Soils of the Puget Sound Area

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Understanding our soils and landscapes can help us learn how to live on the land without abusing it. As we have developed more land in the Puget Sound region, we have become more aware of the effects of development on the environment. Using our knowledge of local soils can help us become better caretakers of the land and water, so that we can maintain them for future generations.

Okanogan County

To understand the soils in an area, soil scientists study the landscape and the soils below the surface at different places in the landscape. The landscape in this slide has three distinct landforms, which formed by different geologic processes and contain different types of soils. A glacier covered the lower and middle areas of the landscape more than 15,000 years ago. The soils on the hummocky land in the middle developed from material left behind by glacial ice. Soils formed from material that was moved, sorted, and deposited by water comprise the foreground, once a stream bed for meltwater from the glaciers. The mountains in the background poked above the glacier; there the mountain soils developed directly from the underlying bedrock.

Carstairs Soil Profile, Mason County

This soil has three distinct layers or horizons, each with different properties. Soil scientists use information on the color, texture, and other properties of each horizon, along with landscape information, to describe a soil and its uses and limitations.

Parent Materials:

Glacial • Volcanic • Flood Deposits

Parent material is the geologic material from which a soil has formed. Glacial ice and meltwater, volcanic activity, and flood water deposited the major parent materials for soils in the Puget Sound area. Because soils in our area are young in terms of development, their properties strongly reflect the properties of the parent materials.

In addition to parent material, four other factors affect soil development. These are:

- Climate
- Vegetation and other organisms that live in the soil
- Topography or landscape position of the site
- Age of the soil

In the following slides we will see some important parent materials of the Puget Sound area, and the types of soils which have developed from them.

Glacial Parent Materials:

Till (ice laid)
Outwash (meltwater deposits)
Lacustrine (lakebed deposits)

Three important types of glacial parent materials occur in the Puget Sound area – glacial till (deposited by ice), glacial outwash (deposited in glacial meltwater streams), and lacustrine (glacial lakebed sediments). Each has different properties and has formed distinct types of soils.

Carbon Glacier, Mount Rainier

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Olympia. More than fifteen thousand years ago, massive glaciers covered the Puget Sound area as far south as Olympia. The glacial ice was nearly one-half mile thick at Seattle and obliterated all the soils beneath it. When the glaciers melted, much of what was left behind was a mixture of sand, silt, clay, and rocks called till, much like the material at the front of and under the Carbon Glacier in the slide.

Carbon Glacier, Polarized Filter

When the glaciers move, soils and rocks freeze along the glacier, and eventually they are buried within the glacier and compressed by the overlying ice. This mixed, compacted material is called basal glacial till.

Glacial Boulders, Douglas County

A very large glacier, such as the one that covered the Puget Lowland, A very large glacier, such as the one that covered the Puget Lowland, can move large amounts of material and subject it to tremendous pressure. Glaciers plucked these boulders from the ground and moved them across the landscape.

Glacial Till Near Lake Tapps, Pierce County

When the great glaciers melted, they left behind thick, very dense deposits of basal till, which you see in the slide. Basal till contains an unsorted mixture of materials ranging in size from microscopic clay particles to rocks and boulders.

Shelton Soil Profile, Mason County

This is the profile of a soil developed from glacial till. The upper part of the profile developed from material that was at or near the top of the glacier, where it was not under great pressure. It also may be mixed with material moved by wind or water. It is quite permeable, and water has drained freely through it since the glaciers melted, giving it the brownish to reddish color typical of well-drained soils. The lower part of the profile is the very dense, nearly impermeable basal till. Often called hardpan, it usually appears 20 to 40 inches below the surface, and extends to a depth of 10 or more feet. The soil in this slide is on a slope. Water can move downslope along the basal till, leaving the overlying soil well drained. Soils similar to this one are common throughout the Puget Sound area, from Bellingham south to Olympia. Although used for urban and suburban development, these soils are seldom deep enough for conventional septic systems. The basal till does provide a stable base that is resistant to earthquakes. Glacial till soils are suitable for pasture. They are also used for growing row crops, but are limited by rocks and shallow depth.

Kapowsin Soil, Pierce County

This soil also developed from glacial till, but it looks much different. The profile is grayer because the soil is wetter.

Since the soil sits on a flat landscape, water that hits the hardpan has no place to go. The lowest spots on glacial till landscape collect water from higher ground and are usually wetlands.

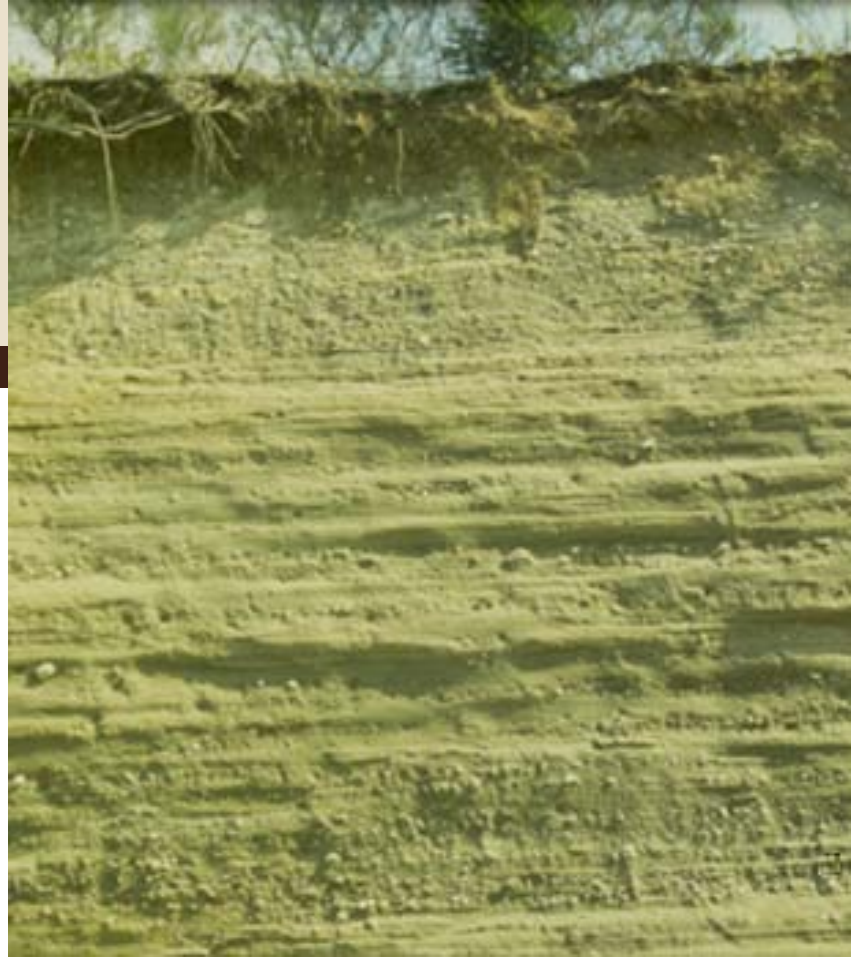
Soil Shallow to Bedrock, San Juan Island

In parts of the San Juan Islands and some nearby mainland areas, only a shallow layer of glacial till covers the bedrock. These soils often are too shallow for septic systems and have little potential for agriculture or forest production.

Outwash from Carbon Glacier, Mount Rainier

A second type of parent materials from glaciers is outwash. It consists primarily of sand, gravel, and rocks that meltwaters from glaciers have moved and sorted.

Outwash Deposit, Pierce County



Glacial outwash materials were separated by size as meltwater moved them. Changes in the speed of the flowing meltwater caused the different bands or strata visible in this deposit. Faster-moving water deposited the strata containing mostly gravel, while slower-moving water deposited those containing mostly sand. Often deposits of outwash are many feet thick, similar to the one shown in this slide. The lowest parts of outwash deposits, often saturated, can be important sources of groundwater (aquifers).

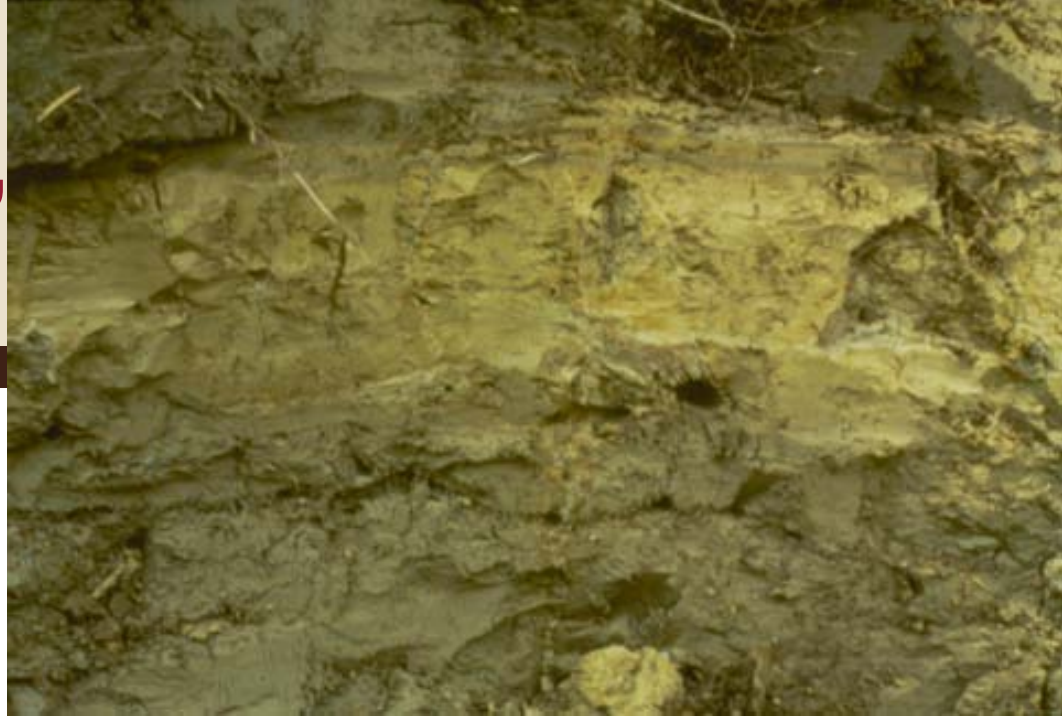
Everett Soil, Pierce County

This soil developed from gravelly glacial outwash. The dark surface is thicker than commonly seen, but the rusty-colored subsurface is typical. Soils of this type usually are loose, coarse-textured, and uncompacted, and water percolates through them easily. They are difficult to farm because they often are stony and hold too little water for crops. In the past, much suburban growth came to be concentrated on these soils. Gravelly outwash soils usually do not provide much protection for underlying groundwater. Because of concerns about groundwater contamination, health departments now require larger lots and more complex septic systems in these soils. Similar soils are common in much of the Puget Sound area. Some outwash soils are mostly sandy with little or no gravel. They are common in Whatcom and Thurston counties, where they are important agricultural soils.

Lake Campbell, Skagit County

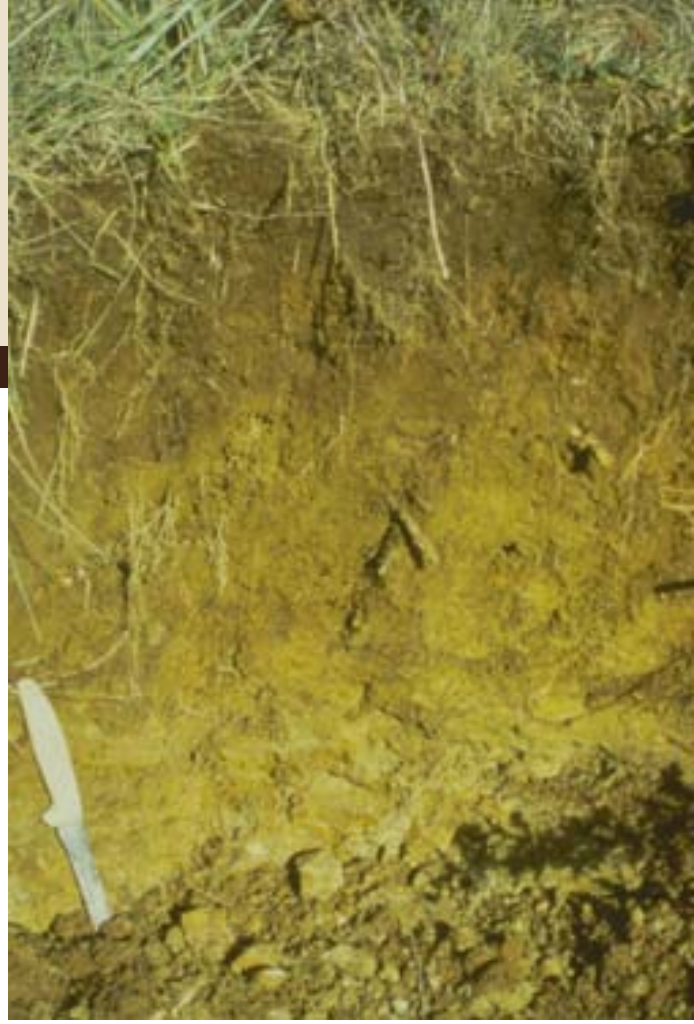
Glaciers deposited a third type of material in the beds of glacial lakes and marine bays. As the glaciers melted, many temporary lakes formed where ice blocked valleys and trapped glacial meltwater behind them. In the quiet waters of the lakes, fine-textured sediments (silt and clay) settled out, forming lacustrine parent materials.

Cloquallum Subsoil (Lacustrine Deposit), Mason County



Lacustrine soils hold more water than outwash or till soils because they contain more silt and clay. They also are less permeable than outwash soils.

Whatcom Soil, Whatcom County



The mottled gray and brown subsurface of this profile indicates that it is very wet for at least part of the year. Glacial lacustrine and marine soils can be good agricultural soils, but seasonal wetness often limits them. They also are harder to cultivate than sandier soils. Lacustrine soils occur in pockets throughout the Puget Sound area. They are common on the slopes above Puget Sound and the major river valleys in areas prized as view lots. However, their fine texture and susceptibility to landslides and erosion on steep slopes makes them poorly suited for development.

Till and Outwash Mixed, Key Center, Pierce County

Sometimes we find a mixture of parent materials in the same profile. This profile has both sandy outwash and compact basal till. Evaluate soils like this carefully to determine how best to use them.

Volcanic Parent Materials:

Tephra (ash)
Mudflow

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Mount St. Helens

Volcanoes also have been a source of parent material for some western Washington soils.

Mt. St. Helen's Tephra in Sand Dune, Grant Cty

We all know about the volcanic ash that erupted from Mt. St. Helens. Geologists call this "tephra." Most of the Mt. St. Helens tephra blew to the east of the Cascade Mountains, where it has become part of the soils. In the sand dune in the slide above, a layer of sand has blown over the layer of tephra, preserving it intact. The Northwest has a long history of volcanic activity, but prevailing winds have blown most of the tephra east of the Cascades. Soils in the Puget Sound area contain some tephra, primarily from the Mt. Mazama (Crater Lake) eruption that occurred more than 6800 years ago. Weathered tephra tends to increase the water holding capacity and reduce the density of soils.

Mudflow, Mt. St. Helens

Mudflows also result from volcanic activity. Massive floods of melted snow and ice combined with soil, rocks, and debris to create mudflow deposits. They look and behave very much like basal glacial till; they are a mixture of materials, and they are compact and often slowly permeable.

Profile of a 1980 Mt. St. Helens Mudflow Deposit Along the Toutle River

This 1980 Mt. St. Helens mudflow just now is beginning to weather into soil. It looks very much like glacial till parent material.

Buckley Soil Profile, Pierce County

Mudflow deposits from Mt. Rainier dominate the landscape in parts of King and Pierce counties. These soils are quite wet because they are slowly permeable and are located on flat landscapes. The thick, dark surface, combined with the mottled color pattern in the subsurface, results from wet conditions. The wetness severely limits their suitability for development. They are best suited to pastures, woodland, and wetlands.

Alluvial Parent Materials:

Flood Deposits

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Puyallup River at Flood Stage

Floods have provided the parent material for the Puget Sound region's fertile young valley soils. Modern flood control, however, has cut the supply of sediments to many of our valleys.

Daffodils and Mt. Rainier, Puyallup Valley, Pierce County

These alluvial (water-deposited) soils are level, permeable, free of rocks and ideal for agriculture. They often have layers of different texture, resulting from different rates of flow of flood water. A high water table exists in most of our alluvial soils, making these soils better suited for agriculture than for development. In addition, they do not provide stable support during earthquakes. Shallow groundwater beneath these soils is vulnerable to contamination from both agricultural and nonagricultural sources, as occurs with the groundwater beneath glacial outwash soils.

Minter Creek, Pierce County

We have many different soils in the Puget Sound area, each having its own origins, history, and characteristics. Some soils are better suited for development, some for agriculture, and some are best left to serve their natural functions in wetlands, buffers, and wildlife habitat. Understanding our soils is a key to environmentally sound land use and planning.