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Soil: descriptions, water levels, and data access

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The basics of soil descriptions

Horizons

Texture

Coarse Fragments

Color

Structure

Consistence

Redoximorphic features

<https://www.nrcs.usda.gov/sites/default/files/2022-09/field-book.pdf>



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Form 11:

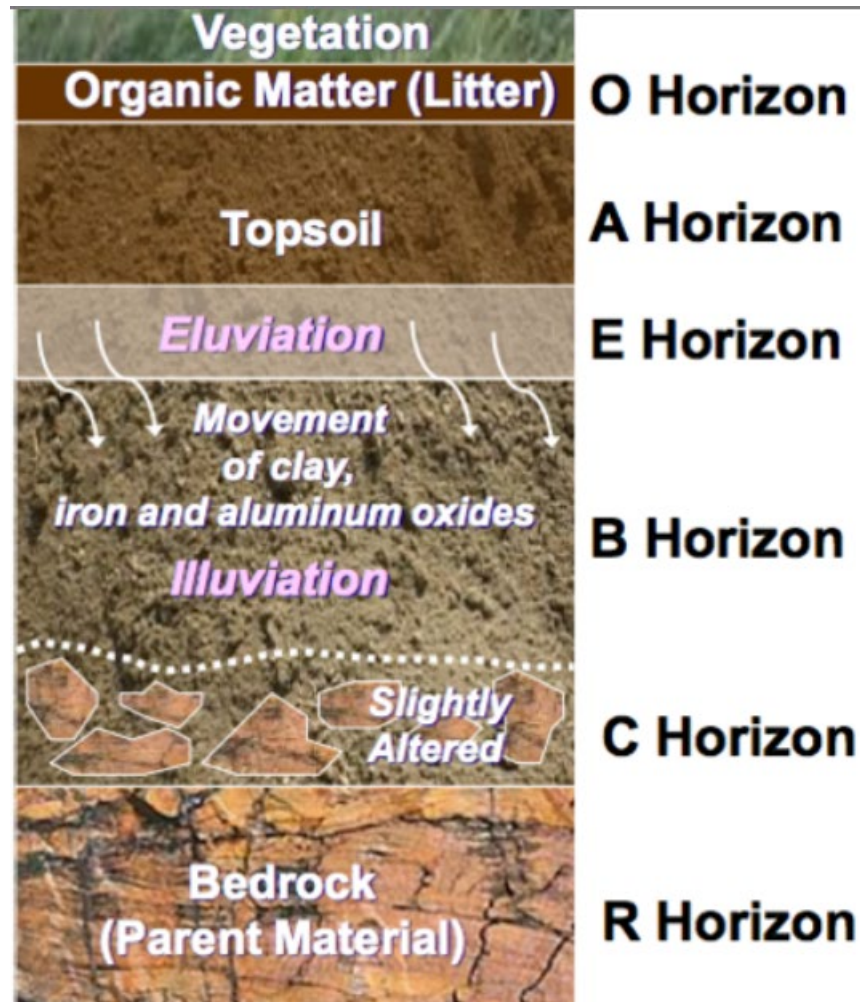
Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
					Cnc : Dpl:						
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Additional Notes:



Major Horizon Designations





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A Horizon →

B Horizon →

C Horizon →





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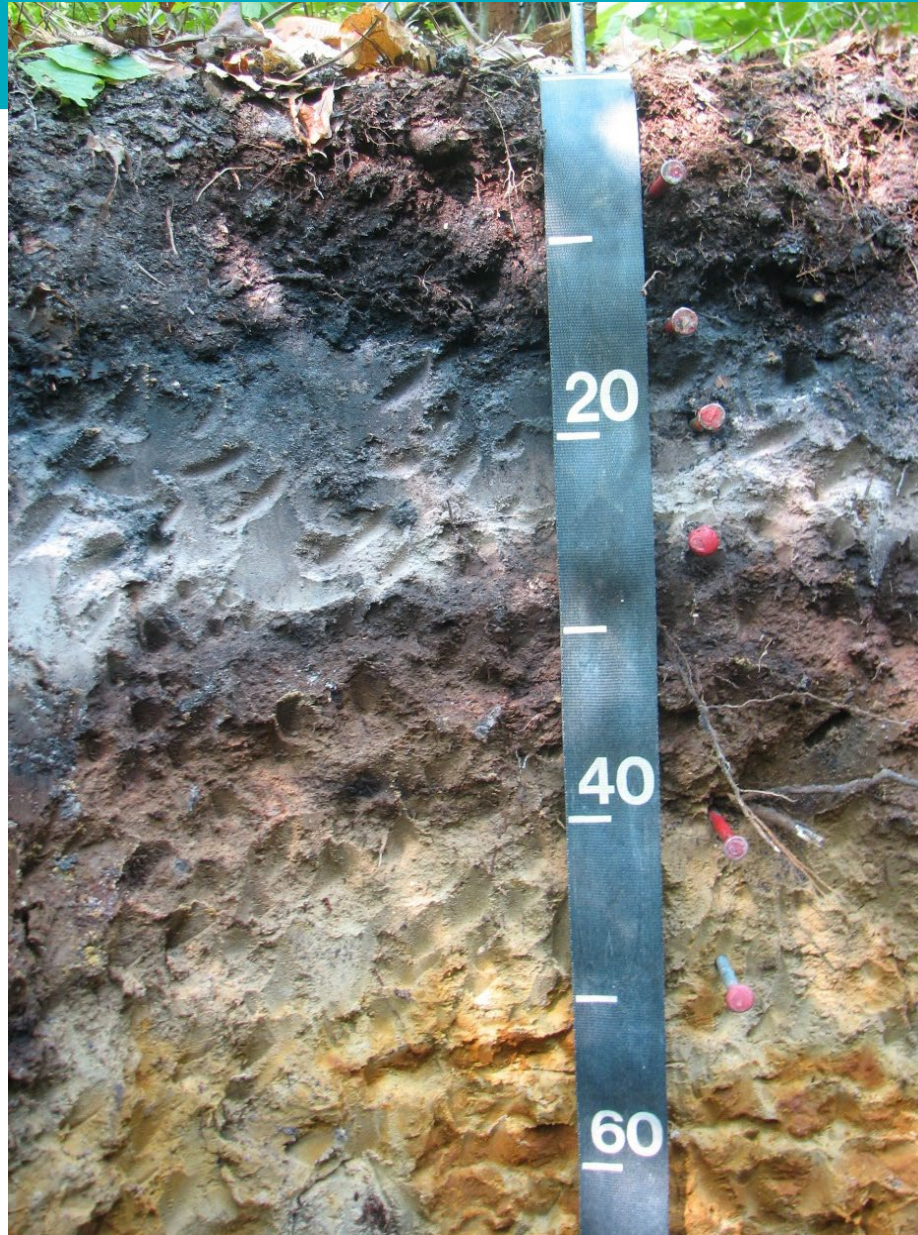
O Horizon

E Horizon

B Horizon

B Horizon

C Horizon



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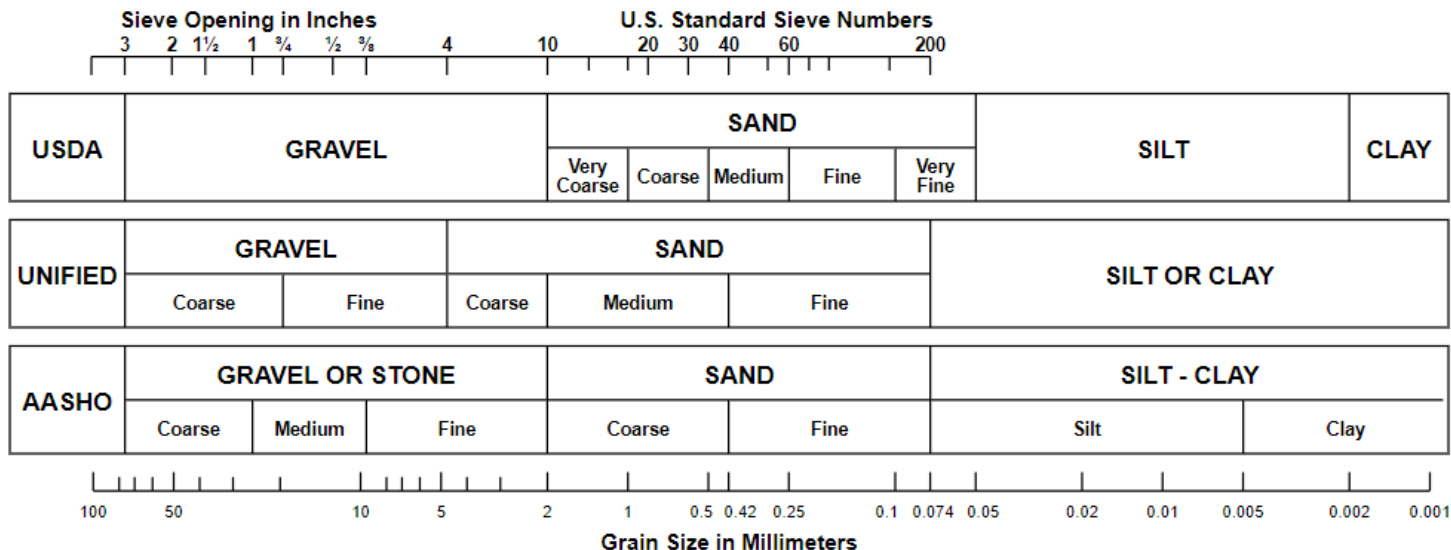
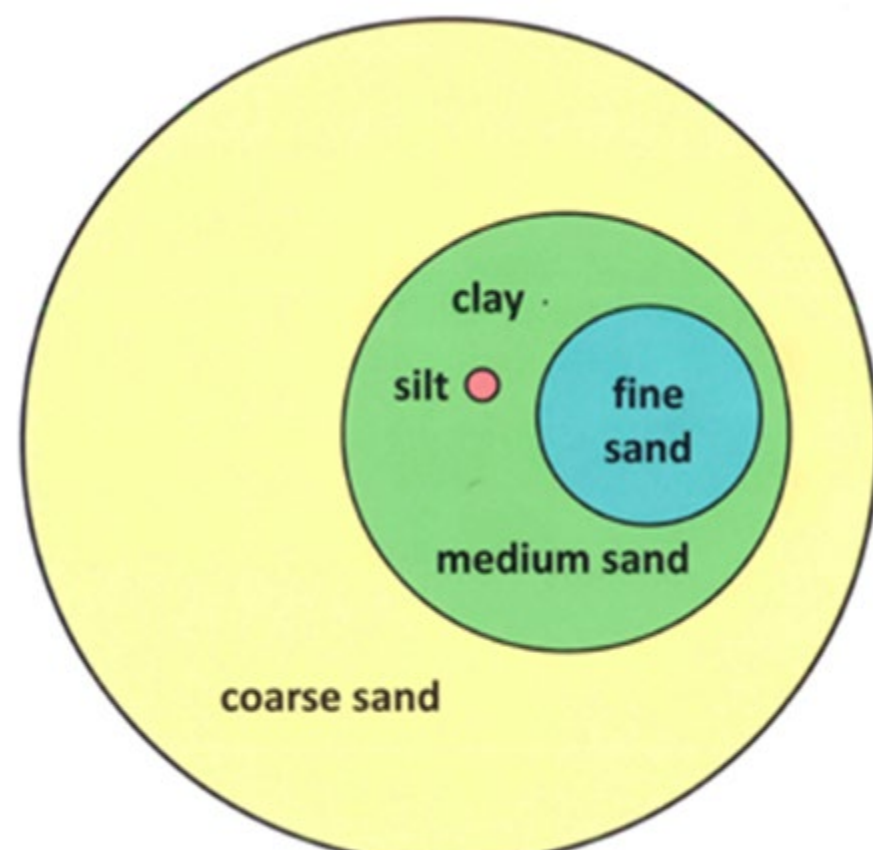
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Soil Texture

The proportion of

- Sand (0.05-2.0 mm)
- Silt (0.002-0.05 mm)
- Clay (<0.002 mm)

Anything larger is gravel, stones, boulders



Clay size particles

- <0.002 mm
- When wet – very smooth, sticky, forms a strong ribbon
- When dry – extremely firm and requires strong pressure to crush
- Dirties pores of one's hands
- Particles stay suspended in water for long periods of time

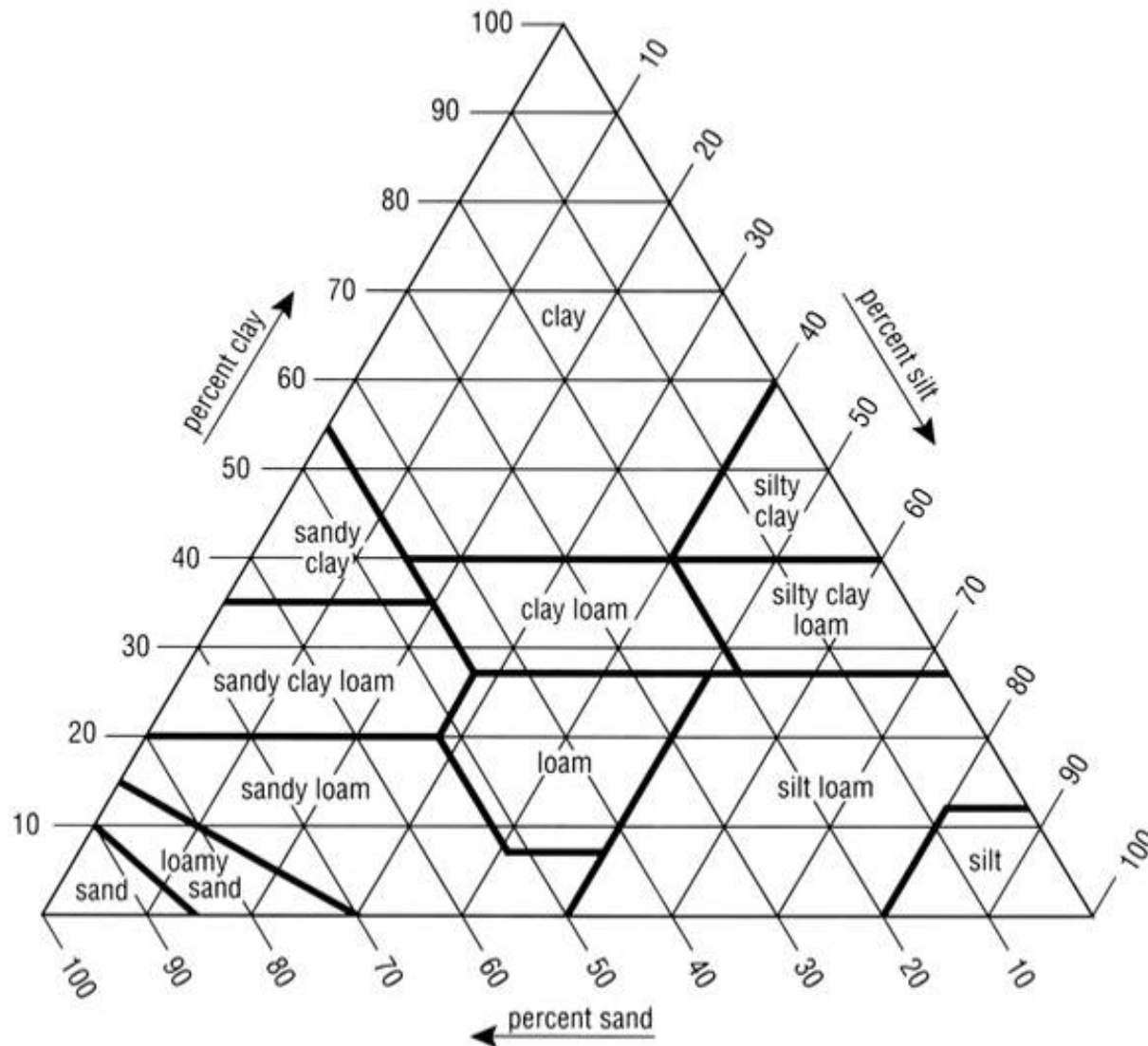
Silt size particles

- 0.002 to 0.05 mm
- Very smooth, non gritty feel like flour or talcum powder
- When wet – slightly to non sticky, forms a weak ribbon
- When dry – crushes with moderate pressure
- Dirties pores of one's hands
- Particle will suspend in water when mixed

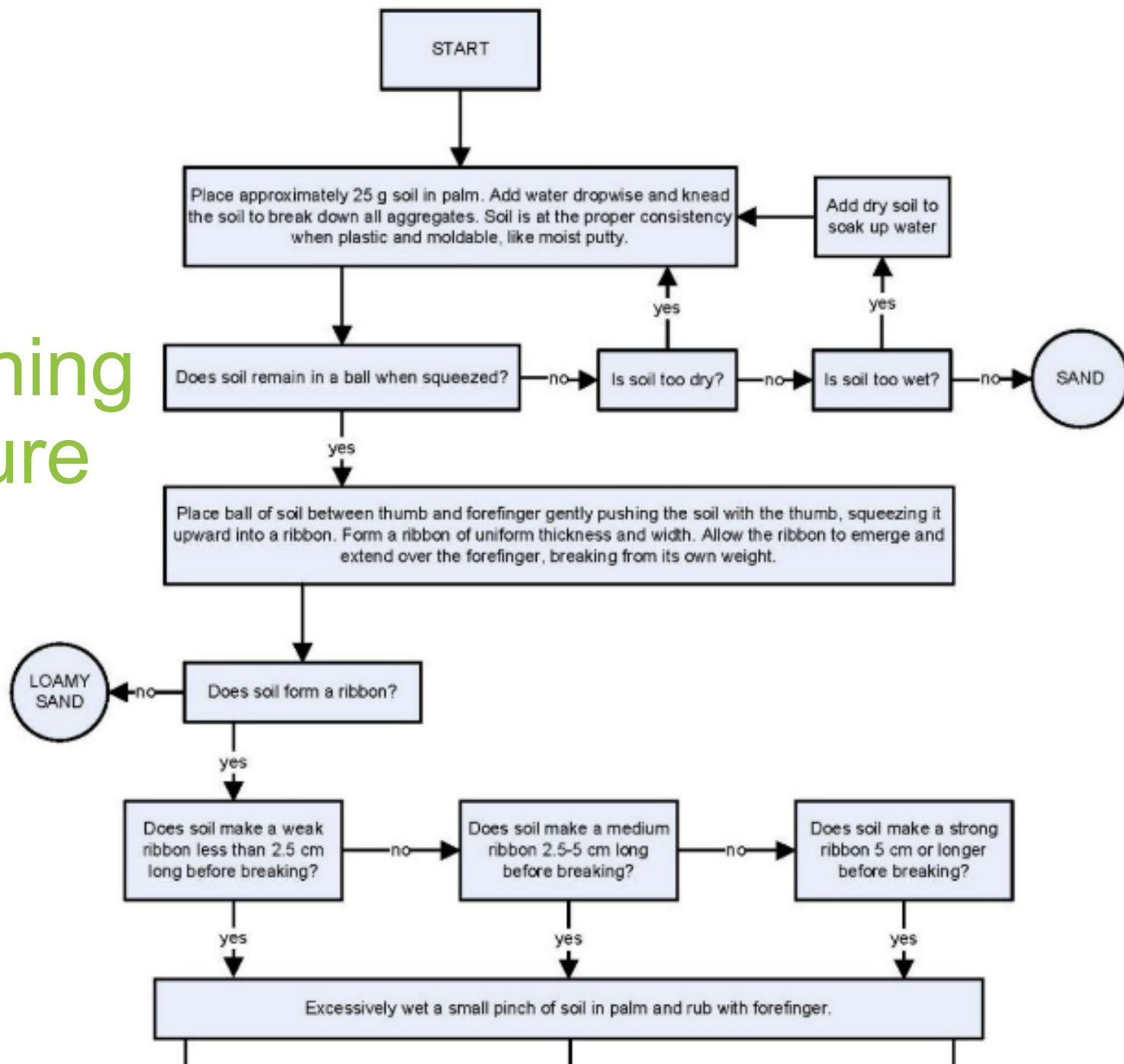
Sand size particles

- 0.05 to 2 mm
- Largest size class and is further divided into subcategories.
 - Very coarse sand (1 to 2 mm)
 - Coarse sand (0.5 to 1 mm)
 - Medium sand (0.25 to 0.5 mm)
 - Fine Sand (0.1 to 0.25 mm)
 - Very fine sand (0.05 to 0.1 mm)
- Composed mainly of weathered grains of quartz.
 - Sand is gritty to the touch.
 - Sand grains will not stick to each other.
- Non sticky
- Hands can be wiped clean
- Particles do not suspend in water

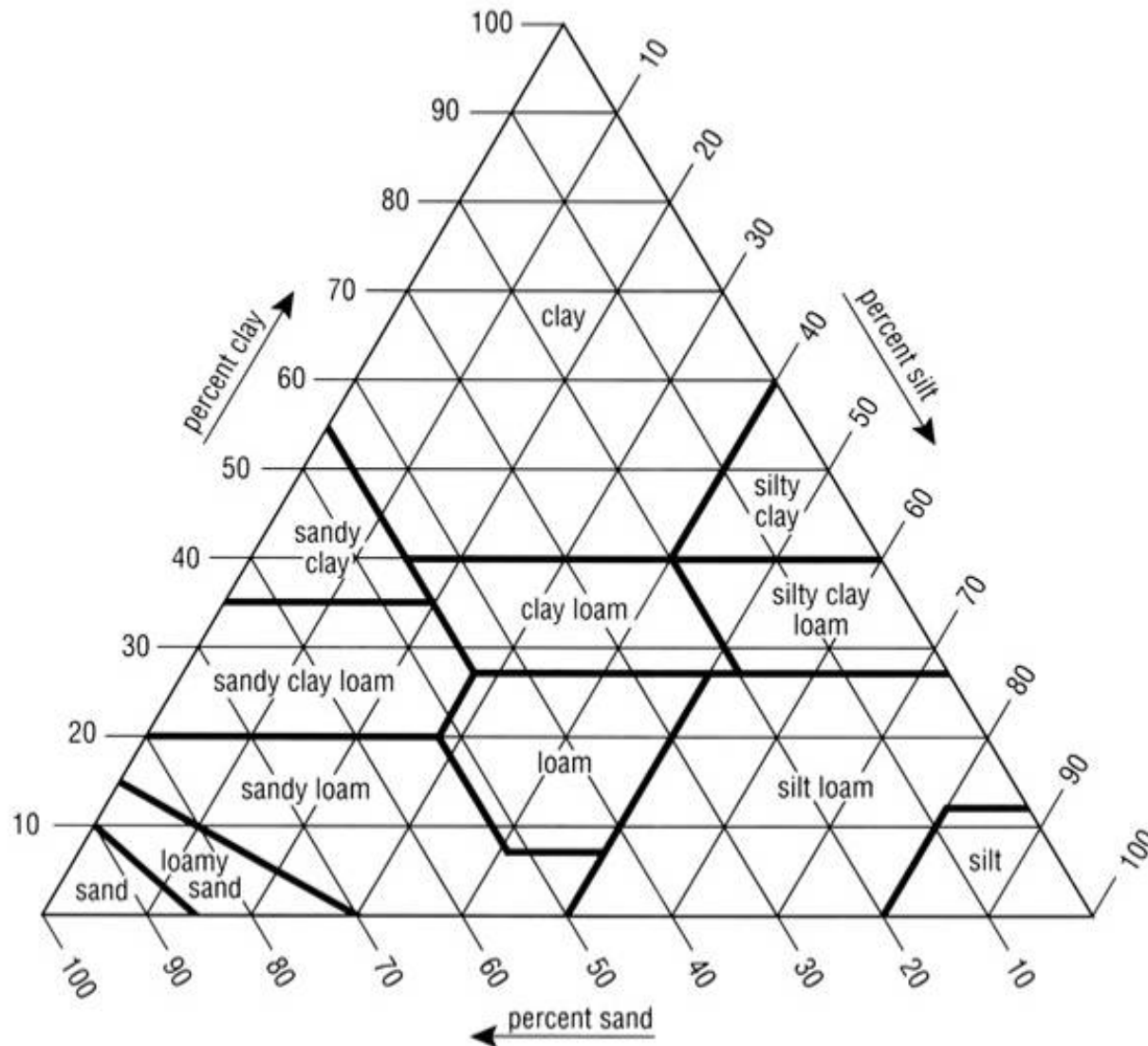
Texture = Relative
 proportion of sand,
 silt, and clay sized
 particles by weight



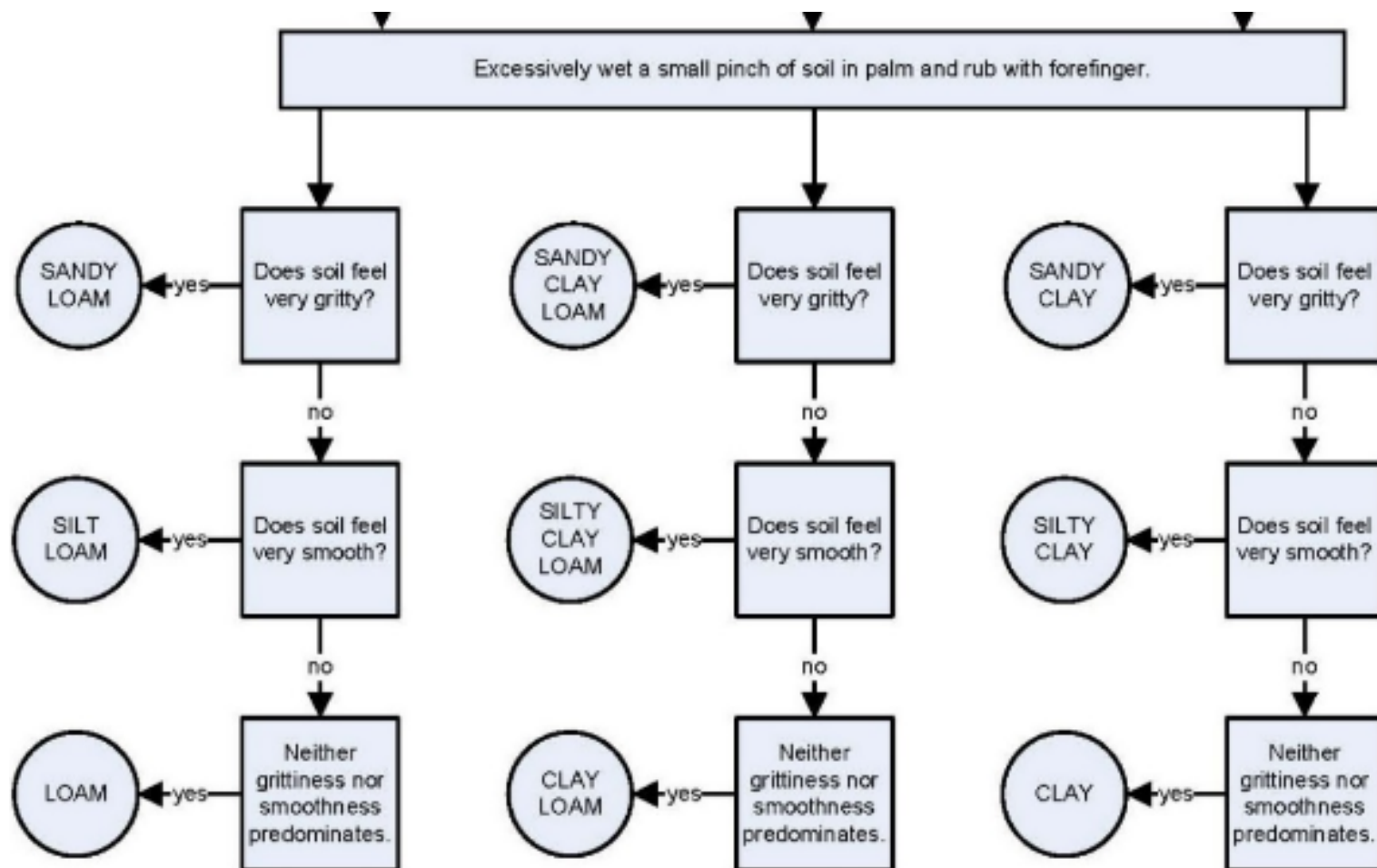
Determining soil texture by feel



Texture = Relative
 proportion of sand,
 silt, and clay sized
 particles by weight



Determining soil texture by feel



Organic Soil Material vs. Mineral Soil Material

- Mineral, mucky modified (A, B, C horizon)
- Organic (O horizon) – 20 to 30 percent organic matter by weight (12 to 18 percent organic carbon)
- Kinds of Organic Material:
 - Fibric: non to slightly decomposed organic matter, $>2/3$ fiber content
 - Hemic: partially decomposed organic matter, $1/3$ to $2/3$ fiber content
 - Sapric: well decomposed organic matter, $<1/3$ fiber content

Coarse fragments

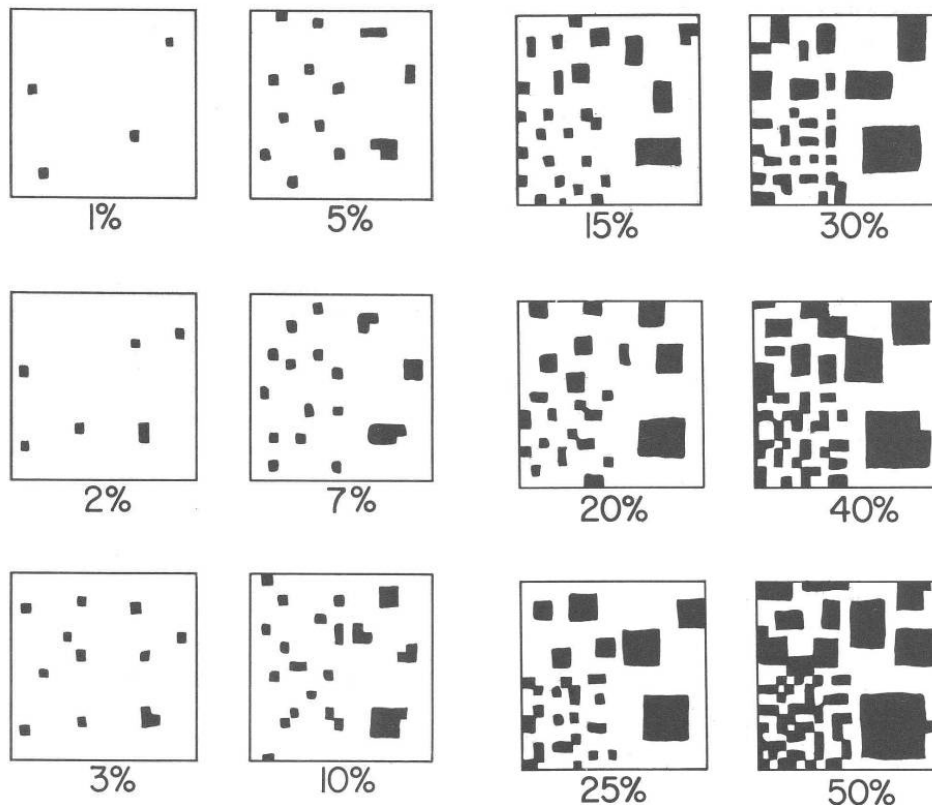
Gravel 2.0 mm to 3 inches

Cobbles 3 inches to 10 inches

Stones 10 inches to 2 feet

Boulders Greater than 2 feet

CHARTS FOR ESTIMATING PROPORTIONS OF MOTTLES AND COARSE FRAGMENTS



Each fourth of any one square has the same amount of black

Estimated by volume

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Soil Color

- Organic matter: Brown or black
- Iron: Yellow, orange, and red
- Manganese: purplish black
- Parent material mineralogy: varies

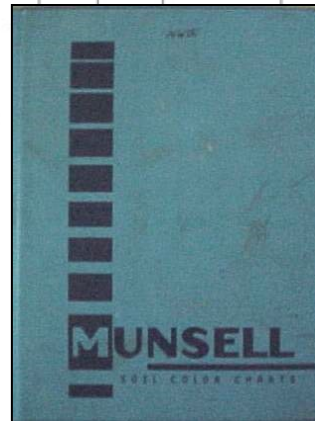
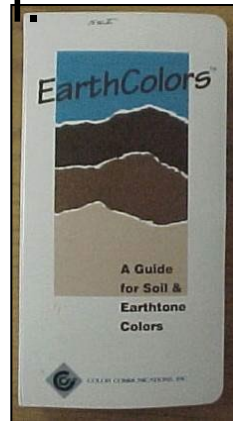
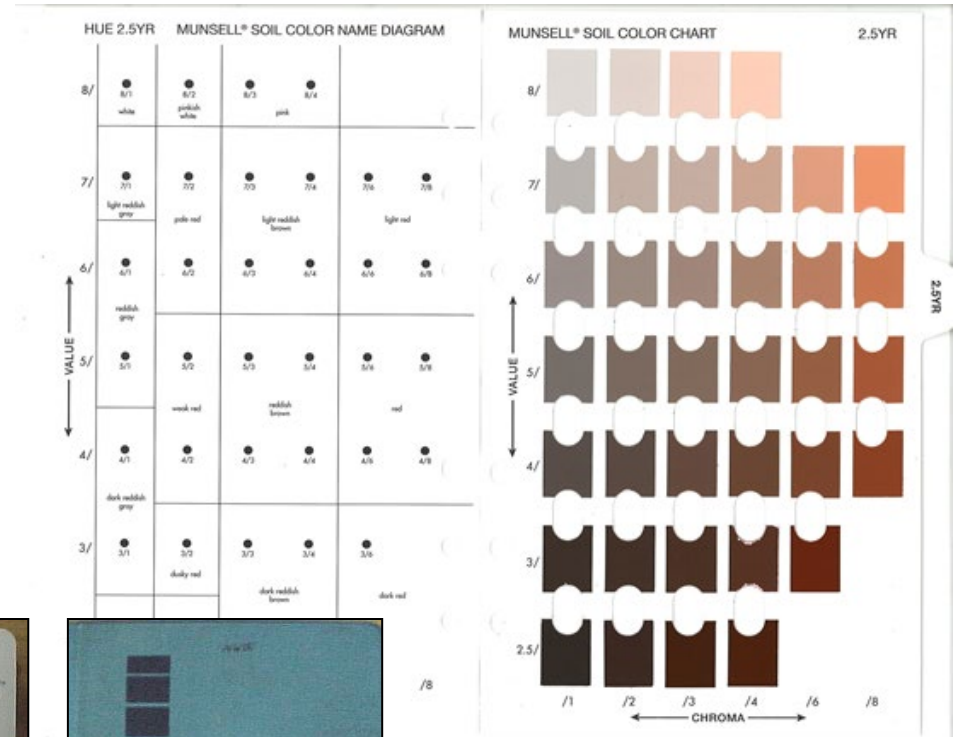




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Munsell® or Earth Colors®

- The Munsell notation system is a system for recording color.
 - Earth Colors and Munsell books use the same color notation.



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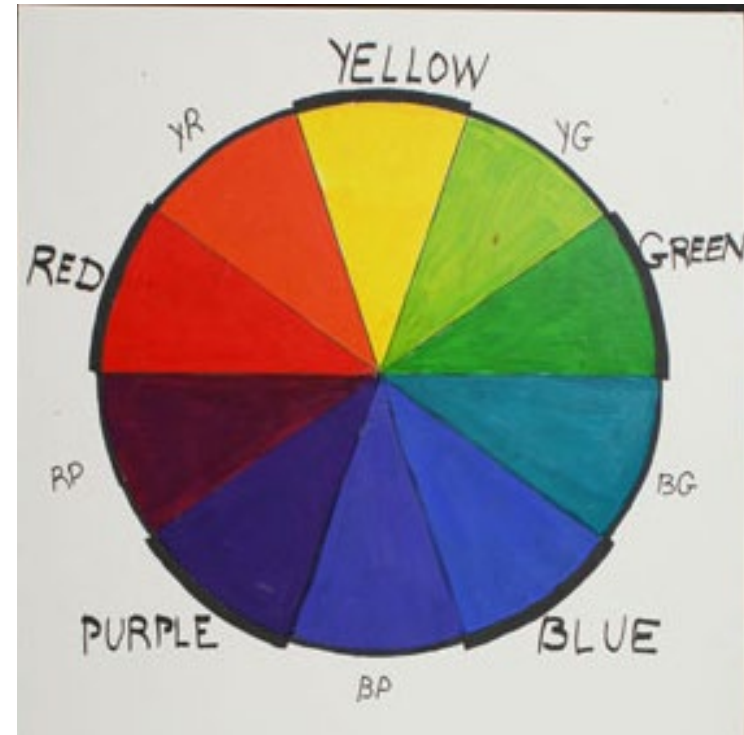
Soil Color

- Munsell system uses three elements of color:
 - Hue
 - Value
 - Chroma



Hue

- The dominant color
 - R (Red)
 - Y (Yellow)
 - YR (Yellow-Red)



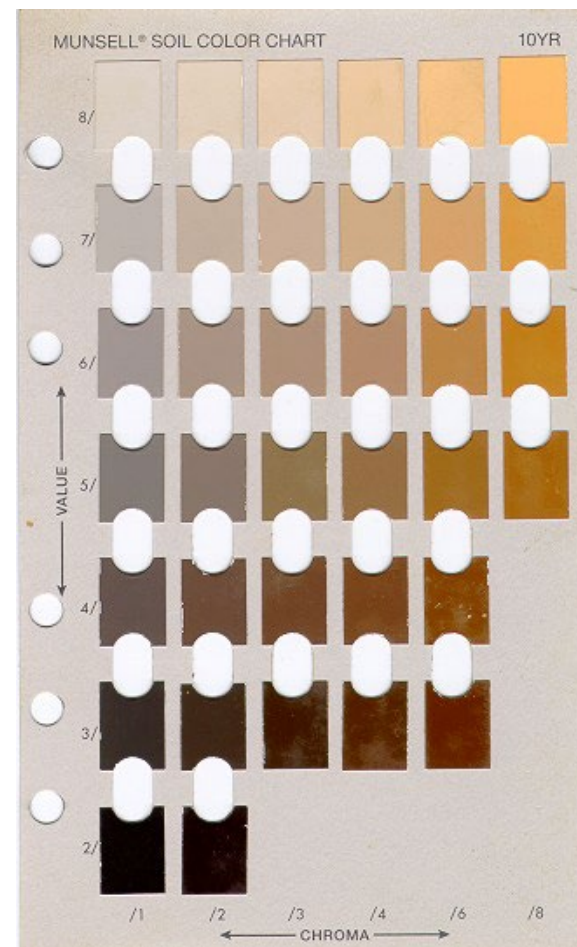
Value

- How light or dark is the color
 - High value = white
 - Low value = black



Chroma

- The strength or saturation of color
 - Low chroma: lack of saturation
 - High chroma: more saturation

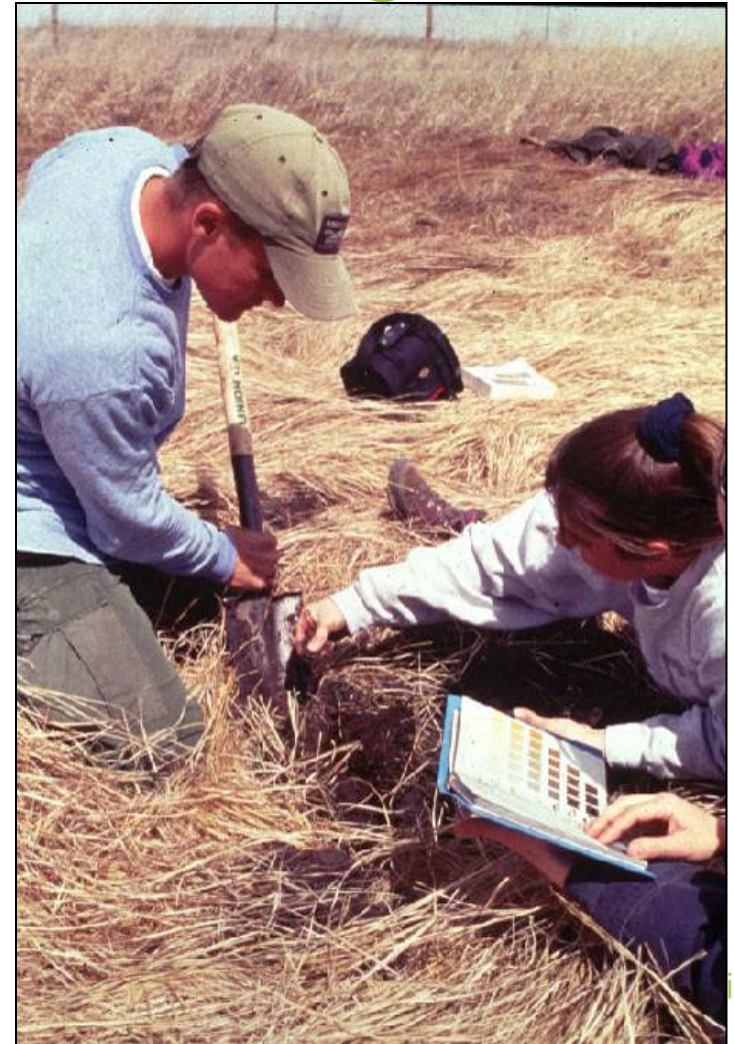




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Optimum conditions for reading soil colors:

- Soil moisture:
 - Moist
- Light:
 - In the sunlight
 - No artificial light
 - No sunglasses
- Soil surface:
 - broken face
- If dry, moisten to record color
- If wet, allow to dry to moist state
- Record color immediately after sampling.
 - Ferrous iron can oxidize rapidly after exposure to oxygen and can create colors of higher chroma.





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Describing Soil Color



- Matrix (predominant) color for each layer.
- Multiple soil colors can be redoximorphic features.



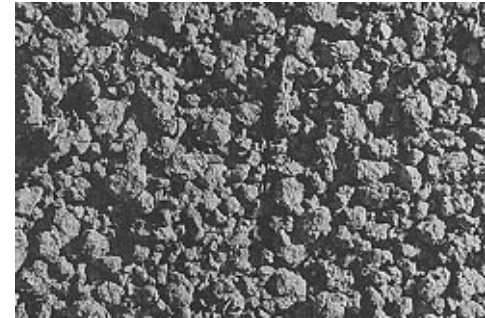


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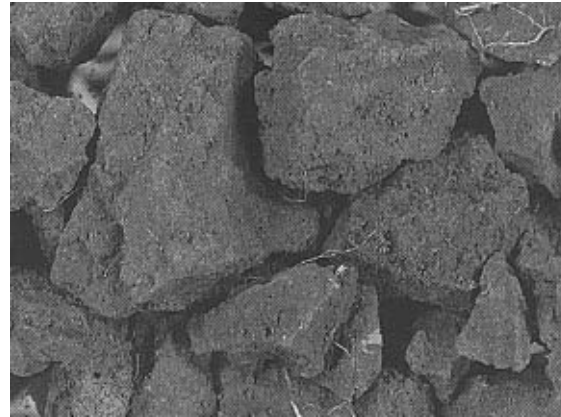
Structure

- Cohesion of particles into larger units = PEDS

Granular



Blocky



Single-Grain



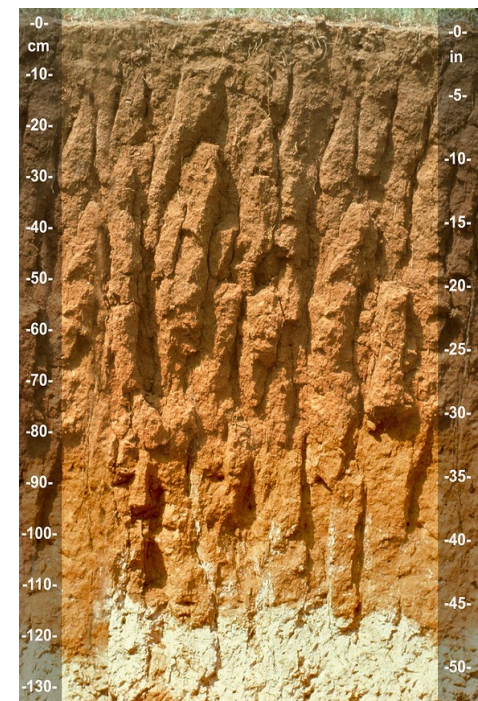
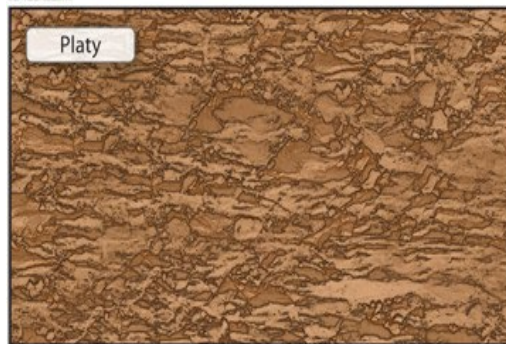
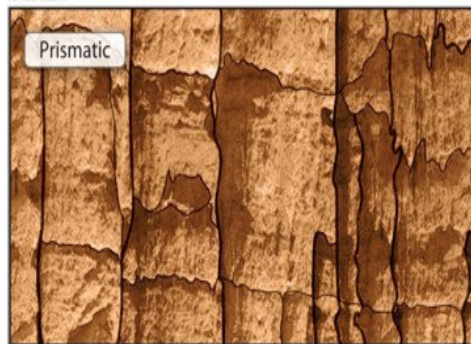
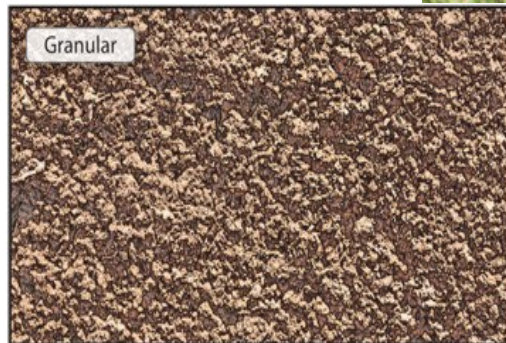
USDA-NRCS Davis, CA

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Structure

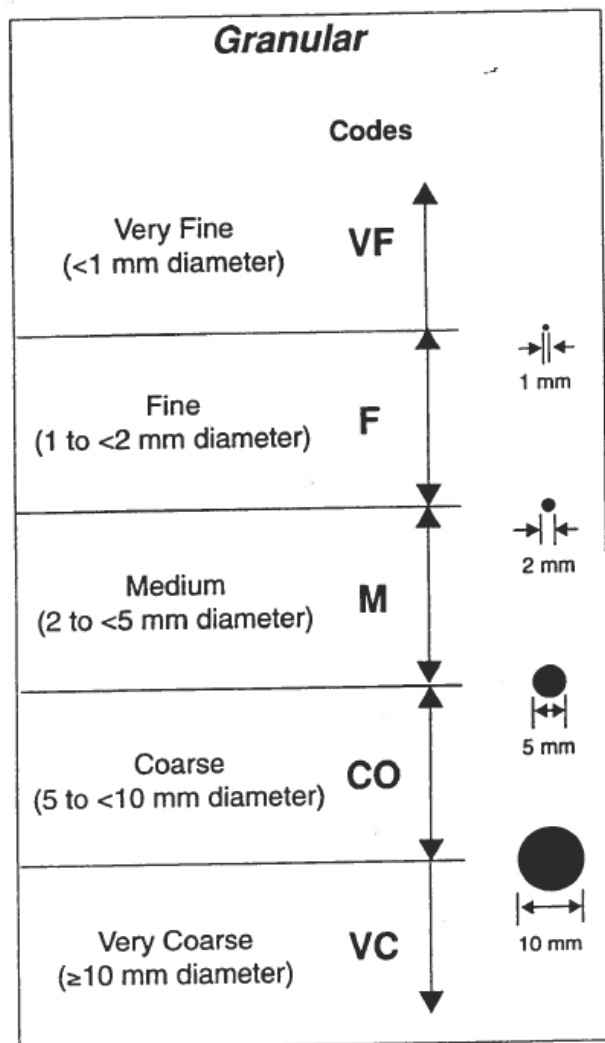
Granular, blocky, platy, prismatic



Photos courtesy of John Kelley

Pearson Education, Inc 2011

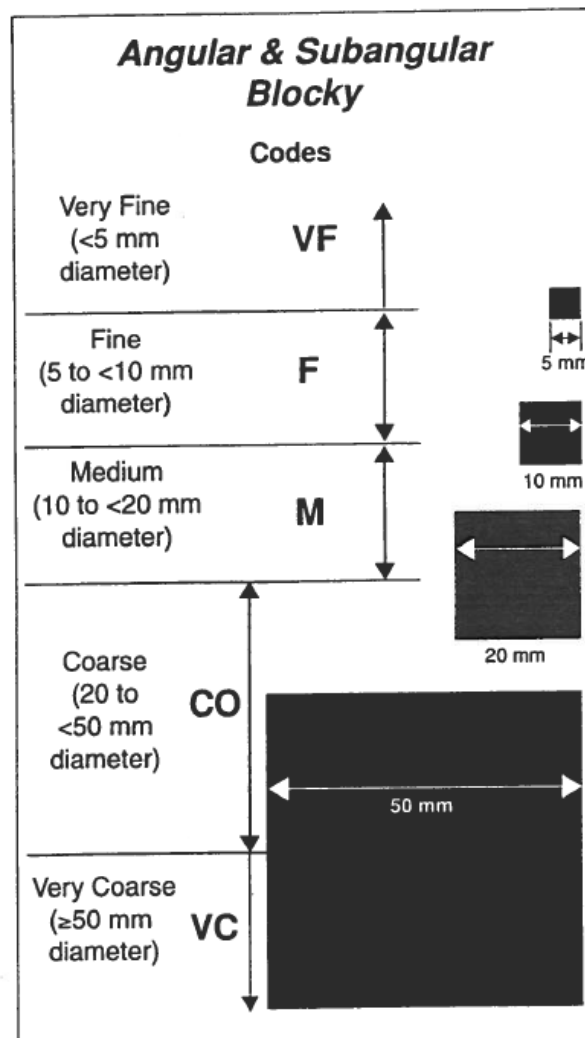




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2-44

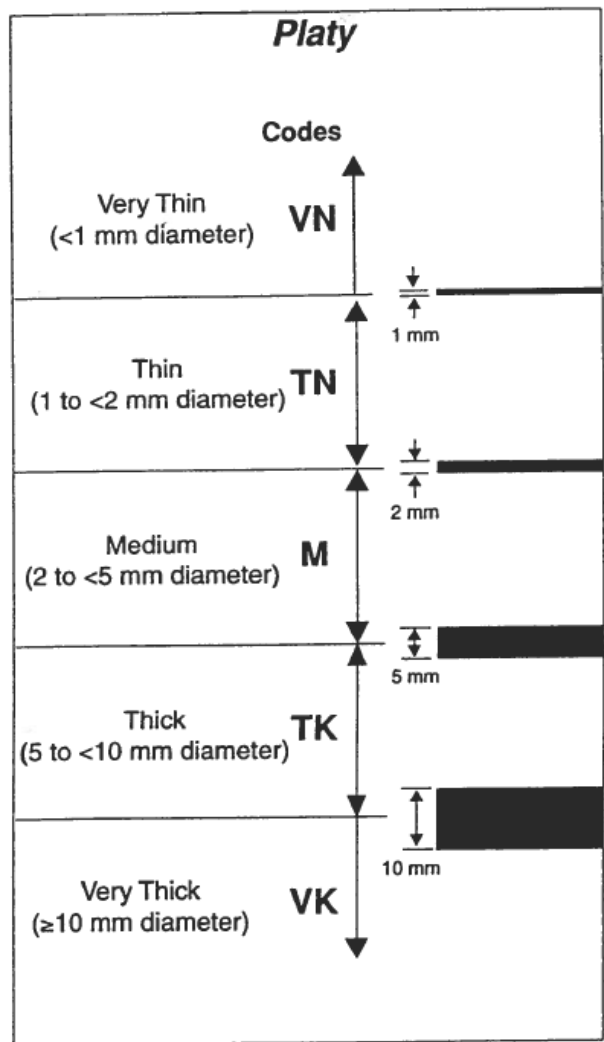
September 2002



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2-46

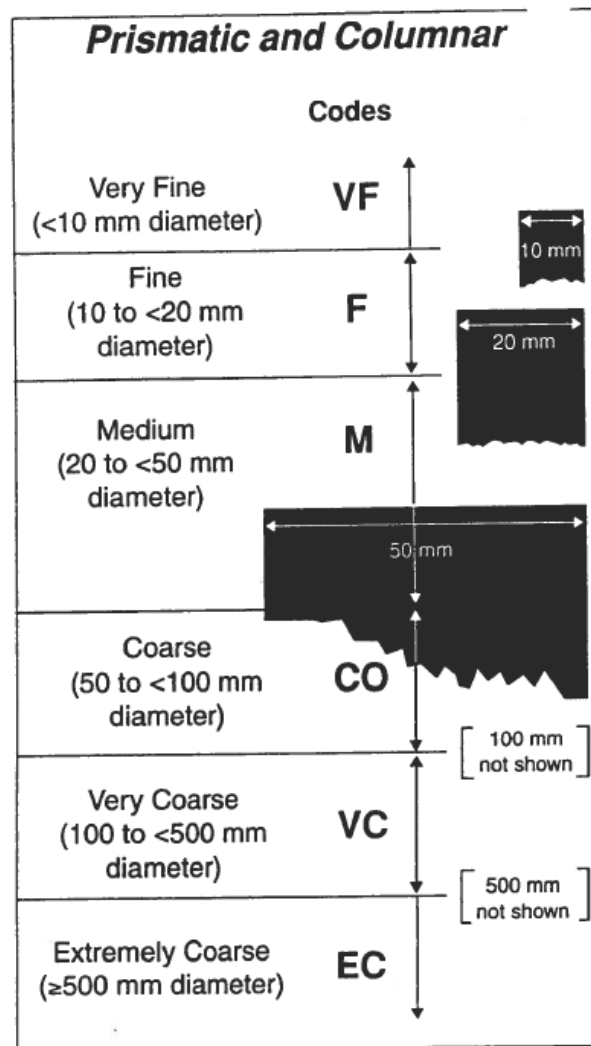
September 2002



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2-45

September 2002



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2-47

September 2002

Consistence

Cohesiveness, adhesiveness, bulk density
resistance to force



Loose- intact specimen not obtainable

Very Friable – very slight force between fingers

Friable – slight force between fingers

Firm – moderate force between fingers

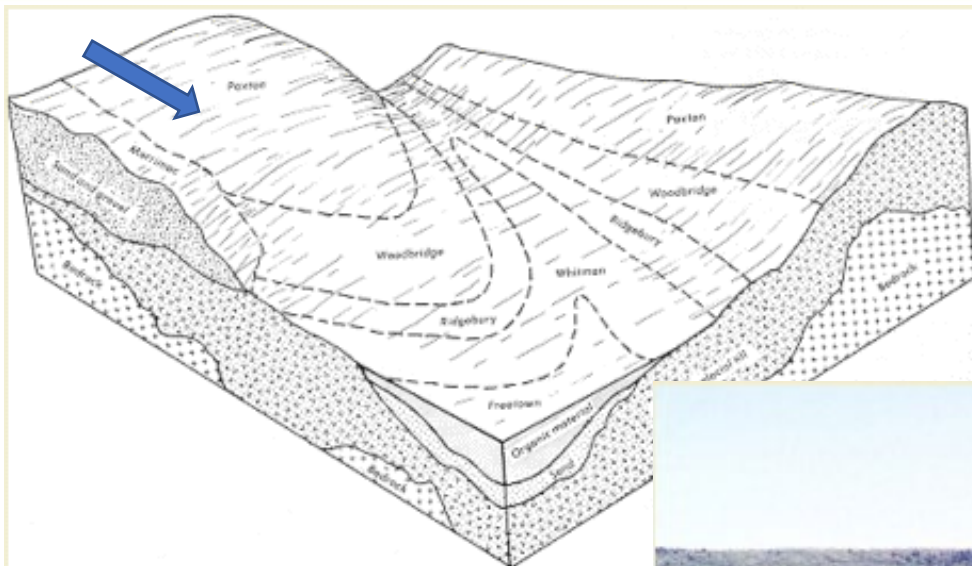
Very Firm – strong force between fingers

Extremely Firm – moderate force between hands

Slightly Rigid – foot pressure by full body weight



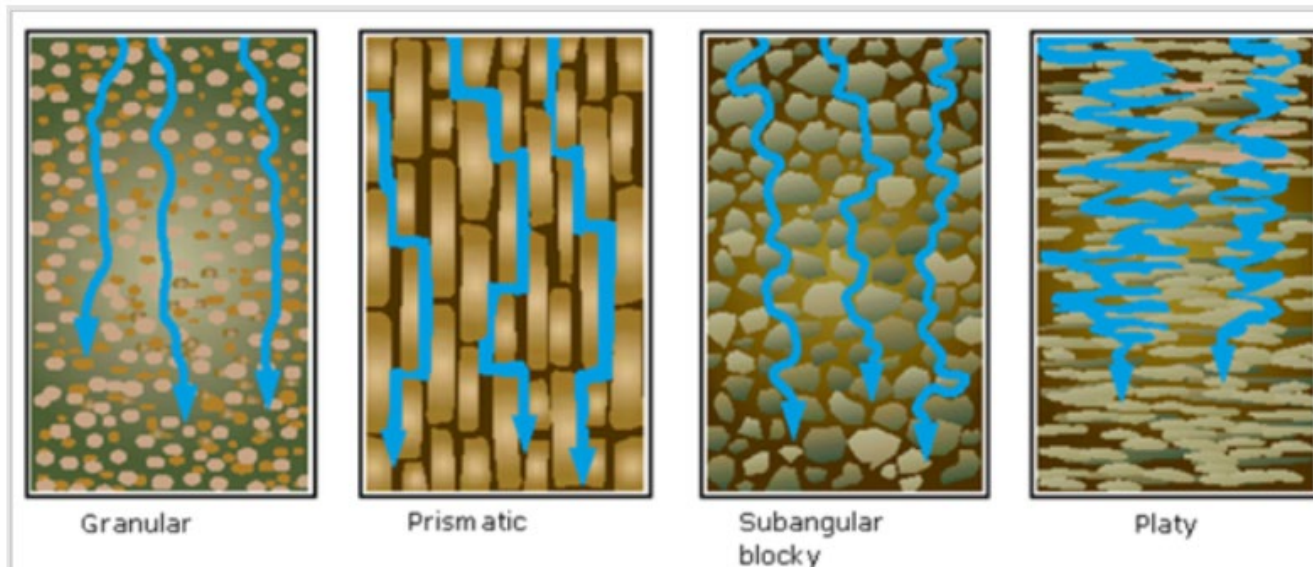
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What influences water movement?

- Gravity
 - Texture
 - Structure
 - Slope
 - Impermeable layers
- Capillary action
 - Texture
 - Structure



Water movement through different soil structure shapes. Developed by USDA-NRCS.

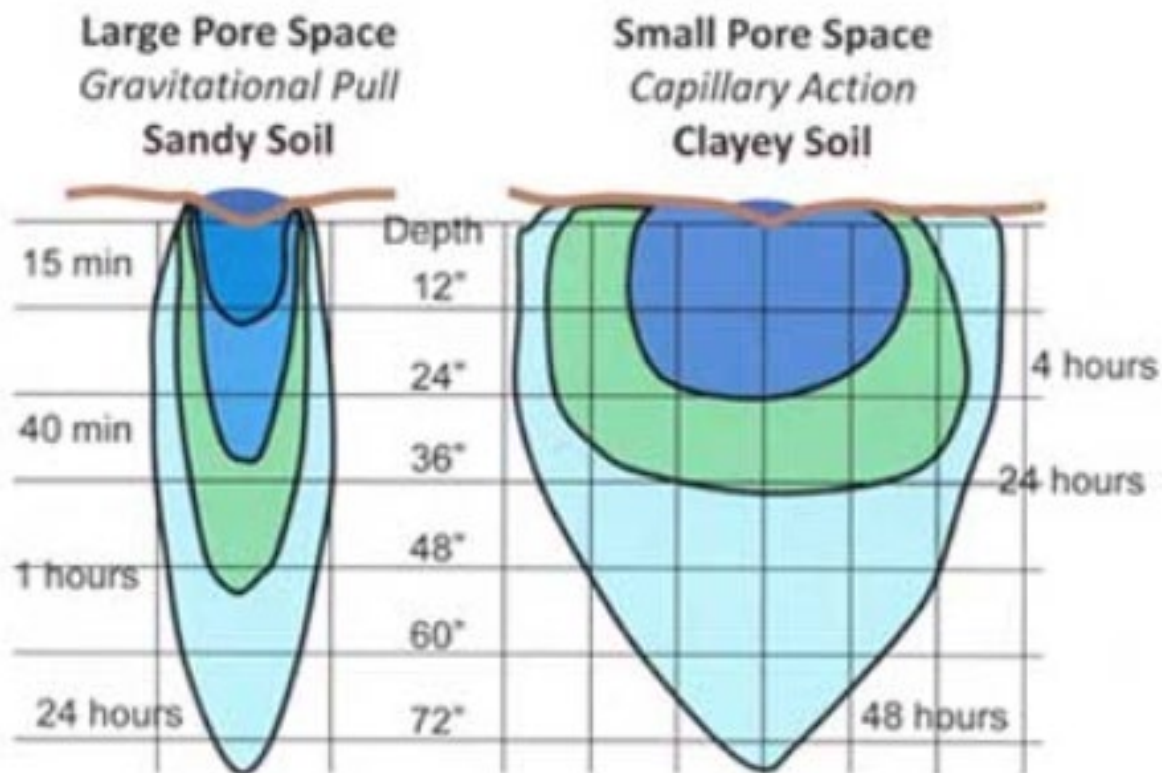
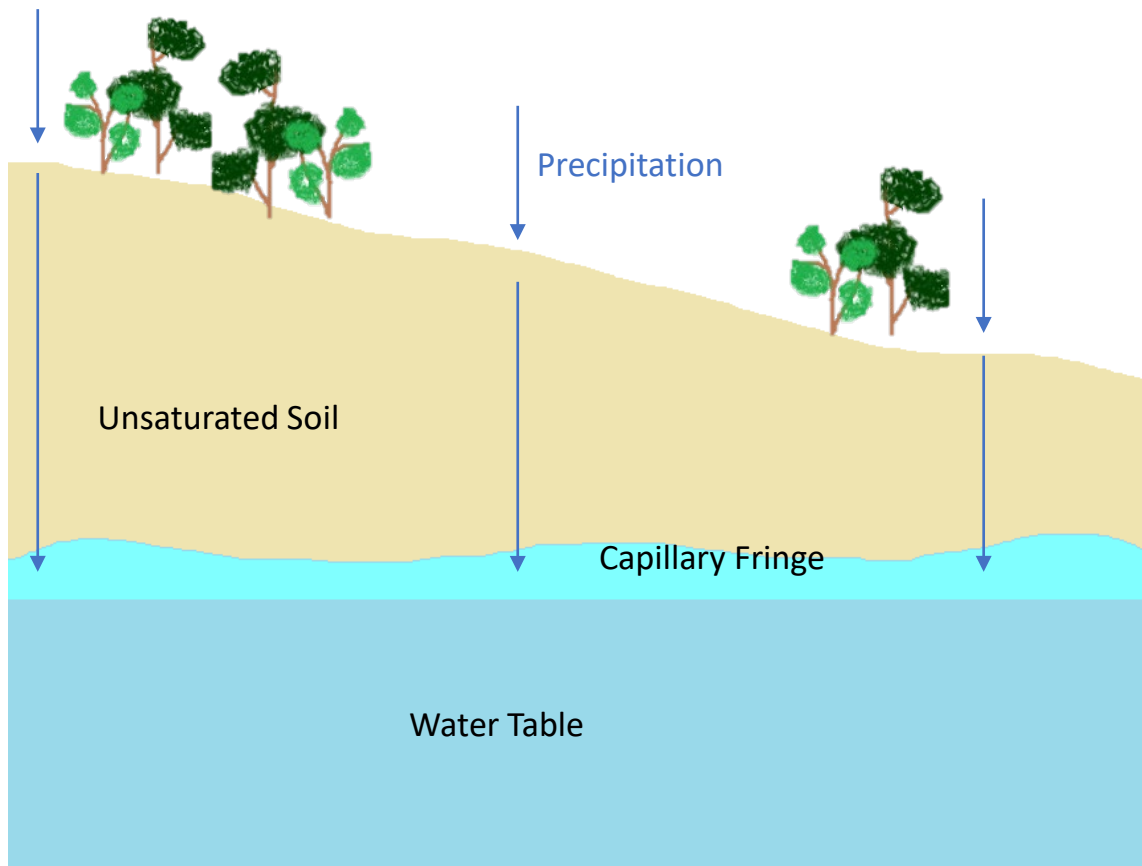
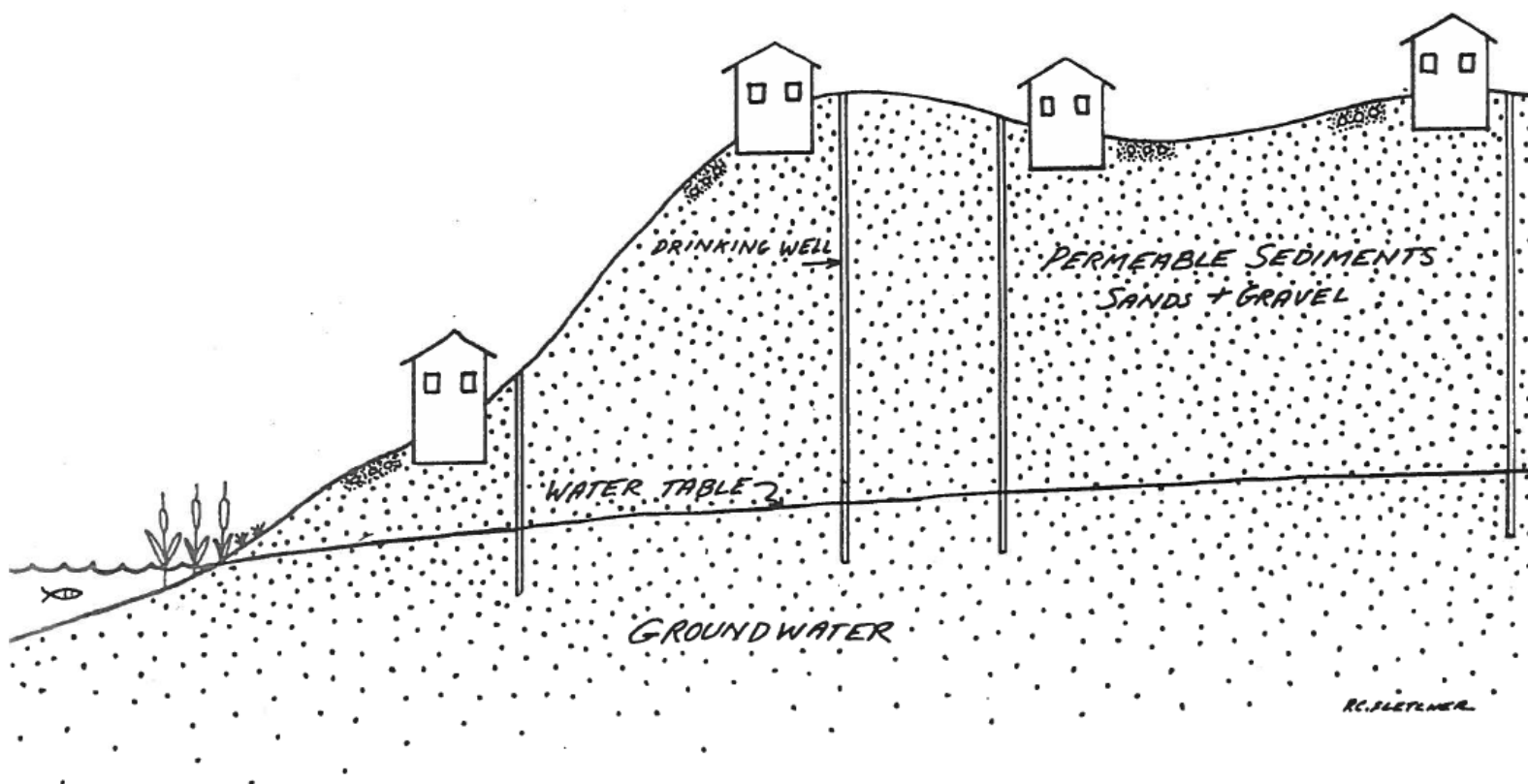


Figure 1: Comparison of water movement in sandy versus clayey soils. Water moves more quickly through sandy soils due to larger pore spaces and the force of gravity. In finer textured soils, water moves more slowly and is drawn through by capillary action. Figure: Colorado State Extension

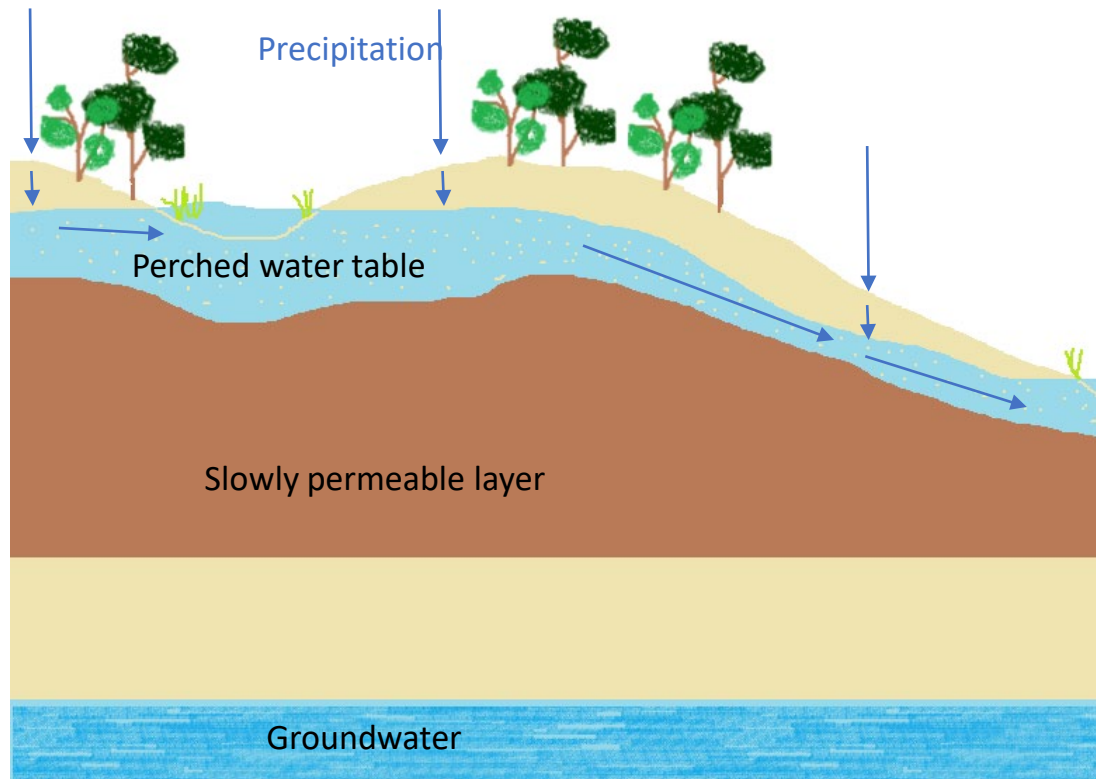
Soils no limiting layer – outwash/glaciofluvial

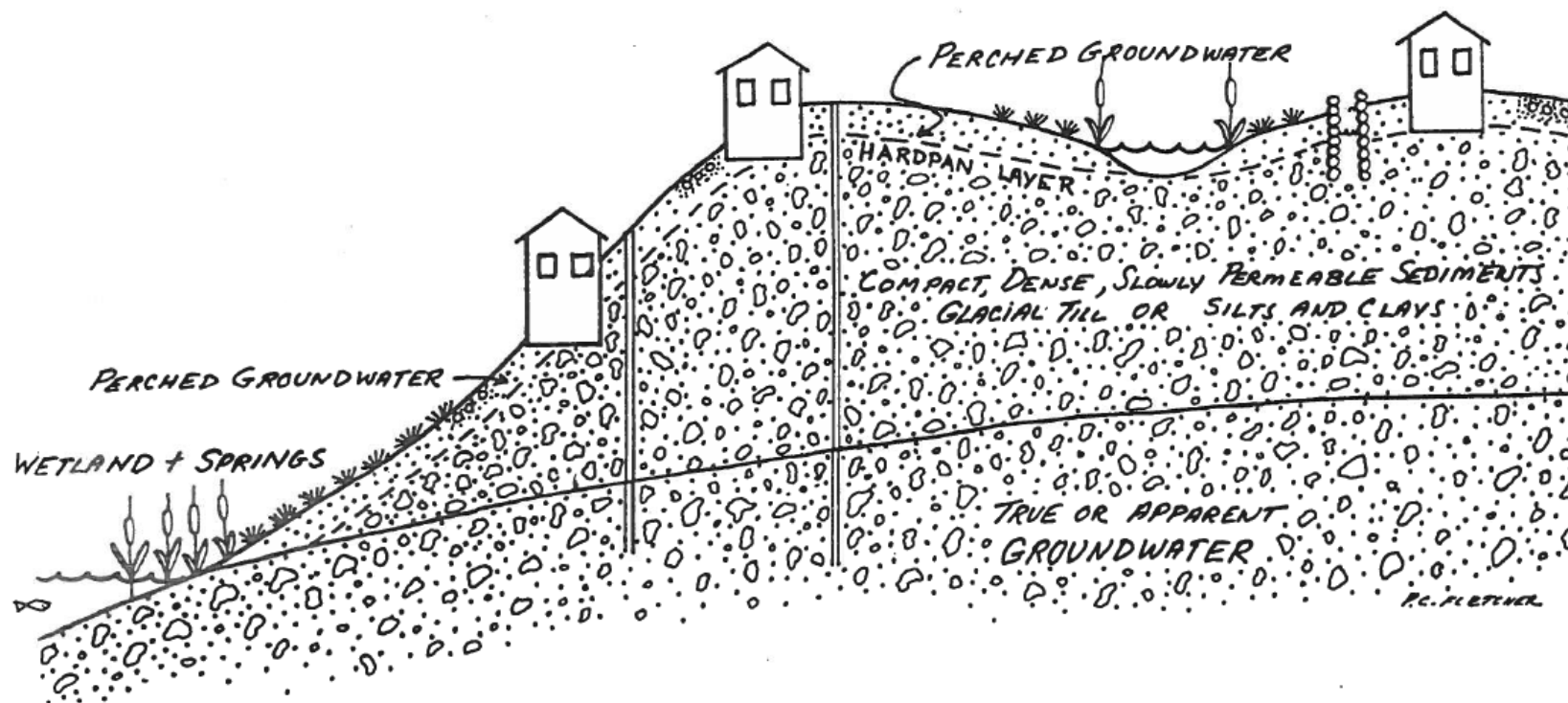


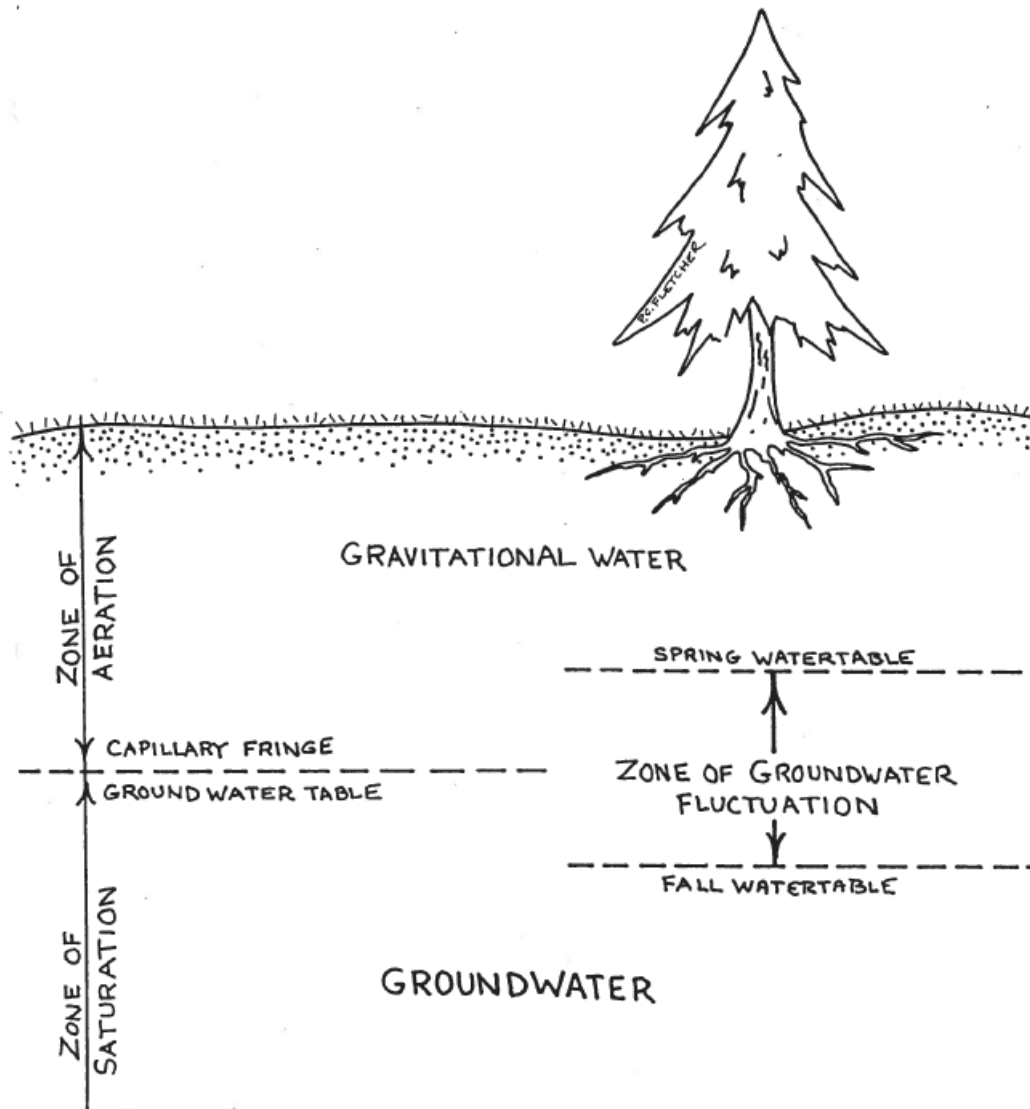
Soils no limiting layer – outwash/glaciofluvial



Soils with a limiting layer – dense till/ impermeable bedrock

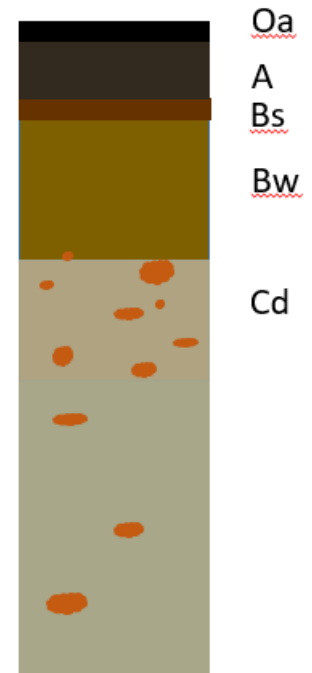
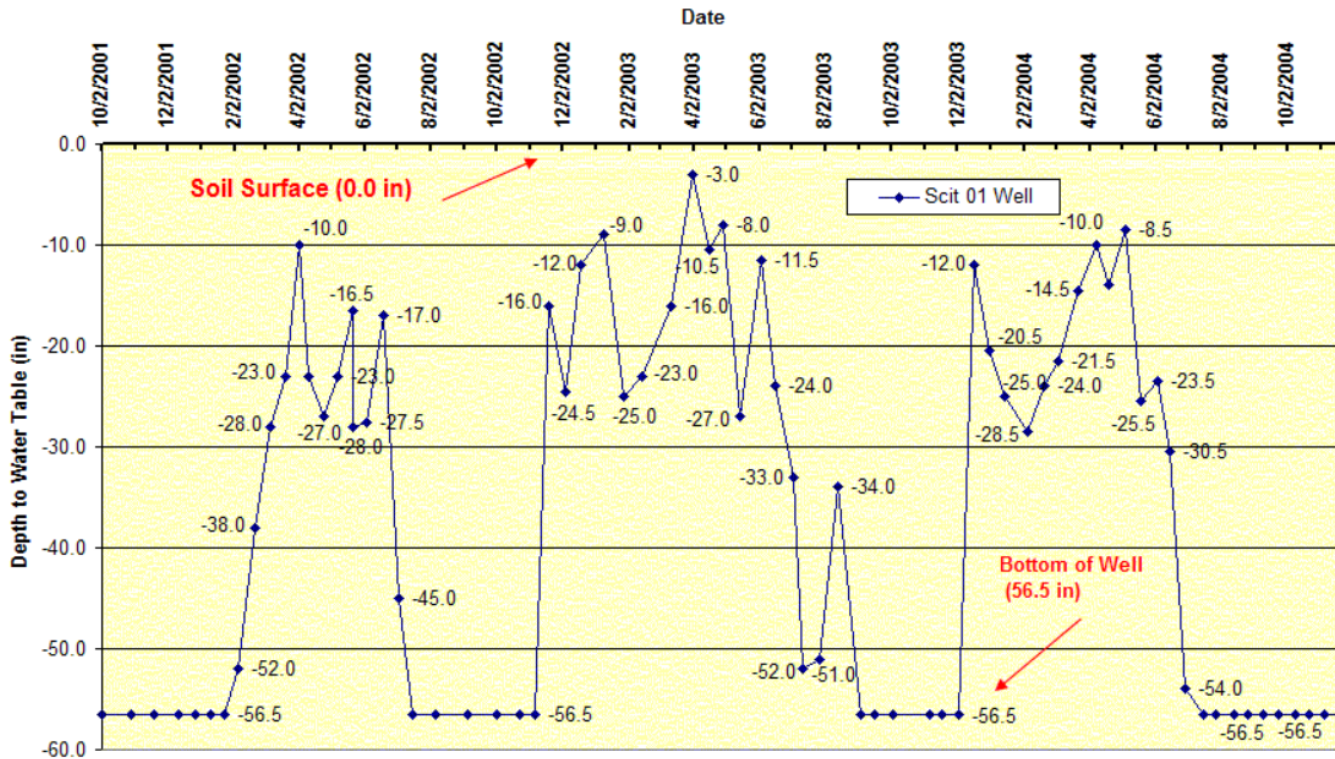






Water table fluctuations

Scit 01 Well - Water table, Oct. 2001 to Nov. 2004

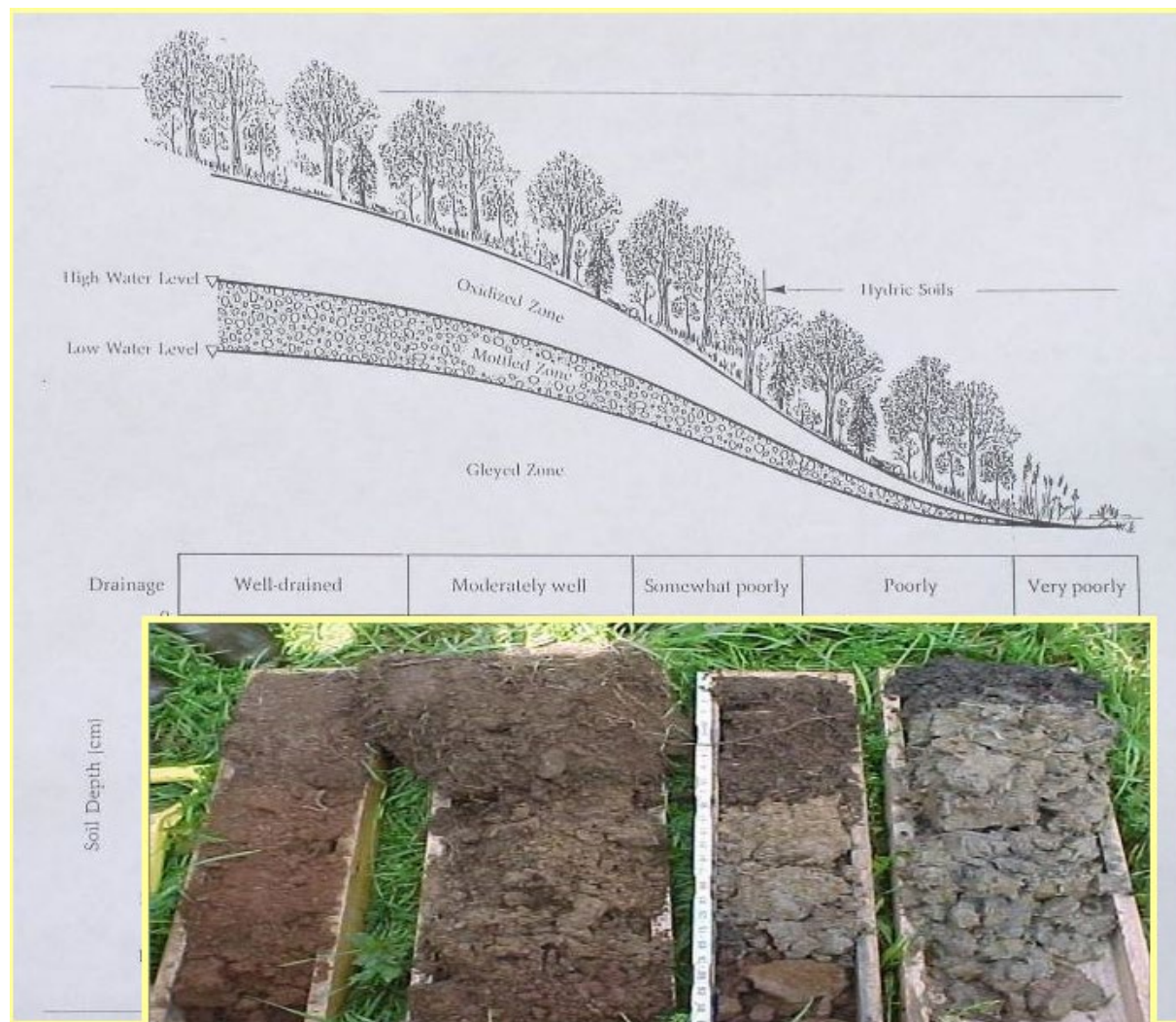




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Soil Drainage Class

(water table depth)



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Redoximorphic Features

Features formed by the processes of reduction, translocation, and/or oxidation of Iron (Fe) and Manganese (Mn) oxides

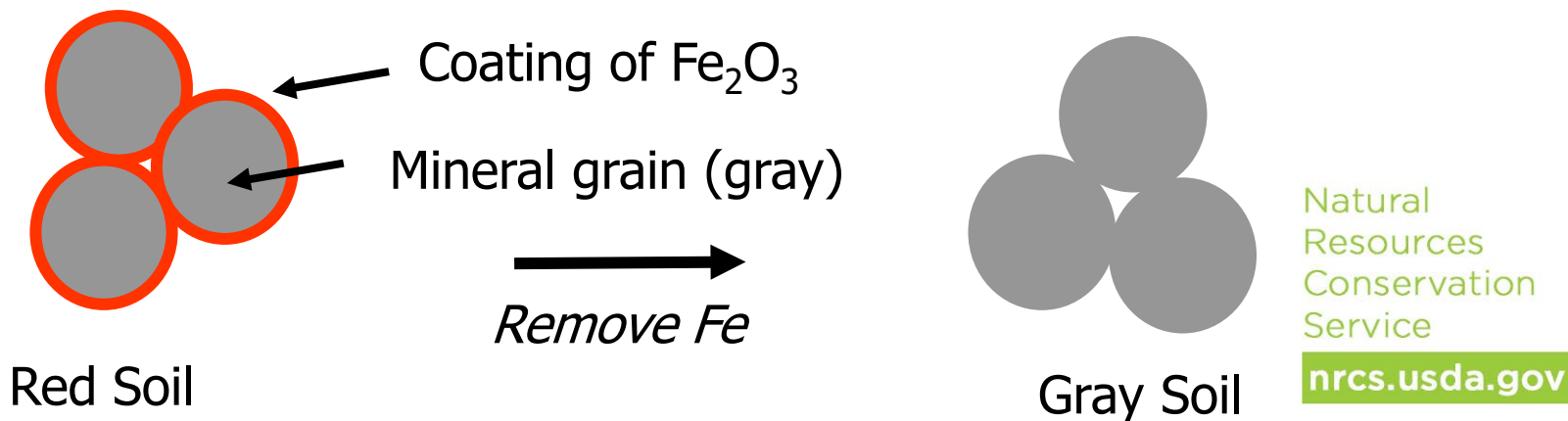




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Oxidation/Reduction and Soil Color

- In subsoil horizons, Fe and Mn oxides give soils their characteristic brown, red, and yellow colors.
- When saturated and reduced, Fe and Mn are mobile and can be stripped from soil particles.
- This leaves the characteristic mineral grain color, usually a neutral gray.



How Redox Features Form

Conditions needed:

- Fluctuating water table
- Temp above biological zero
- Organic matter
- Microorganisms
- Anaerobic conditions
- Iron minerals in the soil

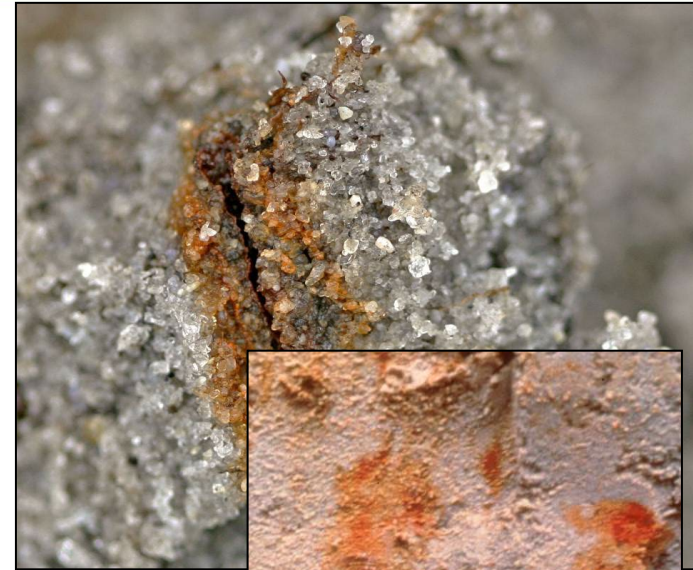


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How Redox Features Form

Oxygen	O_2	→	H_2O	
Nitrogen	NO_3^-	→	$N_2↑$; NH_4^+	
Manganese	Mn^{+4}	→	Mn^{+2}	
Iron	Fe^{+3}	→	Fe^{+2}	
Sulfur	SO_4^{-2}	→	H_2S	(Hydrogen sulfide gas)
Carbon	CO_2	→	CH_4	(Methane)



Water table rises and soil becomes saturated

Aerobic microorganisms in soil consume the free O_2 (1-2 days)

Electrons produced by microorganisms (respiration) reduce elements

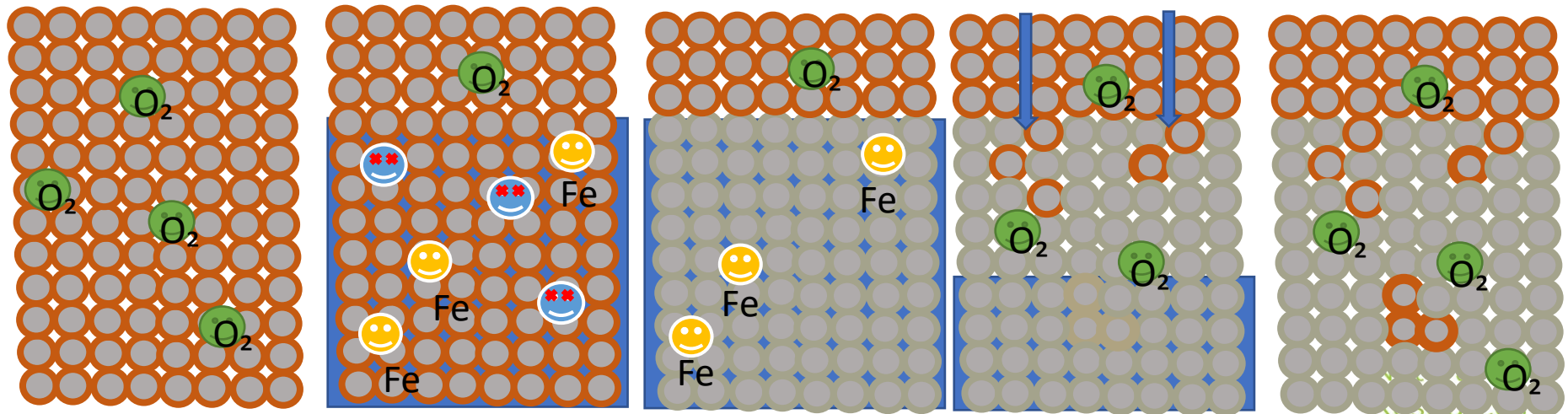
Ferrous (reduced) iron is clear and more mobile than Ferric (oxidized) iron. It may move with the groundwater

Water table drops, O_2 is reintroduced, Iron oxidizes (1-2 years to see features with the naked eye)

Anaerobic microorganisms begin to consume organic matter

It takes about 10 days in a lab under ideal conditions for the iron to become reduced. Can take years to see a gray matrix.

~30 days of flooding needed to produce a visible concentration





Redox Concentrations

Bodies of apparent accumulation of Fe/Mn oxides

- Masses
- Pore linings
 - on ped faces
 - in root channels
- Nodules and concretions



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Redox concentrations

- Masses
- Pore linings
- Root channels
- Iron (red) and Manganese (black)



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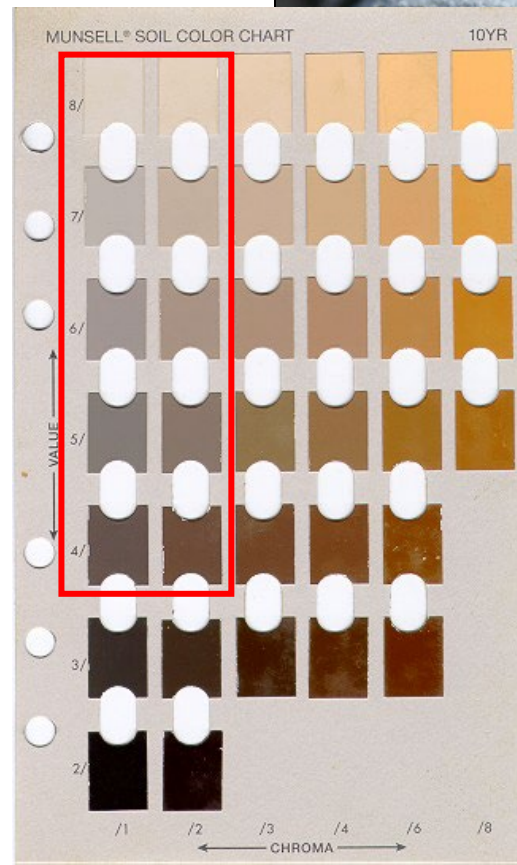


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Redox Depletions

Bodies of low chroma where Fe/Mn oxides have been stripped out

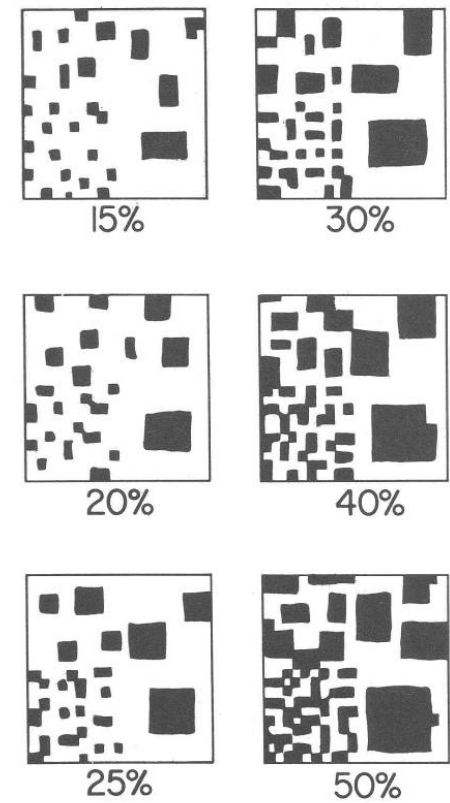
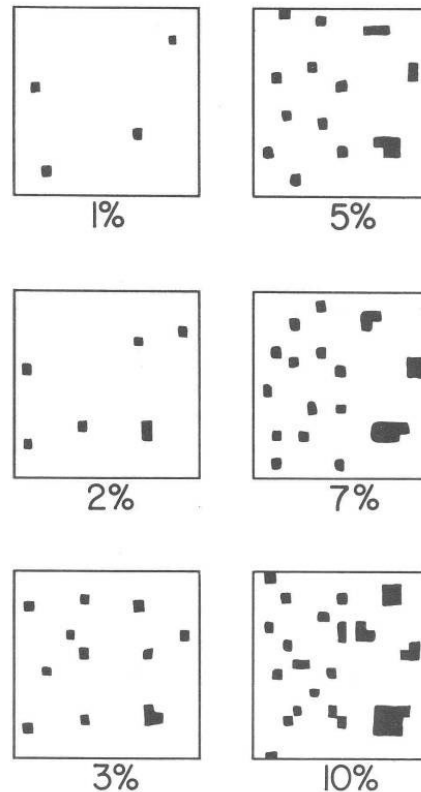
- Generally value ≥ 4
- Chroma ≤ 2
- Formerly called “gray mottles”



Abundance of Features

- Few: <2%
- Common: 2 to <20%
- Many: >20%

CHARTS FOR ESTIMATING PROPORTIONS
OF MOTTLES AND COARSE FRAGMENTS



Each fourth of any one square has the same amount of black



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Supplemental Materials

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Can you see
the redox?

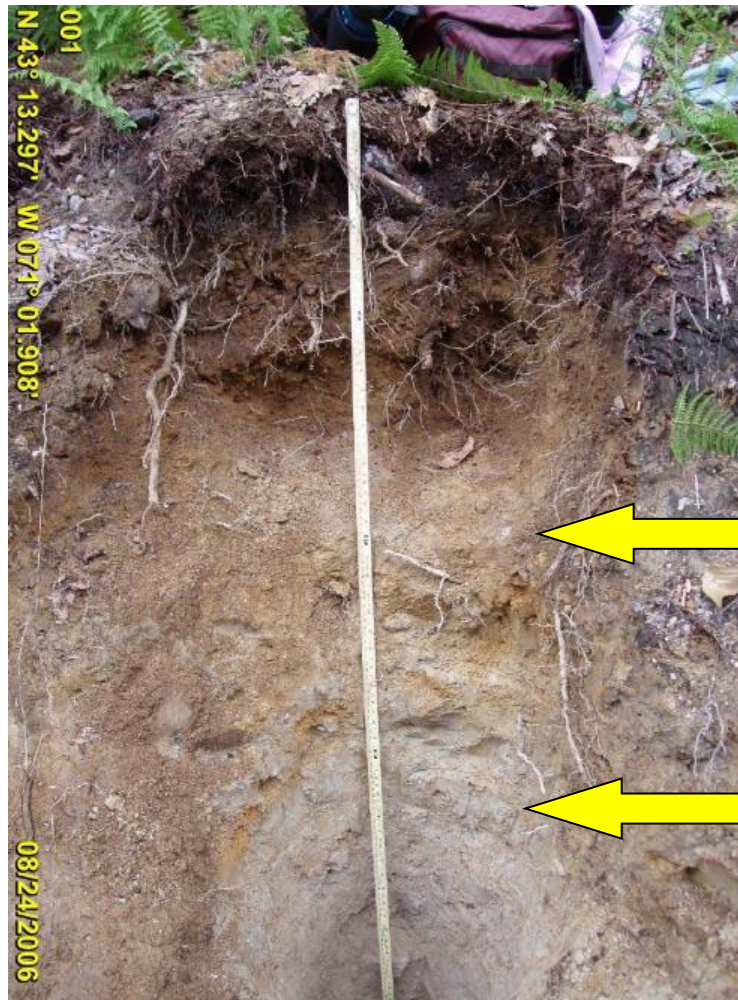
Where is the
water table in
the spring?



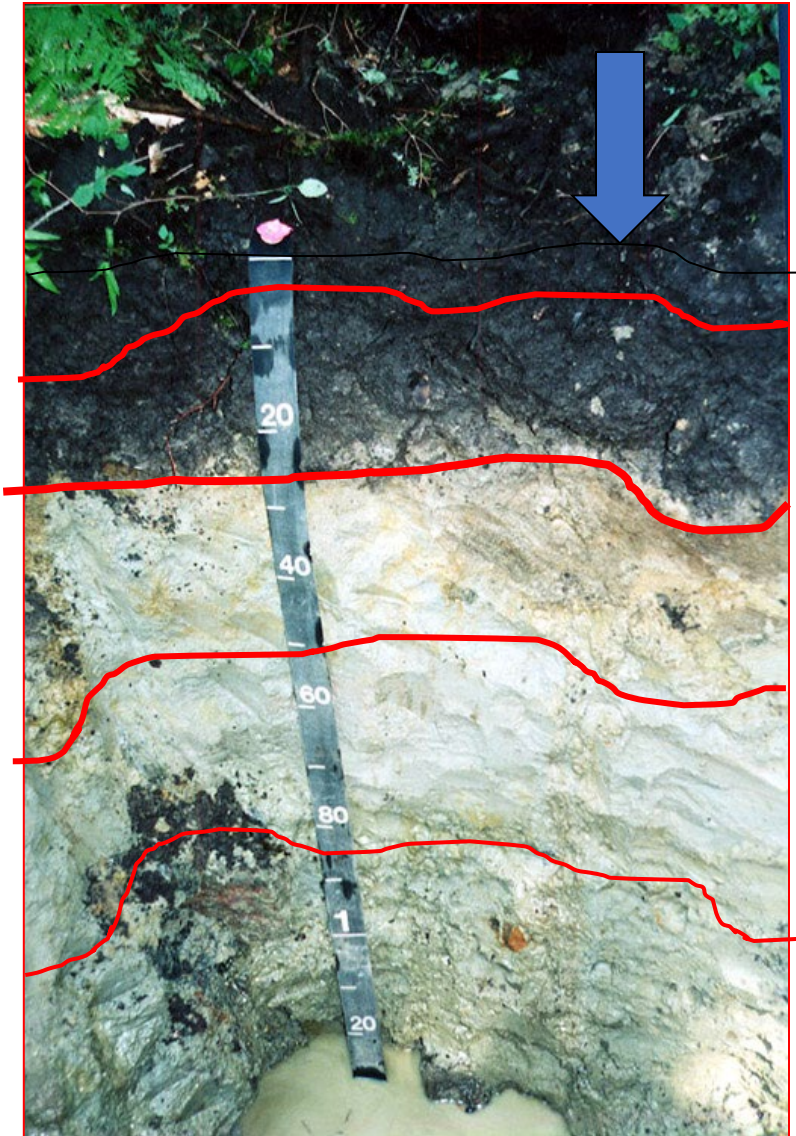
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Top of the water
table is at 24"
making it a
moderately well
drained soil



Describing Soils



Layer 1: Oa Muck surface

Layer 2: A horizon, MK L,
10YR 2/1, with Roots

Layer 3: Bg1 horizon, VFSL,
5Y 5/2 with Redox, No Roots

Layer 4: BCg horizon, FSL,
5Y 5/2, No Roots

Layer 5: 2Cg horizon, GR COS,
5Y 4/2, No Roots

Describing soils



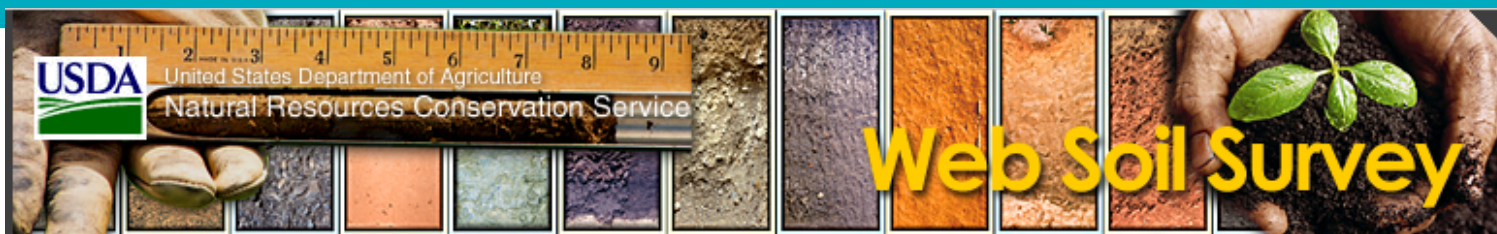
Layer 1, Ap,
FSL, 10YR 2/2,
Many Roots

Layer 2, Bw,
FSL, 10 YR 4/3,
with redox,
Common roots

Layer 3, Bg,
FSL, 10YR 5/2
with redox, Few
Roots

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- ▶ Official Soil Series Descriptions (OSD)
- ▶ Soil Series Extent Mapping Tool
- ▶ Geospatial Data Gateway
- ▶ eFOTG
- ▶ National Soil Characterization Data
- ▶ Soil Quality
- ▶ Soil Geography

The simple yet powerful way to access and use soil data.

START
WSS

Welcome to Web Soil Survey (WSS)



Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Soil surveys can be used for general farm, local, and wider area planning. Onsite investigation is needed in some cases, such as soil quality assessments and certain conservation and engineering applications. For more detailed information, contact your local [USDA Service Center](#) or your [NRCS State Soil Scientist](#).

Four Basic Steps

1 Define.

Area of Interest (AOI)

Use the Area of Interest tab

I Want To...

- [Start Web Soil Survey \(WSS\)](#)
- [Know the requirements for running Web Soil Survey — will Web Soil Survey work in my web browser?](#)
- [Know the Web Soil Survey hours of operation](#)
- [Find what areas of the U.S. have soil data](#)
- [Find information by topic](#)
- [Know how to hyperlink from other documents to Web Soil Survey](#)
- [Know the SSURGO data structure](#)

Announcements/Events

- [Web Soil Survey 3.1 has been released! View description of new features and fixes.](#)
- [Web Soil Survey Release History](#)

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Area of Interest (AOI)

Soil Map

Soil Data Explorer

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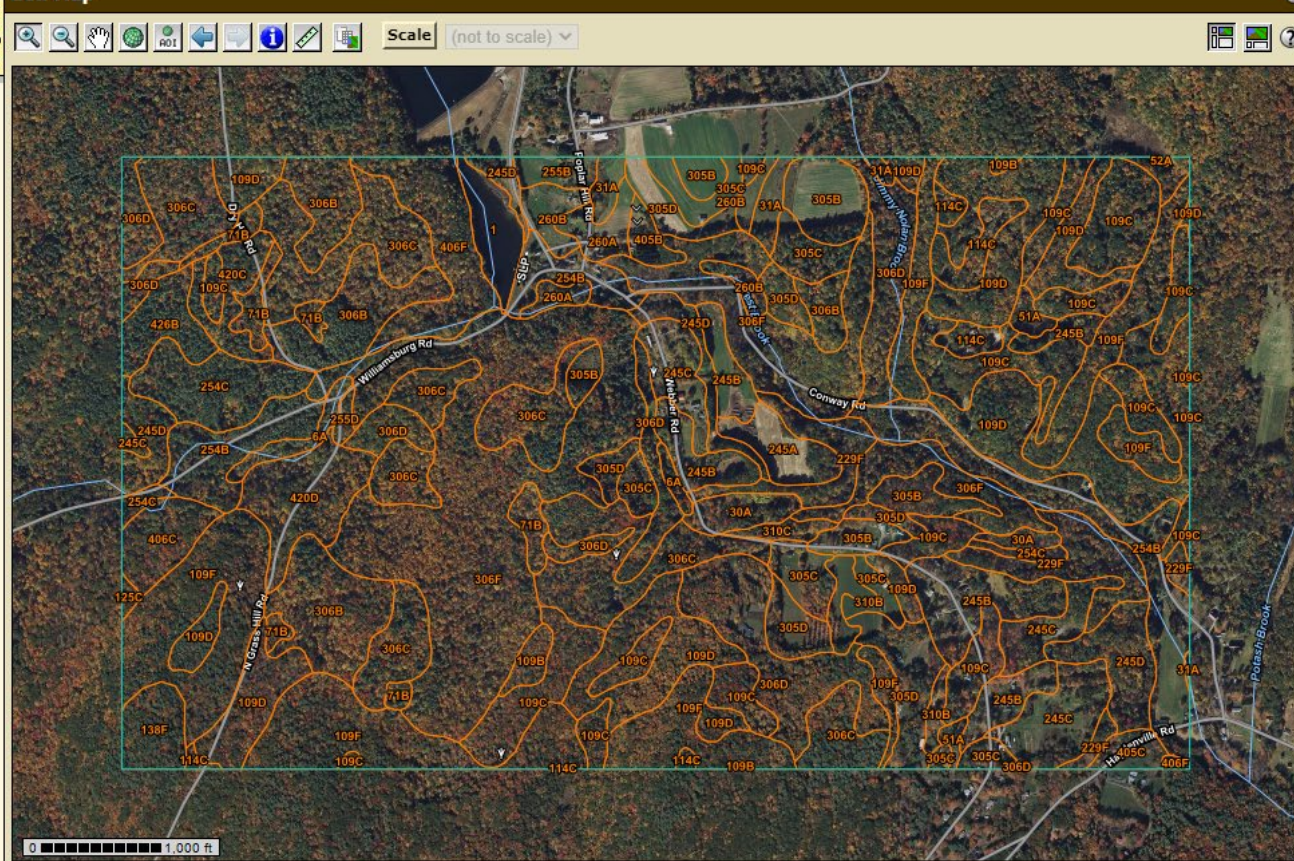
Map Unit Legend

Franklin County, Massachusetts (MA011)

Franklin County, Massachusetts (MA011)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	8.2	0.8%
6A	Scarboro mucky sandy loam, 0 to 2 percent slopes	5.3	0.5%
30A	Raynham silt loam, 0 to 3 percent slopes	7.6	0.7%
31A	Walpole sandy loam, 0 to 3 percent slopes	7.0	0.7%
51A	Swansea muck, 0 to 1 percent slopes	3.3	0.3%
52A	Freetown	0.2	0.0%

Soil Map



Map Unit Legend

Franklin County, Massachusetts
(MA011)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	8.2	0.8%
6A	Scarboro mucky sandy loam, 0 to 2 percent slopes	5.3	0.5%
30A	Raynham silt loam, 0 to 3 percent slopes	7.6	0.7%
31A	Walpole sandy loam, 0 to 3 percent slopes	7.0	0.7%
51A	Swansea muck, 0 to 1 percent slopes	3.3	0.3%
52A	Freetown	0.2	0.0%

[Printable Version](#)

Franklin County, Massachusetts

31A—Walpole sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svkl
Elevation: 0 to 1,020 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Walpole and similar soils: 80 percent
Minor components: 20 percent

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

Description of Walpole Setting

Landform: Depressions, outwash plains, outwash terraces, depressions, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from igneous, metamorphic and sedimentary rock

~~Typical profile~~

Oe - 0 to 1 inches: mucky peat
A - 1 to 7 inches: sandy loam
Bg - 7 to 21 inches: sandy loam
BC - 21 to 25 inches: gravelly sandy loam
C - 25 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (K_{sat}):
Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: None

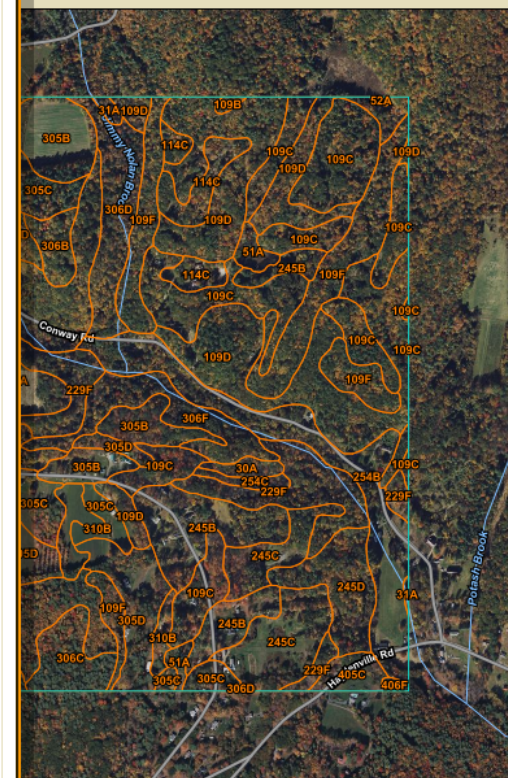


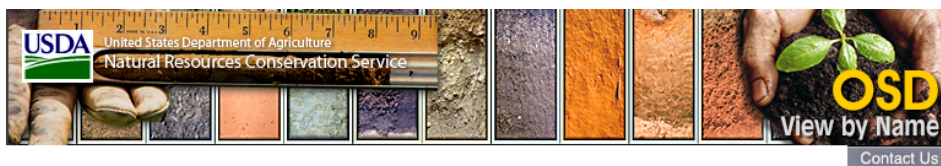
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A A A

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DIRECTIONS

The following entry field may be used to retrieve an Official Soil Series Description and/or a Series Extent Map. If you enter a series name that is found in the database, the Official Soil Series Description will be displayed with a link to the Series Extent Map at the end. If you enter a series name that is not found, the best-matched series names will be displayed with links to the Official Soil Series Description and Series Extent Map. You may also retrieve a list of soil series names that match a partial name you enter using wildcard characters with links to the Official Soil Series Description and Series Extent Map. Click [here](#) to see the possible wildcard characters.

Enter the Official Soil Series Description name you would like to view or a partial name with wildcard characters. Capitalization does not matter.

REPORT

Series	Classification	OSD Link	Series Extent Map Link
WALPOLE	SANDY, MIXED, MESIC AERIC ENDOAQUEPTS	View WALPOLE Description	View WALPOLE Extent Map

<https://soilseries.sc.egov.usda.gov/osdname.aspx>

LOCATION WALPOLE

CT+MA NH NY RI VT

Established Series
Rev. MFF-SMF
05/2014

WALPOLE SERIES

The Walpole Series consists of very deep, poorly drained sandy soils formed in outwash and stratified drift. They are nearly level to gently sloping soils in low-lying positions on terraces and plains. Slope ranges from 0 to 8 percent. Saturated hydraulic conductivity is moderately high or high in the surface layer and subsoil, and high or very high in the substratum. Mean annual temperature is about 48 degrees F., and mean annual precipitation is about 43 inches.

TAXONOMIC CLASS: Sandy, mixed, mesic Aeric Endoaquepts

TYPICAL PEDON: Walpole sandy loam - forested, 2 percent slope. (Colors are for moist soil.)

Oe--0 to 3 cm (0 to 1 in); black (10YR 2/1) moderately decomposed forest plant material. (0 to 7 cm thick)

A--3 to 18 cm (1 to 7 in); very dark brown (10YR 2/2) sandy loam; weak medium granular structure; very friable; many fine and medium roots; 8 percent gravel; very strongly acid; clear smooth boundary. (8 to 33 cm thick)

Bg--18 to 53 cm (7 to 21 in); dark grayish brown (2.5Y 4/2) sandy loam; massive; friable; common fine and few medium roots in the upper part of the horizon and few fine roots in the lower part; 10 percent gravel; common medium prominent strong brown (7.5YR 5/6) and common medium prominent yellowish brown (10YR 5/4) and yellowish brown (10YR 5/6) masses of iron accumulation and common medium distinct light brownish gray (10YR 6/2) iron depletions; strongly acid; gradual smooth boundary.

BC--53 to 63 cm (21 to 25 in); light olive brown (2.5Y 5/4) gravelly sandy loam; massive; friable; 20 percent gravel; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation and light brownish gray (10YR 6/2) and dark grayish brown (2.5Y 4/2) iron depletions; strongly acid; clear smooth boundary. (Combined thickness of the Bg and BC horizons is 36 to 61 cm.)

C1--63 to 104 cm (25 to 41 in); light yellowish brown (2.5Y 6/4) very gravelly loamy sand; single grain; very friable; 30 percent gravel and 5 percent cobbles; common medium distinct strong brown (7.5YR 5/6) and yellowish brown (10YR 5/4) masses of iron accumulation; strongly acid; gradual smooth boundary. (25 to 102 cm thick)

C2--104 to 165 cm (41 to 65 in); light brownish gray (10YR 6/2) very gravelly sand, few brown (10YR 5/3) streaks; single grain; loose; 35 percent gravel and 5 percent cobbles; moderately acid.

TYPE LOCATION: Windham County, Connecticut; town of Killingly; 400 feet north along North Shore Drive from the intersection with Connecticut Route 101, 500 feet east of North Shore Drive; USGS Danielson topographic quadrangle; latitude 41 degrees 50 minutes 58 seconds N. and longitude 71 degrees 54 minutes 28 seconds W., NAD 27

RANGE IN CHARACTERISTICS: Thickness of the solum and depth to sand or loamy sand substratum layers range from 46 to 71 cm. Rock fragments range from 0 to 25 percent by volume in the solum and from 0 to 50 percent in individual layers of the substratum. Typically, 70 percent or more of the rock fragments are rounded gravel. Reaction ranges from very strongly acid to neutral throughout.



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Tie-break Rule: ☒ Lower ☐ Higher

Map Legend

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☒ Location Marker

☒ Soils

☐ Soil Survey Areas

☐ Soil Map Unit Polygons

☐ Soil Map Unit Lines

☐ Soil Map Unit Points

☒ Soil Rating Polygons

☐ 0 - 25

☐ 25 - 50

☐ 50 - 100

☐ 100 - 150

☐ 150 - 200

☐ > 200

☐ Not rated or not available

☒ Soil Rating Lines

☐ 0 - 25

☐ 25 - 50

☐ 50 - 100

☐ 100 - 150

☐ 150 - 200

☐ > 200

☐ Not rated or not available

☒ Soil Rating Points

☐ 0 - 25

☐ 25 - 50

☐ 50 - 100

☐ 100 - 150

☐ 150 - 200

☐ > 200

☐ Not rated or not available

Map

Scale: (not to scale)

Table — Summary By Map Unit

Map Unit — Hampshire County, Massachusetts, Central Part (MA609)

Hampshire County, Massachusetts, Central Part (MA609)

Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
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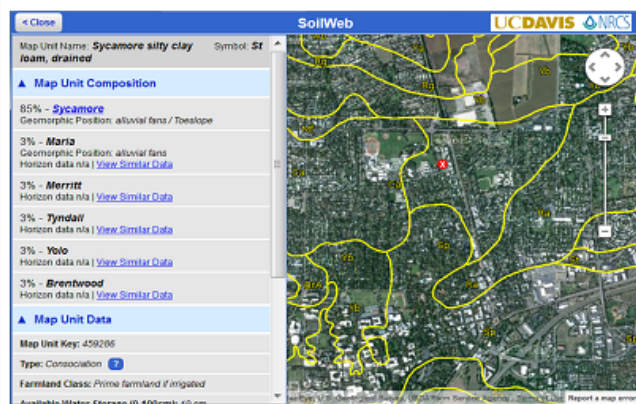
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SoilWeb Apps

Our online soil survey can be used to access USDA-NCSS detailed soil survey data (SSURGO) for most of the United States. Please choose an interface to SoilWeb:

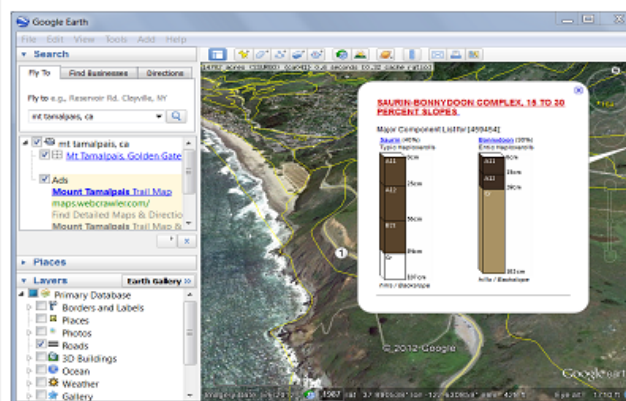
SoilWeb

Explore soil survey areas using an interactive Google map. View detailed information about map units and their components. This app runs in your web browser and is compatible with desktop computers, tablets, and smartphones.



SoilWeb Earth

Soil survey data are delivered dynamically in a [KML](#) file, allowing you to view mapped areas in a 3-D display. You must have [Google Earth](#) or some other means of viewing KML files installed on your desktop computer, tablet, or smartphone.



SoilWeb for the iPhone

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By CA Soil Resource Lab

Open iTunes to buy and download apps.



Description

GPS based, real-time access to USDA-NRCS soil survey data, formatted for the iPhone. This application retrieves graphical summaries of soil types associated with the iPhone's current geographic location, based on a user defined horizontal precision. Sketches of soil profiles are linked to their official soil series description (OSD) page. Soil series names are linked to their associated page within the CA Soil Resource Lab's online soil survey, SoilWeb [1]. An up-to-date map of where data is available for queries can be found here [http://casoilresource.lawr.ucdavis.edu/soil_web/national_status_map.php].

References:

1. <http://dx.doi.org/10.1016/j.cageo.2008.10.016>

- iPhone and Android app
- Links to phone GPS
- Brings up major component of map unit at your location
- Links to Series and selected interpretations

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