summer water supplies).

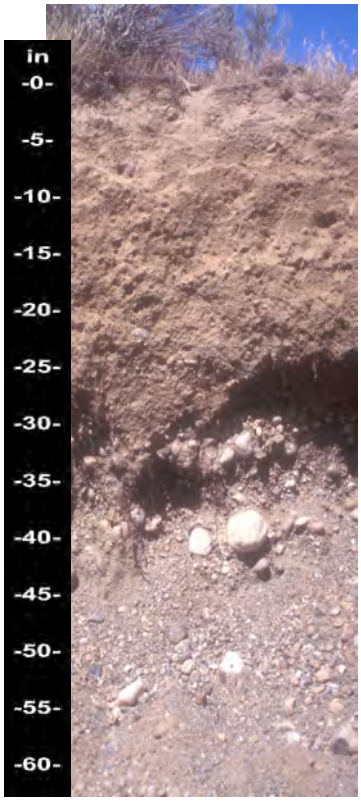
Management considerations: Pelee soils compact easily and are droughty because of the coarse textures.

Laboratory data is available for the Pelee series at the National Soil Survey Laboratory. Sample number S81WA-059-005

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/PELEE.html

POGUE SERIES

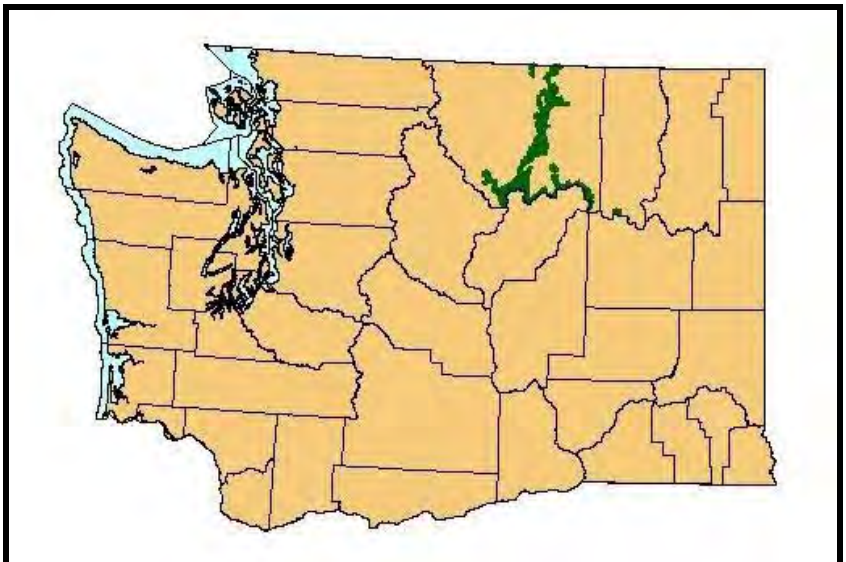
Pogue soils are in the foreground



A

B
w

2C



Location of Pogue soils

POGUE SERIES

Land Resource Region E

Parent material: Wind-blown silt (loess) and glacial outwash

Extent: Moderate extent

Climate: Average annual precipitation is about 10 inches, and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cold, moist winters.

Depth: 60 or more inches

Drainage: Somewhat excessively drained

Average frost-free period: 140 to 190 days

Elevation: 600 to 2,000 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Coarse-loamy over sandy or sandy-skeletal, mixed, superactive mesic Aridic Haploxerolls

Pogue soils are on terraces and terrace escarpments in Douglas and Okanogan Counties, Washington.

Uses: Livestock grazing, wildlife habitat, irrigated crop production and homesites.

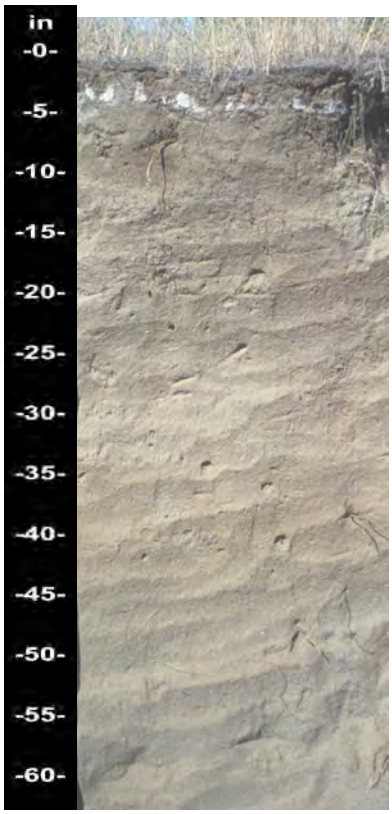
Cultivated areas are used to produce orchard crops, small grains, hay, and pasture. Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, arrowleaf balsam-root, Wyoming big sagebrush, and threetip sagebrush.

Management considerations: Sand and gravel at depths of 20 to 40 inches below the surface limit soil water holding capacity.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/P/POGUE.html

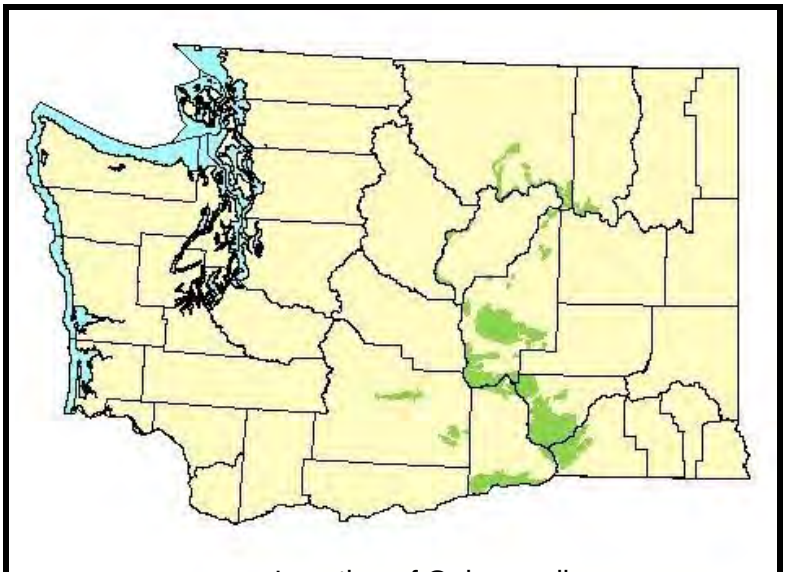
QUINCY SERIES

Quincy soils are in the foreground



A

C



Location of Quincy soils

QUINCY SERIES

Land Resource Region B

Parent material: sand containing a large percentage of dark basalt sand

Extent: Extensive

Climate: Average annual precipitation is about 10 inches, and average annual soil temperature is about 52 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: Very deep

Drainage: Excessively drained

Average frost-free period: 130 to 200 days

Elevation: 150 to 2,800 feet

Soil order: Entisols - soils with very limited weathering or soil development

Family classification: Mixed, mesic Xeric Torriorthents

Quincy soils are on uplands and terraces some of which have hummocky or dune microrelief. They are in Washington, Oregon, Idaho, and a few acres are mapped in California. In Washington, they are in Adams, Benton, Douglas, Franklin, Klickitat, Walla Walla, and Yakima Counties. In Idaho, they are in Ada, Canyon, Elmore, Jerome, Gooding, Cassia, and Power Counties. In Oregon, they are in Gilliam, Morrow, Umatilla, and Sherman Counties.

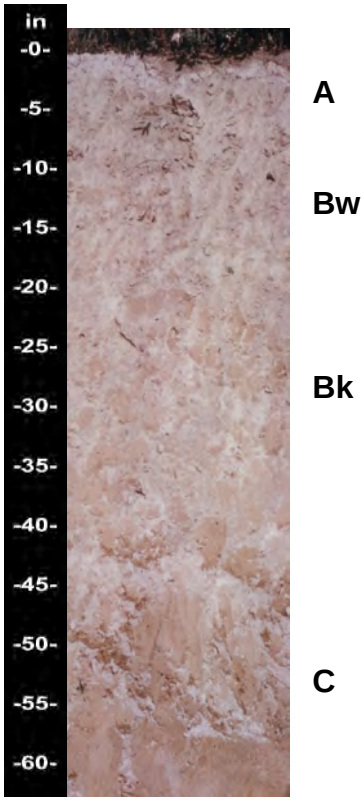
Uses: Livestock grazing and irrigated crop production. Cultivated areas are used for potatoes, hay, pasture, small grain, grapes, and tree fruits. Natural vegetation is grasses, fourwing saltbrush, Antelope bitterbrush, and Wyoming big sagbrush.

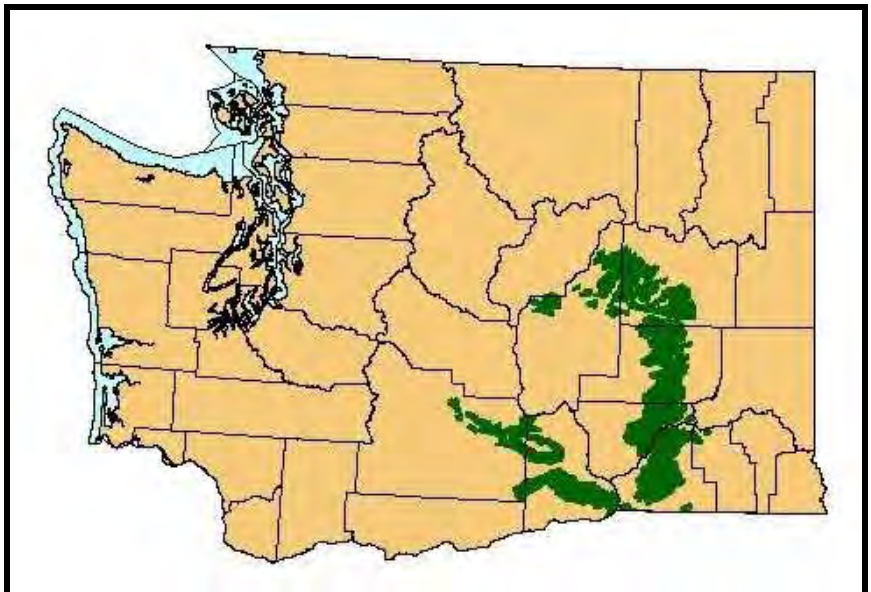
Management considerations: Quincy soils have low water holding capacity because of the sandy textures. Irrigation water must be used to produce crops.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/Q/QUINCY.html

RITZVILLE SERIES

Ritzville soils are on the broad ridge tops in the foreground





Location of Ritzville soils

RITZVILLE SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) with small amounts of volcanic ash in the surface

Extent: Extensive

Climate: Average annual precipitation is about 10 inches and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 130 to 180 days

Elevation: 700 to 3,000 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Coarse-silty, mixed, superactive, mesic Calcidic Haploxerolls

Ritzville soils are on uplands and ridges. They are in Washington and Oregon. In Washington they are in Adams, Benton, Douglas, Franklin, Grant, Walla Walla, Whitman, and Yakima Counties. In Oregon they are in Gilliam, Morrow, Sherman, and Umatilla Counties.

Uses: Crop production and some livestock grazing.

Cultivated areas are used to produce small grains, peas, and lentils.

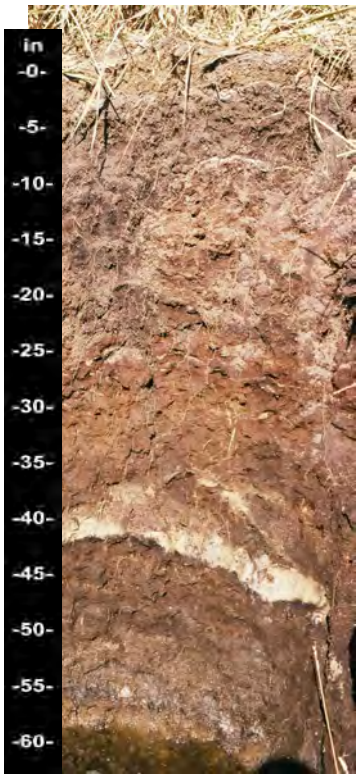
Management considerations: Low organic matter content in the surface horizon makes these soils susceptible to wind and water erosion. Steep slopes in some areas limit management,

Laboratory data are available from the National Soil Survey Laboratory in Lincoln, Nebraska. Pedon numbers 40A0964, 40A0981, 92P0077, and 92P0680.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/R/RITZVILLE.html

SALTESE SERIES

Saltese soils are in the low-lying area between the trees in the foreground and the trees in the background

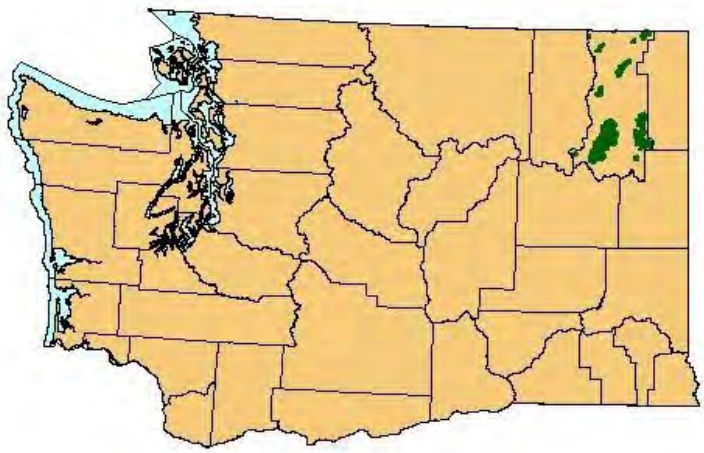


O1

O2

O3

O4



Location of Saltese soils

SALTESE SERIES

Land Resource Region E

Parent material: Decomposed remains of reeds, sedges, and other plant materials

Extent: Moderately extensive

Climate: Average annual precipitation is about 20 inches, and average annual soil temperature is about 47 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Very poorly drained

Average frost-free period: 100 to 130 days

Elevation: 1,000 to 2,500 feet

Soil Order: Histosols - soils formed in organic materials instead of mineral material

Family Classification: Euic, mesic Typic Haplosaprists

Saltese soils are in basins, potholes, river valleys, in the channeled scablands, and around the shore lines of lakes in Stevens and Pend Oreille Counties, Washington. Natural vegetation is sedges, rushes, cattail, alkali cordgrass, and redosier dogwood.

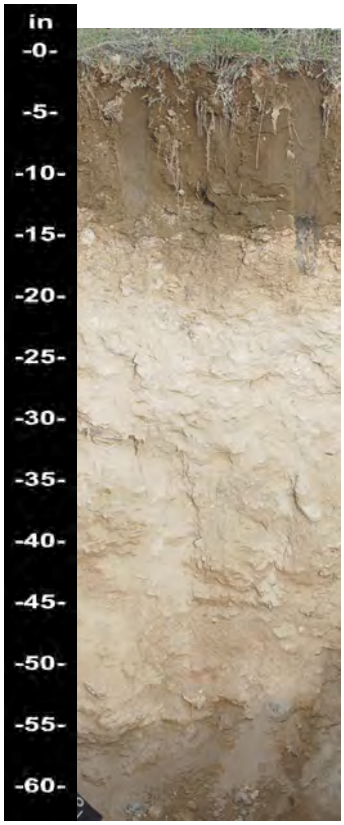
Uses: Wildlife habitat, rangeland, and when drained crop production, hayland, and livestock grazing. Drained areas produce small grains, hay, and pasture.

Management considerations: Saltese soils pond water above the surface at times during December to May. These soils also flood frequently between December and May. The water table is at or near the surface during much of the year so they have limited management unless drained. Saltese soils are unsuitable for building sites because of soil wetness and because the organic material decomposes providing very limited strength.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SALTESE.html

SCOON SERIES

Scoon soils are located in the area producing grapes



A
Bw

Bk

2Bkqm

Location of Scoon soils

SCOON SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) and alluvium

Extent: Moderately extensive

Climate: Average annual precipitation is about 9 inches, and average annual soil temperature is about 50 degrees. The climate is characterized by hot, dry summers and cool, moist winters.

Depth: 10 to 20 inches to a cemented layer (duripan)

Drainage: Well drained

Average frost-free period: 135 to 210 days

Elevation: 800 to 2,300 feet

Soil order: Aridisols - Soils formed in dry climates where natural precipitation limits soil formation and the removal/translocation of soluable materials

Family classification: Loamy, mixed, superactive, mesic, shallow Xeric Haplodurids

Scoon soils are on uplands and terraces in Douglas, Grant, and Yakima Counties, Washington, They are also in Cassia, Elmore, and Jerome Counties, Idaho.

Uses: Livestock grazing and irrigated crop production.

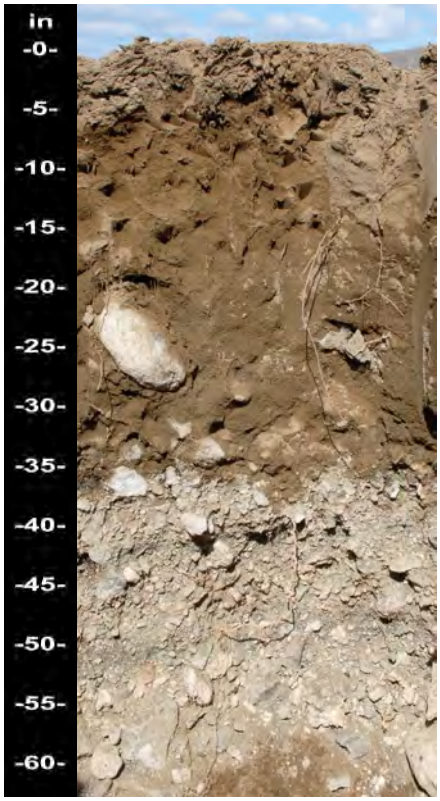
Cultivated areas are used to produce small grains, wine grapes, and vegetable crops. Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Wyoming big sagebrush.

Management considerations: These soils have a hardpan at 10 to 20 inches that limits root development and water storage capacity for most crops.

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SCOON.html

SCOOTENEY SERIES

Scooteney soils are in the foreground



Location of Scooteney soils

SCOOTENY SERIES

Land Resource Region B

Parent material: Alluvium

Extent: Moderately extensive

Climate: Average annual precipitation is about 8 inches, and average annual soil temperature is about 51 degrees. The climate is characterized by hot, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 135 to 170 days

Elevation: 400 to 1,300 feet

Soil order: Aridisols - soils formed in dry climates where natural precipitation limits soil formation and removal/translocation of soluable materials.

Family classification: Coarse-loamy, mixed, superactive, mesic Xeric Haplocambids

Scooteney soils are on alluvial fans and terraces in Adams, Benton, Grant, Klickitat, and Yakima Counties, Washington.

Uses: Livestock grazing and irrigated crop production.

Cultivated areas are used to produce vegetable crops, small grains, wine grapes, and hay. Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Wyoming big sagebrush.

Management considerations: Sand and gravel are at depths of 20 to 40 inches below the surface and large rock fragments in the subsoils limits water storage capacity. Scooteney soils have few limitations for most uses.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SCOOTENEY.html

SEATTLE SERIES

Seattle soils are in the depression in the foreground

O1

O2

O3

Location of Seattle soils

SEATTLE SERIES

Land Resource Region A

Parent material: Decomposing and decomposed herbaceous and woody material

Extent: Moderately extensive

Climate: Average annual precipitation is about 40 inches, and average annual soil temperature is about 50 degrees F. The climate is characterized by a marine climate with cool, dry summers and mild, wet winters.

Depth: 60 or more inches

Drainage: Very poorly drained

Average frost-free period: 150 to 250 days

Elevation: 0 (sea level) to 1,000 feet

Soil order: Histosols - soils formed in organic materials instead of mineral materials.

Family classification: Euic, mesic Hemic Haplosaprists

Seattle soils are in depressions in river valleys and glacial till plains in Jefferson, King, Pierce, San Juan, Skagit, Snohomish, and Thurston Counties, Washington.

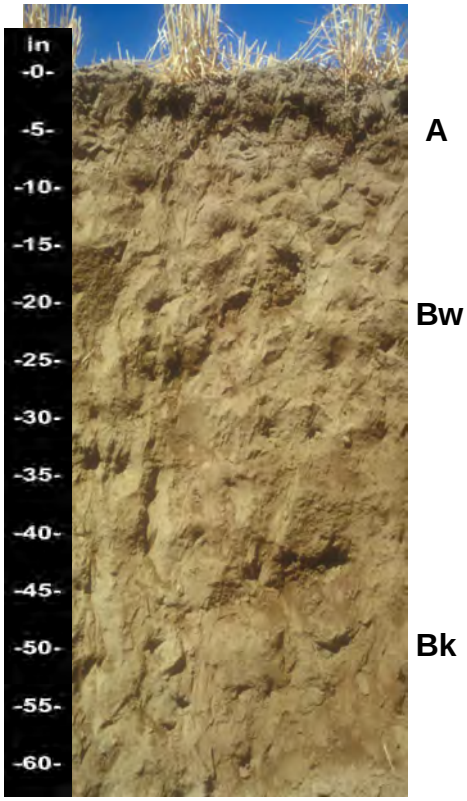
Uses: Wildlife habitat and where cleared and drained, crop production, and livestock grazing. Cultivated areas are used to produce hay, corn silage, blueberries, and vegetable crops. Natural vegetation is red alder, western red cedar, black cotton-wood, and Sitka spruce, Understory is sedge, rushes, cattail, trailing blackberry, red elderberry, devilsclub, trillium, and ladyfern.

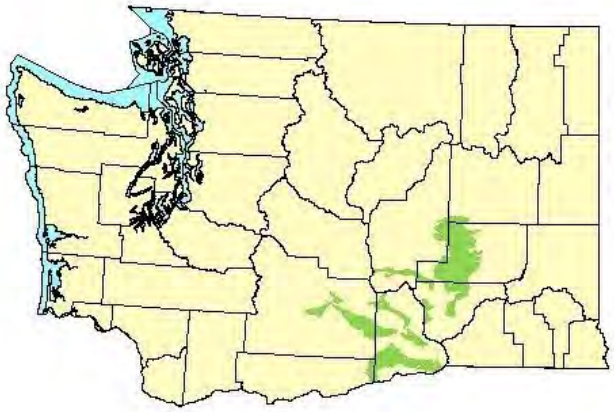
Management considerations: Seattle soils must be drained to be used for crop production. These soils are unsuitable for building sites because of soil wetness and because the organic material decomposes providing very limited strength. These soils, where undrained, are saturated with water for most of the year.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SEATTLE.html

SHANO SERIES

Shano soils are in the foreground





Location of Shano soils

SHANO SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) and small amounts of volcanic ash

Extent: Extensive

Climate: Average annual precipitation is about 8 inches, and average annual soil temperature is about 50 degrees F. The climate is semiarid with warm, dry summers and cool, moist winters

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 120 to 200 days

Elevation: 500 to 2,300 feet

Soil order: Aridisols - soils formed in dry climates where natural precipitation limits soil formation and removal / translocation of soluable materials

Family classification: Coarse-silty, mixed, superactive, mesic Xeric Haplocambids

Shano soils are on terraces, uplands, plateaus and hills. They are in Washington, Idaho, and Oregon. In Washington, they are in Adams, Benton, Franklin, Grant, Klickitat, Lincoln, and Yakima Counties. In Oregon, they are in Umatilla County. In Idaho, they are in Elmore and Jerome Counties. Natural vegetation is Wyoming big sagebrush, bluebunch wheatgrass, Sandberg bluegrass, and Idaho fescue.

Uses: Dryland wheat production but some areas are used for irrigated crop production including orchards, and other areas are used for livestock grazing.

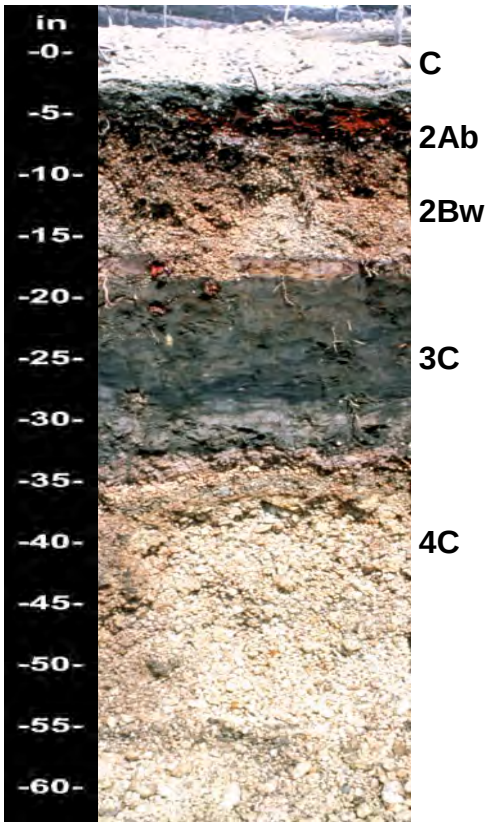
Management considerations: Steep slopes in some areas can limit management for some uses

Laboratory data are available at the National Soil Survey Laboratory: Pedon number S61 Wash-13-14-(1-6)

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SHANO.html

SINNICE SERIES

Sinnice soils are in the foreground



Location of Sinnice soils

SINNICE SERIES

Land Resource Region A

Parent material: volcanic ash and pumice

Extent: Small extent

Climate: Average annual precipitation is about 125 inches, and average annual soil temperature is about 40 degrees F. The climate is characterized by cool, moist summers and cold, wet winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 75 to 90 days

Elevation: 2,800 to 5,000 feet

Soil order: Andisols - soils formed from the weathering of volcanic materials

Family classification: Ashy over pumiceous or cindery, glassy Thaptic Vitricryands

Sinnice soils are on mountain slopes in Cowlitz, King, Lewis, and Skamania Counties, Washington.

Uses: Timber production, recreation, wildlife habitat, and watershed

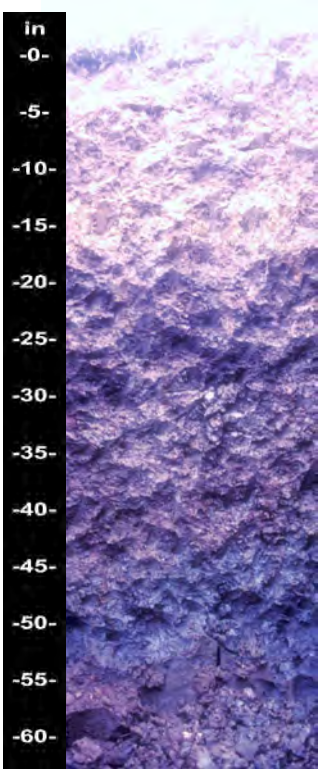
Natural vegetation is Douglas-fir, western hemlock, and Pacific Silver fir, Understory is western brackenfern, red huckleberry, vine maple, Sitka alder and willow.

Management considerations: Steep slopes in some areas limit forest management. Volcanic ash in the profile compacts during timber harvest when wet. Harvest operations should be done when these soils are dry.

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SINNICE.html

SKAGIT SERIES

Skagit soils are in the foreground (Photo from Wikipedia)



A

Bg

Cg

Location of Skagit soils

SKAGIT SERIES

Land Resource Region A

Parent material: Alluvium and volcanic ash

Extent: Moderately extensive

Climate: Average annual precipitation is about 32 inches, and average annual soil temperature is about 51 degrees. The marine climate is characterized by warm, moist summers and cool, wet winters.

Drainage: Poorly drained

Average frost-free period: 160 to 210 days

Elevation: 5 to 50 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development

Family classification: Fine-silty, mixed, superactive, nonacid, mesic Fluvaqentic Endoaquepts

Skagit soils are on floodplains in King, Pierce, Skagit, Snohomish, and Whatcom Counties, Washington.

Uses: Crop production

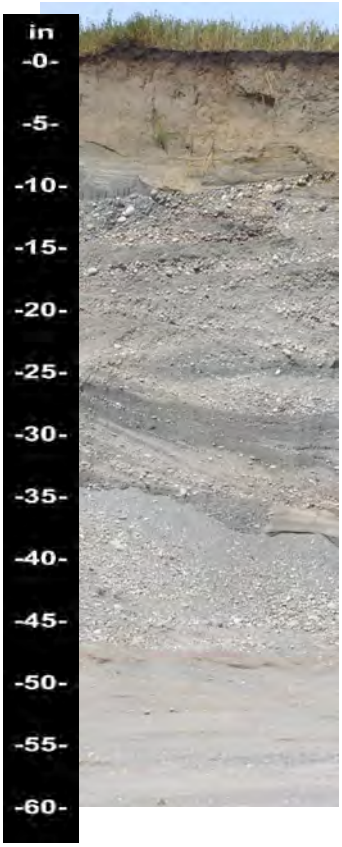
Skagit soils have been cleared and drained, They are used to produce peas, corn, cauliflower, flower bulbs, and green chop. Natural vegetation is western red cedar, bigleaf maple, willow, sedges, and rushes.

Management considerations: Skagit soils must be drained to produce crops. They also have been diked to protect them from the annual floods. They also have water tables at 6 to 12 inches below the surface during much of each year which should be considered when managing these soils.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SKAGIT.html

SNAKELUM SERIES

Snakelum soils occur in the area in the foreground



A
Bw

2C

Location of Snakelum soils

SNAKELUM SERIES

Land Resource Region A

Parent material: Wind-blown sands and compacted glacial till.

Extent: Small extent

Climate: Average annual precipitation is about 18 to 25 inches, and average annual soil temperature is about 50 to 52 degrees F. The climate is characterized by a marine climate with cool, dry summers and mild, moist winters.

Depth: 60 or more inches

Drainage: Somewhat excessively drained

Average frost-free period: 200 to 240 days

Elevation: 0 (sea level) to 300 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Sandy, isotic, mesic Ultic Haploxerolls

Snakelum soils are on glacial outwash plains in San Juan and Island Counties, Washington and likely occur in other areas around the Puget Sound.

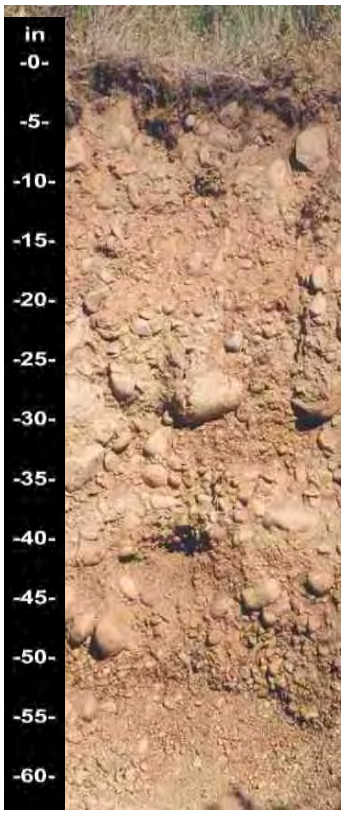
Uses: Homesites, food and forage crop production, wildlife habitat and livestock grazing.

Cultivated areas are used to produce hay and small grain crops. Natural vegetation includes widely spaced Oregon white oak, Pacific madrone, and Douglas-fir but it is mainly prairie vegetation of grasses, shrubs like roses, snowberry, and oceanspray.
.
Management considerations: Snakelum soils have few limitations for most uses. However, Snakelum soils have low water holding capacity because of the sandy texture.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SNAKELUM.html

SPRINGDALE SERIES

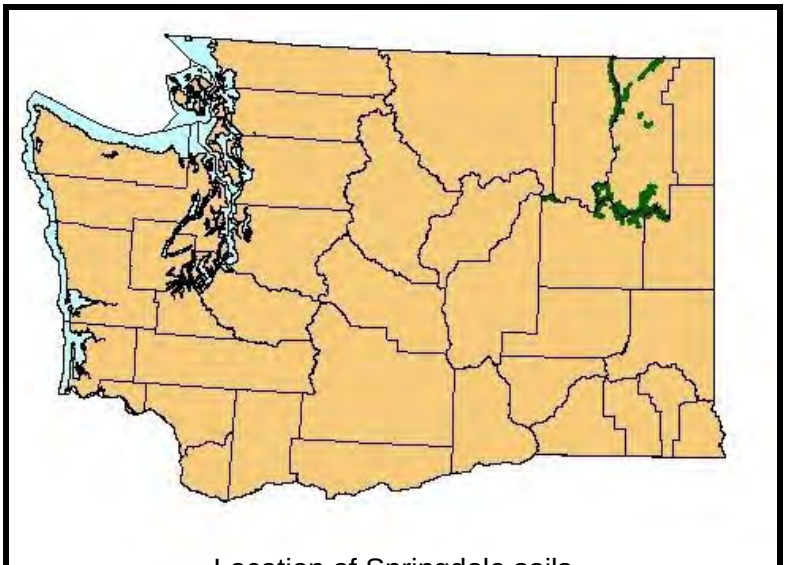
Springdale soils are on the sloping area in the upper part of the landscape



A

Bw

C



Location of Springdale soils

SPRINGDALE SERIES

Land Resource Region E

Parent material: Sandy and gravelly glacial deposits mixed with minor amounts of wind-blown silt (loess) and volcanic ash in the upper part.

Extent: Moderately extensive

Climate: Average annual precipitation is about 19 inches, and average annual soil temperature is about 47 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Somewhat excessively drained

Average frost-free period: 100 to 130 days

Elevation: 1,400 to 4,000 feet

Soil order: Inceptisols - immature soils with weakly expressed features and limited horizon development

Family classification: Sandy-skeletal, isotic, mesic Vitrandic Haploxerepts

Springdale soils are on terrace escarpments in Ferry, Lincoln, Okanogan, Spokane and Stevens Counties, Washington.

Uses: Urban development, timber production, livestock grazing, recreation, and wildlife habitat. Natural vegetation includes ponderosa pine. Understory vegetation includes common snowberry, white spirea, Idaho fescue, bluebunch wheatgrass, arrowleaf balsamroot, and pinegrass.

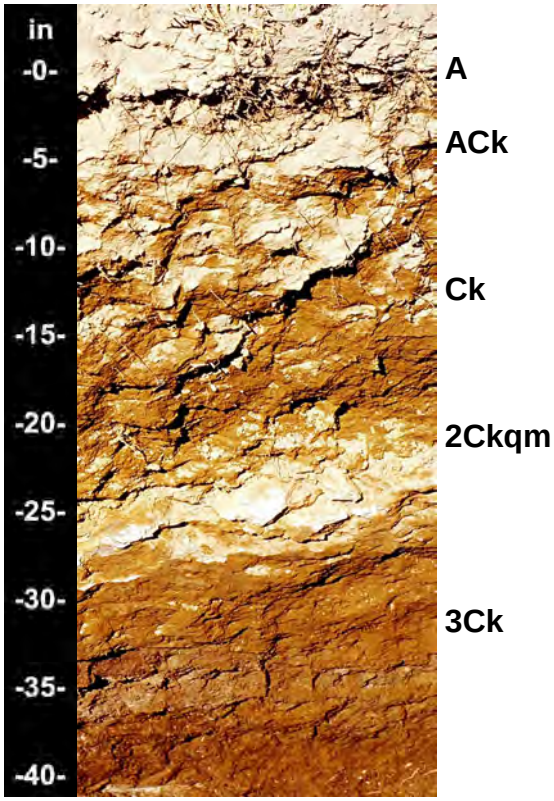
Management considerations: Springdale soils are droughty because of coarse textures and because of the rock fragments in the soil. Steep slopes in some areas limit forest management and other uses.

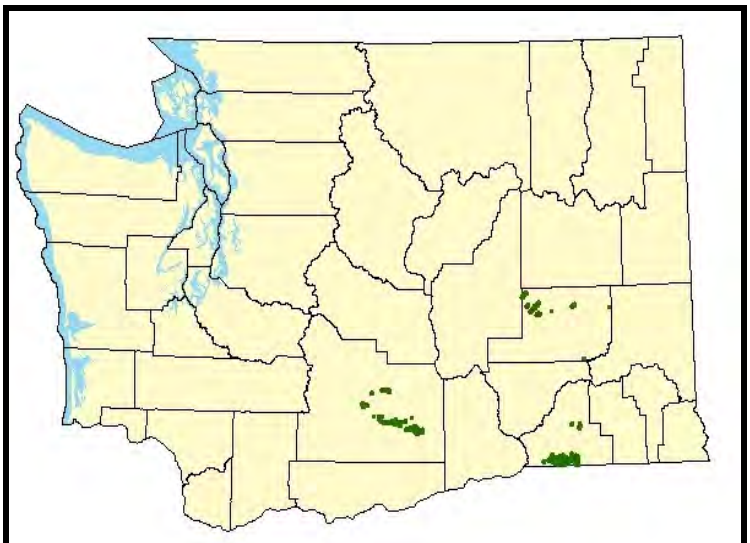
Partial laboratory data is available from the National Soil Survey Laboratory in Lincoln, Nebraska. Pedon number 40A1036 and sample number S57WA063-8

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/SPRINGDALE.html

STANFIELD SERIES

Stanfield Soils are in the foreground





Location of Stanfield soils

STANFIELD SERIES

Land Resource Region B

Parent material: Alluvium from wind-blown silt (loess) and volcanic ash

Extent: Moderately extensive

Climate: Average annual precipitation is about 9 inches, and average annual soil temperature is about 52 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 20 to 40 inches to a cemented layer (duripan)

Drainage: Moderately well drained

Average frost-free period: 120 to 195 days

Elevation: 300 to 3,500 feet

Soil order: Aridisols - soils formed in dry climates where natural precipitation limits soil formation and the removal/translocation of soluable materials.

Family classification: Coarse-silty, mixed, superactive, mesic Aquic Haplodurids

Stanfield soils are on terraces in Adams, Yakima, and Walla Walla Counties, Washington. They are also in Umatilla and Gilliam Counties, Oregon.

Uses: Livestock grazing and irrigated crop production.

Cultivated areas are used to produce small grains, hops, vegetables, and hay. Natural vegetations is saltgrass, giant wildrye, and greasewood.

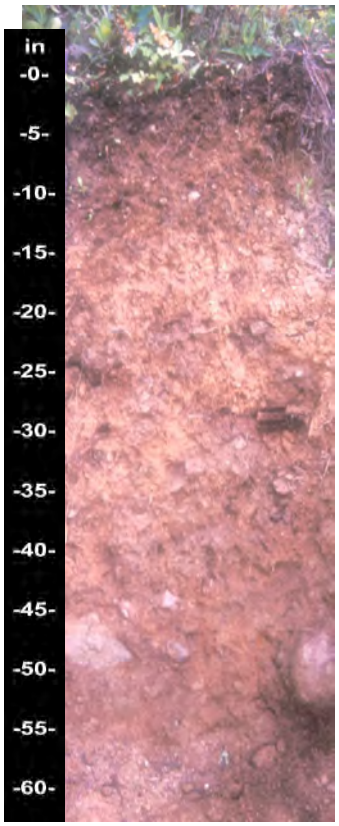
Management considerations: Stanfield soils have concentrations of salts which limit crop selection and plant growth. A cemented layer (duripan) is located at depths of 20 to 40 inches below the surface which limits water movement and root growth.

Laboratory data is available from the Oregon State University in Corvallis, Oregon. Pedon number S62-Ore.30-1-7.

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/STANFIELD.html

STEEVER SERIES

Steever soils are in the foreground and on low ridges in the center



A

Bw

C

Location of Steever soils

STEEVER SERIES

Land Resource Region A

Parent material: Landslide materials from basalt and conglomerate

Extent: Small extent

Climate: Average annual precipitation is about 75 inches, and average annual soil temperature is about 48 degrees, The climate is characterized by warm, dry winters and cool, wet winters.

Depth: 60 inches or more

Drainage: Well drained

Average frost-free period: 100 to 160 days

Elevation: 50 to 1,500 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development.

Family classification: Loamy-skeletal, mixed, superactive, mesic Typic Humudepts

Steever soils are on mountain slopes in old landslide areas in Skamania County, Washington. Natural vegetation is Douglas-fir, western hemlock, red alder, grand fir, and bigleaf maple. Understory is vine maple, western brackenfern, Oregon grape, thimbleberry, red huckleberry, training blackberry, Pacific dogwood, and common snowberry.

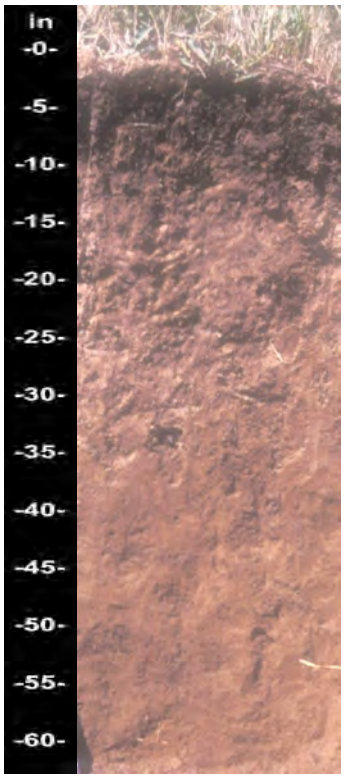
Uses: Timber production, wildlife habitat, recreation, and watershed. Some small areas have been cleared and are used for home sites.

Management considerations: High clay content in some horizons restrict water intake and shrink and swell when they wet and dry. Homesites and septic facilities require special design. Steep slopes in some areas limit forest management. Steep slopes also restrict home site development.

The official soil series description is available online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/STEEVER.html

STEVENSON SERIES

Stevenson soils are on the ridges in the foreground



A

Bw

C

Location of Stevenson soils

STEVENSON SERIES

Land Resource Region A

Parent material: Colluvium from basalt

Extent: Small extent

Climate: Average annual precipitation is about 80 inches, and average annual soil temperature is about 47 degrees F. The climate is characterized by warm, dry summers and cool, wet winters.

Depth: 60 or more inches

Drainage: Well drained

Average frost-free period: 110 to 150 days

Elevation: 100 to 1,200 feet

Soil order: Inceptisols - Immature soils with weakly expressed features and limited horizon development.

Family classification: Fine-loamy, mixed, superactive, mesic Humic Dystrudepts

Stevenson soils are on slopes of old landslides in Skamania County, Washington. The natural vegetation is Douglas-fir, western hemlock, grand fir, western redcedar, and bigleaf maple. Understory is vine maple, Pacific dogwood, common snowberry, red huckleberry, dwarf rose, western brackenfern, trailing blackberry, and Oregon grape.

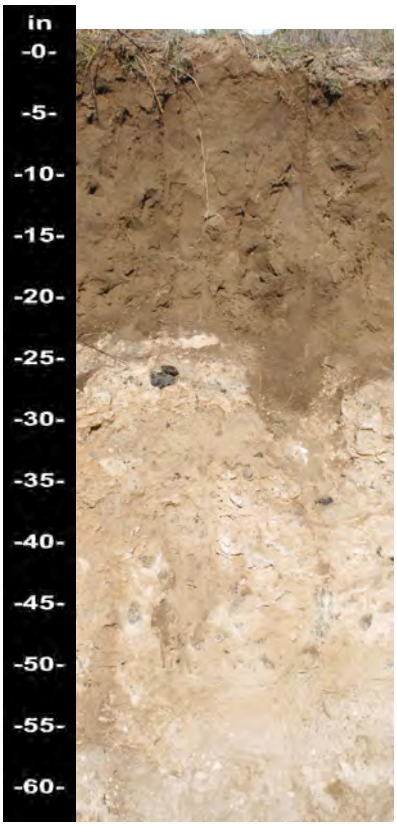
Uses: Timber production, wildlife habitat, recreation, and watershed. Some small areas have been cleared and are used for livestock grazing.

Management considerations: Areas of steep slopes limit forest management.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/S/STEVENSON.html

TAUNTON SERIES

Taunton soils are on slopes in the foreground and background



A

Bw

Bkq

2Bkqm

Location of Taunton soils

TAUNTON SERIES

Land Resource Region B

Parent material: Alluvium

Extent: Moderately extensive

Climate: Average annual precipitation is about 8 inches, and average annual soil temperature is about 50 degrees F. The climate is characterized by hot, dry summers and cool, moist winters.

Depth: 20 to 40 inches to a hardpan

Drainage: Well drained

Average frost-free period: 135 to 210 days

Elevation: 200 to 2,200 feet

Soil order: Aridisols - soils formed in dry climates where natural precipitation limits soil formation and the removal/translocation of soluable materials.

Family classification: Coarse-loamy, mixed, superactive, mesic Xeric Haplodurids

Taunton soils are on terraces and plains in Adams, Douglas, Franklin, Grant, and Walla Walla Counties, Washington; in Gooding, Cassia, Jerome, and Twin Falls Counties, Idaho; and in Gilliam, Morrow, and Umatilla Counties Oregon.

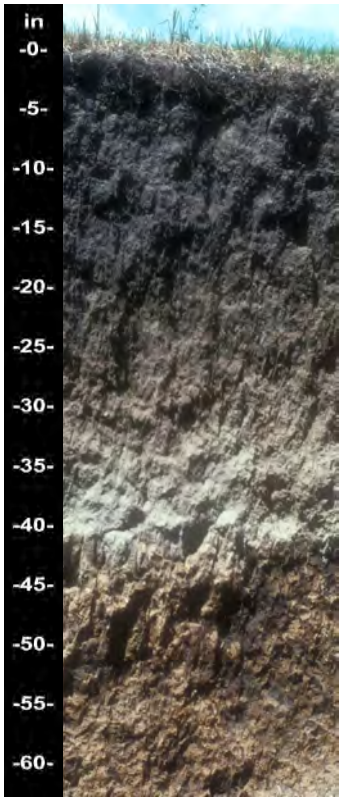
Uses: Livestock grazing and irrigated crop production. Cultivated areas are used to produce small grains, vegetables, hay, pasture, and some areas are used to produce wine grapes. Natural vegetation is bluebunch wheatgrass, needlegrass, Sandberg bluegrass, and Wyoming big sagebrush.

Management considerations: The hardpan at 20 to 40 inches limits root growth in plants and limits the amount of water the soil can hold and store.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/T/TAUNTON.html

THATUNA SERIES

Thatuna soils are on north-facing slopes (Photo by Tom Munson)



A

Bw

E

Btb

Location of Thatuna soils

THATUNA SERIES

Land Resource Region B

Parent material: Wind-blown silt (loess) with additions of volcanic ash in the surface.

Extent: Moderately extensive

Climate: Average annual precipitation is about 21 inches, and average annual soil temperature is about 48 degrees. F. The climate is characterized by warm, dry summers and mild, wet winters.

Depth: 60 inches or more

Drainage: Moderately well drained

Average frost-free period: 110 to 160 days

Elevation: 1,800 to 3,200 feet

Soil order: Mollisols - grassland soils with dark-colored surfaces and high natural fertility

Family classification: Fine-silty, mixed, superactive, mesic Oxyaquic Argixerolls

Thatuna soils are on north-facing slopes of hills in the Palouse area. They are in Washington, Idaho, and Oregon. In Washington, they are in Spokane and Whitman Counties. In Idaho, they are n Benewah, Kootenai, Latah, Lewis, and Nez Perce Counties, Idaho. In Oregon, they are in Umatilla County.

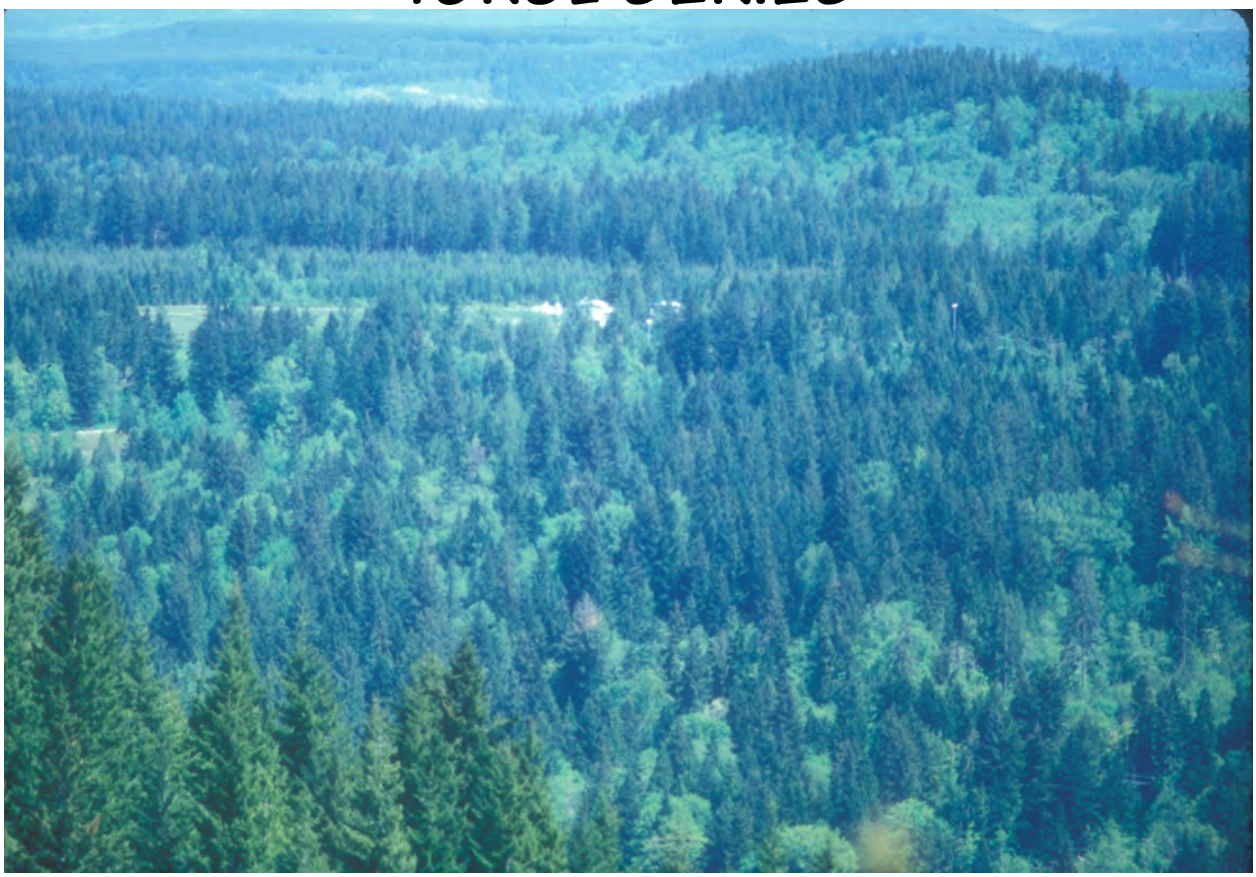
Uses: Crop production and pastureland. Cultivated areas are used to produce wheat, barley, peas, and lentils. Some areas are used to produce hay.

Management considerations: There is a perched water table between 24 and 48 inches from February to April. Water perches above the Btb horizon during spring and may cause the upper portion of the soil profile to slide downhill burying crops and leaving large holes in the slopes. Steep slopes are susceptible to water erosion.

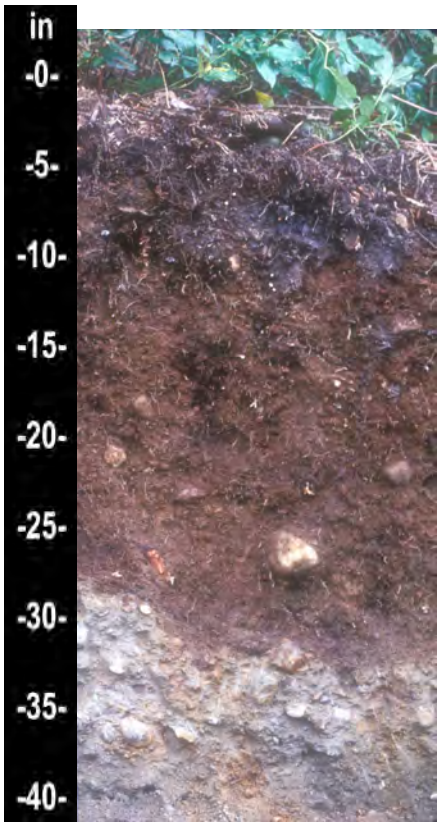
Laboratory data is available for Thatuna soils at the National Soil Survey Laboratory in Lincoln, Nebraska. Pedon numbers 65IDA 0502 and 61IDA 0513.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/T/THATUNA.html

TOKUL SERIES



Tokul soils are in the flatter area in the foreground



O

A

Bs

2Bsm

Location of Tokul soils

TOKUL SERIES

Land Resource Region A

Parent material: Glacial till, wind-blown silt (loess) and volcanic ash.

Extent: Extensive

Climate: Average annual precipitation is about 60 inches and average annual soil temperature is about 50 degrees F. The climate is characterized by cool, moist summers and cold, wet winters.

Depth: Moderately deep (20 to 40 inches to a cemented layer)

Drainage: Moderately well drained

Average frost-free period: 140 to 200 days

Elevation: 200 to 1,100 feet

Soil order: Spodosols - acidic soils of cold, wet coniferous forests that have grayish and reddish brown subsoil horizons.

Family classification: Medial, amorphic, mesic Aquic Vitrixerands

Tokul soils are on plains and glacially modified hills and mountains in King, Pierce, Skagit, and Snohomish Counties, Washington. Natural vegetation is Douglas-fir, western hemlock and western red cedar. Understory consists of western Swordfern, vine maple, huckleberry, trailing blackberry, and Oregon grape.

Uses: Timber production, wildlife habitat, and watershed (store snowpack for summer water). Some areas have been cleared and used for pasture.

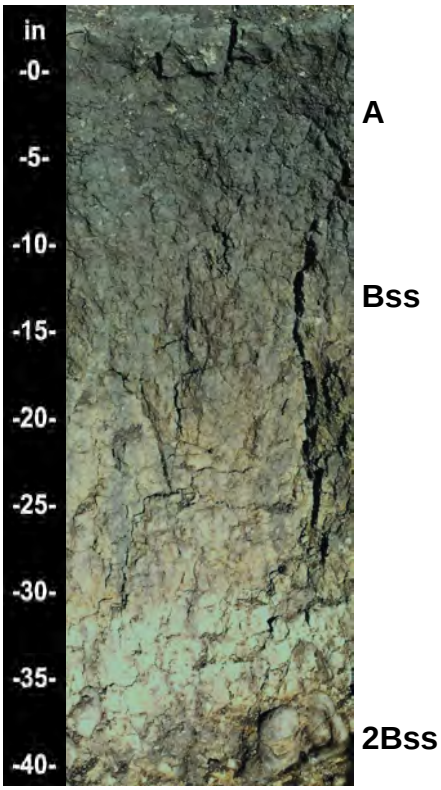
Management considerations: This soil has a cemented layer at 20 to 40 inches below the soil surface. Steep slopes in some area limit some uses.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/T/TOKUL.html

The Tokul soil has been nominated as the “Official Soil of Washington State”. Tokul soil would then hold a place in the state’s history similar to the state flower, state bird, etc. To date the Washington State Legislature has not officially approved Tokul as the “Washington State Soil”.

VARODALE SERIES

Varodale soils are in the foreground from the ditch to the buildings



Location of Varodale soils

VARODALE SERIES

Land Resource Region B

Parent material: Alluvium with an influence of volcanic ash

Extent: Small extent

Climate: Average annual precipitation is about 14 inches, and average annual soil temperature is about 49 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 60 or more inches

Drainage: Moderately well drained

Average frost-free period: 130 to 150 days

Elevation: 1,500 to 2,400 feet

Soil order: Vertisols - soils with large amounts of expansive clays (e.g. smectite) that form deep cracks in dry seasons of the year.

Family classification: Fine, smectitic, mesic Aquic Haploxerets

Varodale soils are on terraces and alluvial fans in Kittitas County, Washington.

Uses: Irrigated crop production and livestock grazing.

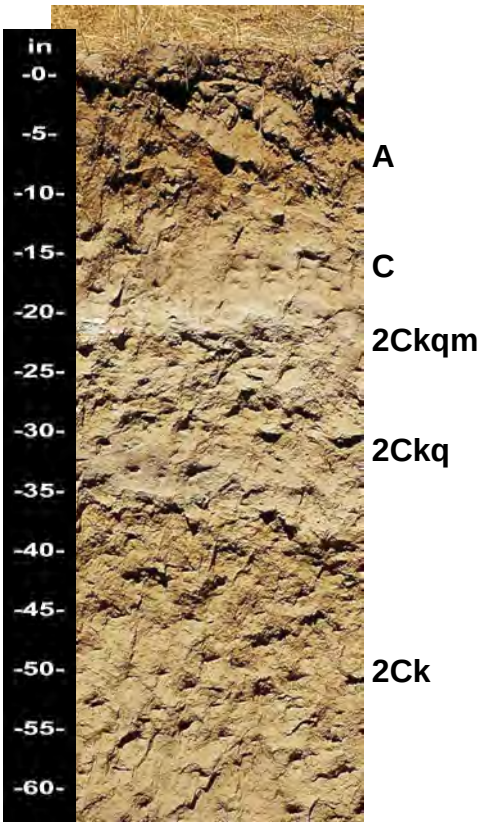
Irrigated and cultivated areas are used to produce hay, oats, wheat, corn, and peas. Natural vegetation includes grasses and forbs.

Management considerations: High amounts of clay that shrink and swell when wetted and dried limits management opportunities. An irrigation induced water table is present during the irrigation season which limits some management practices.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/V/VARODALE.html

WAHLUKE SERIES

Wahluke soils are in the foreground



Location of Wahluke soils

WAHLUKE SERIES

Land Resource Region B

Parent material: Lacustrine sediments

Extent: Small extent

Climate: Average annual precipitation is about 7 inches, and average annual soil temperature is about 53 degrees F. The climate is characterized by warm, dry summers and cool, moist winters.

Depth: 20 to 40 inches to a thin weakly cemented layer

Drainage: Well drained

Average frost-free period: 135 to 210 days

Elevation: 750 to 1,200 feet

Soil order: Entisols - soils with very limited weathering and soil development

Family classification: Coarse-silty, mixed, superactive, calcareous, mesic Duric Torriorthents

Waluke soils are on lakebeds and terraces in Grant County, Washington.

Uses: Livestock grazing and irrigated crop production. Cultivated areas are used to produce irrigated small grains, potatoes, and hay. Natural vegetation is bluebunch wheatgrass, Sandberg bluegrass, and Wyoming big sagebrush.

Management considerations: A thin weakly cemented layer is at 20 to 40 inches below the surface which restricts root development and water movement. These soils must be irrigated to produce crops.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/W/WAHLUKE.html

WESTPORT SERIES

Westport soils are on the area to the left with vegetation

A

AC

C

Location of Westport soils

WESTPORT SERIES

Land Resource Region A

Parent material: Wind-blown sand

Extent: Small extent

Climate: Average annual precipitation is about 70 inches, and average annual soil temperature is about 52 degrees F. The climate is characterized by cool, moist summers and mild, wet winters.

Depth: 60 or more inches

Drainage: Excessively drained

Average frost-free period: 180 to 250 days

Elevation: 10 to 50 feet

Soil order: Entisols - soils with very little weathering or soil development

Family classification: Mixed, isomesic Typic Udisamments

Westport soils are on sand dunes in Grays Harbor, Pacific, and Wahkiakum Counties, Washington. They likely occur on coastal beach areas in other counties.

Uses: Many areas of Westport soils are used for homesites. Natural vegetation is native grasses and widely spaced Sitka spruce and shore pine.

Management considerations: Westport soils have low water holding capacity because of their sandy textures. Because of their location, Westport soils have limitations because of storm tides.

The official soil series description is online at:
https://soilseries.sc.egov.usda.gov/OSD_Docs/W/WESTPORT.html

APPENDIX 1

Numbers or lowercase letters that follow symbols for major horizons represent specific kinds of master horizons and layers. The term “accumulation” is used in many of the definitions of such horizons to indicate that these horizons must contain more of the material in question than is presumed to have been originally present in the parent material. The suffix symbols and their meanings are as follows:

b *Buried genetic horizon*
This symbol is used in mineral soils to indicate identifiable buried horizons with major genetic features that were developed before burial. Genetic horizons may or may not have formed in the overlying material, which may be either like or unlike the assumed parent material of the buried soil. This symbol is not used in organic soils, nor is it used to separate an organic layer from a mineral layer.

c *Concretions or nodules*
This symbol indicates a significant accumulation of concretions or nodules. Cementation is required. The cementing agent commonly is iron, aluminum, manganese, or titanium. It cannot be silica, dolomite, calcite, or more soluble salts.

d *Physical root restriction*
This symbol indicates noncemented, root-restricting layers in naturally occurring or human-made sediments or materials. Examples are dense basal till, plowpans, and other mechanically compacted zones.

g *Strong gleying*
This symbol indicates either that iron has been reduced and removed during soil formation or that saturation with stagnant water has preserved it in a reduced state.

h *Illuvial accumulation of organic matter*
This symbol is used with B to indicate the accumulation of illuvial, amorphous, dispersible complexes of organic matter and sesquioxides if the sesquioxide component is dominated by aluminum but is present only in very small quantities. The organosesquioxide material coats sand and silt particles. In some horizons these coatings have coalesced, filled pores, and cemented the horizon. The symbol h is also used in combination with s as “Bhs” if the amount of the sesquioxide component is significant but the color value and chroma, moist, of the horizon are 3 or less.

k *Accumulation of secondary carbonates*
This symbol indicates an accumulation of visible pedogenic calcium carbonate (less than 50 percent, by volume). Carbonate accumulations occur as carbonate filaments, coatings, masses, nodules, disseminated carbonate, or other forms.

m *Cementation or induration*
This symbol indicates continuous or nearly continuous cementation. It is used only for horizons that are more than 90 percent cemented, although they may be fractured. The cemented layer is physically root-restrictive. The predominant cementing agent (or the two dominant ones) may be indicated by adding defined letter suffixes, singly or in pairs. The horizon suffix kkm (and less commonly km) indicates cementation by carbonates; qm, cementation by silica; sm, cementation by gypsum; kqm gypsum.

n *Accumulation of sodium*
This symbol indicates an accumulation of exchangeable sodium.

o *Residual accumulation of sesquioxides*
This symbol indicates a residual accumulation of sesquioxides.

p *Tillage or other disturbance*
This symbol indicates a disturbance of the surface layer by mechanical means, pasturing, or similar uses. A disturbed organic horizon is designated Op. A disturbed mineral horizon is designated Ap even though it is clearly a former E, B, or C horizon.

q *Accumulation of silica*
This symbol indicates an accumulation of secondary silica.

r *Weathered or soft bedrock*
This symbol is used with C to indicate layers of bedrock that are moderately cemented or less cemented. Examples are weathered igneous rock and partly consolidated sandstone, siltstone, or shale. The excavation difficulty is low to high.

s *Illuvial accumulation of sesquioxides and organic matter*
This symbol is used with B to indicate an accumulation of illuvial, amorphous, dispersible complexes of organic matter and sesquioxides if both the organic matter and sesquioxide components are significant and if either the color value or chroma, moist, of the horizon is 4 or more. The symbol is also used in combination with h as “Bhs” if both the organic matter and sesquioxide components are significant and if the color value and chroma, moist, are 3 or less.

ss *Presence of slickensides*
This symbol indicates the presence of slickensides. Slickensides result directly from the swelling of clay minerals and shear failure, commonly at angles of 20 to 60 degrees above horizontal. They are indicators that other vertic characteristics, such as wedge-shaped peds and surface cracks, may be present.

t *Accumulation of silicate clay*
This symbol indicates an accumulation of silicate clay that either has formed within a horizon and subsequently has been translocated within the horizon or has been moved into the horizon by illuviation, or both. At least some part of the horizon should show evidence of clay accumulation either as coatings on surfaces of peds or in pores, as lamellae, or as bridges between mineral grains

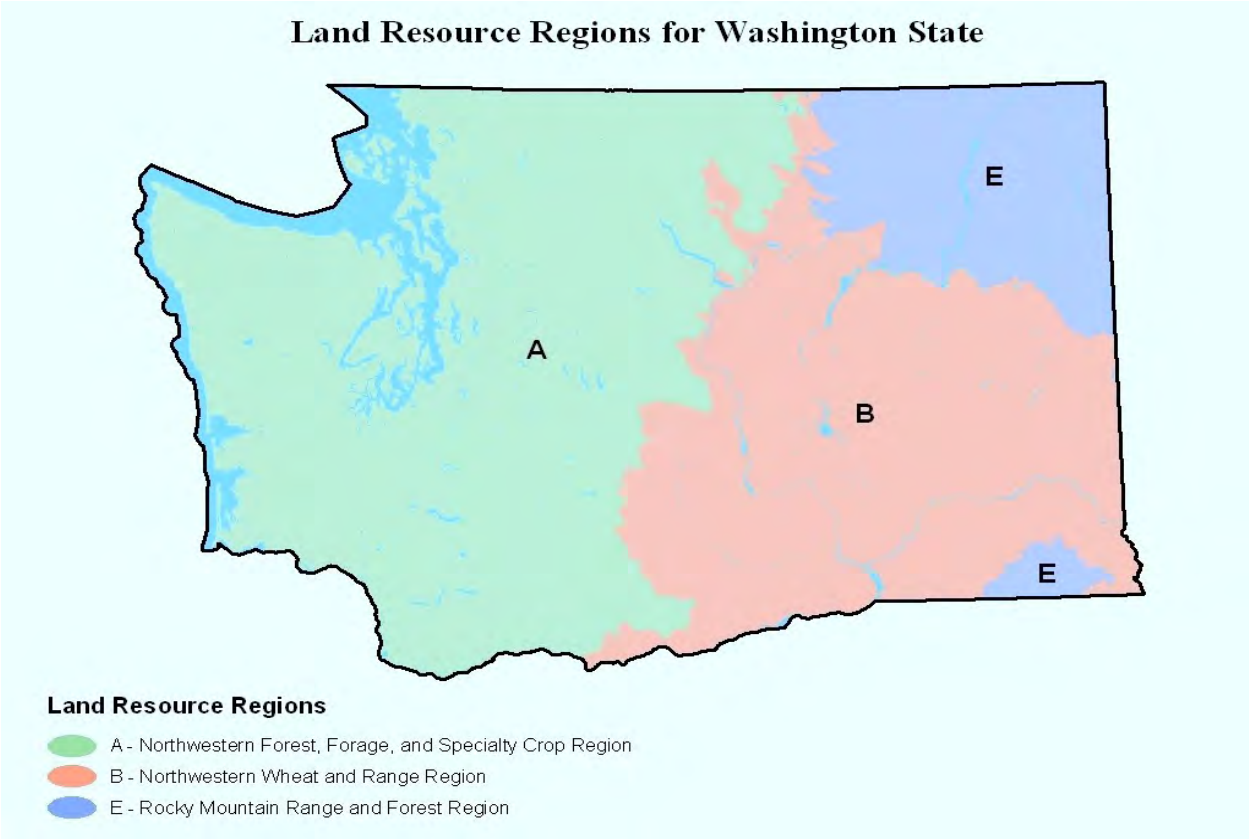
v *Plinthite*
This symbol indicates the presence of iron-rich, humus-poor, reddish material that is firm or very firm
when moist and is less than strongly cemented. It hardens irreversibly when exposed to the atmosphere and to repeated wetting and drying.

w *Development of color or structure*
This symbol is used only with B horizons to indicate the development of color or structure, or both, with little or no apparent illuvial accumulation of material. It should not be used to indicate a transitional horizon.

y *Accumulation of gypsum*
This symbol indicates an accumulation of gypsum. The suffix y is used when the horizon fabric is dominated by soil particles or minerals other than gypsum. Gypsum is present in amounts that do not significantly obscure or disrupt other features of the horizon.

z *Accumulation of salts more soluble than gypsum*
This symbol indicates an accumulation of salts that are more soluble than gypsum.

APPENDIX 2



Land Resource Region A

Land Resource Region A is the largest Land Resource Region in Washington. It includes steep mountains and narrow to broad, gently sloping valleys and plains characterize this region. Two major mountain systems are in this region. One, the Coast Range, parallels the coast. The Cascade Mountains is the other major mountain system in the region. This area has a rich agricultural areas because of a mild coastal climate, high rainfall, and deep soils that formed in alluvium and glacial drift. The annual precipitation in the mountains is typically more than 100 inches, but it can exceed 250 inches on the highest peaks. This region is dry in summer. The average annual temperature is 45 to 55 degrees F. in most of the region. The frost-free period is more than 200 days in most of the valleys, and only 40 to 70 days on mountain slopes. Some areas on the highest mountains are covered by glaciers. The ground is permanently frozen in these areas. The dominant soil orders in this region are Alfisols, Andisols, Entisols, Inceptisols, Spodosols, and Ultisols.

A large part of this region is Federal land, mostly in national forests. The mountains are heavily forested, and timber production is the major industry. Dairy farming is an important enterprise in the valleys that receive abundant rainfall. Grain crops, grass and legume seeds, fruits, and horticultural specialty crops are grown extensively in the drier valleys.

Land Resource Region B

Land Resource Region B is on the lee side of the Cascade Mountains in Washington. It is an area of smooth to deeply dissected plains and plateaus. Most of this region is underlain by basalt flows from the Columbia and Idaho Batholiths. The basalt is covered with a veneer of loess and volcanic ash in most areas. The region has a few isolated mountain ranges. The average annual precipitation is 6 to 20 inches in most of the region. It is lowest in the Columbia Basin area in central Washington. The average annual precipitation can be as much as 45 to 85 inches in the mountains. Summers are dry. The average annual temperature is 40 to 49 degrees F. In most areas the frost-free period ranges from 125 to 220 days. It is typically 40 to 70 days in the mountains. Irrigation is a dominant use of water in the region. The dominant soil orders in the region are Mollisols and Aridisols. Other soil orders that occur are Alfisols, Andisols, Entisols, and Inceptisols.

About 29 percent of the land is federally owned grazing land, rangeland and cropland. A few very small areas are forested. Wheat, grown without irrigation, is the major crop in the region, but oats, barley, lentils, and peas also are important. Fruits, mainly apples, are a major crop in the western part of the region. Potatoes, sugar beets, beans, and forage crops are grown under irrigation in the central Columbia basin in Washington. A variety of specialty crops are grown in local areas, including vegetables, vegetable seeds, mint, and hops. Grazing is the major land use in the drier parts of the region. This region is primarily a mixture of grazing land and cropland.

Land Resource Region E

Land Resource Region E is characterized mainly by rugged mountains, but it has some broad valleys and remnants of high plateaus . The average annual precipitation ranges from 9 inches in some of the valleys to 63 inches on some of the mountain peaks. The average annual temperature ranges from 32 to 50 degrees F. The frost-free period is 65 days or less in the high mountains, where freezing temperatures occur every month of the year. Some areas on the highest mountains are covered by glaciers. The ground is permanently frozen in these areas. The freeze-free period on the foothills in the southern part of the region is as long as 190 days. The soils in this region are dominantly Alfisols, Entisols, Inceptisols, and Mollisols.

About 60 percent of the land in this region is federally owned. The mountain slopes generally are forested, and the valleys are dominated by shrubs and grasses. Grazing is the leading land use in the valleys and mountains, but timber production is important on some of the forested mountain slopes. Recreation is an important use throughout the region. Some of the valleys are irrigated. Grain and forage for livestock are the main crops. Beans, sugar beets, peas, and seed crops are grown in areas where soils, climate, and markets are favorable.

GLOSSARY

Many of the terms relating to landforms, geology, and geomorphology are defined in more detail in the "National Soil Survey Handbook" (available in local offices of the Natural Resources Conservation Service or online at: http://soils.usda.gov/technical/handbook).

Alluvial fan. A low, outspread mass of loose materials and/or rock material, commonly with gentle slopes. It is shaped like an open fan or a segment of a cone. The material was deposited by a stream at the place where it issues from a narrow mountain valley or upland valley or where a tributary stream is near or at its junction with the main stream. The fan is steepest near its apex, which points upstream, and slopes gently and convexly outward (downstream) with a gradual decrease in gradient.

Alluvium. Unconsolidated material, such as gravel, sand, silt, clay, and various mixtures of these, deposited on land by running water.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction toward which a slope faces. Also called slope aspect.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point.

Basin. (a) Drainage basin; (b) A low area in the Earth's crust in which sediments have accumulated. A general term for the nearly level to gently sloping, bottom surface of a depression.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench. A platform-like, nearly level to gently inclined surface developed on resistant materials in areas where valleys are cut. Structural benches are bedrock controlled, and in contrast to stream terraces, have little or no suggestion of former erosion cycles.

Bottom land. An informal term loosely applied to various portions of a flood plain.

Canyon. A long, deep, narrow valley with high, precipitous walls in an area of high local relief.

Cirque. A steep-walled, semicircular or crescent-shaped, half-bowl-like recess or hollow commonly situated at the head of a glaciated mountain valley or high on the side of a mountain. It was produced by the erosive activity of a mountain glacier. It commonly contains a small round lake (tarn).

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A dense, compact, slowly permeable subsoil layer that contains much more clay than the overlying materials, from which it is separated by a sharply defined boundary. A claypan is commonly hard when dry and plastic and sticky when wet.

Colluvium. Unconsolidated, unsorted earth material being transported or deposited on side slopes and/or at the base of slopes by mass movement (e.g., direct gravitational action) and by local, unconcentrated runoff.

Dense layer. A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock or other root restrictive horizon. Very deep soils are more than 60 inches deep over bedrock or some restriction; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual" (http://soils.usda.gov/technical/manual/contents/chapter3.html#4c.)

Drainageway. A general term for a channel which drains water from an area.

Drift. A general term applied to all mineral material (clay, silt, sand, gravel, and boulders) transported by a glacier and deposited directly by or from the ice or transported by running water emanating from a glacier. Drift includes unstratified material (till) that forms moraines and stratified deposits that form outwash plains, eskers, kames, varves, and glaciofluvial sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Dune. A low mound, ridge, bank, or hill of loose, windblown granular material (generally sand), either barren and capable of movement from place to place or covered and stabilized with vegetation but retaining its characteristic shape.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian deposit. Sand, silt, or clay-sized clastic material transported and deposited primarily by wind, commonly in the form of a dune or a sheet of sand or loess.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

> *Erosion (geologic).* Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
>
> *Erosion (accelerated).* Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Most commonly applied to cliffs produced by differential erosion. Synonym: scarp.

Extent. See soil extent

Fan terrace. A general term for landforms that are the remaining parts of older fan-landforms, such as alluvial fans, fan aprons, inset fans, and fan skirts, that either have been exposed by erosion or partially buried. An erosional fan remnant must have a relatively flat summit that is a relict fan-surface.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Flood plain. The nearly level plain that borders a stream and is subject to flooding unless protected artificially.

Foothills. A region of steeply sloping hills that fringes a mountain range or high-plateau escarpment. The hills have relief of as much as 1,000 feet (300 meters).

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial. a) Of or relating to the presence and activities of ice and glaciers, as in glacial erosion. (b) Pertaining to distinctive features and materials produced by or derived from glaciers and ice sheets, as in glacial lakes such as glacial outwash terrace, glacial outwash plains, or glacial drift plains.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are bedded or laminated.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water. Water filling all the unblocked pores of the material below the water table.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Hill. A generic term for an elevated area of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline. Slopes are generally more than 15 percent. The distinction between a hill and a mountain is arbitrary and may depend on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the Appendix. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake terrace. A narrow shelf, partly cut and partly built, produced along a lake shore and later exposed when the water level falls.

Landslide. A general, encompassing term for most types of mass movement landforms and processes involving the downslope transport and outward deposition of soil and rock materials caused by gravitational forces; the movement may or may not involve saturated materials. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Lateral moraine. A moraine that looks like a ridge at the sides of a valley glacier. It is composed chiefly of rock fragments removed from valley walls by glacial movement through the valley, or by materials tumbling off adjacent slopes.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loess. Material transported and deposited by wind and consisting dominantly of silt-sized particles.

Mass movement. A generic term for the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that have high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. In terms of glacial geology, a mound, ridge, or other topographically distinct accumulation of unsorted, unstratified drift, predominantly till, deposited primarily by the direct action of glacial ice in a variety of landforms. Also, a general term for a landform composed mainly of till (except for kame moraines, which are composed mainly of stratified outwash) that has been deposited by a glacier. Some types of moraines are disintegration, end, ground, kame, lateral, recessional, and terminal.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mountain. A generic term for an elevated area of the land surface, rising more than 1,000 feet (300 meters) above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range. Mountains are formed primarily by tectonic activity and/or volcanic action but can also be formed by differential erosion.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash. Stratified and sorted sediments (chiefly sand and gravel) removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of a glacier. The coarser material is deposited nearer to the ice.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan*, *fragipan*, *claypan*, *plowpan*, and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Plain. A general term referring to any flat mostly smooth and level lowland area, large or small, at a low elevation. A plain has few or no prominent hills or valleys but sometimes has considerable slope, and usually occurs at low elevation relative to surrounding areas.

Plateau (geomorphology). A comparatively flat area of great extent and elevation; specifically, an extensive land region that is considerably elevated (more than 100 meters) above the adjacent lower lying terrain, is commonly limited on at least one side by an abrupt descent, and has a flat or nearly level surface. A comparatively large part of a plateau surface is near summit level.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Pothole. A type of small pit or closed depression (1 to several feet deep), generally round or oblong that occurs in a part of a glacial landscape.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Redoximorphic features. Redoximorphic features are associated with wetness and result from alternating periods of reduction and oxidation of iron and manganese compounds in the soil. Reduction occurs during saturation with water, and oxidation occurs when the soil is not saturated. Characteristic color patterns are created by these processes. The reduced iron and manganese ions may be removed from a soil if vertical or lateral fluxes of water occur, in which case there is no iron or manganese precipitation in that soil. Wherever the iron and manganese are oxidized and precipitated, they form either soft masses or hard concretions or nodules. Movement of iron and manganese as a result of redoximorphic processes in a soil may result in redoximorphic features that are defined as follows:

1. Redoximorphic concentrations.—These are zones of apparent accumulation of iron-manganese oxides, including:

> A. Nodules and concretions, which are cemented bodies that can be removed from the soil intact. Concretions are distinguished from nodules on the basis of internal organization. A concretion typically has concentric layers that are visible to the naked eye. Nodules do not have visible organized internal structure; *and*
>
> B. Masses, which are noncemented concentrations of substances within the soil matrix; *and*
>
> C. Pore linings, i.e., zones of accumulation along pores that may be either coatings on pore surfaces or impregnations from the matrix adjacent to the pores.

2. Redoximorphic depletions.—These are zones of low chroma (chromas less than those in the matrix) where either iron-manganese oxides alone or both iron-manganese oxides and clay have been stripped out, including:

> A. Iron depletions, i.e., zones that contain low amounts of iron and manganese oxides but have a clay content similar to that of the adjacent matrix; *and*
>
> B. Clay depletions, i.e., zones that contain low amounts of iron, manganese, and clay (often referred to as silt coatings or skeletons).

3. Reduced matrix.—This is a soil matrix that has low chroma *in situ* but undergoes a change in hue or chroma within 30 minutes after the soil material has been exposed to air.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as bedrock disintegrated in place.

Ridge. A long, narrow landscape feature that is usually sharp crested with steep sides and forms an extended upland between valleys. The term is used in areas of both hill and mountain relief.

Riser. The vertical or steep side slope (e.g., escarpment) of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural, steplike landforms, such as successive stream terraces.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sag pond. A small body of water occupying an enclosed depression formed where active or recent soil movement downslope has collected water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz.

Scabland. An elevated, flat-lying, basalt-floored area, with little if any soil on it, sparse vegetation, and usually deep, dry channels scoured into the floor, especially by glacial meltwaters such as the Channeled Scablands of eastern Washington.

Series, soil. A group of soils that have profiles that are almost alike. All the soils of a given series have horizons that are similar in composition, thickness, and arrangement.

Side slope (geomorphology). A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel. Side slopes are dominantly colluvium and slope-wash sediments.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter).

Slickensides (pedogenic). Grooved, striated, and/or glossy (shiny) slip faces on structural peds, such as wedges; produced by shrink-swell processes, most commonly in soils that have a high content of expansive clays.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope alluvium. Sediment gradually transported down the slopes of mountains or hills primarily by nonchannel alluvial processes (i.e., slope-wash processes) and characterized by particle sorting.

Lateral particle sorting is evident on long slopes. In a profile sequence, sediments may be distinguished by differences in size and/or specific gravity of rock fragments and may be separated by stone lines. Burnished peds and sorting of rounded or subrounded pebbles or cobbles distinguish these materials from unsorted colluvial deposits.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief and by the passage of time.

Soil extent. Groupings of soils based upon the number of acres that are presently recognized within the National Cooperative Soil Survey.

Small extent - less than 10,000 acres
Moderately extensive - 10,000 to 100,000 acres
Extensive - more than 100,000 acres

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand 2.0 to 1.0
Coarse sand 1.0 to 0.5
Medium sand 0.5 to 0.25
Fine sand 0.25 to 0.10
Very fine sand 0.10 to 0.05
Silt 0.05 to 0.002
Clay less than 0.002

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream; represents the remnants of an abandoned flood plain, stream bed, or valley floor produced during a former state of fluvial erosion or deposition.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. A general term for the top or highest area of a landform such as a hill, mountain, or tableland.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Terrace (geomorphology). A step like surface, bordering a valley floor or shoreline, that represents the former position of a flood plain, lake, or seashore. The term is usually applied both to the relatively flat summit surface (tread) that was cut or built by stream or wave action and to the steeper descending slope (scarp or riser) that has graded to a lower base level of erosion.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Till. Dominantly unsorted and nonstratified drift, generally unconsolidated and deposited directly by a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders; rock fragments of various lithologies are embedded within a finer matrix that can range from clay to sandy loam.

Till plain. An extensive area of level to gently undulating soils underlain predominantly by till and bounded at the distal end by subordinate recessional or end moraines.

Tread. The flat to gently sloping, topmost, laterally extensive slope of terraces, flood-plain steps, or other stepped landforms; commonly a recurring part of a series of natural steplike landforms, such as successive stream terraces.

Upland. An informal, general term used to describe the higher ground of a region, in contrast with a low-lying adjacent area, such as a valley or plain, or for land at a higher elevation than the flood plain or low stream terrace.

Valley. A relatively large, long depression of the Earth's surface that is primarily developed by stream erosion or glacial activity and is drained outside of itself.

Weathering. All physical disintegration, chemical decomposition, and biologically induced changes in rocks or other deposits at or near the earth's surface by atmospheric or biologic agents or by circulating surface waters but involving essentially no transport of the altered material.