

BF 104 Soil Health & Management

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Listo Para Iniciar Farming Program, Stamford, CT

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INTRODUCTIONS

Advancing the Business of Farming in Connecticut in Partnership with Agricultural Learning Centers

Advancing the Business of Farming in Connecticut Project provides new farmers with core training and assistance to develop their farm plan, explore production options, and grow their farming enterprise. Visit www.newfarms.extension.uconn.edu for resources and events.

- **Common Ground, New Haven**
- **Community Farm of Simsbury, Simsbury**
- **Green Village Initiative, Bridgeport**
- **Killingly Agricultural Education Center, Killingly**
- **Knox- Urban Farming Incubator Program, Hartford**
- **Grow Windham, Willimantic, Windham**
- **Listo Para Iniciar Program, Bethel, Stamford, New Milford**

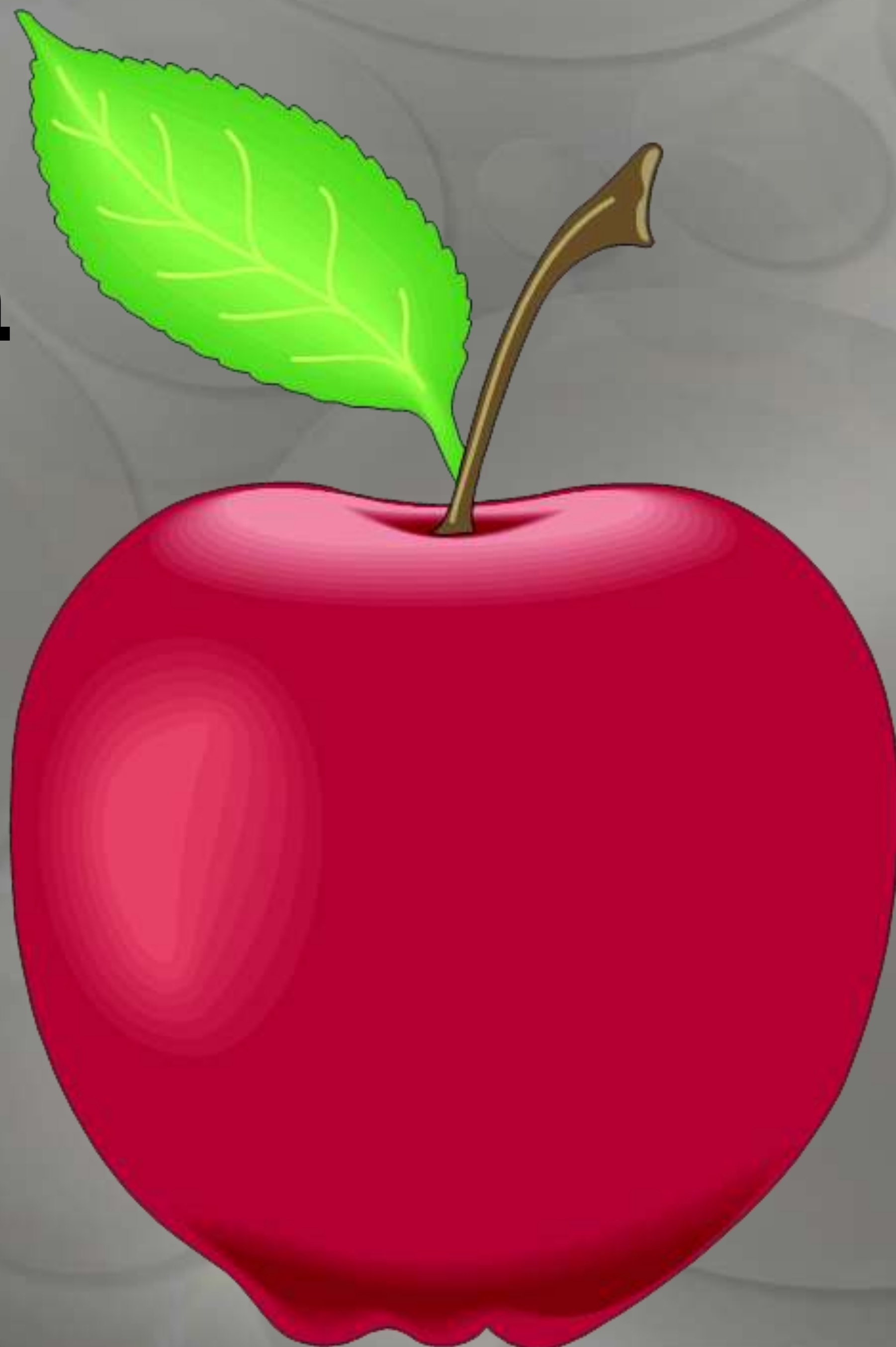
Advancing the Business of Farming in Connecticut in Partnership with Agricultural Learning Centers – Core Trainings

- **BF 101 New Farmer Business Planning**
- **BF 102 Setting Up Financial Records for Farm Business**
- **BF 103 Finding, Evaluating Farm Sites, Leasing Farmland**
- **BF 104 Soil Health & Management**
- **BF 105 Fruit Production for Small Scale Farming**
- **BF 106 Vegetable Production for Small Scale Farming**
- **BF 110 Unheated hoop houses- installation, production systems**
- **BF 120 Irrigation & Water Management Systems**
- **BF 130 Hydroponics/Aeroponics/Aquaponic Systems**
- **BF 140 Post –Harvest Handling**
- **BF 150 How to Enter the Market, State regulations and support for CT Grown, EBT sales**

Core Trainings continued….

- **BF 201 Quickbooks for Farm operations**
- **BF 202 Record Keeping for Organic Certification**
- **BF 203 Balancing Farmland Capacity with Conservation & Financial Goals**
- **BF 210 Design Fundamentals for Greenhouses & Tunnels**
- **BF 220 Safety & Maintenance for Small Engines & Power Tools**
- **BF 221 Tractor Safety & Maintenance**
- **BF 230 Safe & Effective Use of Pesticides- For organic/non-organic producers**
- **BF 240 Climate change and Adaptation Strategies**
- **BF 250 Marketing for Success- developing relationships, branding**
- **BF 261 Selling to Institutional Buyers-schools, hospitals, colleges**

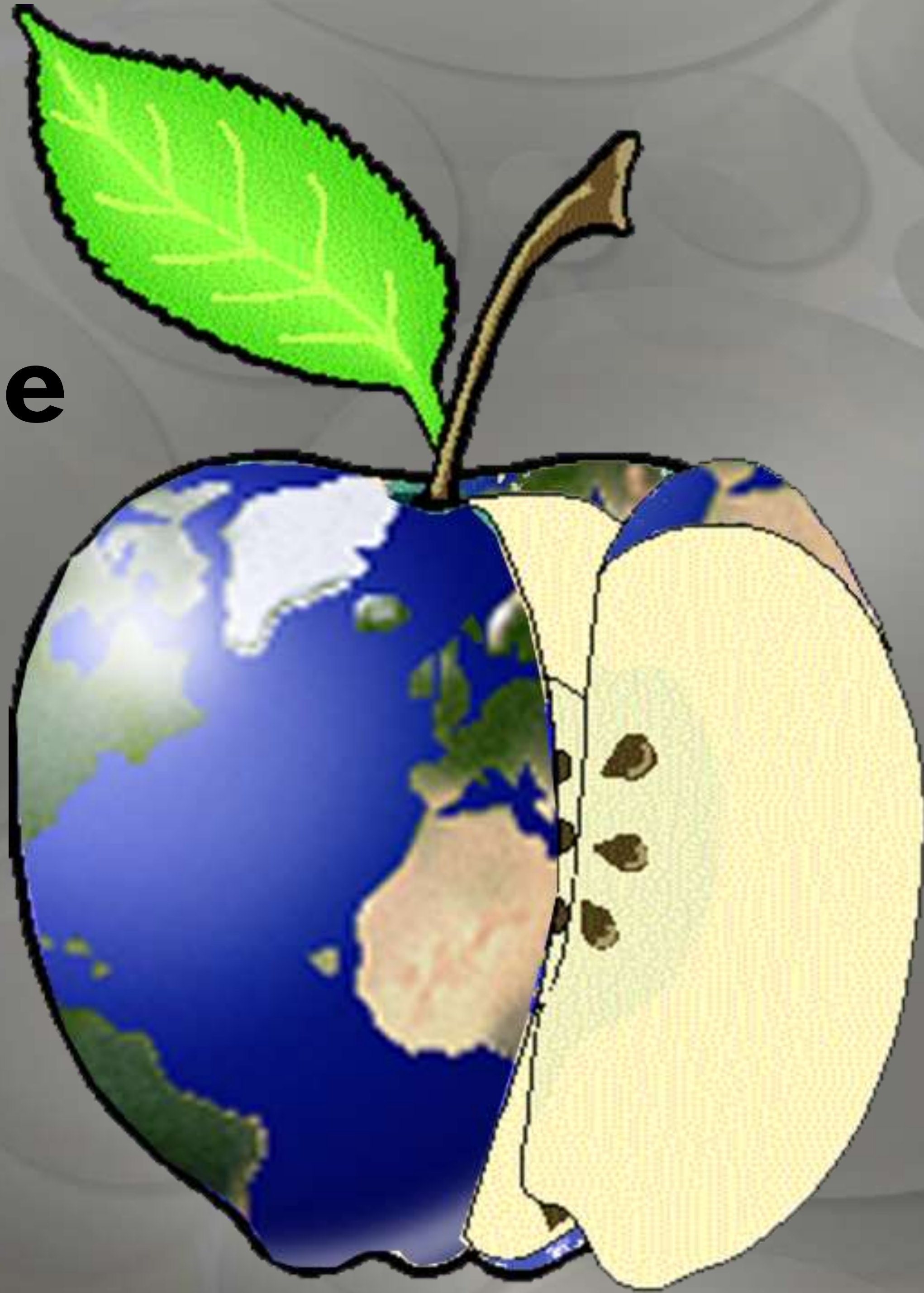
Take an apple



Have it represent the Earth

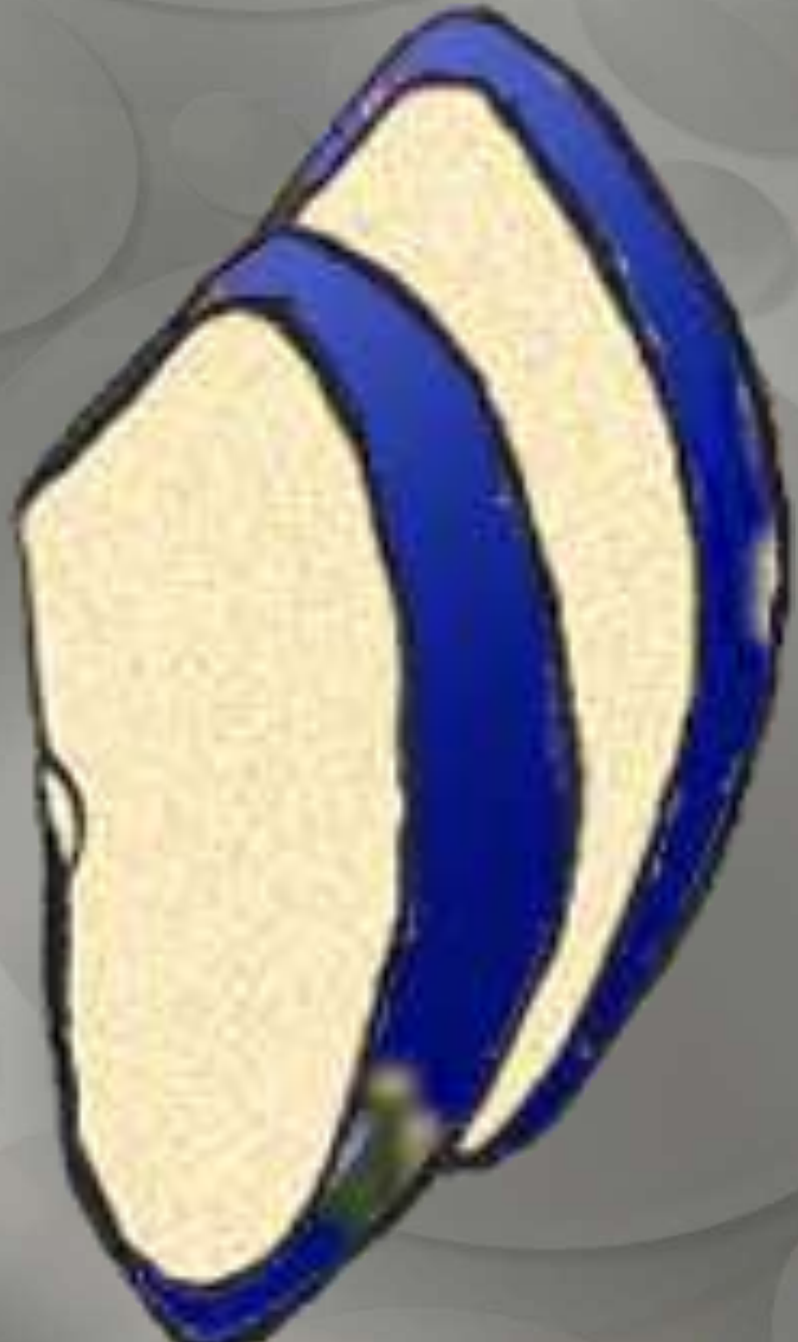
Cut out and save …

¼ of the apple

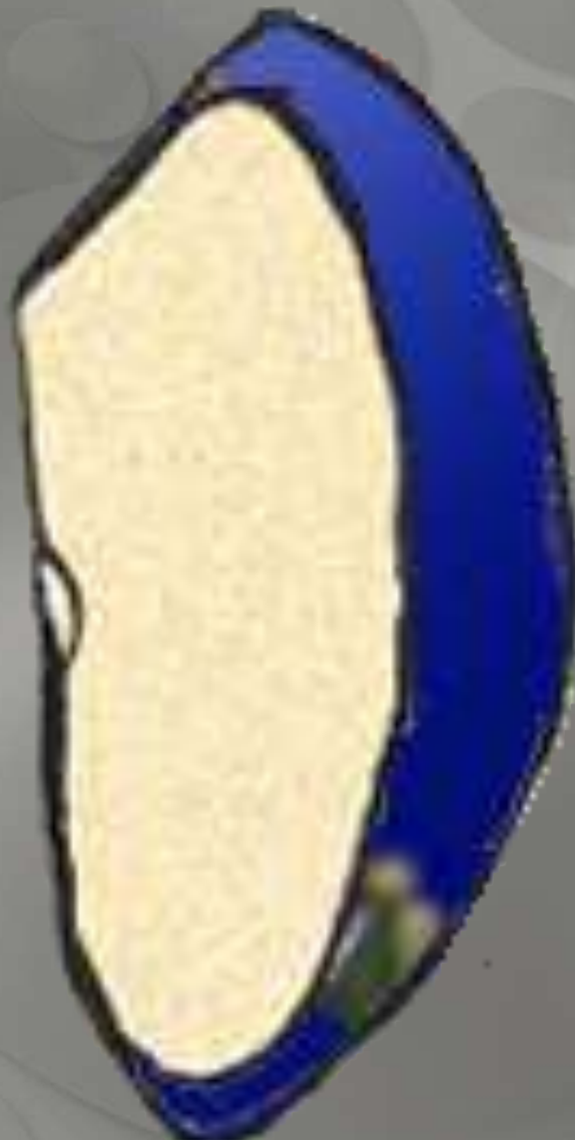


This much represents land area.

Now cut that slice in half, and keep one piece.



This much represents where people live.



Cut that piece in quarters and keep one ¼. This represents the amount of soil where food can be grown.

This is 3% (1/32) of the Earth's surface.

It's All About the Soil!!

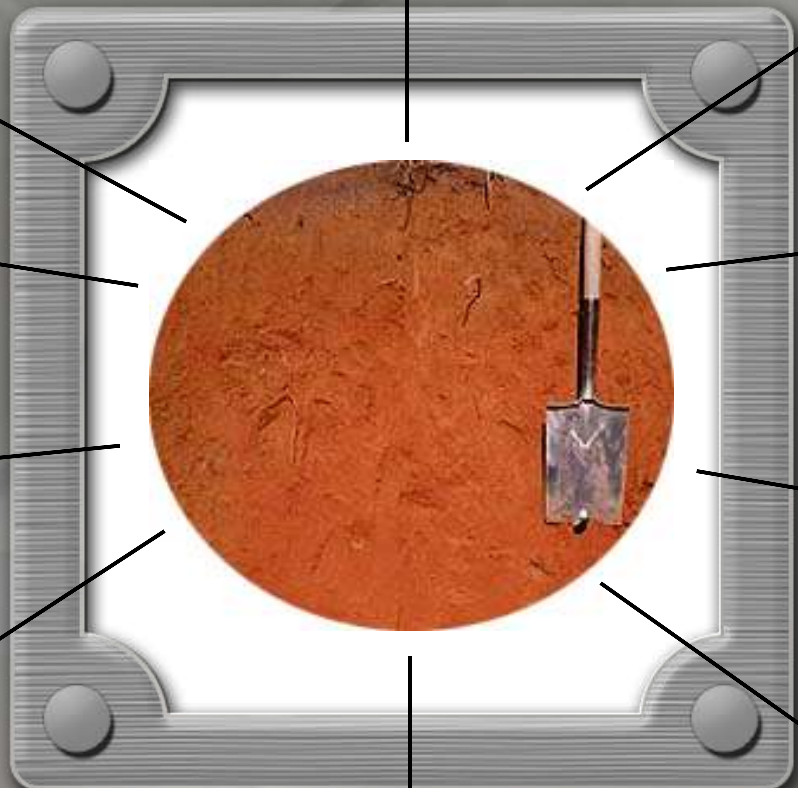
We Study Soil Because It's A(n)

Great integrator

Medium of crop production

Snapshot of geologic, climatic, biological, and human history

Producer and absorber of gases



Waste decomposer

Medium for plant growth

Source material for construction, medicine, art, etc.

Home to organisms (plants, animals and others)

Filter of water and wastes

Essential natural resource

Five Soil Forming Factors

Biota

Parent Material

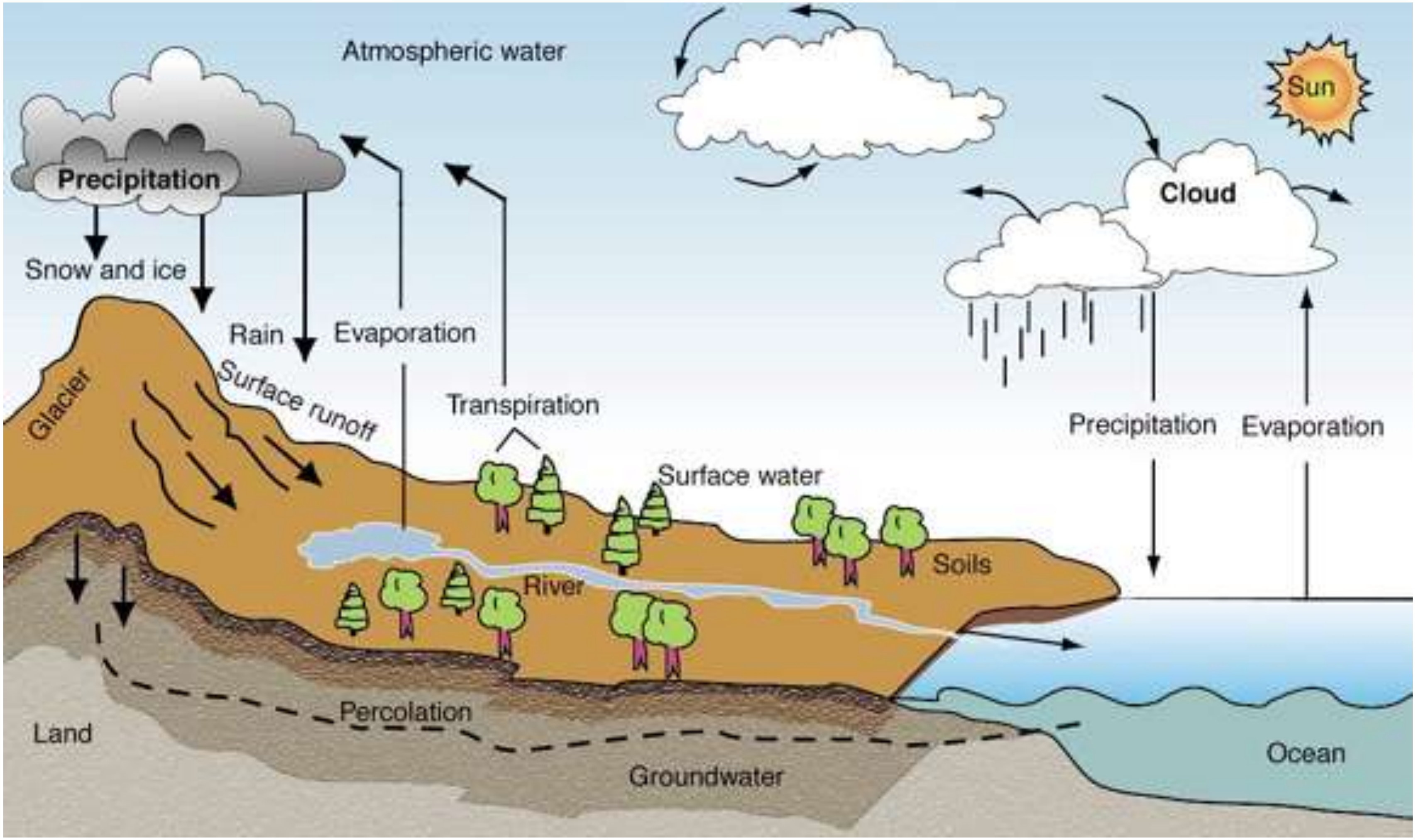
Topography

Climate

(The first four factors over) Time

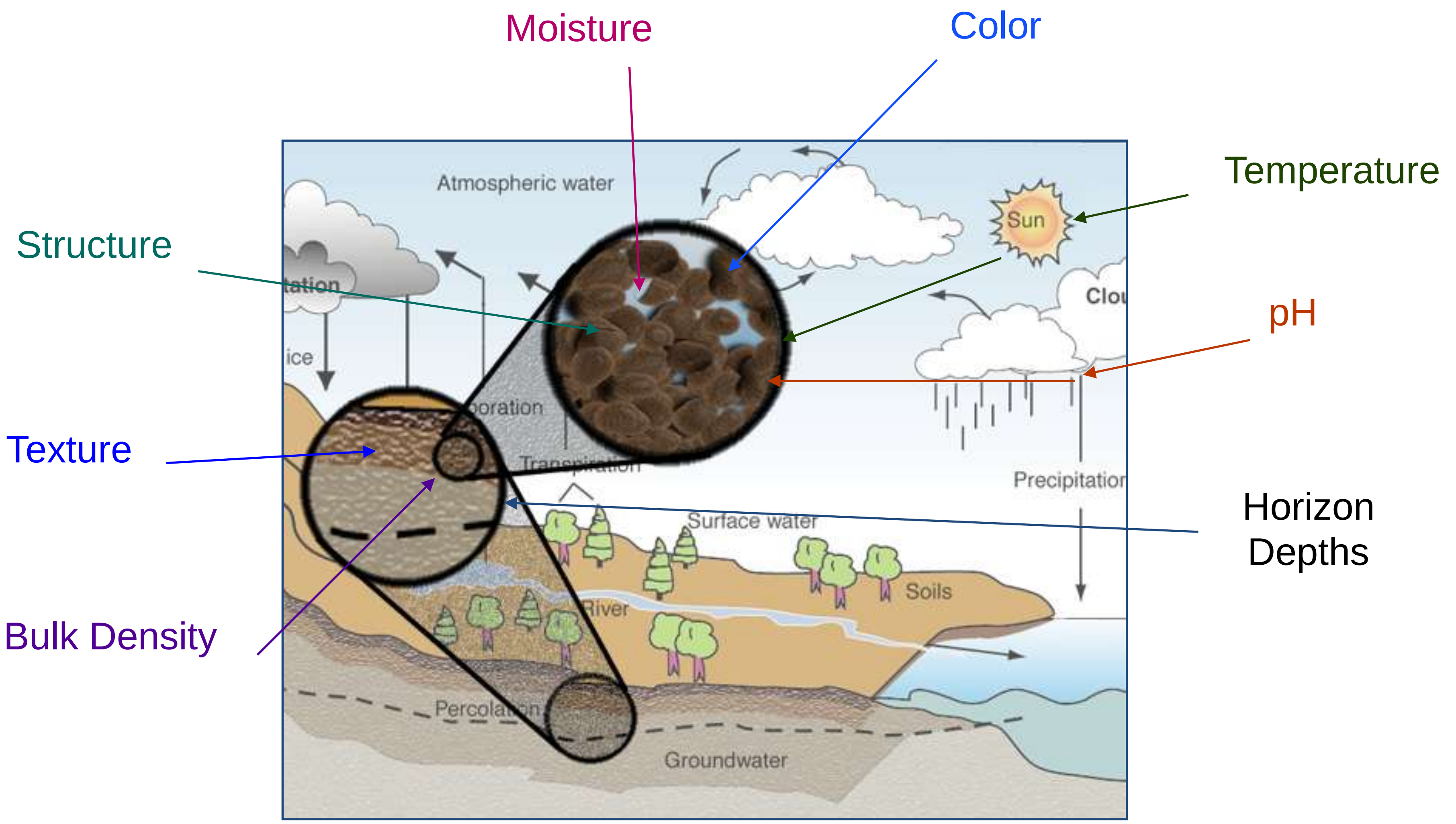
Hydrologic Cycle

Water enters the soil, interacts with soil particles and leaves the soil (through evaporation, transpiration or leaching).

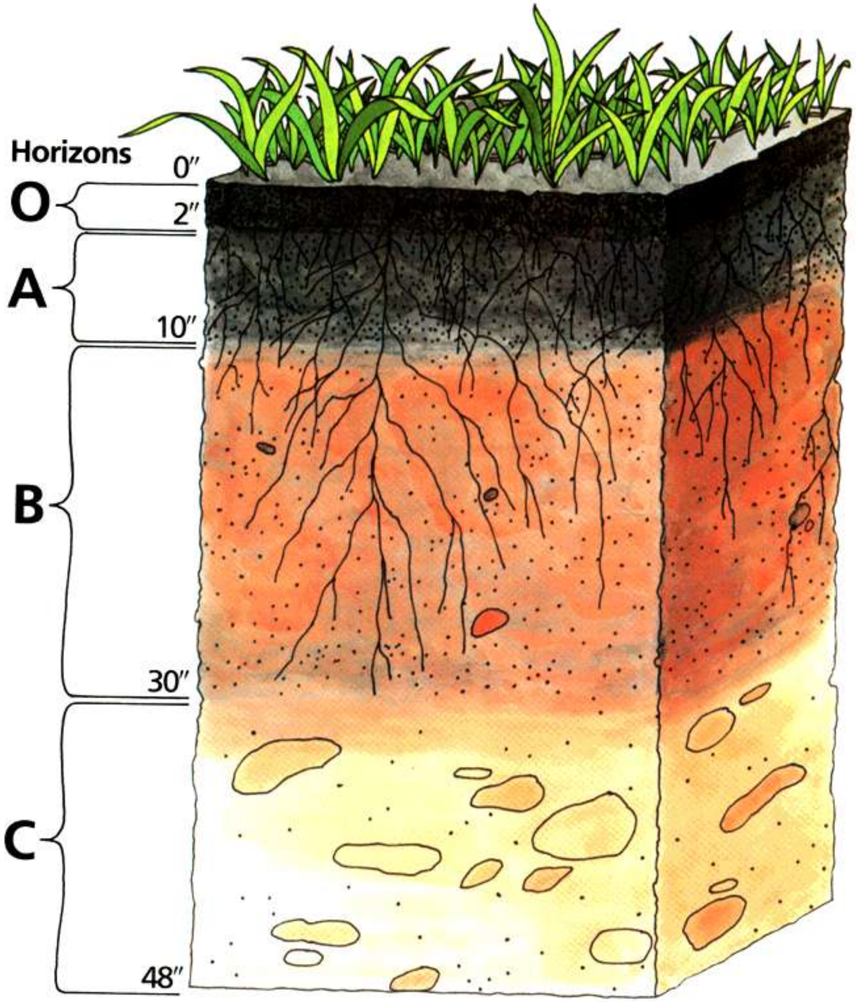


Hydrologic Cycle and the Soil

Soil Properties that are part of the hydrologic cycle.

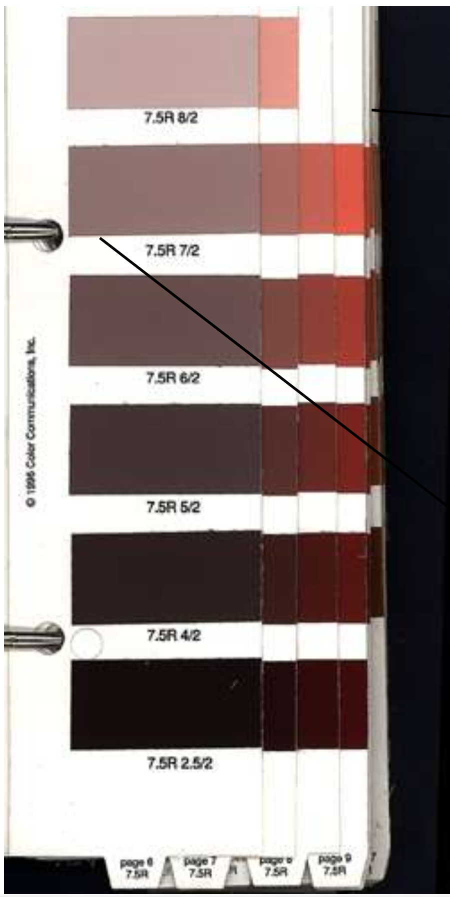


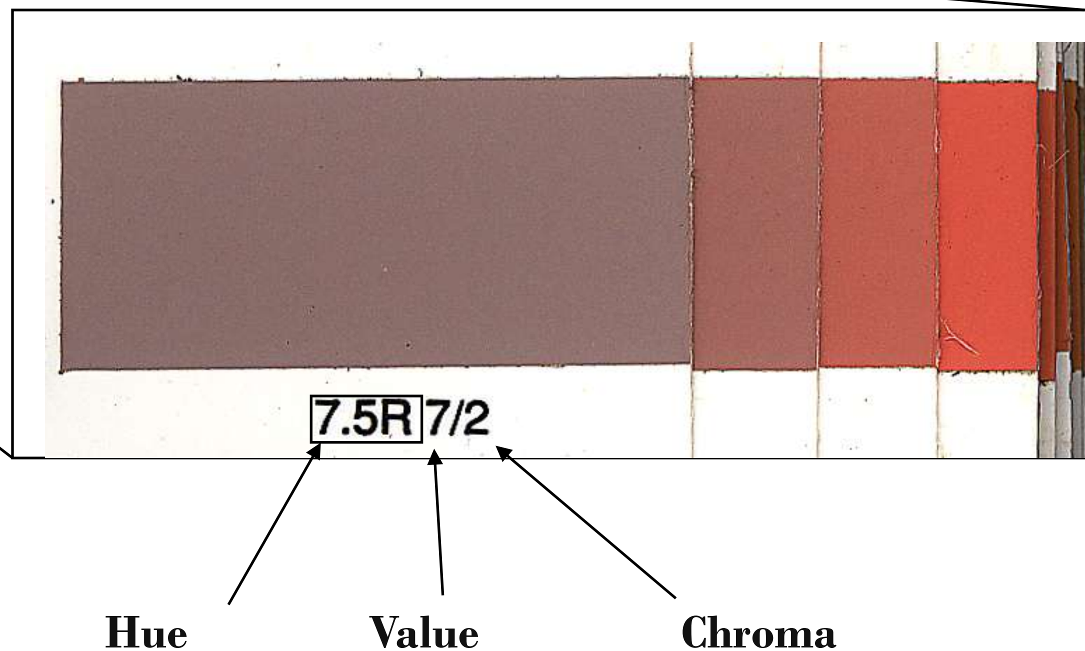
A Soil Profile



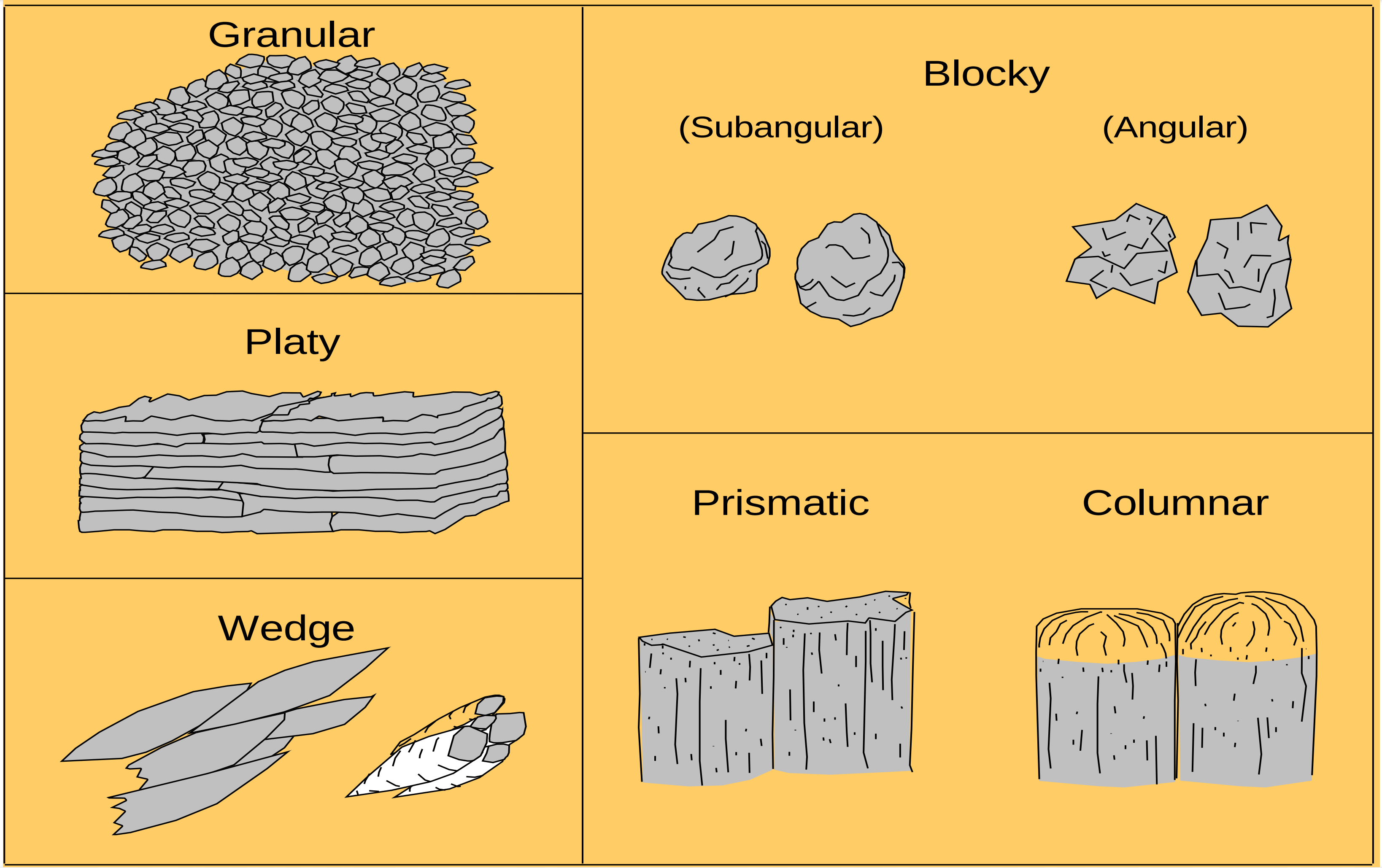
Soil Color

Munsell Notation



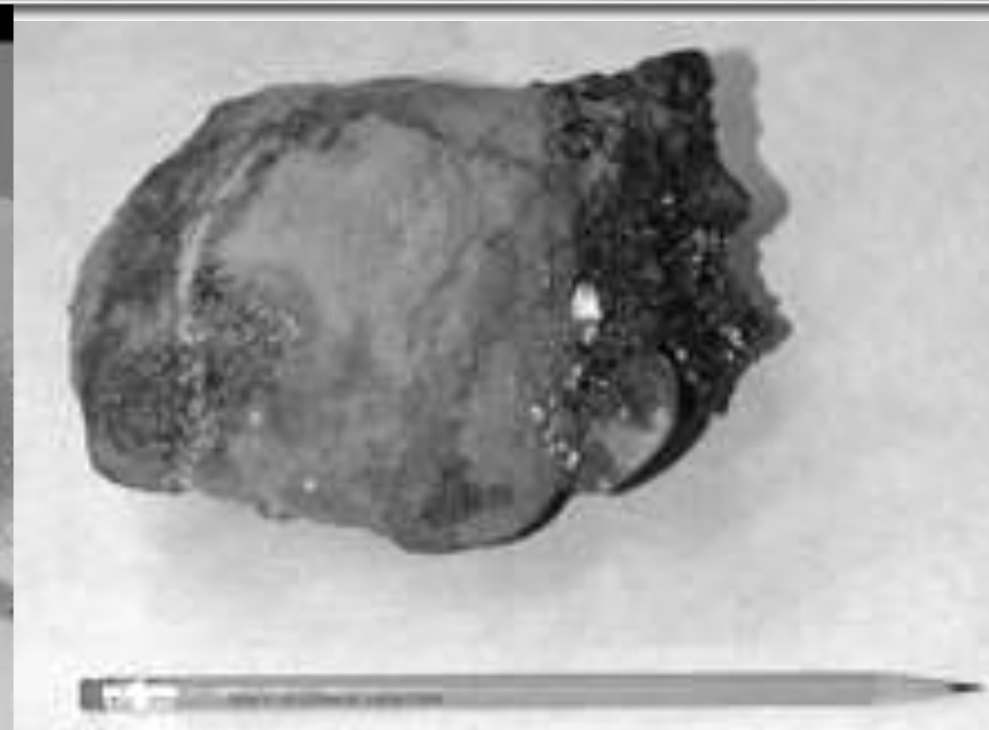


Soil Structure - With Structure



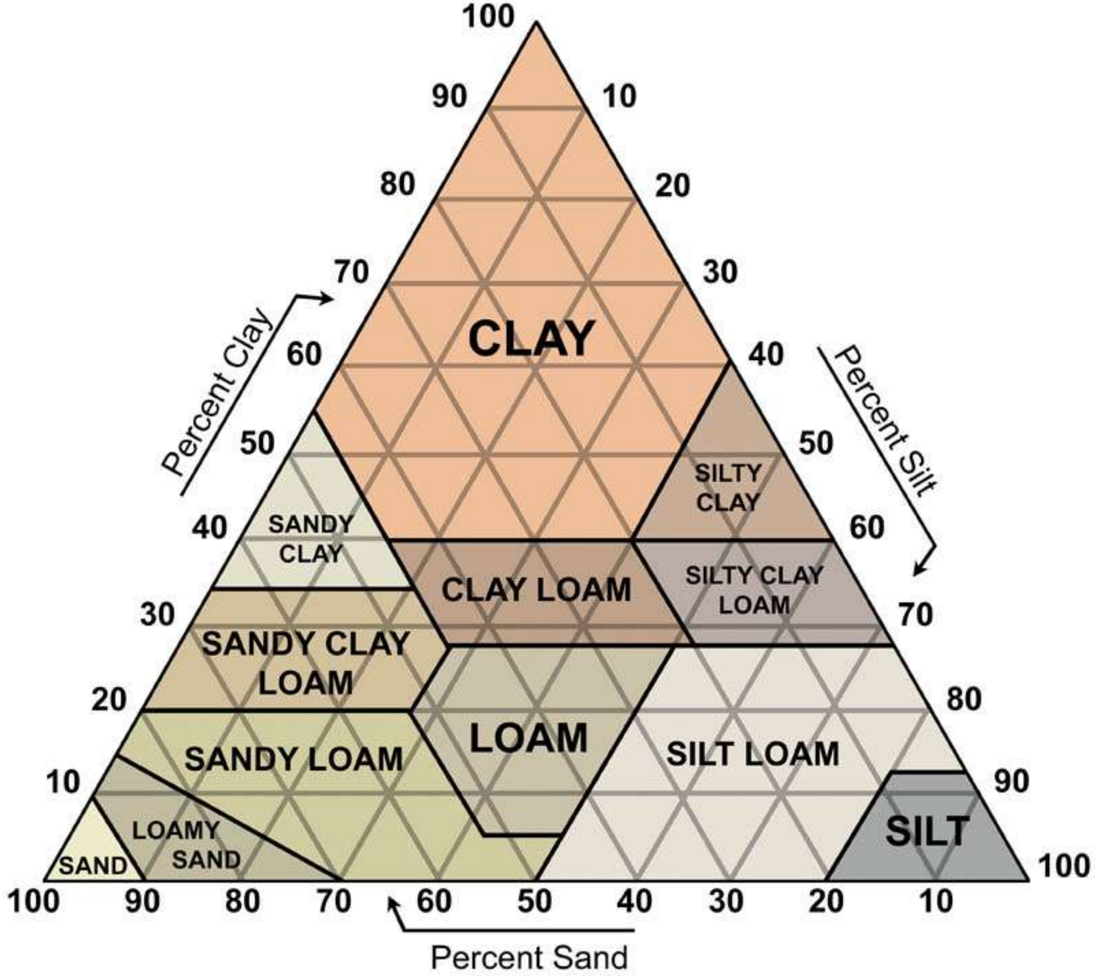
Soil Structure – Without Structure

Single Grain

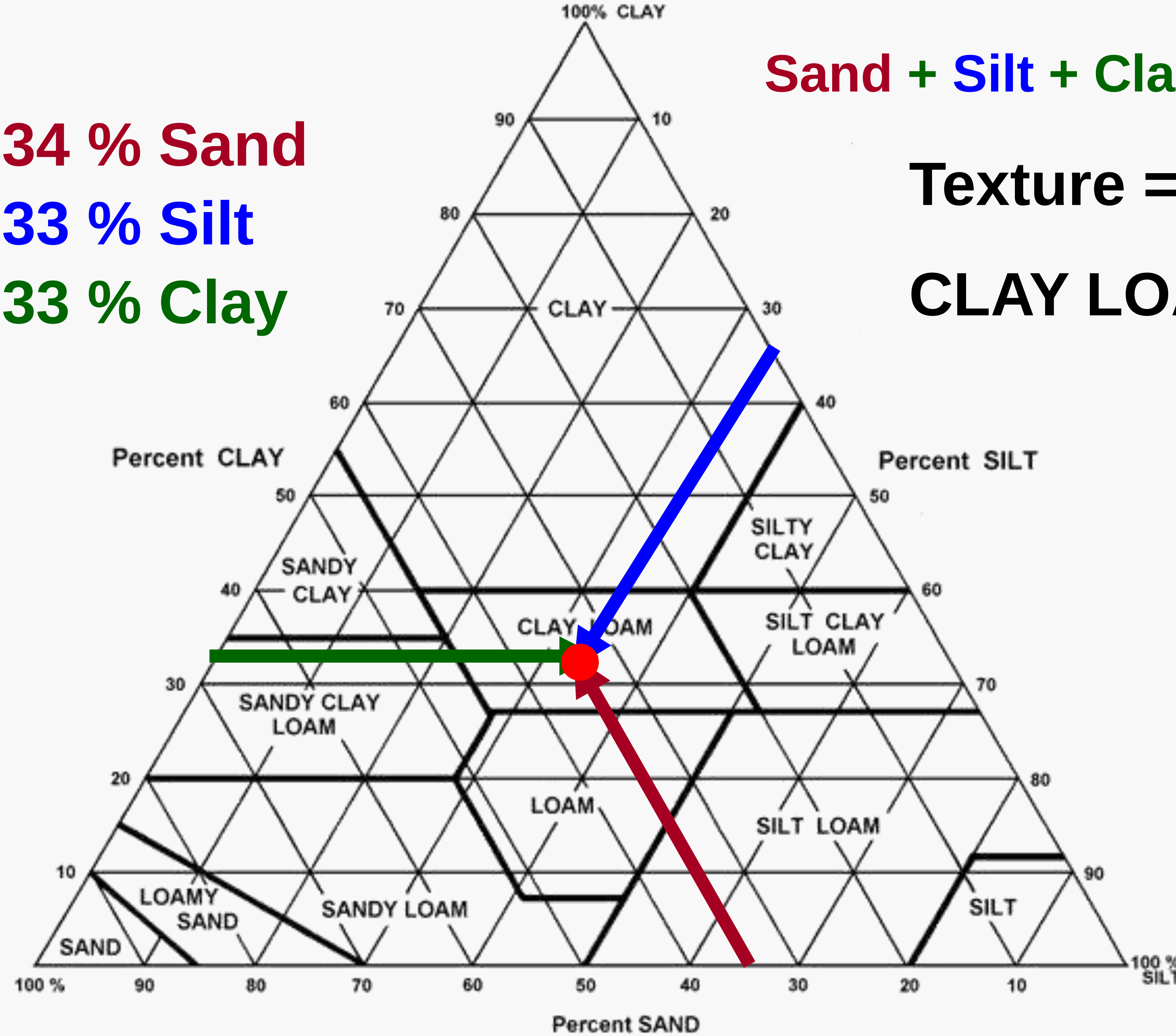


Massive

USDA Textural Triangle



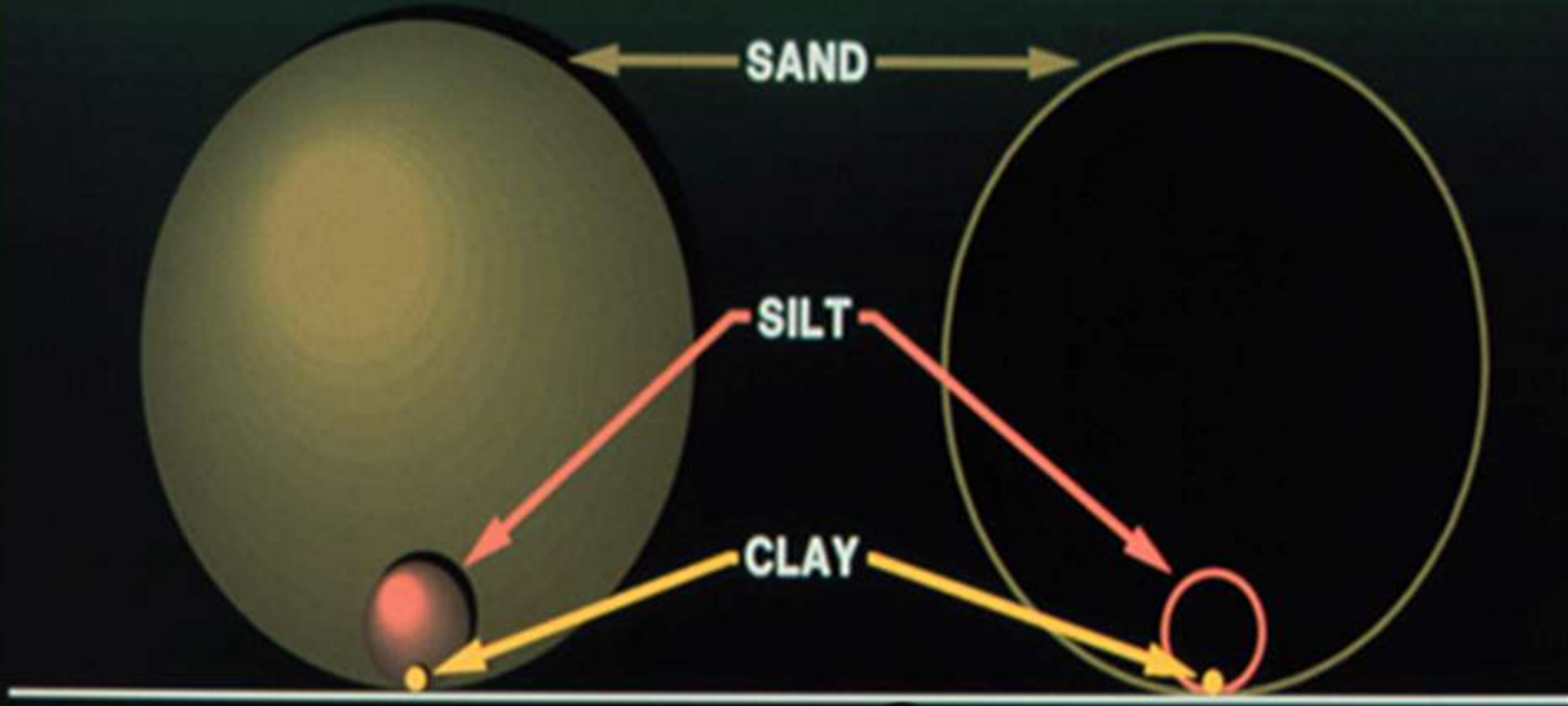
34 % Sand
33 % Silt
33 % Clay



Sand + Silt + Clay = 100%

Texture =

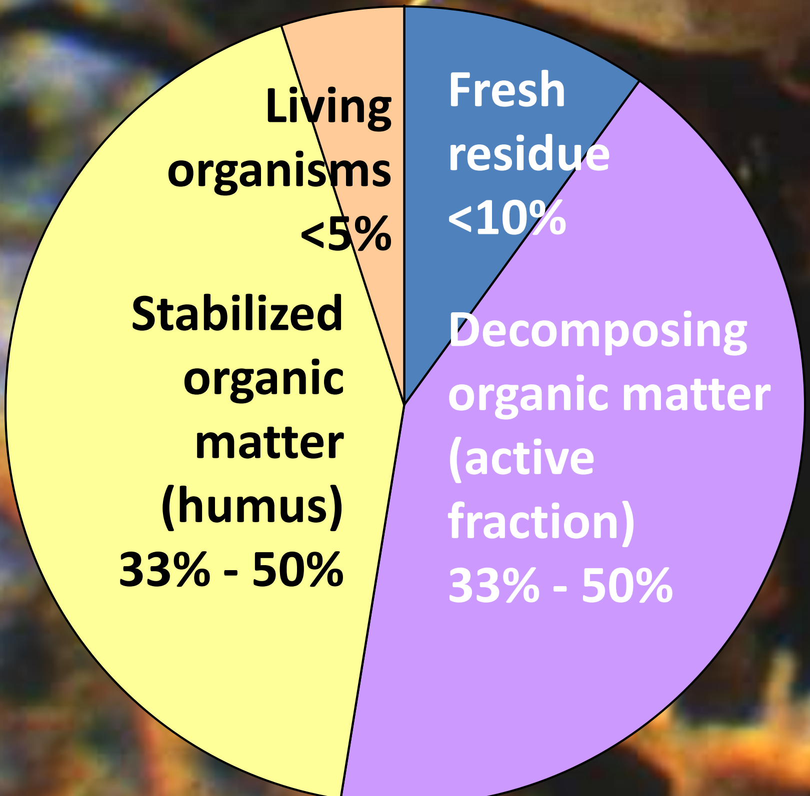
CLAY LOAM


SAND
SILT
CLAY

General Influence of Soil Separates on Properties and Behaviors of Soils

Property/Behavior	Sand	Silt	Clay
Water holding	Low	Med-high	high
Aeration	Good	Med	Poor
OM decomposition	Fast	Med	Slow
Water erosion pot.	Low	High	Low
Compact-ability	Low	Med	High
Sealing (ponds)	Poor	Poor	Good
Nutrient supplying	Poor	Med-high	High
Pollutant leaching	High	Med	Low

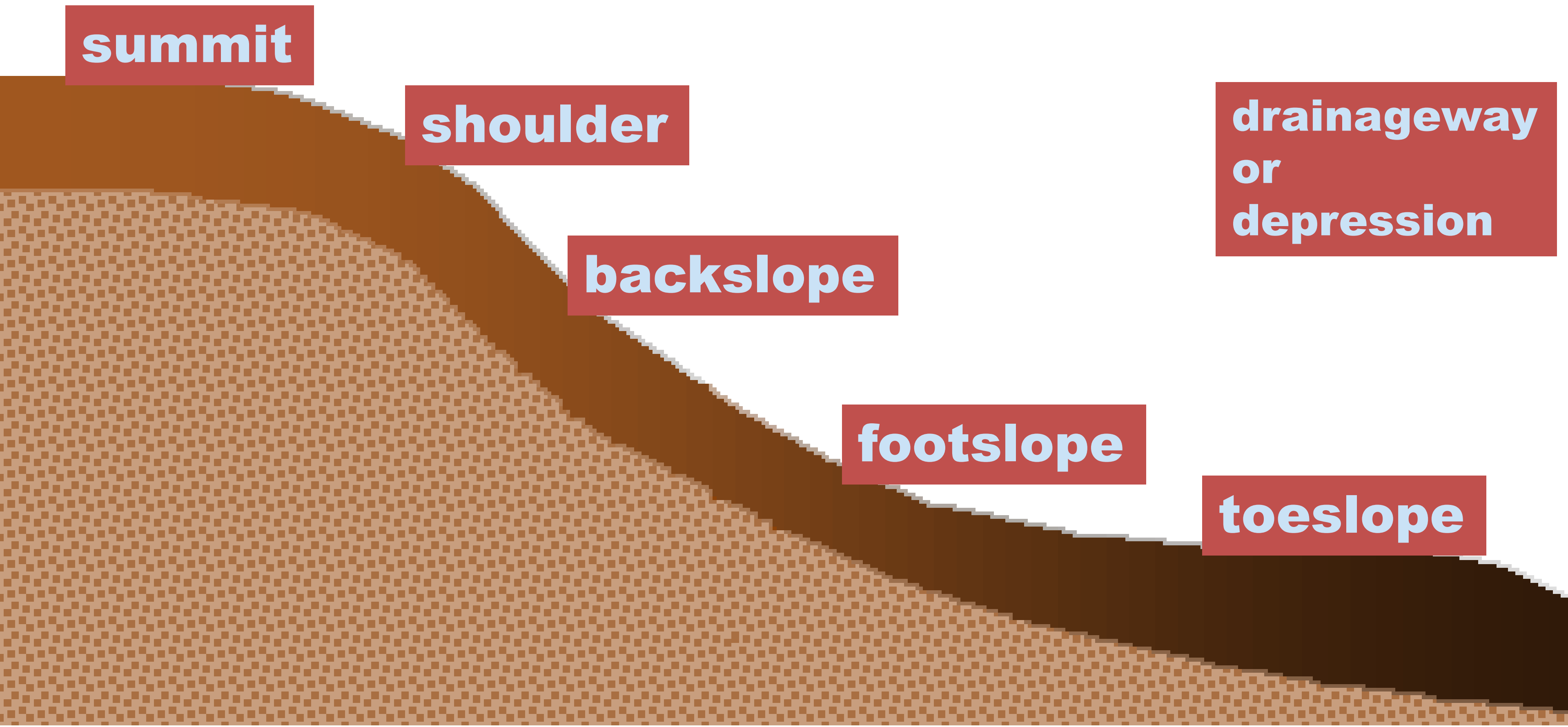
Soil Organic Matter

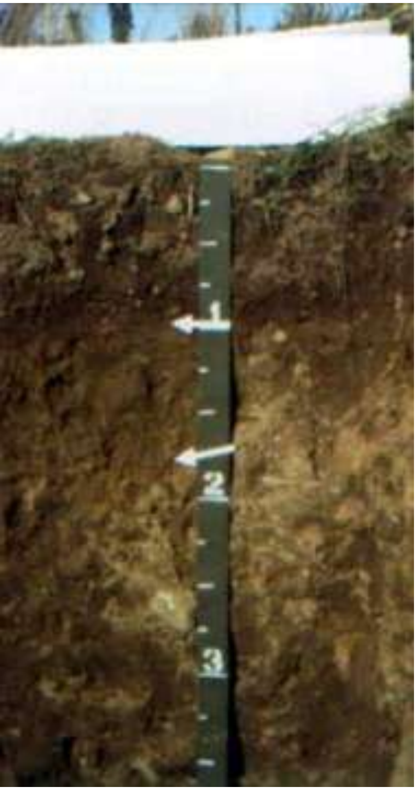


Landscape Factors

- Depth to bedrock
- Depth to water table
- Flooding vs. ponding vs. high water table
- Erosion & water quality concerns
- Human influence

Relative Landscape Position






SOIL CATENAS OF CONNECTICUT

DEPOSIT	LITHOLOGY	TEXTURE GROUP	Excessively	Somewhat Excessively	Well Drained	Moderately Well	Somewhat Poorly	Poorly	Very Poorly
			SOIL DRAINAGE CLASS						
GLACIAL TILL Unstratified Sand, Silt & Rock	GRANITE & SCHIST	SANDY		GLOUCESTER					
	SCHIST, GRANITE & GNEISS	LOAMY		* WESTMINSTER #					
					** MILLSITE #				
				* HOLLIS [28]					
					** CHATFIELD				
					CHARLTON CANTON	SUTTON [1]		LEICESTER	
					BICE #	SCHROON #			LOONMEADOW #
					+ PAXTON + MONTAUK + SHELBURE #	+ WOODBRIDGE + ASHFIELD #		+ RIDGEBURY	+ WHITMAN
	MIXED CARBONATE ROCKS & CRYSTALLINE ROCKS				* FARMINGTON				
					PYRITIES # STOCKBRIDGE NELLIS [11]	+ HOGANSBURG # GEORGIA AMENIA		MUDGEPOND [18,30]	ALDEN [19]
	RED SANDSTONE, SHALE, CONGLOMERATE & BASALT				* HOLYOKE [29]				
					** YALESVILLE				
					CHESHIRE [24,29]	WATCHAUG [5]			
					+ WETHERSFIELD	+ LUDLOW		+ WILBRAHAM	+ MENLO
	BROWN MICACEOUS SCHIST			* BRIMFIELD	BROOKFIELD **NIPMUCK				
	PHYLLITE, SCHIST & SLATE			* TACONIC #	** MACOMBER #				
					+ BERNARDSTON	+ FULLAM #		+ BRAYTON #	
					+ LANESBORO #				
					DUMMERSTON #				
	SHALE, SANDSTONE, BASALT & CRYSTALLINE ROCKS				+ BROADBROOK	+ RAINBOW			
		SILTY / SANDY			NARRAGANSETT	WAPPING			
GLACIOFLUVIAL Stratified Sand & Gravel	ACIDIC CRYSTALLINE ROCKS (granite, gneiss and schist)	SANDY & GRAVELLY	HINCKLEY [17] BOSCAWEN #	MERRIMAC		SUDBURY		WALPOLE MOOSILAUKE #	
		SANDY	WINDSOR			DEERFIELD			SCARBORO [18,32]
		LOAMY / SAND & GRAVEL			AGAWAM	NINIGRET			
		SILTY / SAND & GRAVEL			ENFIELD [16] HAVEN	TISBURY		RAYPOL	
					BRANFORD	ELLINGTON			
	ACIDIC, RED SANDSTONE, SHALE, CONGLOMERATE	SANDY & GRAVELLY	MANCHESTER	HARTFORD					
		SANDY	PENWOOD						
	MIXED CARBONATE ROCKS & CRYSTALLINE ROCKS	SANDY & GRAVELLY	GROTON						
		LOAMY / SAND & GRAVEL			COPAKE	HERO		FREDON	HALSEY [7]
GLACIOLACUSTRINE Stratified Sand, Silt & Clay	MIXED CRYSTALLINE & SEDIMENTARY ROCKS	SILTY				BELGRADE [27]		RAYNHAM [31]	
		LOAMY / CLAYEY				ELMRIDGE [13,21]		SHAKER [30]	
		SILTY & CLAYEY				BRANCROFT [9]		SCITICO [26]	MAYBID [8,33]
						BERLIN			
ALLUVIAL Stratified Sand & Silt	GNEISS, SCHIST, GRANITE & QUARTZITE	SANDY	SUNCOOK						
		LOAMY			ONDAWA [9] OCCUM [9]	POOTATUCK [23]		RUMNEY # RIPPOWAM	
	MIXED CRYSTALLINE & SEDIMENTARY ROCKS	SILTY			HADLEY [14]	WINOOSKI [12]	BASH [4,25]	LIMERICK LIM	MEDOMAK # SACO

	WETLAND TYPE	FIBERS	THICKNESS	SUBSTRATE	SOIL SERIES
ORGANIC Peat & Muck	FRESHWATER (INLAND)	FEW	>51" (>130 cm)	VARIABLE	CATDEN [10]
					FREETOWN
					BUCKSPORT #
			16-51" (40-130 cm)	LOAMY	NATCHAUG [22]
			16-51" (40-130 cm)	LOAMY	WONSQUEAK #
				SANDY	TIMAKWA [2]
	SALT AND BRACKISH (TIDAL)	COMMON			PAWCATUCK
				VARIABLE	WESTBROOK
			>51" (>130 cm)		IPSWICH

	PARENT MATERIAL	HIGHLY FLUID SURFACE	NOT SULFIDIC	SULFIDIC
SUBAQUEOUS Salt & Brackish Waters ++	MARINE/ESTUARINE SANDS	0-4" (0-10 cm)	RHODESFOLLY	
		4-20" (10-50 cm)		MARSHNECK
	MARINE/ESTUARINE SILTS			FORT NECK
		>39" (>100 cm)		PISHAGQUA
				WEQUETEQUOCK
	SUBMERGED TERRESTRIAL	0-4" (0-10 cm)	NAPATREE	ANGUILLA
		>4" (>10 cm)		BILLINGTON

+ Indicates soils underlain by compact till.

* Indicates shallow soils less than 20 inches (< 50 cm) to bedrock.

** Indicates moderately deep soils 20 to 40 inches (50-100 cm) to bedrock.

\# Indicates soils with mean annual soil temperature less than 8°C or 46.4°F (elevations of >1,300 feet/396 meters in Litchfield County) in frigid soils.

++ Coastal subaqueous soils are covered with saline water for more than 21 hours per day.

1-33 Annotations to referenced soil series no longer used in CT.

SOIL SERIES NO LONGER USED IN CONNECTICUT			
1. Acton	9. Buxton	17. Jaffrey	26. Scantic
2. Adrian	10. Carlisle	18. Kendaia	27. Scio
3. Au Gres	11. Dover	19. Lyons	28. Shapleigh
4. Bermudian	12. Eel	20. Massena	29. Sunderland
5. Biddeford	13. Elmwood	21. Melrose	30. Swanton
6. Birchwood	14. Genesse	22. Palms	31. Wallington
7. Birdsall	15. Granby	23. Poquonock	32. Wareham
8. Bowmansville	16. Hartland	25. Rowland	33. Whately

Historical Soil Series

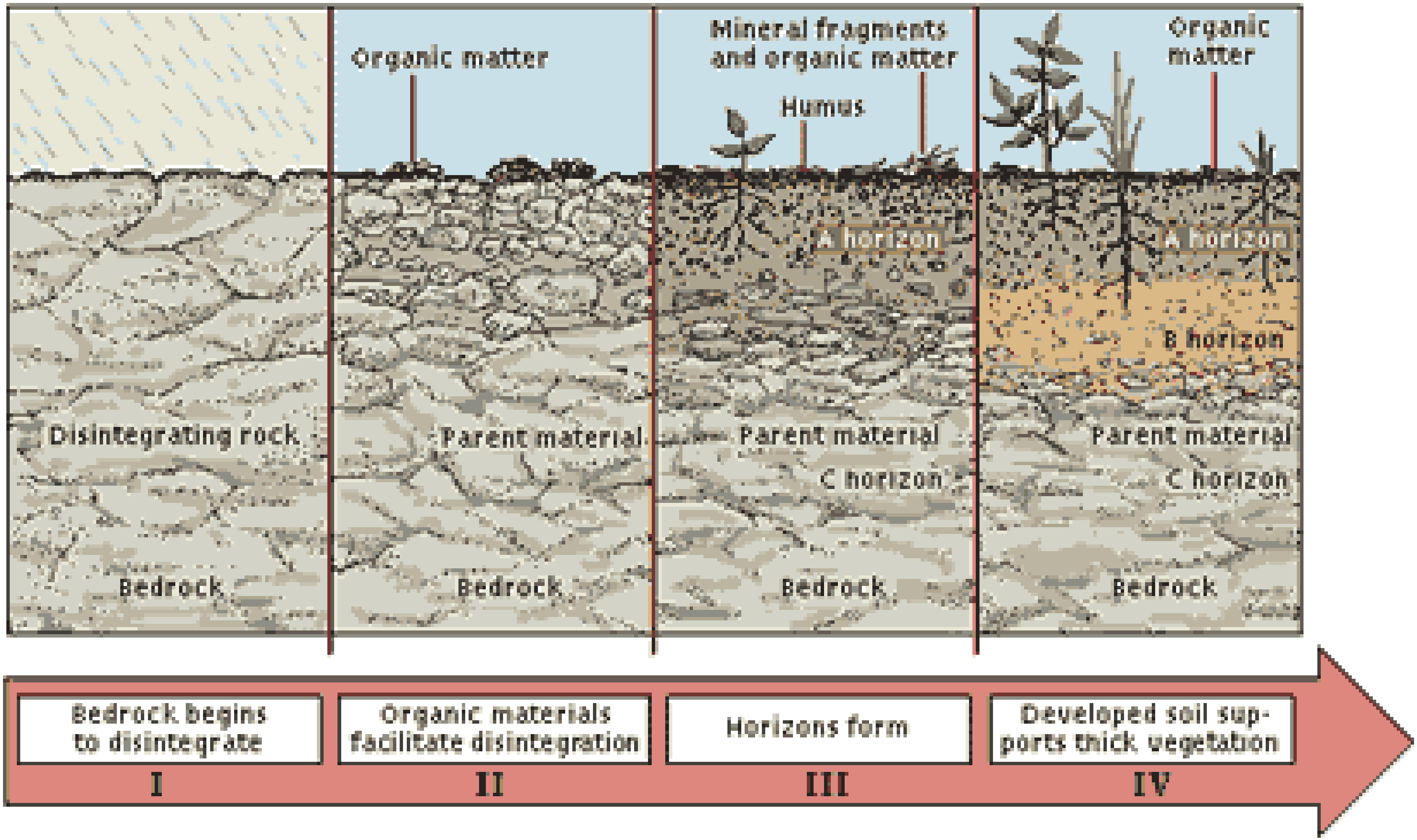
Since the publication of the soil surveys for all eight Connecticut counties, the classification of soils has continued to evolve. When using the historical published soil surveys, one will encounter a variety of soil series names not currently in use. These series, noted above are referenced by number to the most current name available at the time of this publication. For example, the soil mapped as *Acton*, if classified by today's standards, may be named *Sutton*.

Charts on this page supplement all Connecticut soil surveys by referring to both current and previously used soil series names. However, since there are some major differences in map units and soil series interpretations from survey to survey, it is necessary to refer to the narrative descriptions within the appropriate archived survey to obtain complete information concerning a particular soil.

Official Soil Series Descriptions

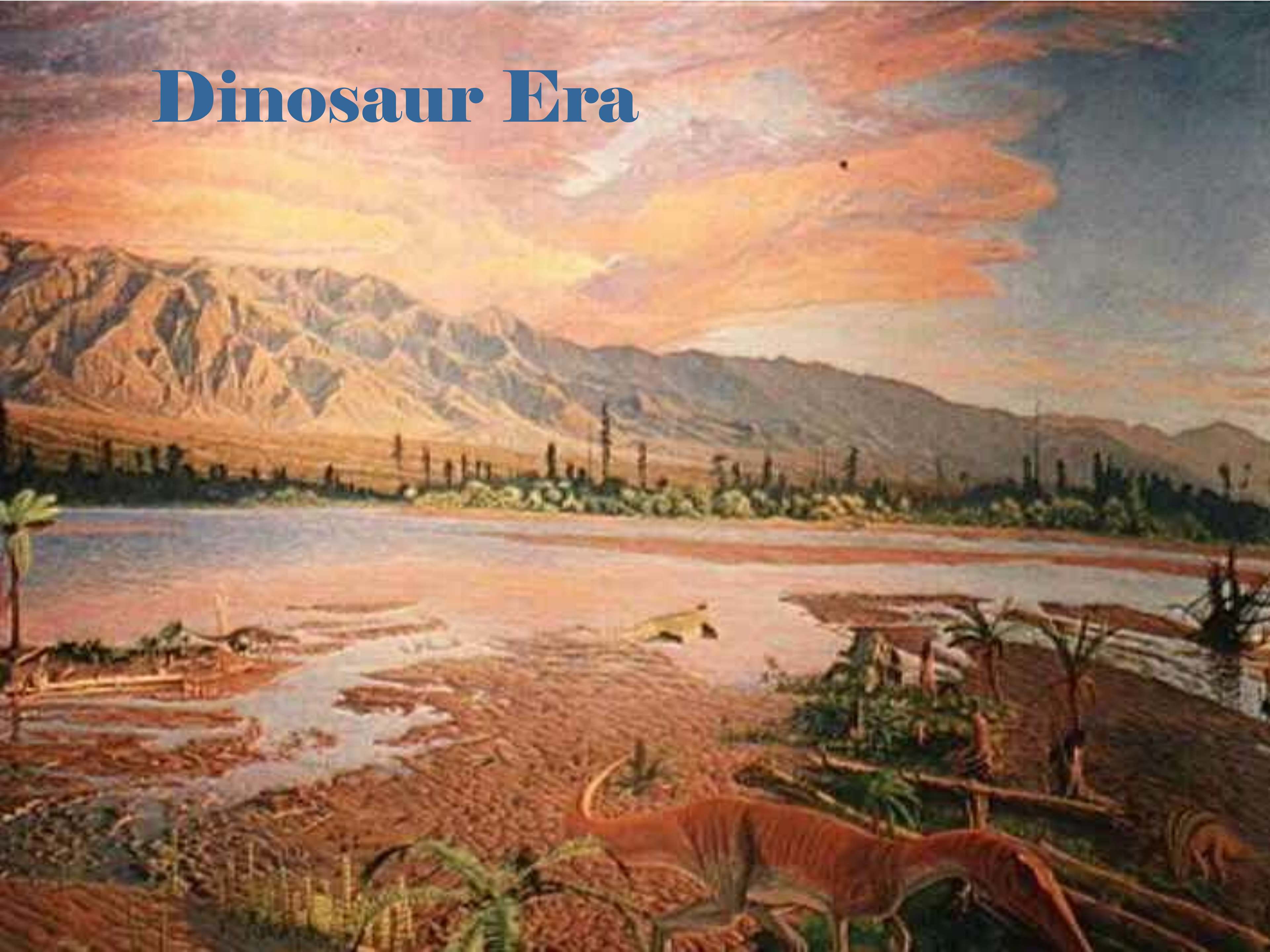
More detailed information about each soil series is located on the USDA-NRCS soils webpage under Official Soil Series Descriptions (OSDs). This site is updated and maintained online as the official source of tentative and established soil series.


MASSACHUSETTS
NEW YORK
RI
Mt Frissell
2380
Canaan
River
Housatonic
Barkhamsted Reservoir
Winsted
Windsor Locks
Putnam
Torrington
Storrs
Hartford
Manchester
Willimantic
Bristol
New Britain
New Milford
Waterbury
Middletown
Meriden
Norwich
Lake Candlewood
Connecticut River
Hamden
Danbury
New London
Groton
Old Lyme
New Haven
Trumbull
Milford
Bridgeport
Norwalk
Stamford
Greenwich
Long Island Sound
84
91
395
95



Organic matter
Mineral fragments and organic matter
Humus
Organic matter
A horizon
A horizon
B horizon
Disintegrating rock
Parent material
Parent material
Parent material
C horizon
C horizon
Bedrock
Bedrock
Bedrock
Bedrock
Bedrock begins to disintegrate
I
Organic materials facilitate disintegration
II
Horizons form
III
Developed soil supports thick vegetation
IV

Dinosaur Era



Adapted from the
Mashantucket Pequot Museum

17,000 years ago

13,000 years ago

10,000 years ago

8,000 years ago

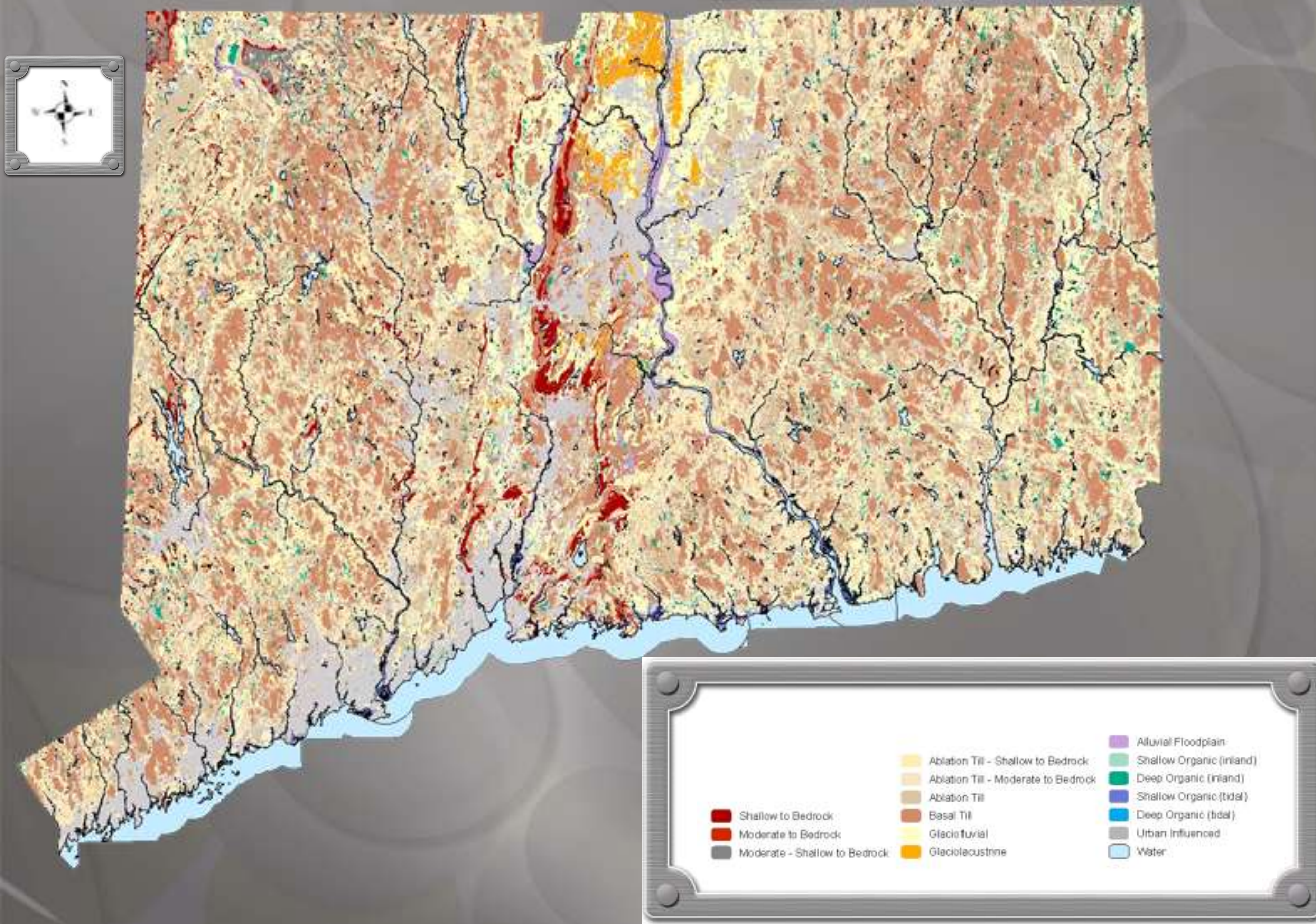
6,000 years ago

4,000 years ago

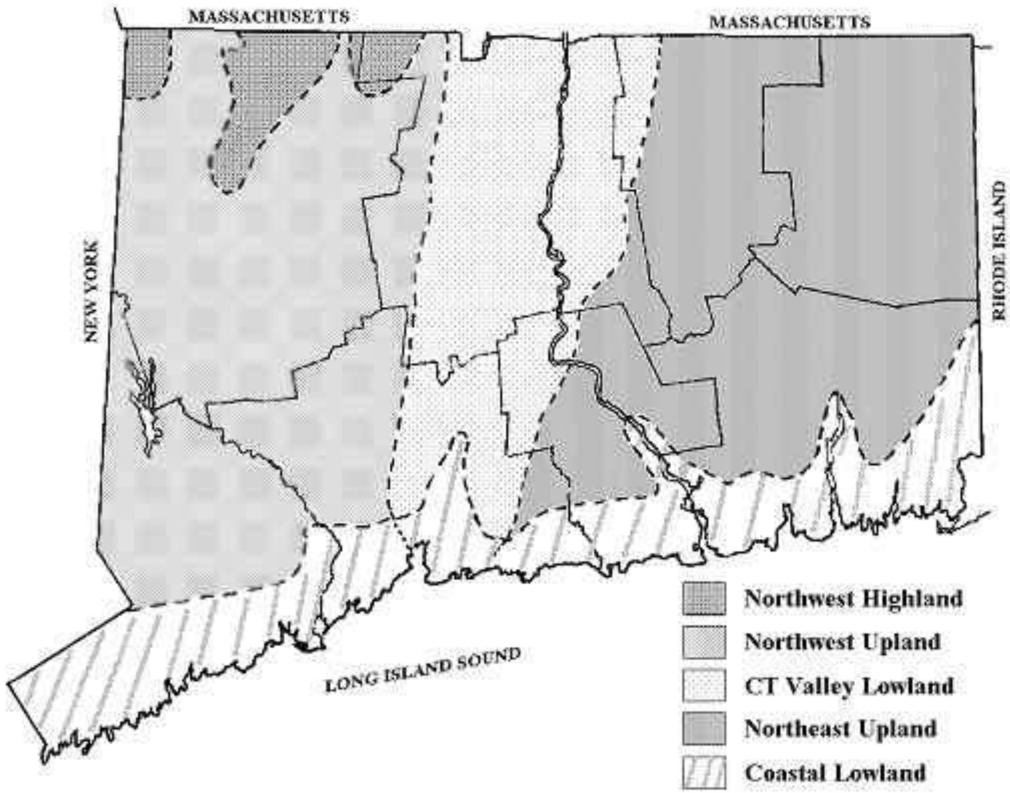
350 years ago

Today

Soil Parent Material



Physiographic Regions of Connecticut



Glacial Till Parent Material

Sutton Series

Glaciofluvial Parent Material

Manchester Series

Alluvium Parent Material

Hadley Series

Glaciolacustrine Parent Material

Scitico Series

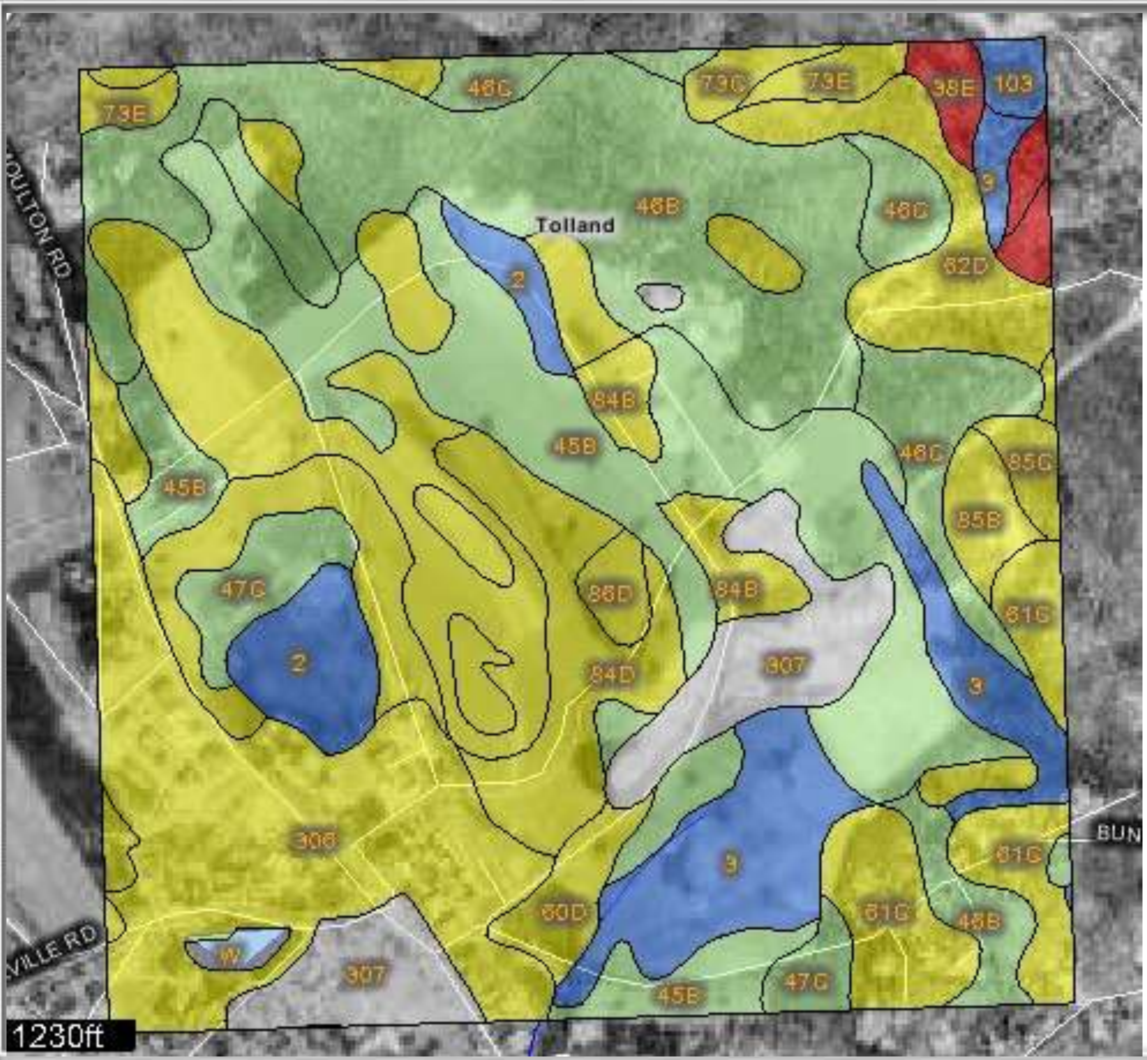
Organic Parent Material

Natchaug Series

Disturbed Parent Material

Soil Classification

Technical Soil Classification



Drainage Class

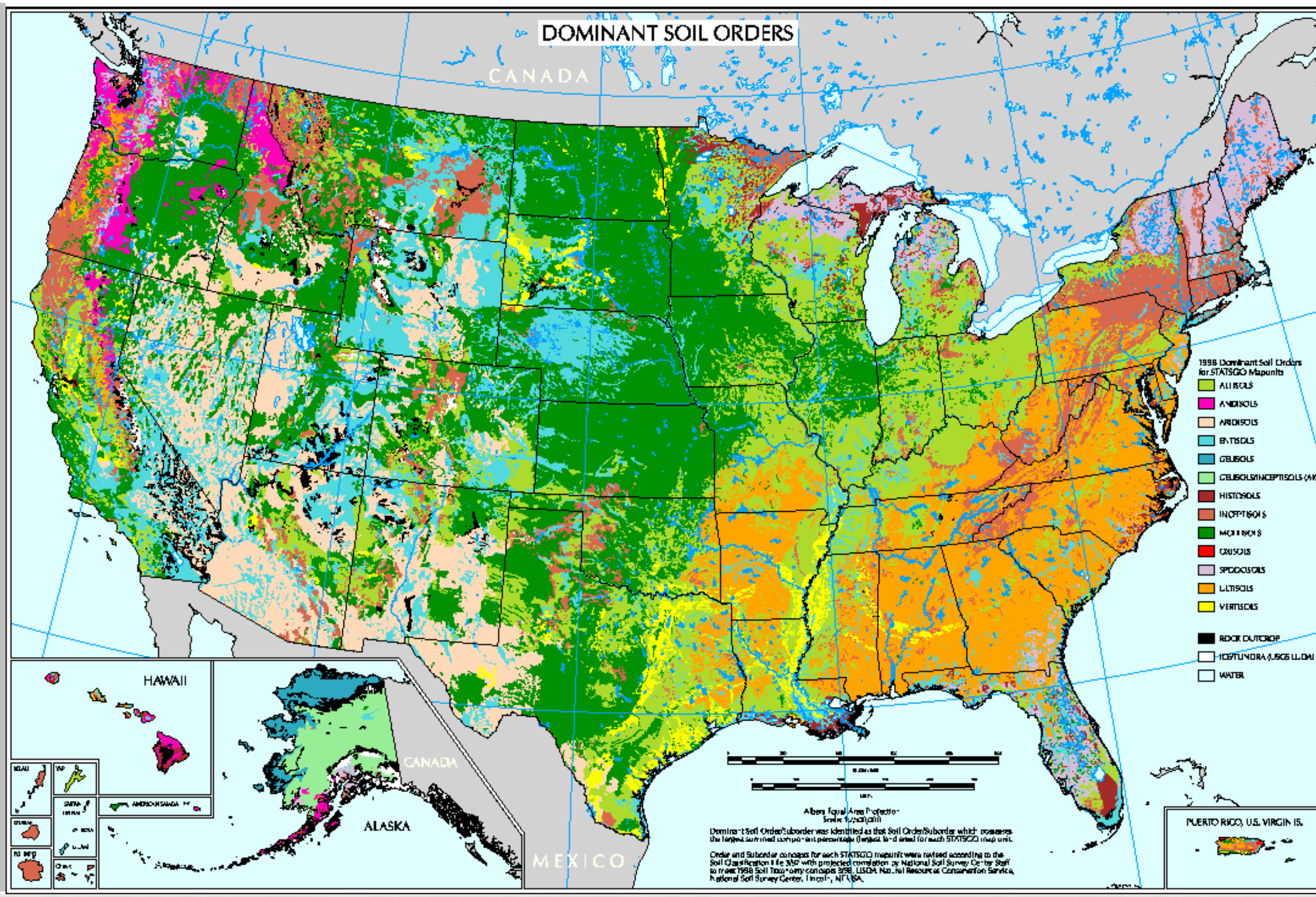
Criteria Used in Soil Taxonomy

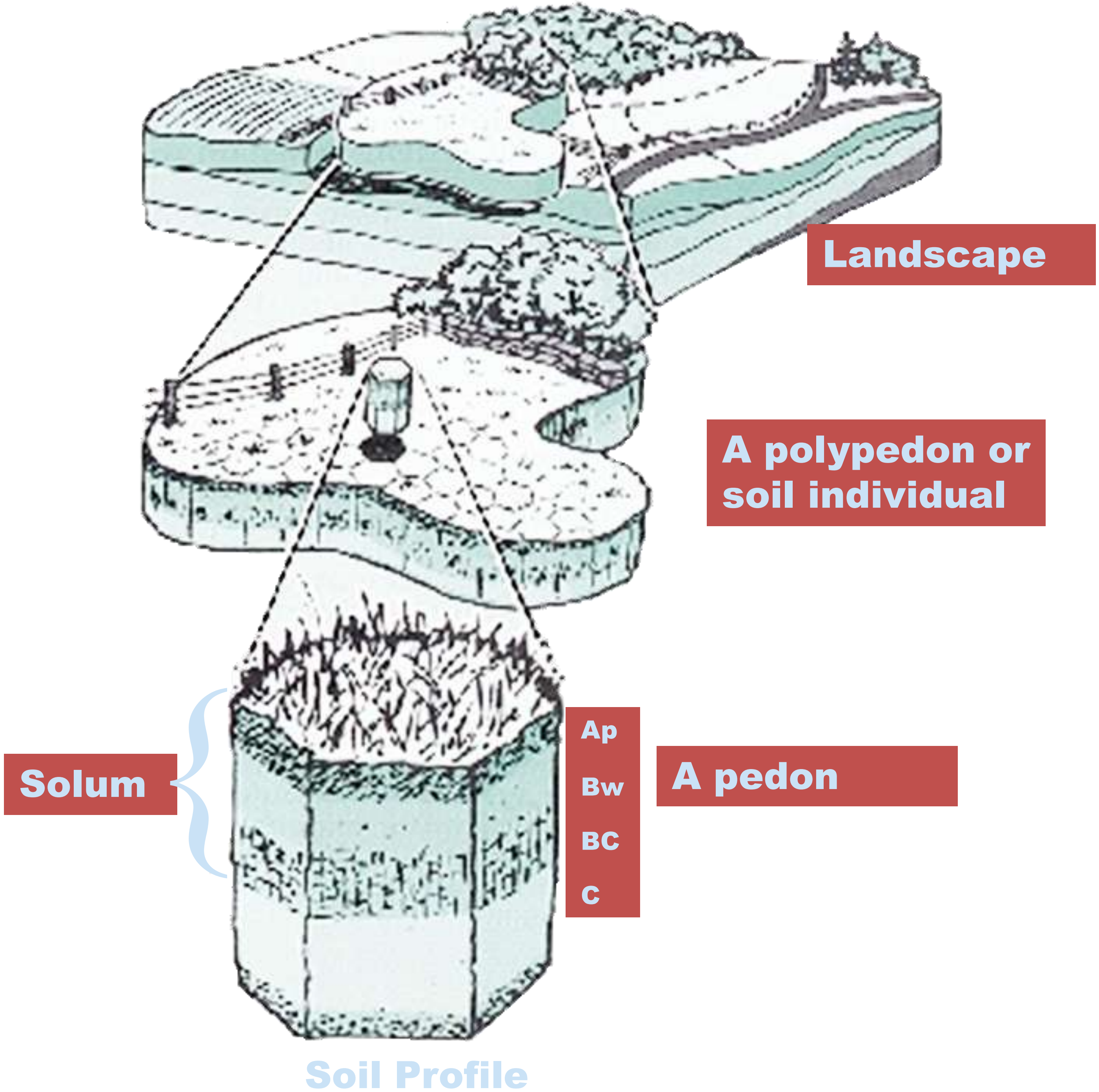
- Chemical, physical, and biological properties (such as moisture, temperature, texture, structure, pH, soil depth)
- Presence or absence of certain diagnostic horizons (surface and subsurface horizons)

12 Soil Orders

http://soils.usda.gov/technical/classification/orders/

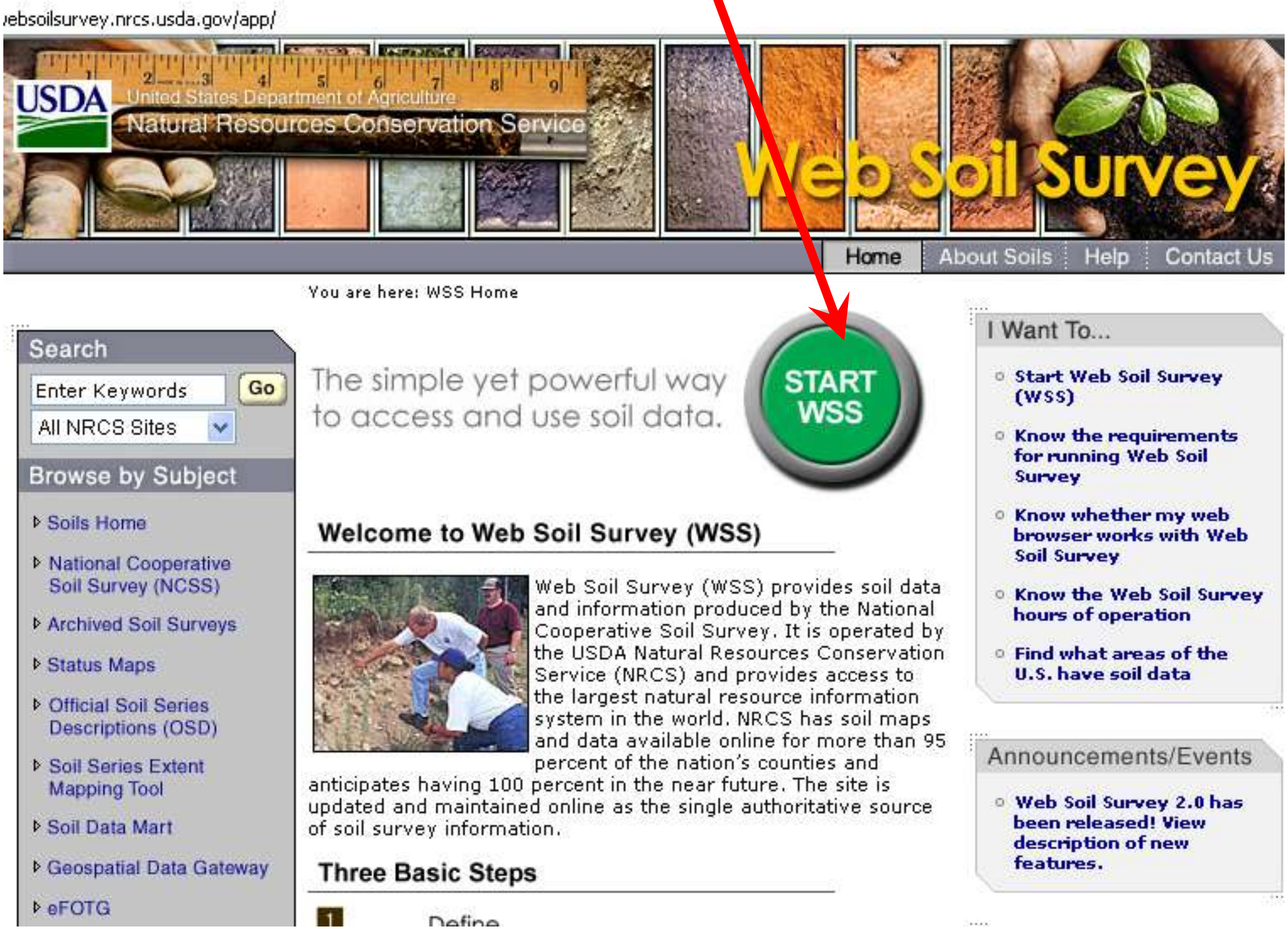
- Entisol
- Inceptisol
- Andisols
- Spodosols
- Mollisols
- Alfisols
- Ultisols
- Oxisols
- Aridisols
- Vertisols
- Histosols
- Gelisols




Landscape
A polypedon or soil individual
Solum
Ap
Bw
BC
C
A pedon
Soil Profile

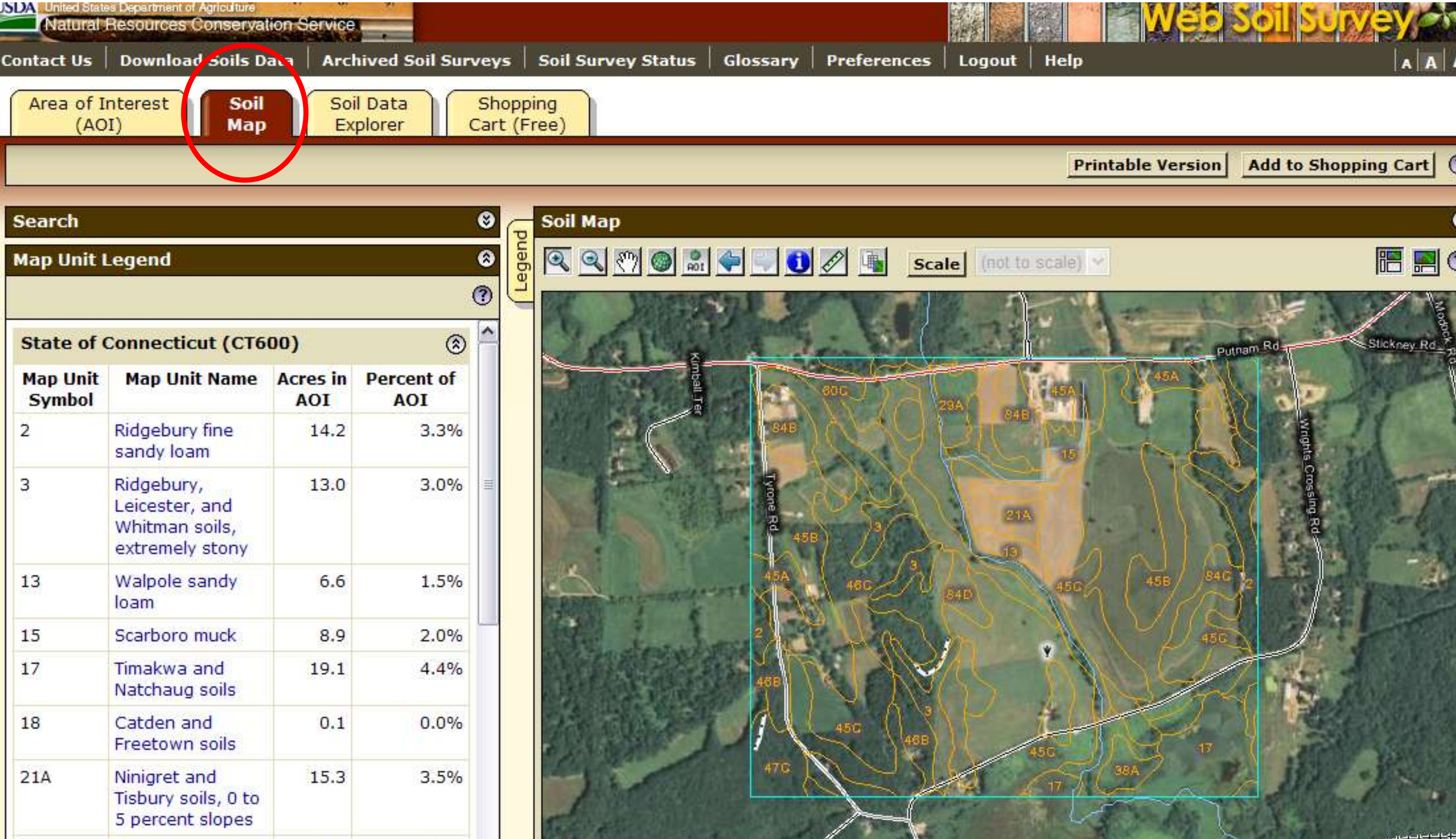
Soil Mapping

Click on the green “start” button

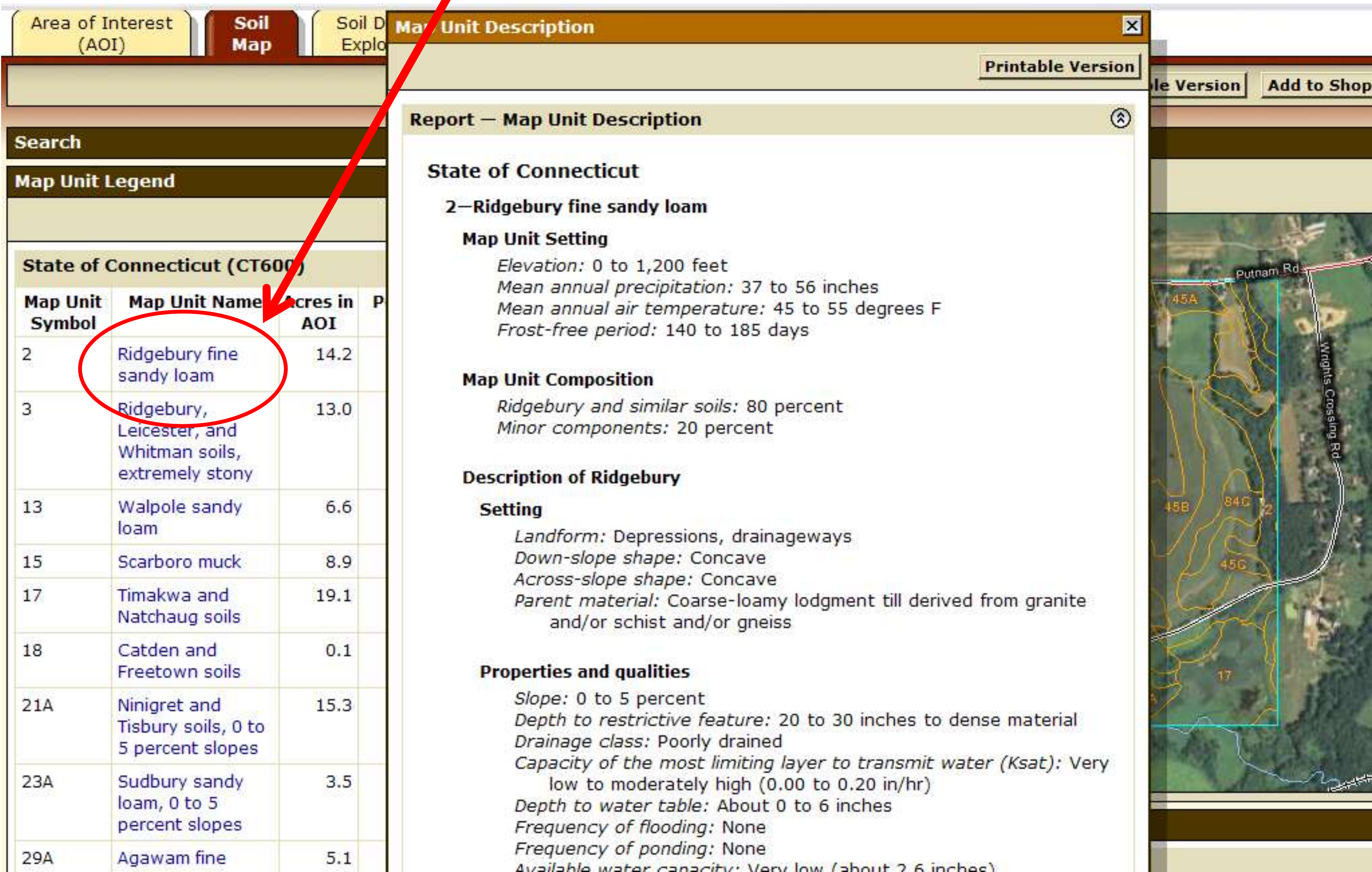


http://websoilsurvey.nrcs.usda.gov

View the Soil Map



Click on map unit name for description



State of Connecticut (CT600)

Map Unit Symbol	Map Unit Name	Acres in AOI	P
2	Ridgebury fine sandy loam	14.2	
3	Ridgebury, Leicester, and Whitman soils, extremely stony	13.0	
13	Walpole sandy loam	6.6	
15	Scarboro muck	8.9	
17	Timakwa and Natchaug soils	19.1	
18	Catden and Freetown soils	0.1	
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	15.3	
23A	Sudbury sandy loam, 0 to 5 percent slopes	3.5	
29A	Agawam fine	5.1	

Report — Map Unit Description

State of Connecticut

2—Ridgebury fine sandy loam

Map Unit Setting

Elevation: 0 to 1,200 feet
Mean annual precipitation: 37 to 56 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days

Map Unit Composition

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

Description of Ridgebury

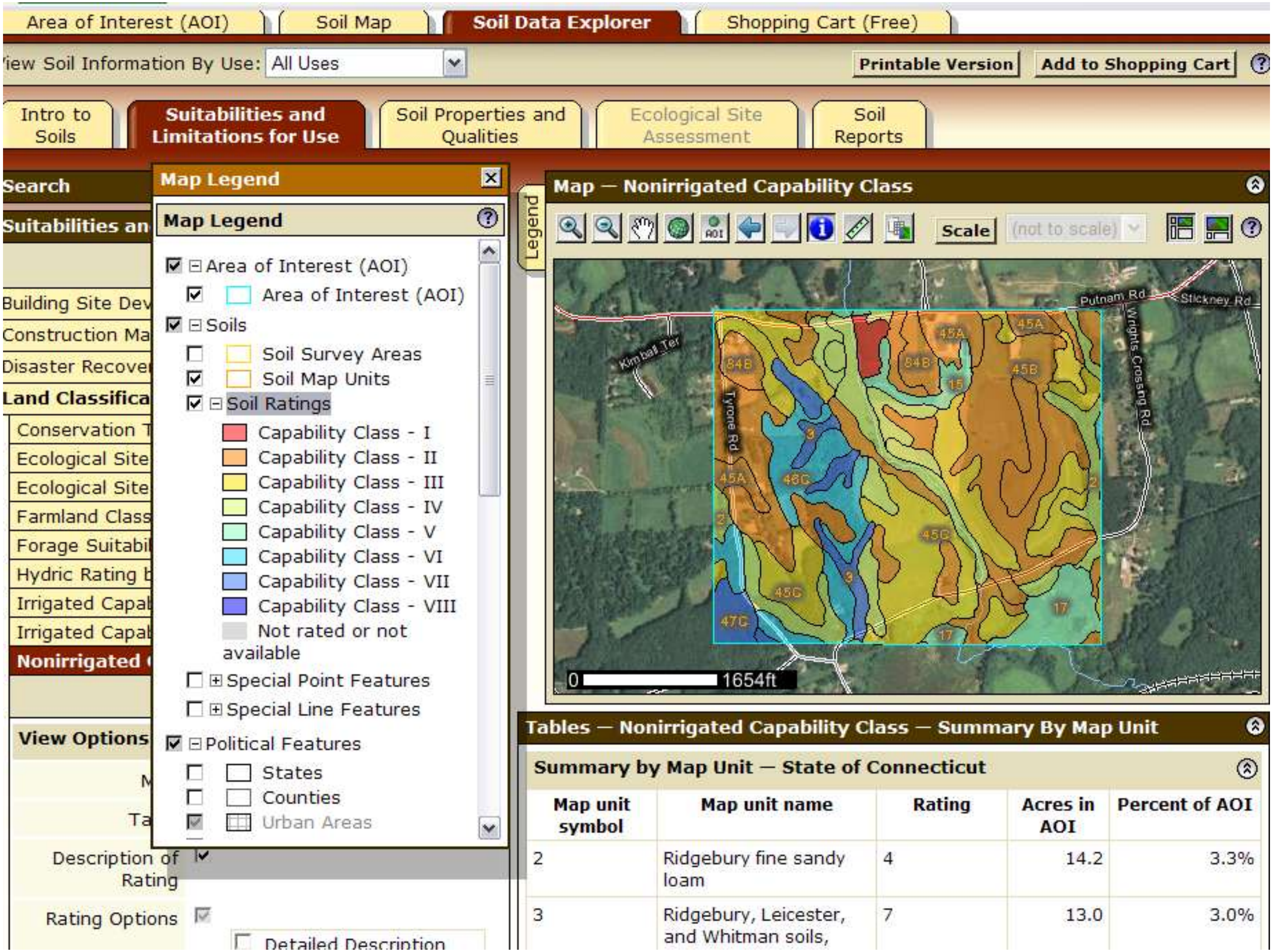
Setting

Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 30 inches to dense material
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.6 inches)

Example Soil Interpretation Land Capability Classification Rating

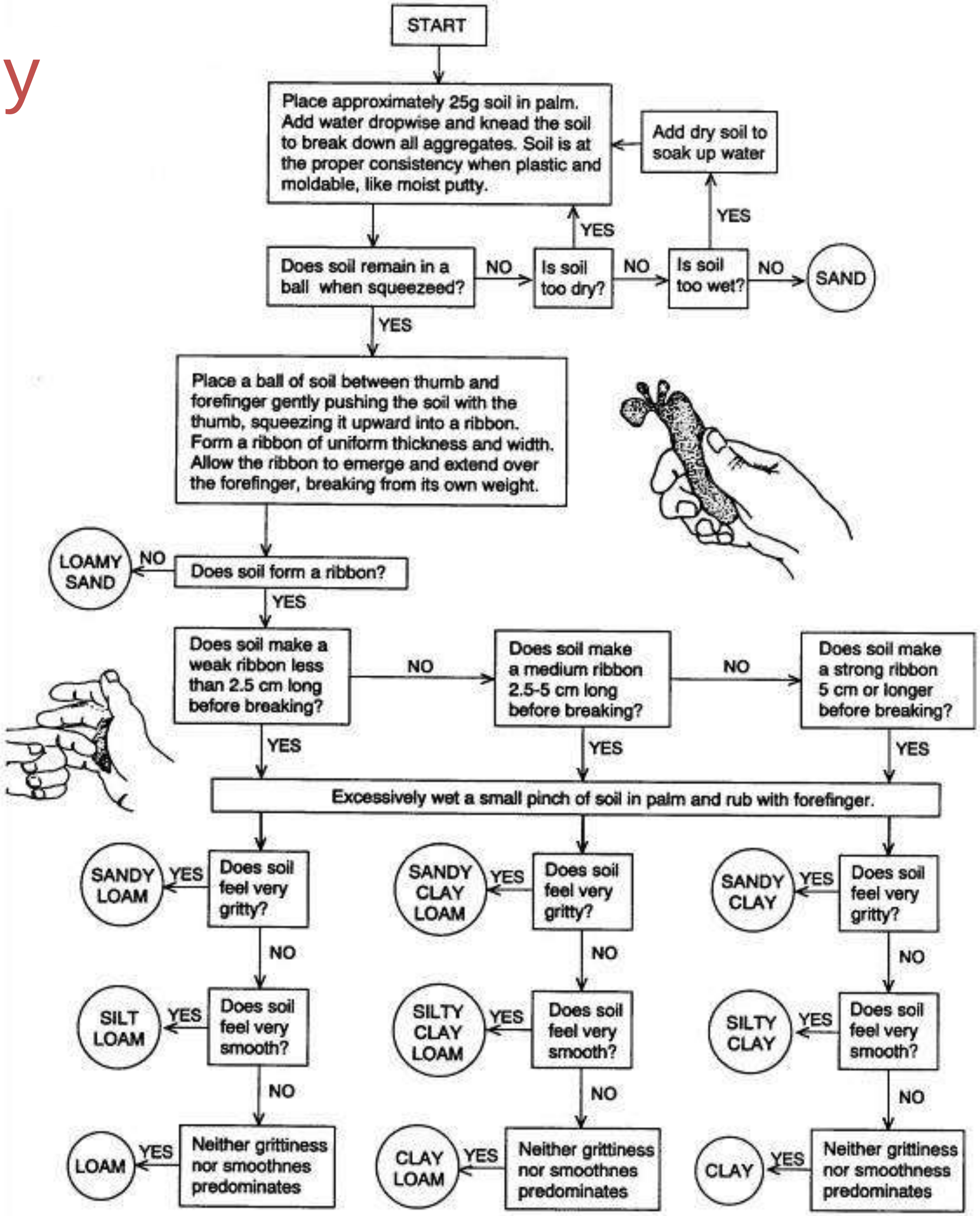


Networking Break & Soil Texture DEMO

Get to know other participants!

35 min

Texture by Feel



SOIL QUALITY/HEALTH:

The continued capacity of the soil to function as a vital living system that sustains plant, animal, and human health.

Properties of Soil Heath:

Inherent Properties:

–Physical properties that usually cannot be changed without much difficulty

- Soil texture
- Type of clay
- Depth to bedrock
- Drainage class

Dynamic Properties:

- Management dependant properties that we do have the ability to change relatively easily
- Organic matter content
- Biological activity
- Aggregate stability
- Infiltration
- Soil fertility
- Soil reaction (pH)

Benefits of Managing for Soil Health

- Improved Nutrient Cycling
- Maximizes fertilizer availability
- Fungi increase P and water supply to plants
- Improved soil aggregation
- Increased water movement and storage
- Better root growth into more soil
- Better habitat for the Soil Food Web
- Fewer weeds and diseases
- A balanced Food Web helps suppress pests
- Less soil disturbance plants fewer weed seeds

Indicators of Soil Health:

Physical indicators commonly used to assess agronomic soil quality include:

Indicators of Soil Health:

- Aggregate stability
- Available water holding capacity
- Bulk density
- Infiltration
- Root distribution
- Soil crusts
- Soil structure and macropores
- Visible soil fauna

Soil is a Living Factory

- Macroscopic and microscopic organisms–Food
  - –Water
  - –Shelter
  - –Habitat
  - –Powered by sunlight

Management activities improve or degrade soil health–Tillage
- –Fertilizer
- –Pesticides
- –Grazing
- –Plant Diversity

What the Soil Food web Does:

Plant nutrient immobilization / mineralization

Creates stable soil aggregates Water infiltration / retention

Habitat for soil food web

Root movement

Nematode, microarthropod movement

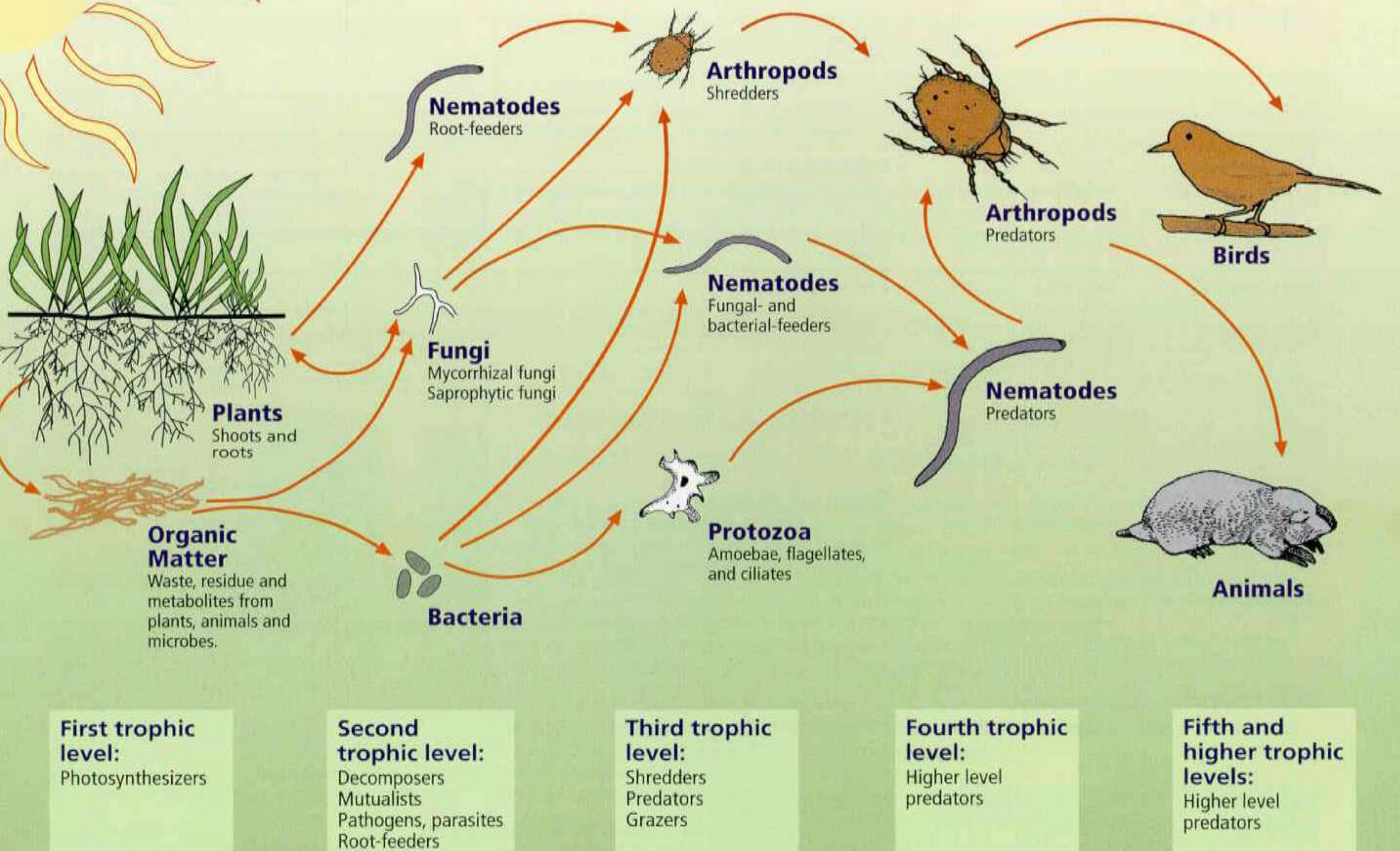
Air movement

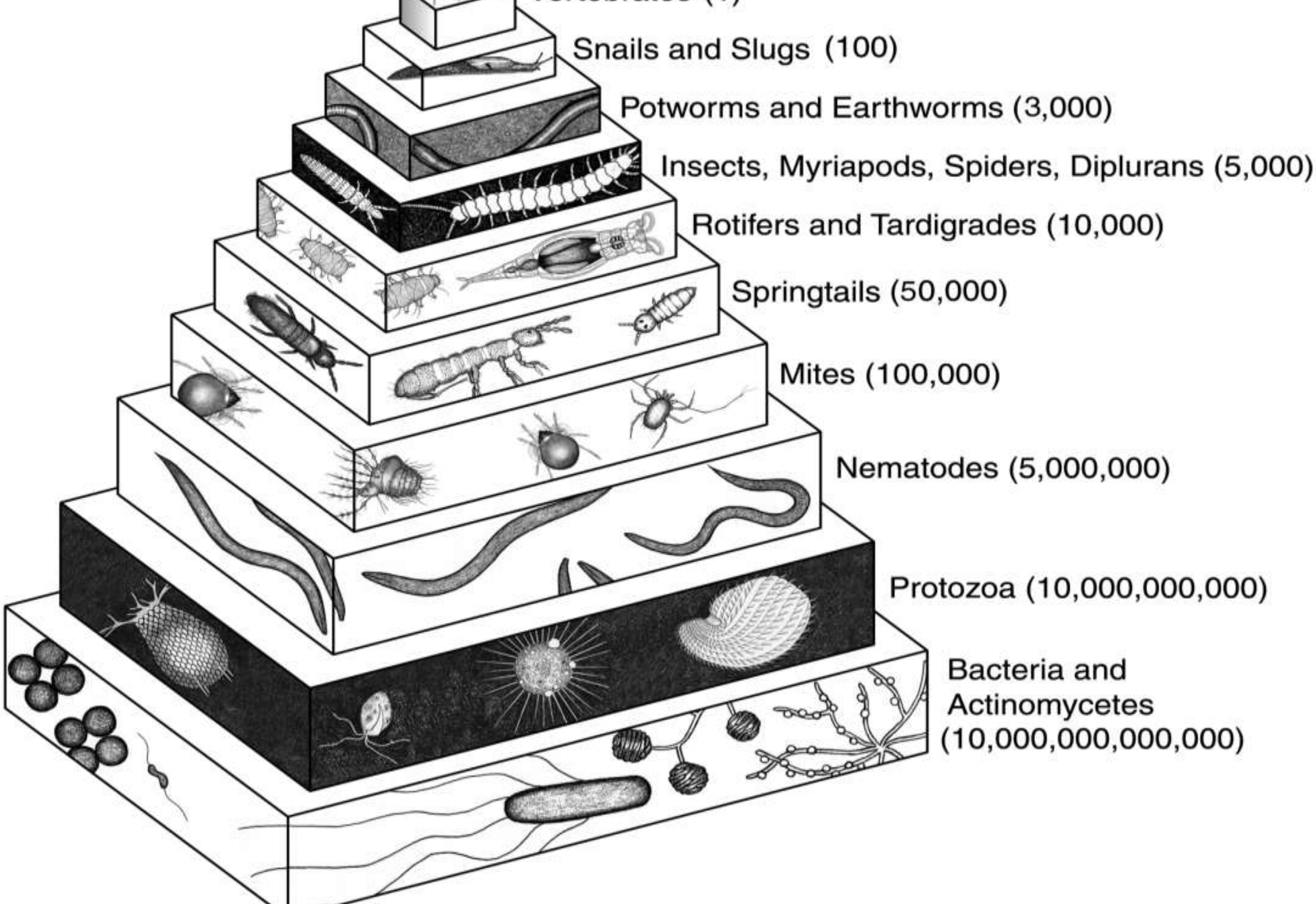
What is the most limiting element in the soil for agricultural production?

Where does the Carbon contained in the soil come from?

The Soil Food Web

Create Quality Microbial Habitat , Every Farmer has Livestock




Snails and Slugs (100)
Potworms and Earthworms (3,000)
Insects, Myriapods, Spiders, Diplurans (5,000)
Rotifers and Tardigrades (10,000)
Springtails (50,000)
Mites (100,000)
Nematodes (5,000,000)
Protozoa (10,000,000,000)
Bacteria and Actinomycetes (10,000,000,000,000)

Rhizosphere…where roots meet soil

Zone of concentrated biological activity adjacent to the root…

Bacteria
Fungi
Protozoa
Nematodes
Microarthropods
Earthworms

Principles of Managing for Soil Health

- Minimize Disturbance of the soil
- Maximize Diversity of plants in rotation
- Keep Living Roots in the soil as much as possible
- Keep the soil covered with plants and plant residues
- Create the most favorable habitat possible for the soil food web

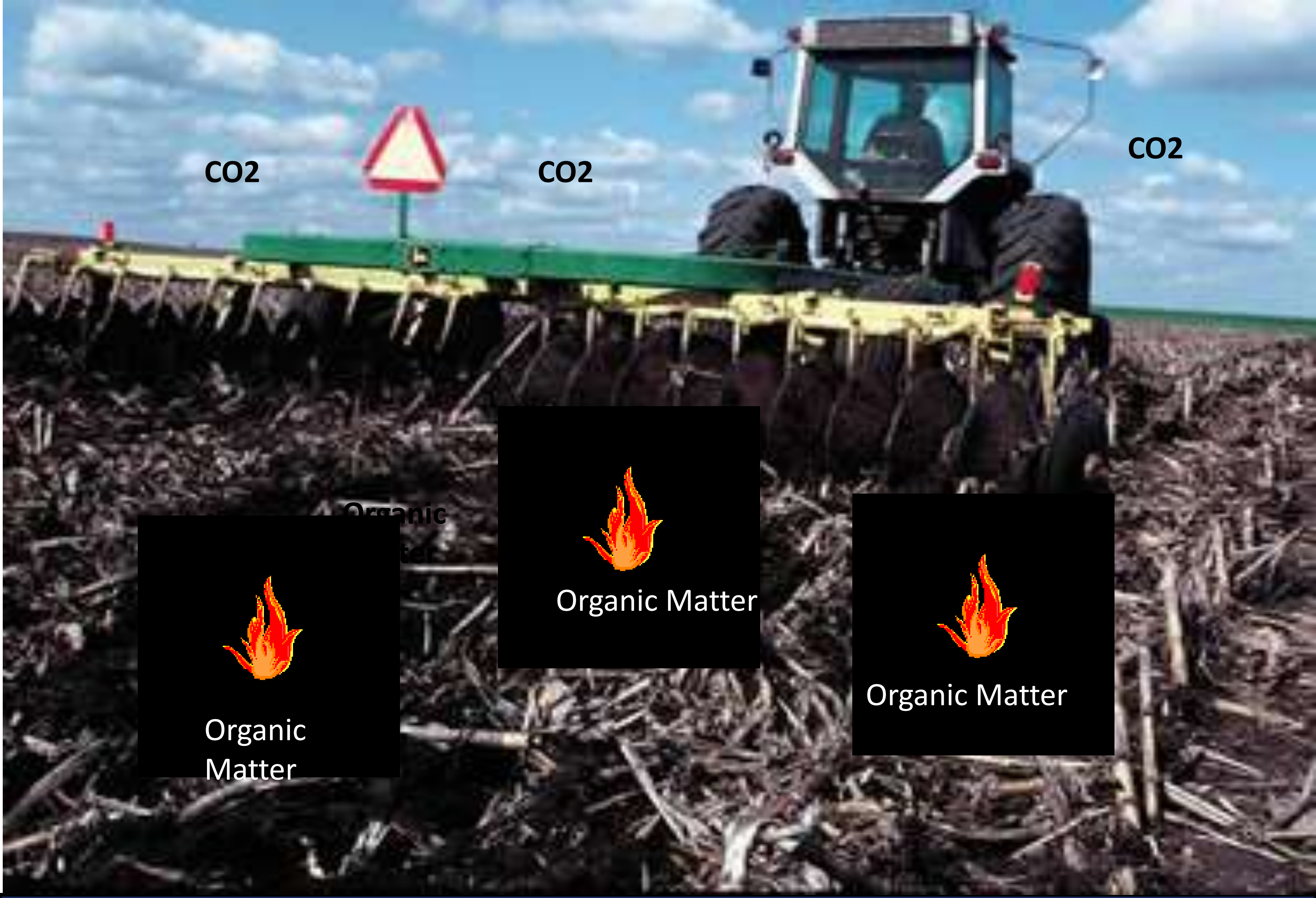
Soil Health Toolbox

- (No) or reduced Tillage
- Crop Rotation Diversity
- Cover Crops
- Degree of Fertilizer use
- Degree of Pesticide use
- Livestock

Which of these tools could positively affect soil health on your farm or garden?

Reduce/Eliminate Tillage of the Soil

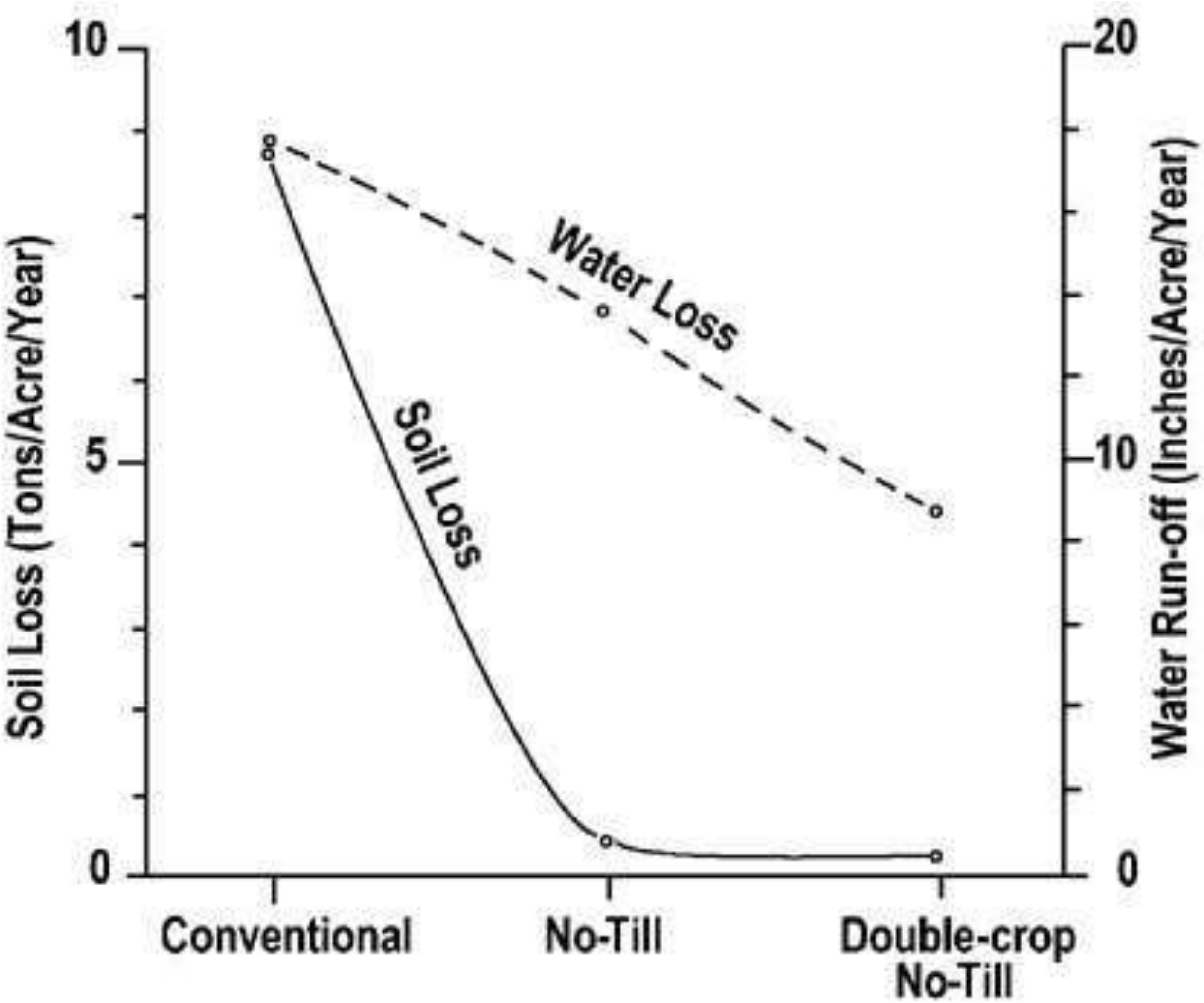
- Tillage is physical soil disturbance
- Destroys aggregates
- Exposes organic matter to decomposition
- Facilitates compaction
- Damages soil fungi
- Reduces habitat for all members of SFW
- Disrupts soil pore continuity
- Promotes salinity at the soil surface


CO2
CO2
CO2
Organic Matter
Organic Matter
Organic Matter

Reduced Tillage and Infiltration

- No-, zone-, strip-, ridge-till, etc.
- Less macro-fauna disturbance (i.e., earthworms)

(Dan Brainard, msue.anr.msu.edu)

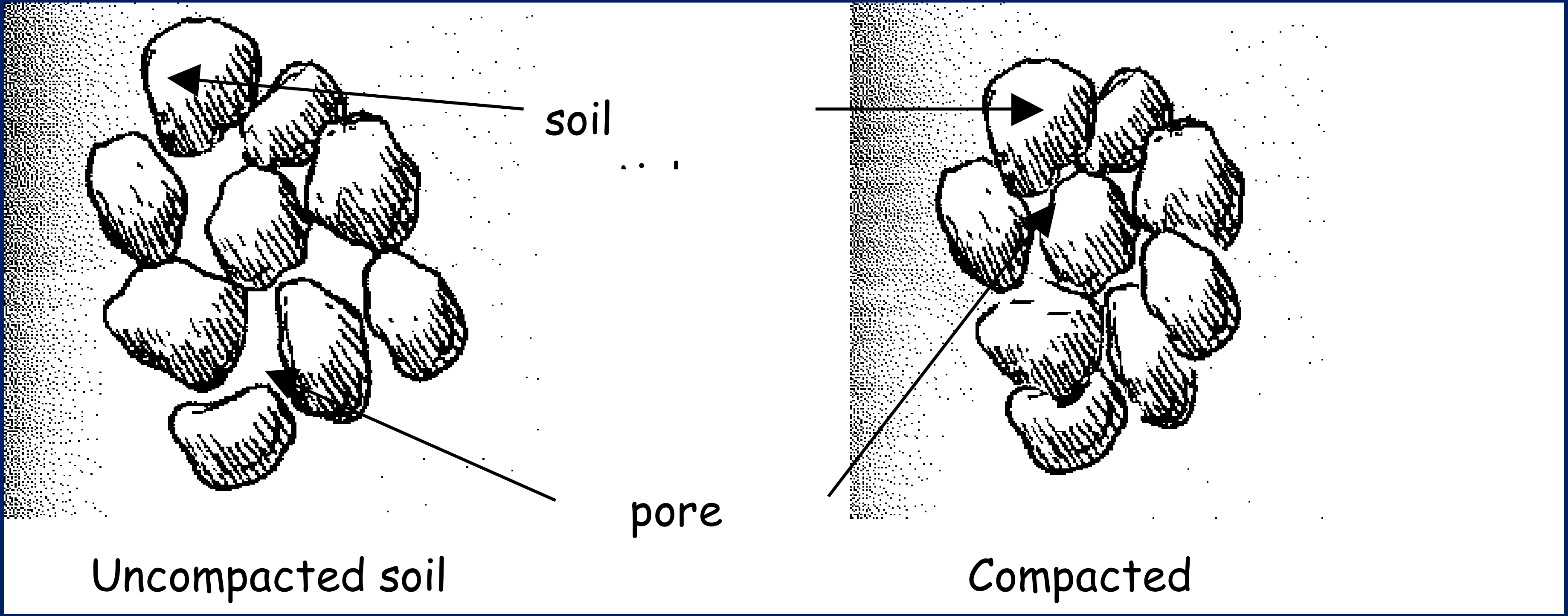


(Source: Herbek, AGR-101; www2.ca.uky.edu)

Field Assessment

Compaction

Decrease in pore spaces are where plants get air, water, and nutrients.



Adapted from Sulzman and Frey, 2003

Try this at home!

Test your compaction!

Use what you have:

- Fingers
- Shovel
- Pin flag
- Rod

Plant Diversity through crop rotation / cover crops:

•Crop diversity = Soil Food Web (SFW) diversity
•Diversity Balanced/Diverse diet to Soil Food Web
•Help Reduce pest pressure
•Help Increase soil nutrient cycling
•Reduces risk
•Increased influence of living roots Feeds Soil Food Web
•Increase soil aggregation and porosity to increase available water holding capacity , infiltration and percolation
•Increase OM holds more available water for plants
•Stimulate SFW into increased activity
•Integrate grazing
•Nitrogen fixation/recovery

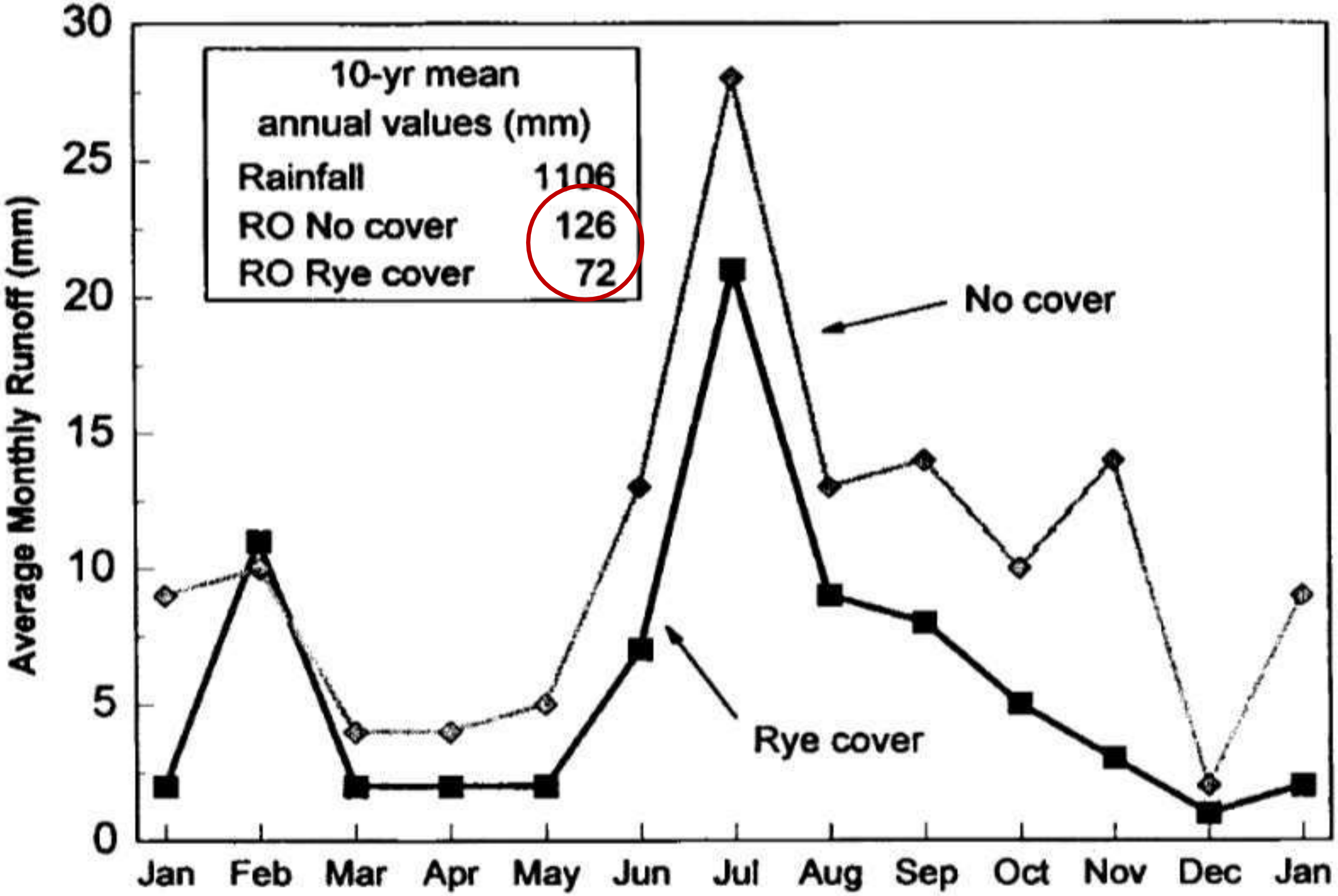
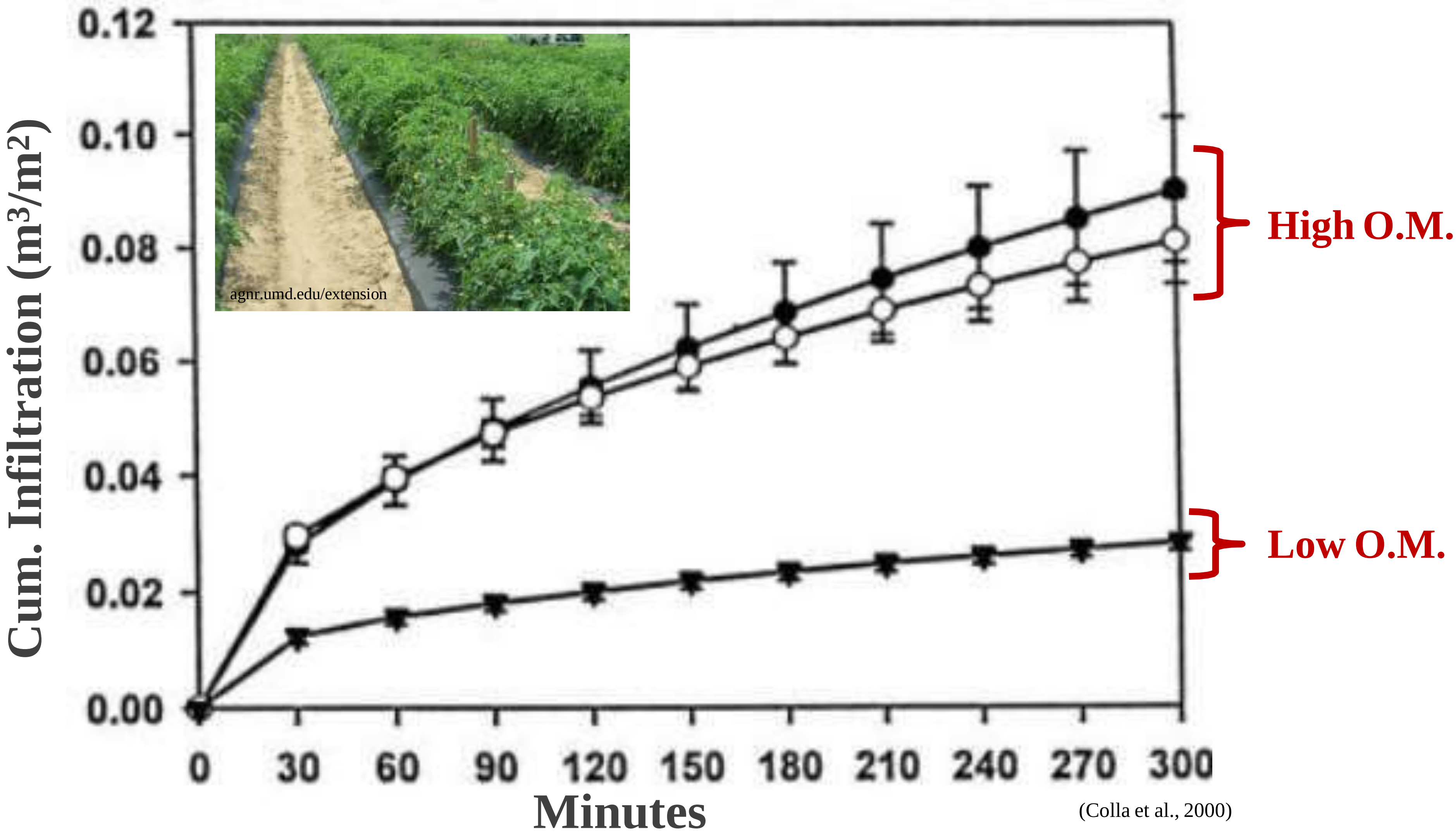


Figure 2. Averaged over 10 years and three vegetable cropping systems, a winter rye cover crop reduced runoff throughout the year on a Freehold loamy sand with 3% slope in New Jersey (Brill and Neal 1950)

(Dabney, 1998)

Organic Matter and Infiltration



(Colla et al., 2000)

Soil Organic Matter Fun Facts

- Soil organic matter (SOM) is <6% of soil by weight but controls >90% of the function
- Density of SOM: .6 g/cm3   Density of Soil: 1.45 g/cm3
- SOM has less density than soil so it has more space for air and water storage.
- SOM is negatively charged, but binds both cations and anions
- As soil organic matter increases from 1% to 3%, the available water holding capacity of the soil doubles (Hudson, 1994).
- Soils stockpile 1500 gigatons of carbon in SOM, more than Earth's atmosphere and all the plants combined (Dance, 2008).
- The majority of the SOM is present in the top 10 cm of soil

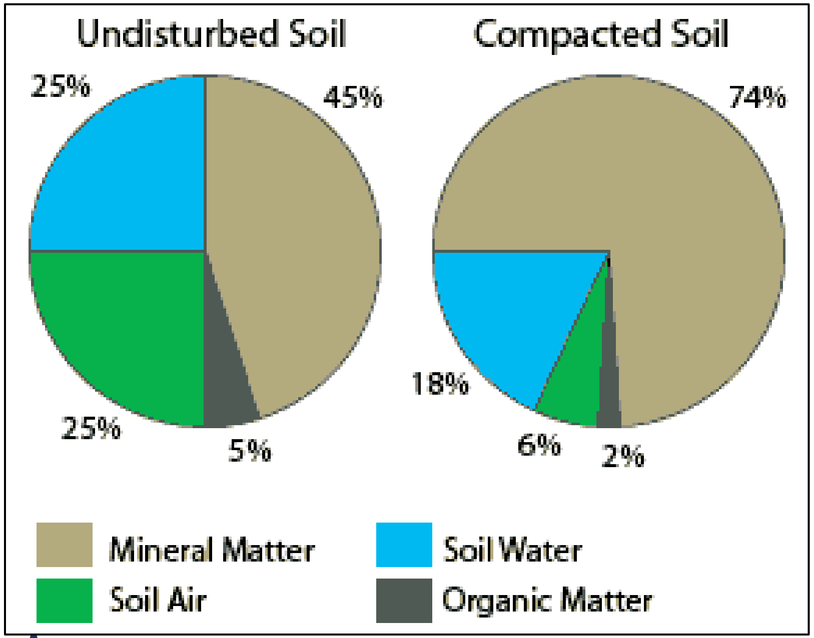
Soil Organic Matter Nutrient Bank Account.

- 1.0% OM = 20,000 #10,000 # Carbon (5 ton)@ $4/ton = $20
- 1,000 # Nitrogen@ $.50/# = $500
- 100 # Phosphorous@ $.70/# = $70
- 100# Potassium@ $.40/# -=$40
- 100 lbs of Sulfur@ $.50/# = $ 50
- Total$680

Mineralization Rate = 2-3% from Organic N to Inorganic N. Resulting in 20 to 30 lbs of useable N per acre.

Drought Resilience

- Crops can't use water that doesn't infiltrate
- Organic matter
  - For every 1% increase in OM, another inch of water available (Emerson, 1995)
- **Avoiding compaction**
  - Deep moisture
  - Increased storage
  - Increased conductivity
- **Role for moisture sensors**
  - Drought and compaction prevention



(Courtesy USDA-NRCS)

Chemical Soil Disturbance from Fertilizer

- Excessive nitrogen or phosphorus fertilizer… Short-circuits the rhizosphere
- Depresses activity of natural N fixers
- Stimulates bacterial decomposition of Soil OM
- N at risk for leaching or denitrification
- Synthetic fertilizers are salts (salinity) and can lower pH

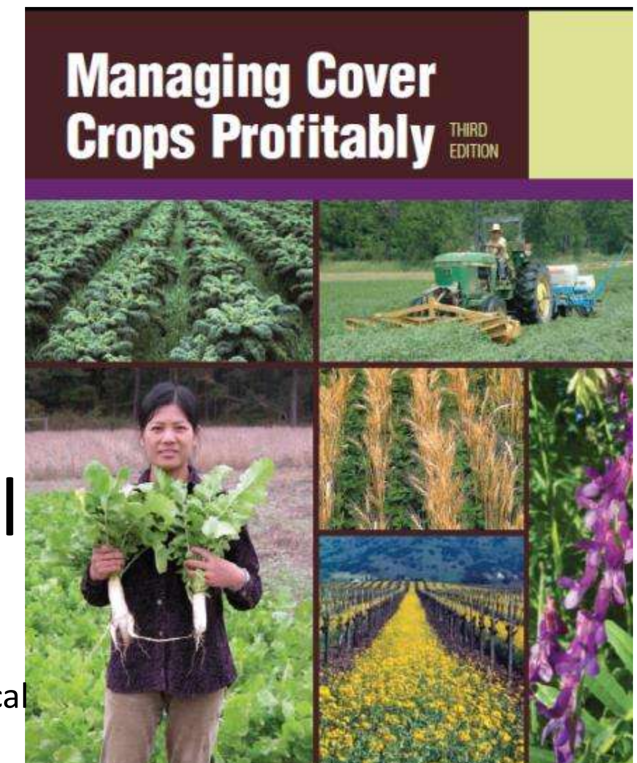
Chemical Soil Disturbance from Pesticide use:

•Impact of pesticides on non-target organisms not well understood.
•Pesticides simplify, not diversify SFW"cides"

•Produces Crop rotation restrictions
•Produces Cover crop diversity restrictions

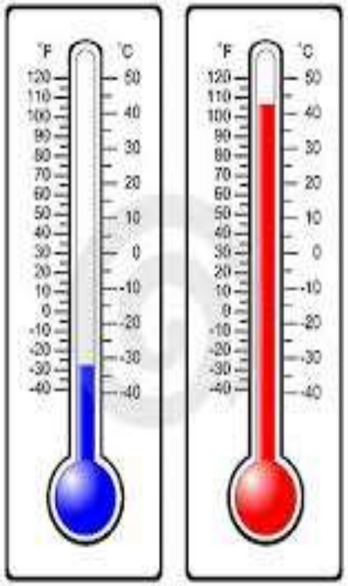
Keep soil covered as much as possible

- Control Erosion
- Protect Soil Aggregates
- Suppresses Weeds
- Conserves Moisture
- Cools the Soil
- Provides Habitat for Soil Organisms



David Lamm, “Soil Health Farming in the 21st Century: a practical approach to improve Soil Health Planning Principles”

When soil temperature reaches…..



140 F Soil bacteria die

130 F 100% moisture is lost through evaporation and transpiration

113 F Some bacteria species start dying

100 F 15% moisture is used for growth

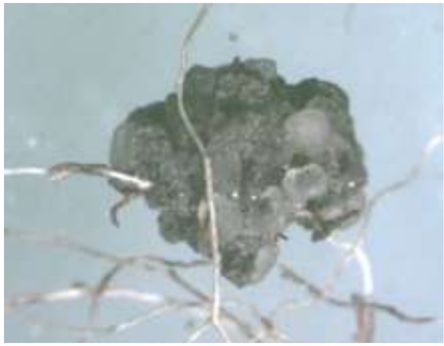
95 F 85% moisture lost through evaporation and transpiration

70 F 100% moisture is used for growth

J.J. McEntire, WUC, USDA SCS, Kernville TX, 3-58 4-R-12198. 1956

Livestock as a practice for soil health

- Add and distribute biology to soil
- Cycle residues, reduce C:N ratios
- Puts plant residues in contact with soil
- Can help control weeds and disease
- Opportunity for increased income
- Increase intensity & reduce duration to improve soil health on pastures



How do we know if soil health is improving?

- Soil aggregate stability increases
- Water infiltration increases
- Organic matter increases
- Crop response
- Plants use less water, nutrients
- Less crusting, ponding, erosion
- Reduced input costs
- Soil Food Web analysis

Site Indicator Scorecard
for Connecticut Community Gardeners

NRCS
USDA, Natural Resources Conservation Service

Date: ______________________
Site Name: ______________________
Form Completed By: ______________________

☒ *applicable box*

Site Indicator	Poor	Tolerable	Best
Accessibility			
1. Walking distance to site.	10+ minutes. ☐	5-10 minutes. ☐	0-5 minutes. ☐
2. Availability of parking.	None. ☐	Difficult. ☐	No problem. ☐
3. Visibility from street.	Can't see site, or it is very visible. ☐	☐	Somewhat visible. ☐
4. Hilliness of site.	Very hilly. ☐	Some slope. ☐	Level or nearly level. ☐
Topography			
5. Direction the slope faces.	North. ☐	East, West. ☐	South. ☐
6. Bedrock, ledge, or large boulders on site.	Too many to work around. ☐	Some, but can work around them. ☐	None. ☐
Location/Distance to Water			
7. Water access — city water, pond, or river for irrigation.	No water available on the site, and no access to bring it to site. ☐	Have to connect to city water or bring water to site. ☐	Water available easily. ☐
8. Water quality tested.	Bad quality, can't use. ☐	Fair quality. ☐	Good quality. ☐
9. Runoff.	After rainfall, a lot of soil washes from site. ☐	After rainfall, a little soil soil washes from site. ☐	After rainfall, no soil is seen to wash from site. ☐
10. Water on surface during the growing season (spring, summer, fall).	After a moderate rain-fall, water stays on surface for a few days. ☐	After heavy rainfall, water stays on surface for a short time. ☐	After rainfall, no water is observed on the soil surface. ☐
11. Sun exposure through the day.	Shady, very little exposure. ☐	Sun is blocked some of the time. ☐	Mostly sunny. ☐
12. Amount of existing pavement on site.	Too much pavement, will interfere with plans for the site. ☐	Some, but can work around. ☐	None. ☐
13. Debris (construction materials, bricks, concrete, etc.)	A lot on the surface. ☐	Occasional. ☐	None. ☐
14. Shortcuts through site.	Lots. ☐	Some. ☐	None. ☐
15. Neighborhood pets.	Site used heavily by animals. ☐	Some use. ☐	No pet evidence observed. ☐
16. Human activity on site.	Lots of evidence of people on site. ☐	Some people use site. ☐	Very little or no evidence of people on site. ☐
17. What's growing on the site now?	Lots of unwanted trees or brush. ☐	Some unwanted trees and brush. ☐	Plants will not interfere with site plans. ☐
History of Site			
18. History of site.	Not known. ☐	Some stories may be true. ☐	Definitely known. ☐

SOIL INDICATOR SCORECARD
for Connecticut Community Gardeners

NRCS
USDA, Natural Resources Conservation Service

Date: ______________________
Site Name: ______________________
Form Completed By: ______________________

☒ *applicable box*

Soil Indicator	Poor	Tolerable	Best
19. Can you use the soil that is on the site? (Is there soil on this site?)	No. Need to bring soil to site. ☐	Some. ☐	Yes, all soil is workable. ☐
Surface of Soil			
20. Cracks on soil surface in July and August.	Many cracks. ☐	Occasional thin cracks. ☐	No cracks. ☐
21. How do existing plants grow? Compare same kind of plant.	Plants are dead or scraggly. ☐	Plant color and size are different. ☐	Plants look healthy. ☐
Soil Examination			
22. Smell of soil.	Oily, chemically, gasoline, rotten eggs, or bad or strange. ☐	No smell. ☐	Fresh, earthy. ☐
It is not possible to smell some contaminants, like lead, in the soil. Avoid the site if the soil smell is poor unless you can determine the site history is safe and environmental testing for contaminants indicates the areas is safe. Do not touch the soil if the smell is offensive.			
23. How hard is it to dig a hole two feet deep?	Not possible. ☐	Moderately difficult. ☐	Easy. ☐
24. Try to insert a wire coat hanger into soil surface two days after rainfall during the growing season.	Coat hanger bends or cannot be inserted. ☐	Coat hanger can be pushed in with pressure. ☐	Coat hanger goes in easily with fingers. ☐
	and	and	and
	Soil feels firm. ☐	Soil feels somewhat firm. ☐	Soil feels loose. ☐
25. Depth of soil	Less than 1 foot. ☐	Between 1 and 2 feet. ☐	More than 2 feet. ☐
26. Depth of topsoil layer	0-2 inches. ☐	2-5 inches. ☐	5+ inches. ☐
27. Color of topsoil layer	Yellow, gray, multi-colored. ☐	Light brown. ☐	Black, dark brown, dark red, color is uniform. ☐
28. Moisture of soil two days after heavy rain.	Soil is very dry or very wet. ☐	Soil is somewhat dry or muddy. ☐	Soil is moist, but not muddy. ☐
29. How quickly water drains in one foot deep hole during the growing season.	Water stays in hole and doesn't drain after 15 minutes. ☐	Water drains, but less than one inch in 15 minutes. ☐	Water enters soil quickly and moves down more than one inch in 15 min. ☐
30. How does moist soil feel (texture) — *Use Guide to Soil Texture by Feel* Handbook.	Sand, loamy sand, sandy clay, silty clay, or clay. ☐	Clay loam, silty clay loam, or sandy clay loam. ☐	Sandy loam, loam, or silt loam. ☐
31. How moist soil particles hold together.	Soil is hard and very difficult to break with fingers. ☐	Soil breaks apart with some difficulty with fingers. ☐	Soil crumbles easily with fingers. ☐
32. Roots in the top 12 inches of soil.	None. ☐	Some, roots grow mostly across the soil, not down. ☐	Many, roots grow mostly down into the soil, not across. ☐
33. Worms and other bugs in the soil.	None. ☐	A few. ☐	Many. ☐
34. Stones or rocks in the soil.	Too many. ☐	Some. ☐	None. ☐
35. Debris in the soil (bricks, construction materials, glass, concrete, etc.)	Too much to dig around. ☐	A little bit, doesn't interfere with digging. ☐	None. ☐
36. Rotten stumps, old trees in the soil.	Lots of stumps and trees. ☐	A few small pieces. ☐	None. ☐

MATTER CYCLING IN ECOSYSTEMS

- Nutrient Cycles: Global Recycling
  - Global Cycles recycle nutrients through the earth's air, land, water, and living organisms.
  - Nutrients are the elements and compounds that organisms need to live, grow, and reproduce.
  - Biogeochemical cycles move these substances through air, water, soil, rock and living organisms.

To know if nutrients are available in the soil for plants, TEST the Soil!

University of Connecticut
Department of Plant Science

Soil Nutrient Analysis Laboratory, 6 Sherman Place, Box U-102, Storrs, CT 06269-5102, Phone : 860-486-4274, Fax : 860-486-4562.

GROWER'S ADDRESS
IRONWOOD COMMUNITY PARTNE 52 DUNCASTER RD BLOOMFIELD, CT 06002

SAMPLE ID		
#2 ICP		
LAB ID	RECEIVED	REPORTED
3043	05/06/15	05/19/15
SALES AGENT		

NUTRIENTS EXTRACTED FROM YOUR SOIL (MODIFIED MORGAN EXTRACTABLE)

		BELOW OPTIMUM	OPTIMUM	ABOVE OPTIMUM
pH	5.3			
Calcium	1174 lbs/acre	**********************		
Magnesium	254 lbs/acre	********************************	*********	
Phosphorus	7 lbs/acre	******************		
Potassium	97 lbs/acre	************		

Element	ppm	Soil Range
Boron (B)	0.10	**0.1-2.0**
Copper (Cu)	0.30	**0.3-8.0**
Iron (Fe)	4.20	**1.0-40.0**
Manganese (Mn)	4.00	**3.0-20.0**
Zinc (Zn)	3.00	**0.1-70.0**
Aluminum (Al)	119	**10-300**

Estimated Total Lead: Low, typical background levels

LIME AND FERTILIZER RECOMMENDATIONS

CROP OR PLANT : VEGETABLE GARDEN

LIMESTONE (GROUND, GRANULAR, PULVERIZED OR PELLETED):
Apply 90 lbs. per 1000 sq. ft. to raise the pH level.Have your soil re-tested in 3-4 years. Apply half the lime in the spring and half in the fall.

FERTILIZER:
Soil test values for both phosphorus and potassium are below optimum. Before planting, incorporate 40 lbs of 5-10-10 per 1000 sq ft or the equivalent from other sources. If plants develop pale green to yellow color, sidedress with 3 lbs. of 10-6-4 or 10-10-10 per 100 ft. of row in late June or early July. Apply next to the row about six inches from plants avoiding contact with foliage to prevent burning.
See the enclosed information on natural fertilizers for alternatives to synthetic chemical fertilizers.

COMMENTS:
Soil texture classification: Sandy loam
Organic content classification: Medium

Nutrients in Soil

- Nutrients are chemical elements and compounds found in the environment that plants and animals need to grow and survive.
  - Nitrate (NO_3-),
  - nitrite (NO_2-),
  - ammonia (NH_3),
  - organic nitrogen (in the form of plant material or other organic compounds), and
  - phosphates (PO_4^{3}-)(orthophosphate and others)

The Big 13

- The **13 mineral nutrients**, which come from the soil, are dissolved in water and absorbed through a plant's roots. There are not always enough of these nutrients in the soil for a plant to grow healthy. This is why many farmers and gardeners use fertilizers to add the nutrients to the soil.

Macronutrients: Primary Nutrients

- Macronutrients are those elements and compounds needed in large quantities for a plant to grow.
- The primary nutrients are nitrogen (N), phosphorus (P), and potassium (K).
- These major nutrients usually are lacking from the soil first because plants use large amounts for their growth and survival.
- A fertilizer of 5-10-10 contains 5% N, 10% P, 10% K

Macronutrients: Secondary Nutrients

- The secondary nutrients are calcium (Ca), magnesium (Mg), and sulfur (S). There are usually enough of these nutrients in the soil so fertilization is not always needed.
  - Large amounts of Ca and Mg are added when lime is applied to soils.
  - Sulfur is usually found in sufficient amounts from the decomposition of soil organic matter.

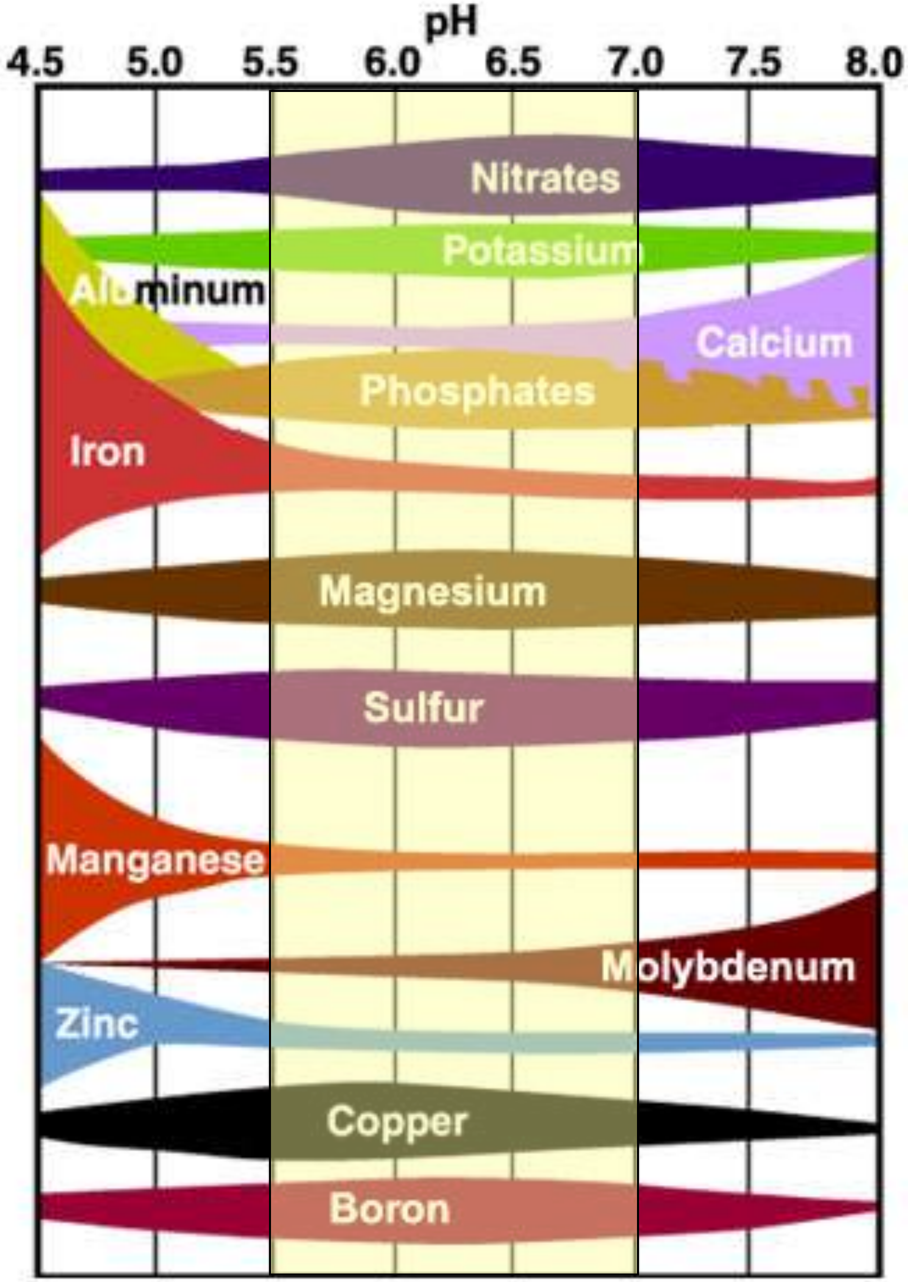
Micronutrients

- Micronutrients are those elements essential for plant growth which are needed in only very small (micro) quantities and are sometimes called minor elements or trace elements.
- Micronutrients include boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese (Mn), molybdenum (Mo) and zinc (Zn).

Soil pH is a major factor

- Soil pH (a measure of the acidity or alkalinity of the soil)
- Soil pH is one of the most important soil properties that affects the availability of nutrients.
  - Macronutrients tend to be less available in soils with low pH.
  - Micronutrients tend to be less available in soils with high pH.

Most *nutrients* are highest and most *toxins* are lower at pH 5.5-7



http://www.traylorchemical.com/images/faqs/phchart.jpg

The pH can be changed

- Lime can be added to the soil to make it less acidic and also supplies calcium and magnesium for plants to use.
  - Lime also raises the pH to the desired range of 6.0 to 7.0. In this pH range, nutrients are more readily available to plants, and microbial populations in the soil increase.

Nitrogen

- Nitrogen is a part of all living cells and is a necessary part of all proteins, enzymes and metabolic processes involved in the synthesis and transfer of energy.
- Nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis.
- Nitrogen is usable in the forms of NO_3^-, NO_2^-, and NH_3

Where does N come from?

- **Helps plants with rapid growth, increasing seed and fruit production and improving the quality of leaf and forage crops.**
- Nitrogen often comes from fertilizer application whether it is industrial fertilizer or animal waste.
- Bacteria can fix Nitrogen from the atmosphere (N_2) into a more usable form.
- Decomposition of organic matter puts nitrogen back into the soil.

Phosphorus

- Like nitrogen, phosphorus (P) is an essential part of the process of photosynthesis.
- Involved in the formation of all oils, sugars, starches, etc.
- **Helps with the transformation of solar energy into chemical energy; proper plant maturation; effects rapid growth; and, encourages blooming and root growth.**

Sources of Phosphorus

- Phosphorus often comes from fertilizer, bone meal, and from rock.
- Phosphorus is found in rock and is therefore a function of the rock cycle.
  - P is in limited supply and is often a limiting factor because the rock cycle is so slow!
- Phosphorus also comes from bird guano.

Potassium

- Potassium is absorbed by plants in larger amounts than any other mineral element except nitrogen and, in some cases, calcium.
- **Helps in the building of protein, photosynthesis, fruit quality and reduction of diseases.**
- Potassium is supplied to plants by soil minerals, organic materials, and fertilizer.

Calcium

- Calcium, an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength in the plant. It is also thought to counteract the effect of alkali salts and organic acids within a plant.
- Sources of calcium are dolomitic lime and gypsum

Magnesium

- Magnesium is part of the chlorophyll in all green plants and essential for photosynthesis. It also helps activate many plant enzymes needed for growth.
- Soil minerals, organic material, fertilizers, and dolomitic limestone are sources of magnesium for plants.

Sulfur

- Sulfur is essential plant food for production of protein. It promotes activity and development of enzymes and vitamins; helps in chlorophyll formation; improves root growth and seed production; helps with vigorous plant growth and resistance to cold.

- Sulfur may be supplied to the soil from rainwater. It is also added in some fertilizers as an impurity, especially the lower grade fertilizers. The use of gypsum also increases soil sulfur levels.

- The decomposition of organisms can add sulfur to the soil.

- Sulfur is used by plants in the form of sulfates (SO_4^{2-}) and sulfites (SO_3^{2-})

Micronutrients

Boron (B)

- Helps in the use of nutrients and regulates other nutrients.
- Aids production of sugar and carbohydrates.
- Essential for seed and fruit development.
- Sources of boron are organic matter and borax

Copper (Cu)

- Important for reproductive growth.

Aids in root metabolism and helps in the utilization of proteins.

Chloride (Cl)

- Aids plant metabolism.
- Chloride is found in the soil.

Iron (Fe)

- Essential for formation of chlorophyll.
- Sources of iron are the soil, iron sulfate, iron chelate.

Manganese (Mn)

- Functions with enzyme systems involved in breakdown of carbohydrates, and nitrogen metabolism.
- Soil is a source of manganese.

Sampling instructions for a Soil Test

1. Follow the instructions from the testing lab, there are variations
2. Fill out the form, include crop information
3. If manure or compost applied, estimate amount
4. Sampling in Fall is best, other times ok too
5. Areas of different soils, crops, or management should be tested/sampled separately
6. Avoid non typical areas for sampling
7. Take 6-20 (depends on size area) thin slices/cores of soil to depth of 4-8 inches, mix in clean container
8. No sample should be for an area larger than 10-15acres
9. Pull out one cup of soil mix, this = 1 soil sample
10. Label samples, keep track of location and sample # on a map/sketch

Other Tests

- Percolation (permeability), infiltration
- Bulk density
- Organic matter
- Salinity
- Ion Exchange
- Heavy and Trace Metals
- Biological activity
- Aggregate stability

Soil pH Test Kit DEMO- 15min

Best Management Practices for Agriculture

Conservation practices and systems address:

- **Water Quality**
- **Water Quantity**
- **Soil Quality**
- **Air Quality**

Best Management Practices for Agriculture

Conservation practices and systems address:

- **Energy Conservation**
- **Animal Health and Welfare**
- **Plant Health**
- **Fish and Wildlife Habitat**

Best Management Practices for Agriculture

Well managed agriculture systems provide:

- Food, Fiber, and Wood Products
- Clean and Abundant Water
- Clean Air
- Fish and Wildlife Habitat

Best Management Practices for Agriculture

Well managed agriculture systems provide:

- **Scenic Vistas**

- **Open Space**

Best Management Practices for Agriculture

Well managed agriculture systems provide:

- **Cultural Heritage**
- **Support to Local Economies**

Best Management Practices for Agriculture

Well managed agriculture systems provide:

- **Enhanced Quality of Life**

Social Awareness

Best Management Practices for Agriculture

Best management practices, also called conservation practices, are implemented based on a conservation plan.

Best Management Practices for Agriculture

Conservation planning steps include:

- Taking an inventory of resource conditions

Best Management Practices for Agriculture

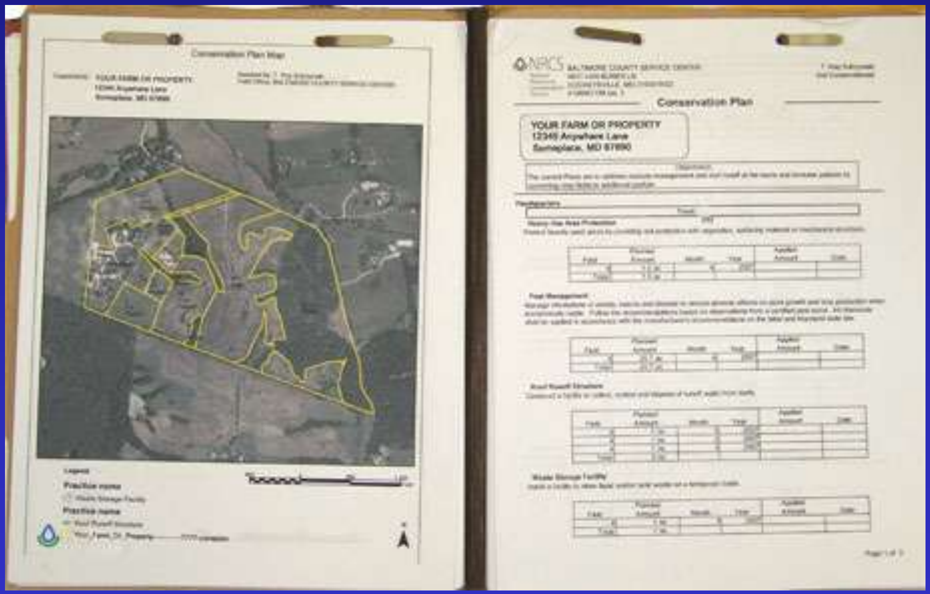
Conservation planning steps include:

- **Identifying issues and opportunities with the farmer**

Best Management Practices for Agriculture

Conservation planning steps include:

- Developing choices and solutions
- Scheduling implementation of practices
- Evaluating effectiveness of the plan



Best Management Practices for Agriculture

Cropping Systems

- Cross slope tillage
- Contour strip cropping

•Residue management

Best Management Practices for Agriculture

Cropping Systems

- **Cover crops / green manure**

Best Management Practices for Agriculture

Cropping Systems

- Crop rotation
- Grassed waterways

Best Management Practices for Agriculture

Cropping Systems

- Nutrient management
- Pest Management

Best Management Practices for Agriculture

Cropping Systems

- Irrigation water management
- Buffers and field borders

Best Management Practices for Agriculture

Grazing Systems

- Rotational grazing
- Fencing systems

•Animal trails and walkways

Best Management Practices for Agriculture

Grazing Systems

- Water systems
- Nutrient management
- Pathogen control

Best Management Practices for Agriculture

Manure / Waste Management

- **Waste storage structures**

Best Management Practices for Agriculture

Manure / Waste Management

- Heavy use/sacrifice areas
- Composting systems

Best Management Practices for Agriculture

Manure / Waste Management

- Transfer and application
- Nutrient management

- Septic systems
- Silage leachate collection

Best Management Practices for Agriculture

Farmstead Management

- Gutter systems
- Storm drains / subsurface drains
- Sediment basins

Best Management Practices for Agriculture

Farmstead Management

- Diversions / waterways
- Wellhead protection
- Covered heavy use areas

Best Management Practices for Agriculture

Habitat Management

- Riparian buffers
- Streambank protection
- Food plots
- Pollinator plantings

Best Management Practices for Agriculture

Habitat Management

- Woodland management
- Delayed mowing
- Wetland restoration
- Invasives control

Best Management Practices for Agriculture

Natural Resources Conservation Service

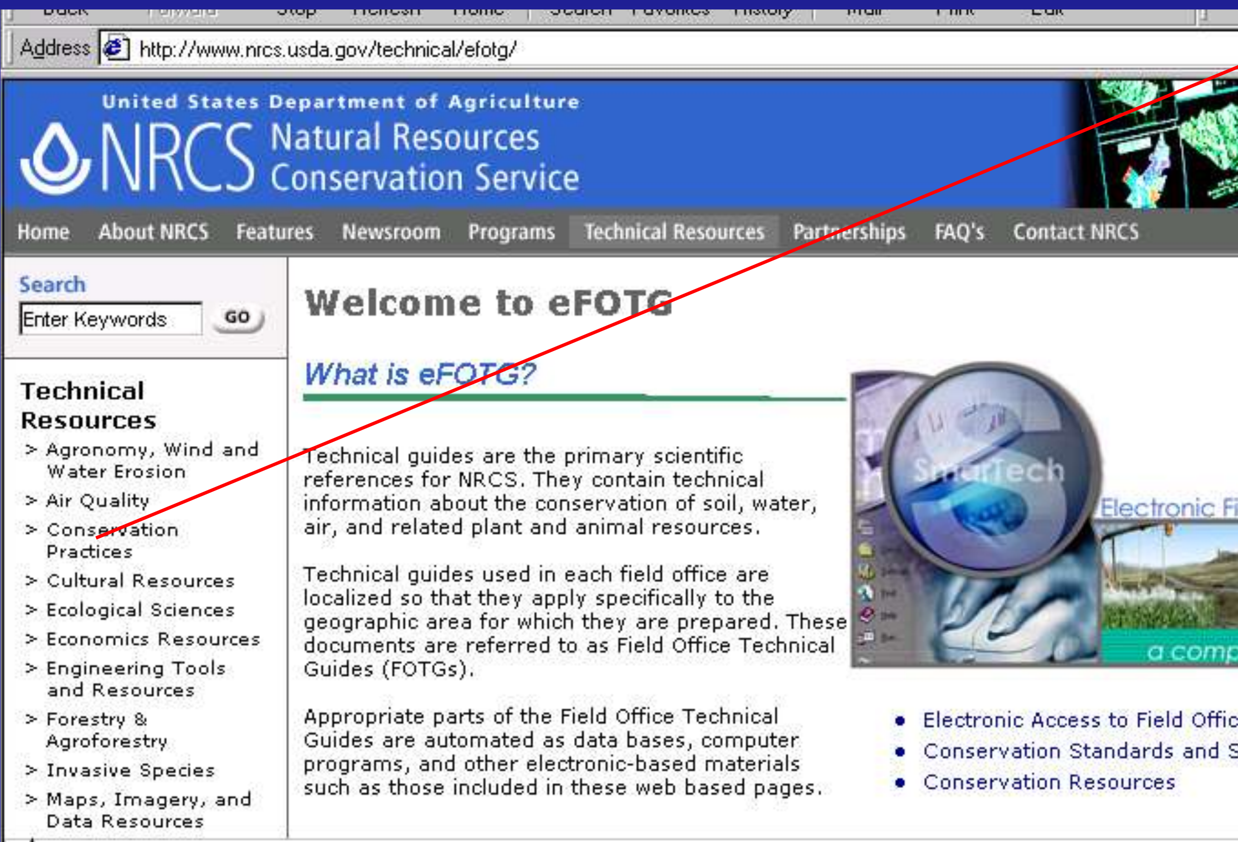
Helping People Help the Land Through …

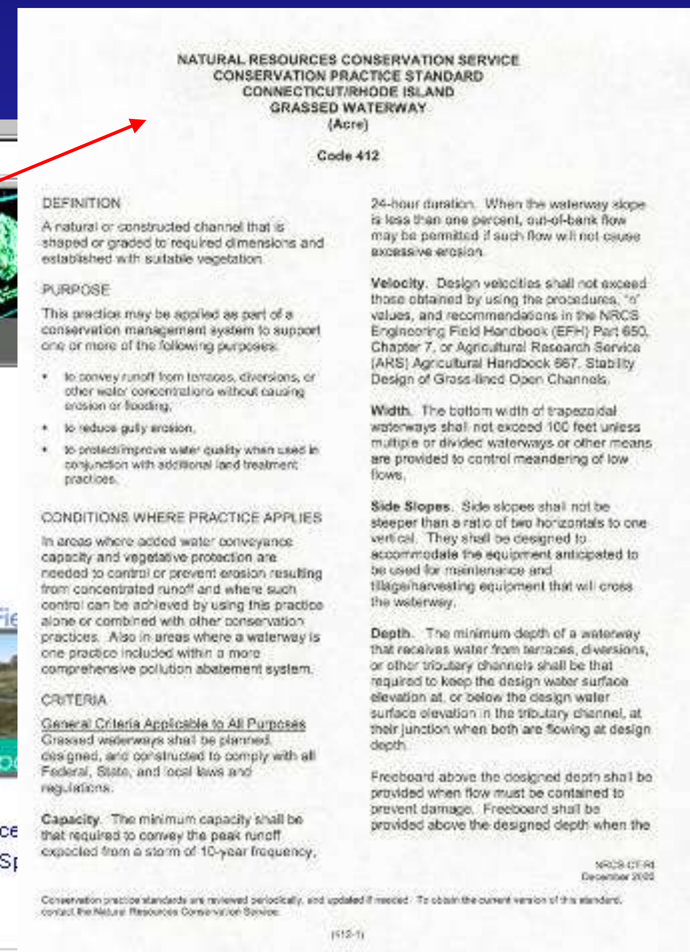
- **Conservation Planning and Technical Consultation**
- **Conservation Implementation**
- **Technical Standards and References**
- **Financial Assistance Programs**

Best Management Practices for Agriculture

Natural Resources Conservation Service

•Technical Standards and References





NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
CONNECTICUT/RHODE ISLAND
GRASSED WATERWAY
(Acre)

Code 412

DEFINITION

A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- to convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding.
- to reduce gully erosion.
- to protect/improve water quality when used in conjunction with additional land treatment practices.

CONDITIONS WHERE PRACTICE APPLIES

In areas where added water conveyance capacity and vegetative protection are needed to control or prevent erosion resulting from concentrated runoff and where such control can be achieved by using this practice alone or combined with other conservation practices. Also in areas where a waterway is one practice included within a more comprehensive pollution abatement system.

CRITERIA

General Criteria Applicable to All Purposes
Grassed waterways shall be planned, designed, and constructed to comply with all Federal, State, and local laws and regulations.

Capacity. The minimum capacity shall be that required to convey the peak runoff expected from a storm of 10-year frequency, 24-hour duration. When the waterway slope is less than one percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion.

Velocity. Design velocities shall not exceed those obtained by using the procedures, "n" values, and recommendations in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-lined Open Channels.

Width. The bottom width of trapezoidal waterways shall not exceed 100 feet unless multiple or divided waterways or other means are provided to control meandering of low flows.

Side Slopes. Side slopes shall not be steeper than a ratio of two horizontals to one vertical. They shall be designed to accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment that will cross the waterway.

Depth. The minimum depth of a waterway that receives water from terraces, diversions, or other tributary channels shall be that required to keep the design water surface elevation at, or below the design water surface elevation in the tributary channel, at their junction when both are flowing at design depth.

Freeboard above the designed depth shall be provided when flow must be contained to prevent damage. Freeboard shall be provided above the designed depth when the

December 2005

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

(412-1)

Best Management Practices for Agriculture

Conservation Partners

- Natural Resources Conservation Service
- UConn Cooperative Extension
- CT Agriculture Experiment Station
- CT Department of Agriculture
- CT Department of Energy & Environmental Protection
- USDA Farm Services Agency
- USDA Rural Development
- Conservation Districts
- CT NOFA

Questions?

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Kip Kolesinskas, Conservation Scientist, 860-878-0393, kip.kolesinskas@gmail.com

Please Complete the Survey!

Thank You…

Advancing the Business of Farming in Connecticut Project provides new farmers with core training and assistance to develop their farm plan, explore production options, and grow their farming enterprise.

Visit www.newfarms.extension.uconn.edu for resources and events.