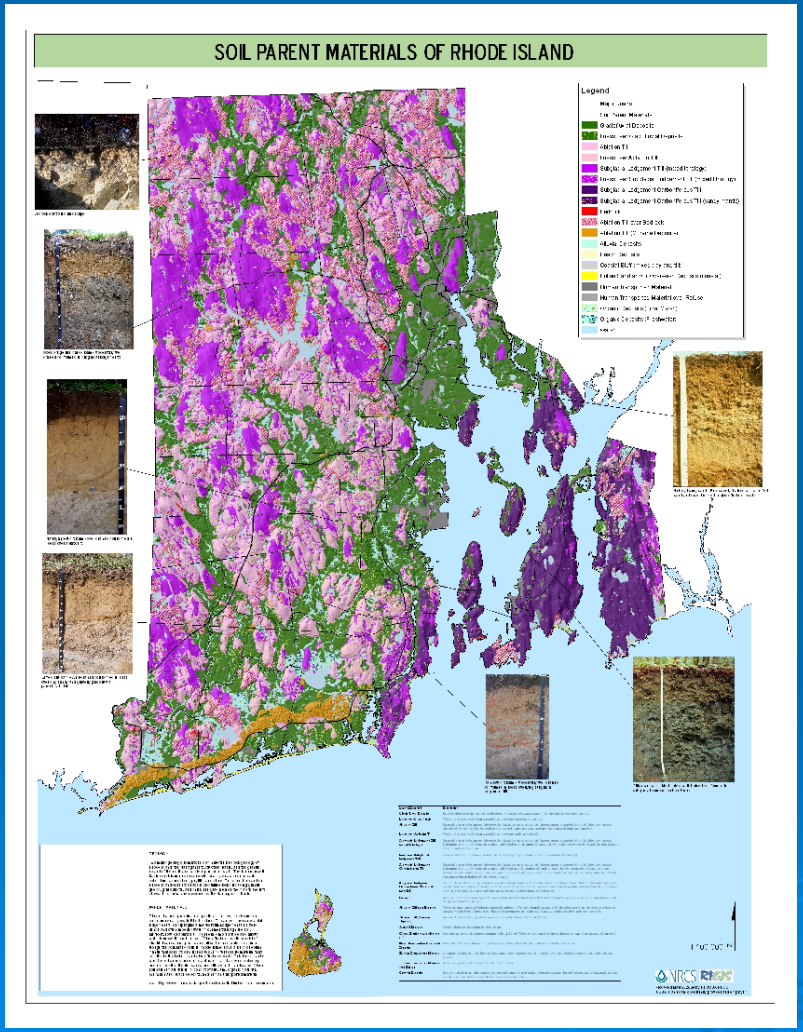
Soils of Rhode Island



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About NRCS

Established as the Soil Conservation Service to combat the soil erosion know as the “dust bowl” in 1935

Provide technical assistance to private land owners to address soil, water, air, plant/animal concerns.

RI NRCS – www.ri.nrcs.usda.gov

Soil Science (Pedology)

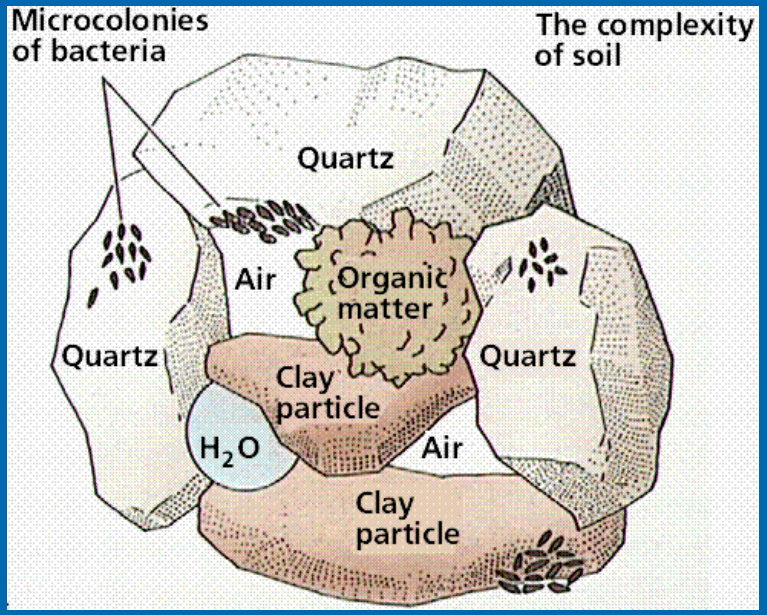
The scientific study of soils, including their origins, characteristics, and uses.

- Many different areas – soil chemistry, physics, genesis, classification, morphology.
- A soil scientist can read the layers of earth to tell what has occurred in the past (ST).

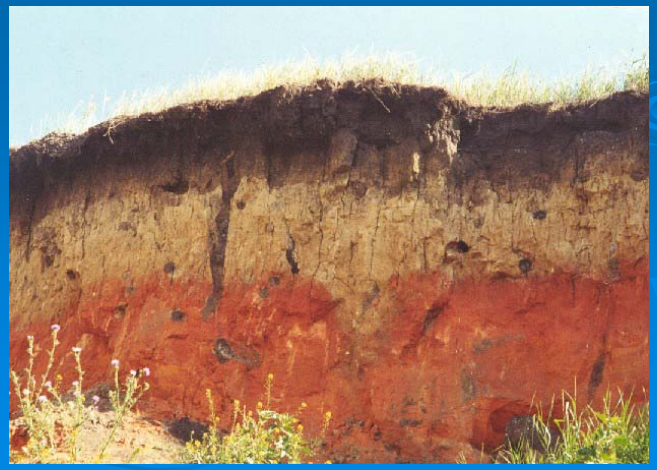
Narragansett Silt Loam – The (Unofficial) State Soil of RI

Soil - Definition

Natural body that occurs on the land surface, occupies space, and is characterized by one or both of the following:

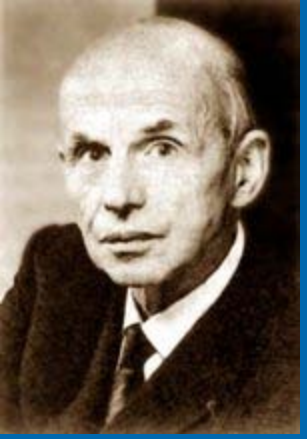


- Horizons formed by pedogenesis.
- The ability to support rooted plants in a natural environment.



Why are Soils Important?

- **Importance to Society** – Food, fiber, woodland, waste disposal, filter of pollutants, used by most animals to live in and on, part of nutrient and hydrologic cycle.



Soil Formation

Biota

Climate

Topography

SOIL!

Parent Material

(The first four factors over) Time

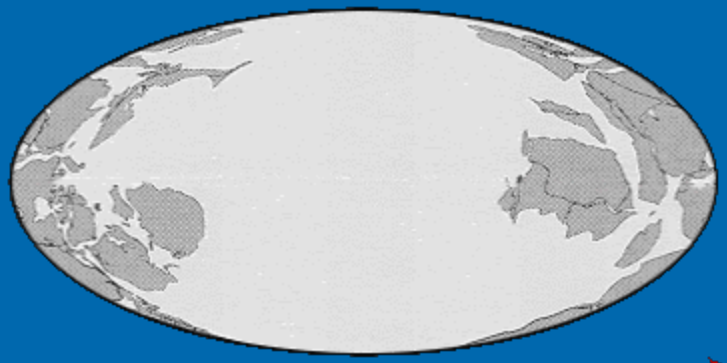
These five factors work together to create a unique soil profile made of layers called horizons.

Soil Forming Factor: **Parent Material**

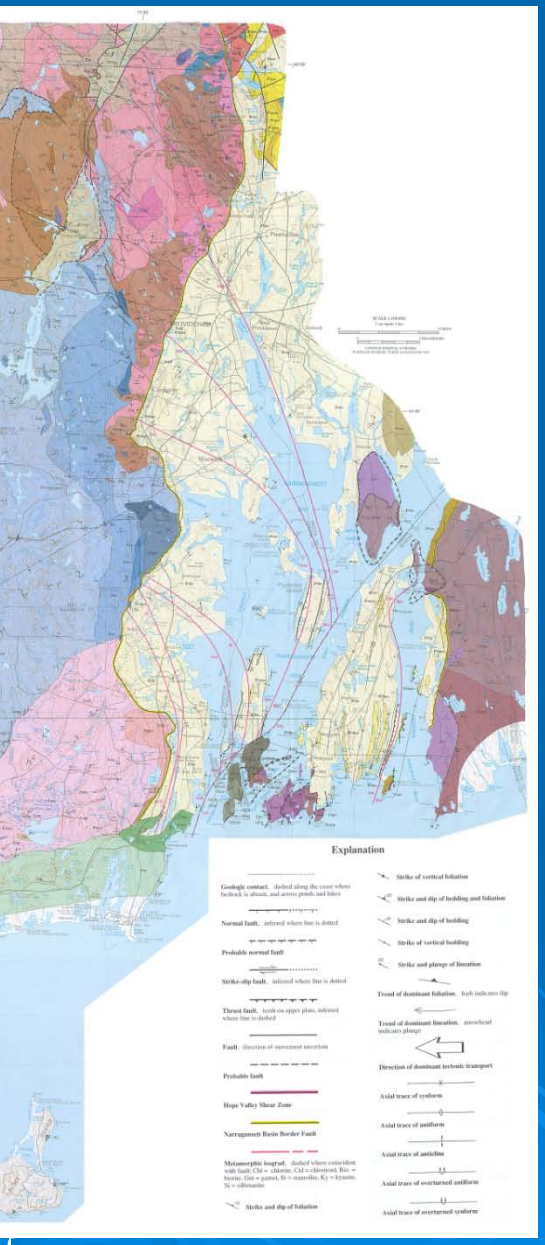
Geologic material the soil formed from (or in).

- Types of minerals.
- Reaction of soil.
- Soil Color.
- Chemical/physical properties

Types of PM: Bedrock, Glacial, Volcanic, Organic, Loess, Colluvium, Alluvium, Residuim, Karst, etc.




PANTHALASSA OCEAN
NSL
SIB
KAS
URAL OCEAN
GRN
LAURUSSIA
(old red continent)
BAL
CALEDONIAN OROGENY
NAM
SCT
MEX
ACADIAN OROGENY
EAV
WAV
AMR
PROTOTETHYS OCEAN
IBR
ITA
GRE
TUR
MEG
AFR
ARA
GONDWANA
YUC
SAM
FLA
~500 km of Equator
Early Devonian [400.00 Ma]

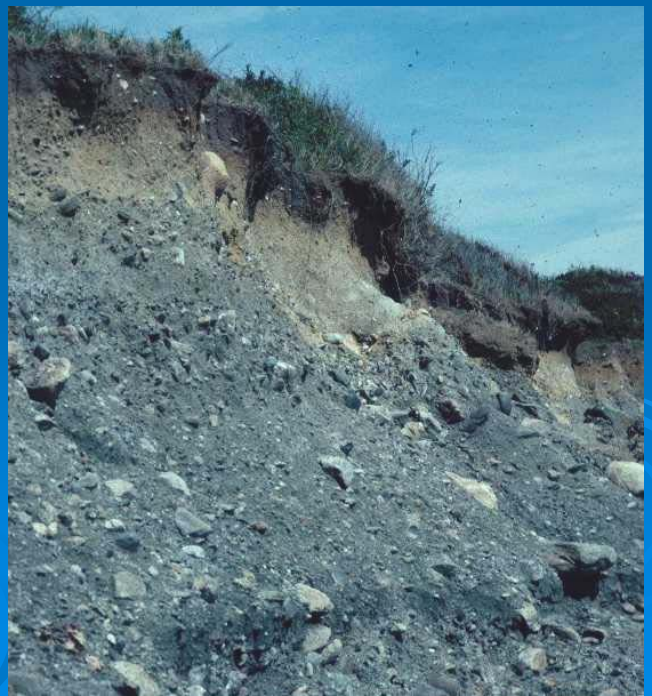

Explanation
Geologic contact.
Normal fault.
Probable normal fault
Strike-slip fault.
Thrust fault.
Fault.
Probable fault
Hope Valley Shear Zone
Narragansett Basin Border Fault
Strike and dip of foliation
Strike of vertical foliation
Strike and dip of bedding and foliation
Strike and dip of bedding
Strike of vertical bedding
Strike and plunge of lineation
Trend of dominant foliation.
Trend of dominant lineation.
Direction of dominant tectonic transport
Axial trace of synform
Axial trace of antiform
Axial trace of anticline
Axial trace of overturned antiform
Axial trace of overturned synform

RI Parent Materials

- Pleistocene Epoch (Ice Age) - 1.8 MYBP to 8 KYBP.
- 4 Major advances.
- Last- Wisconsinan advance covered all of NE.
- Soil parent materials - glacial & post glacial

Glacial Till

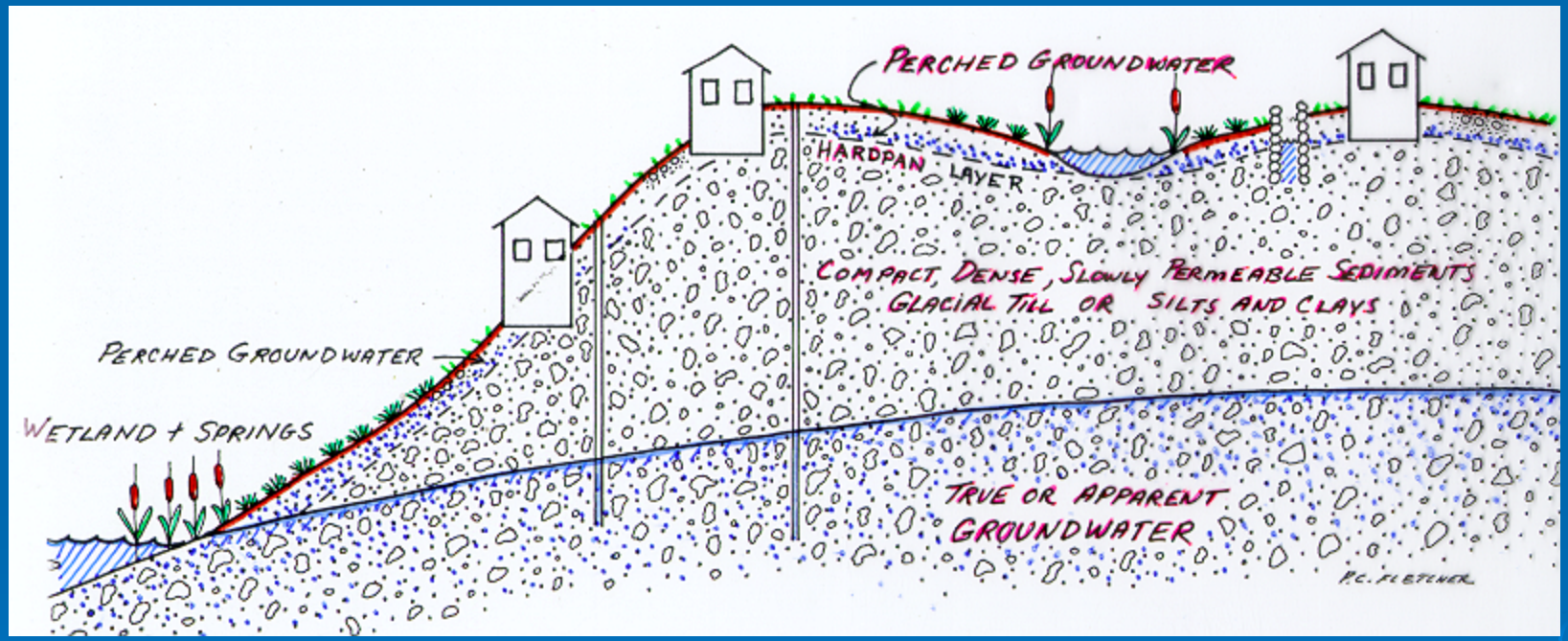
- Unsorted/stratified material deposited beneath and within glacial ice.
- Heterogeneous mixture of all particle sizes (boulder to clay).
- Oldest surficial deposit overlying most bedrock areas.



Till Properties

- Major Types: Basal and Ablation.
- Landforms: Drumlins, moraines, Ice contact.
- Basal till has a dense restrictive layer which impedes downward water movement.
- Large angular stones and boulders.

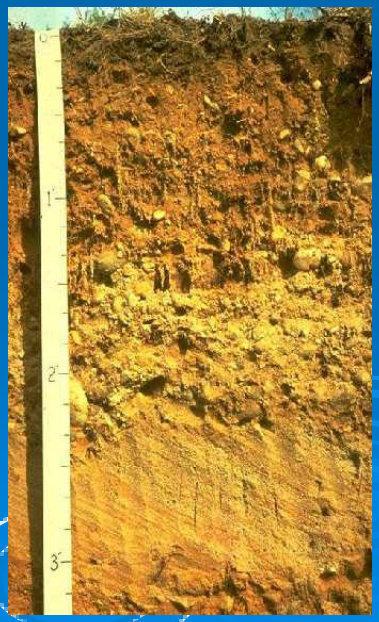
Hydrology in Tills



Hardpan (dense till) perches water causing wet basements, wetlands on hill tops and slopes – drainage driven by landscape position.

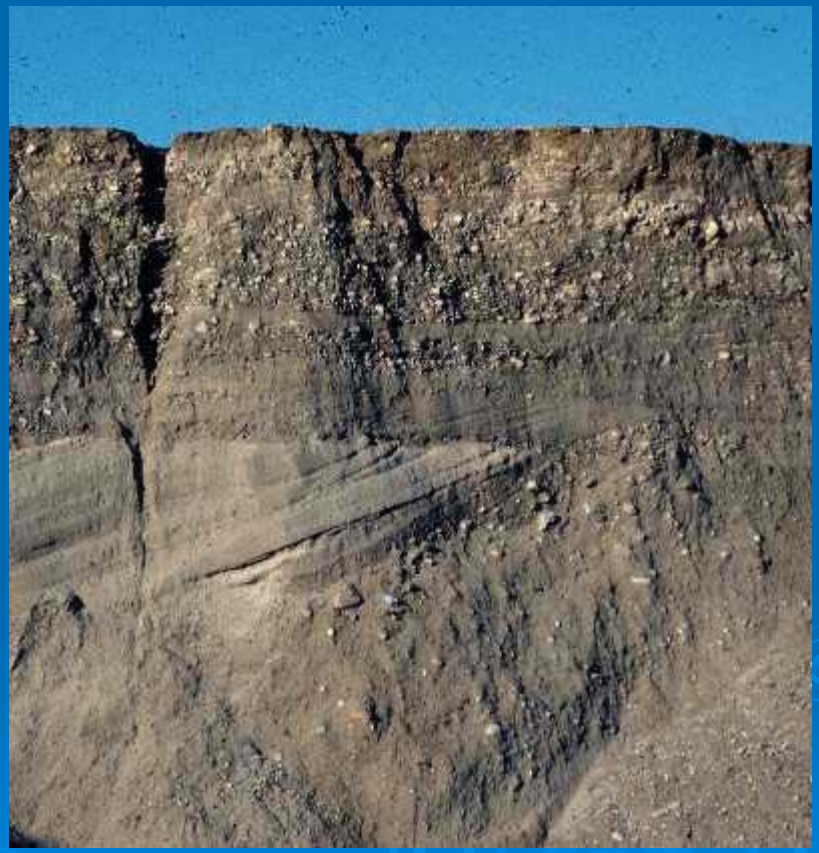
Glacial Fluvial (outwash)

- Sediments deposited by glacial meltwater.
- Stratified layers of sand, gravel, and fines.
- Types: Proglacial and Proximal (ice contact).
- Landforms: Plains, eskers, kames, deltas.



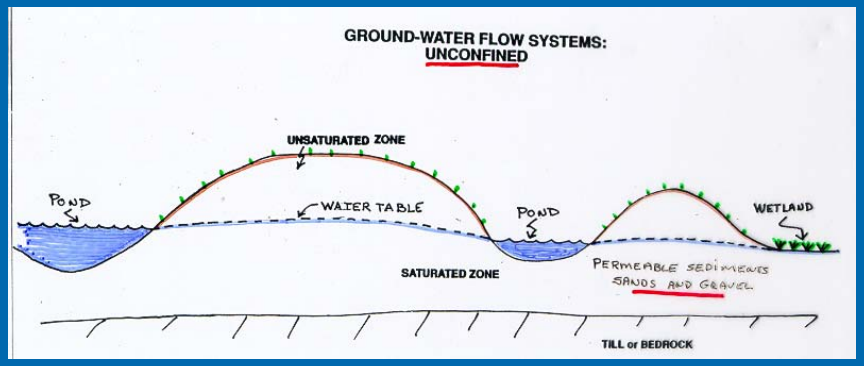
Outwash Properties

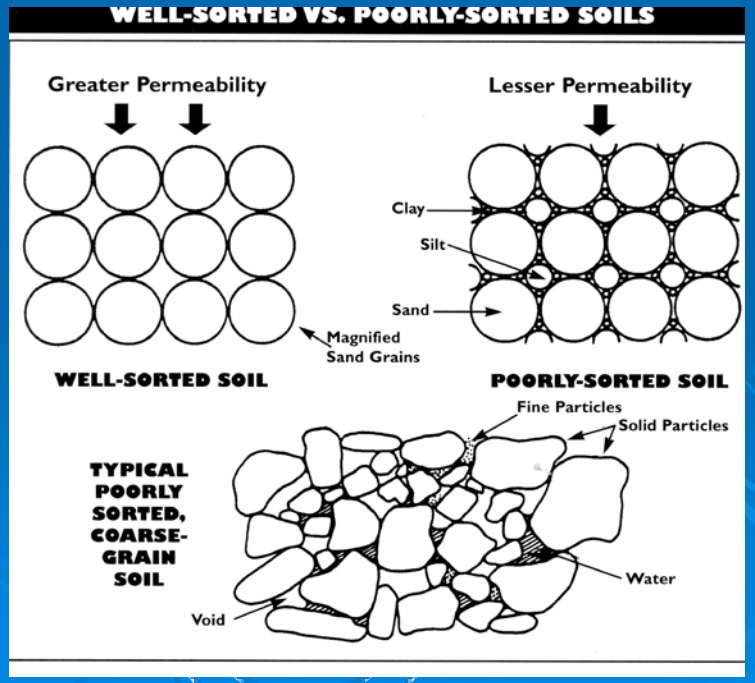
- Dominantly sand and gravel sized particles.
- Rapid water movement, associated with aquifers.
- Apparent watertable.
- Few limitations for most uses.



Outwash Hydrology Concerns

- Apparent watertables, generally easy to interpret hydrology.
- Large pore space causes rapid permeability.
- Aquifer recharge areas.
- Poor filtering capacity.

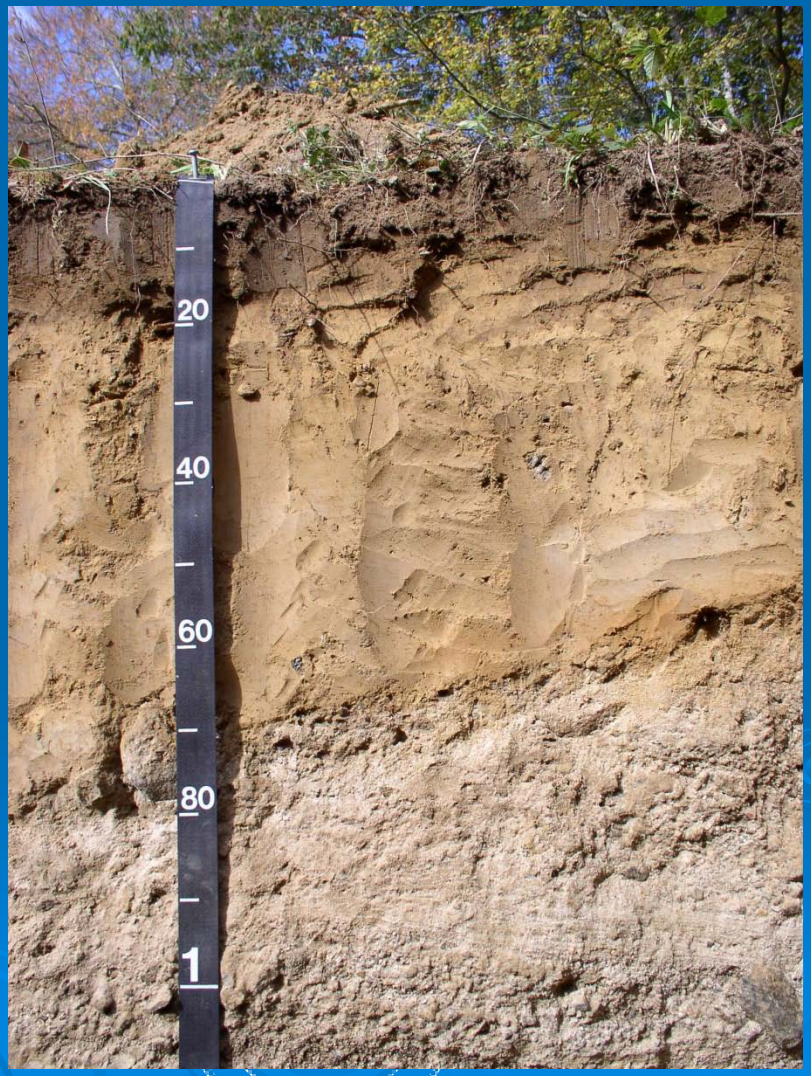




Post Glacial Deposits

- Material deposited after glacier left (Holocene-10K BP).
- Eolian - wind deposited sand to silt sized particles.

Most upland soils in NE have a thin 18-36 inch eolian cap. Deposited rapidly after ice left.

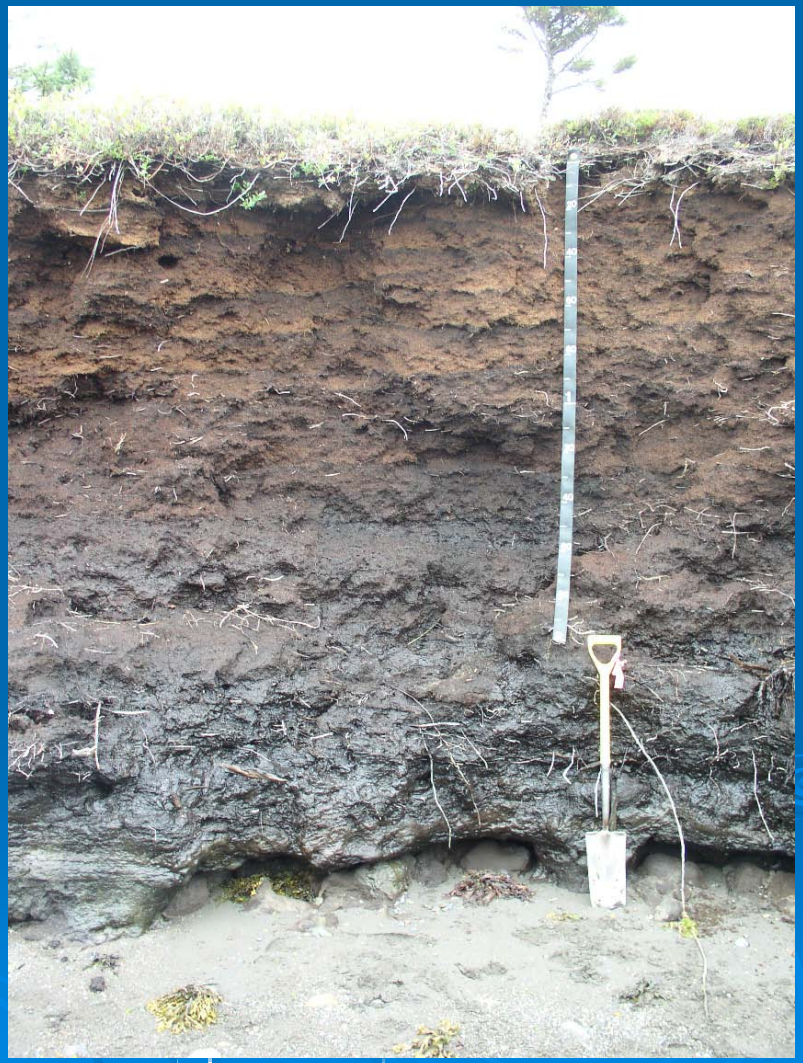


Post Glacial Deposits

- Alluvium - sediments deposited in modern-day floodplains.

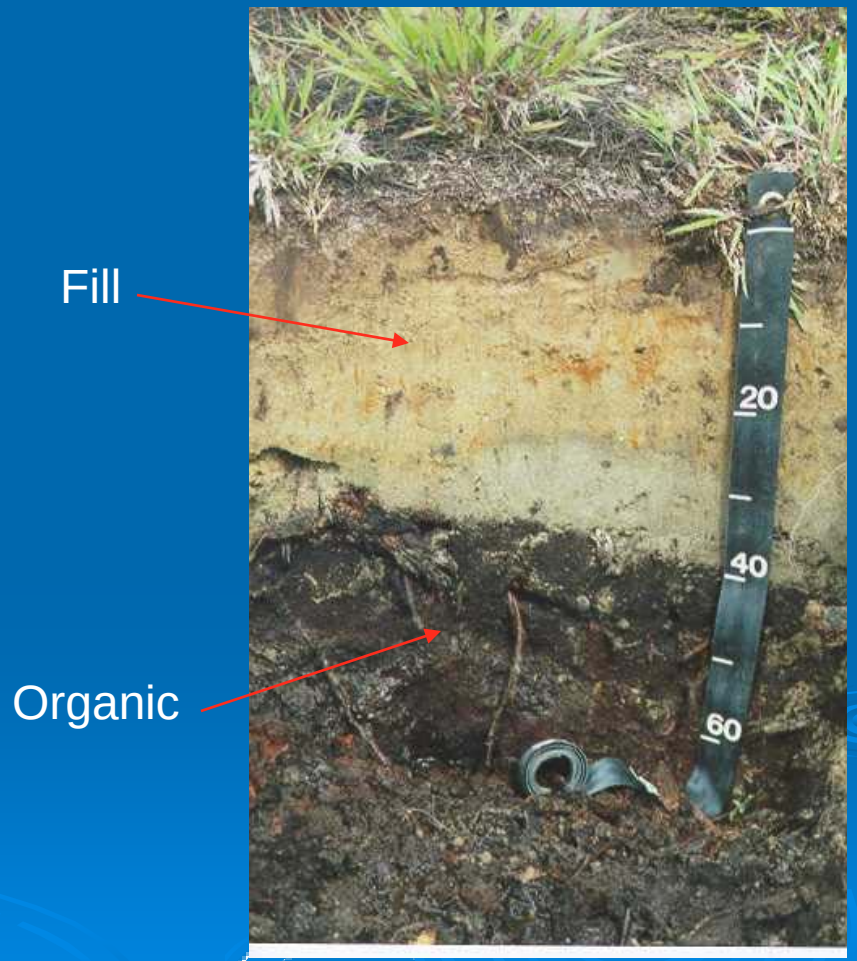
  Organic - material consisting of decaying plant material.

  - source of fuel grade peat. Study of Chapman Swamp showed enough peat to power 20% of the homes in Westerly for 45 years.



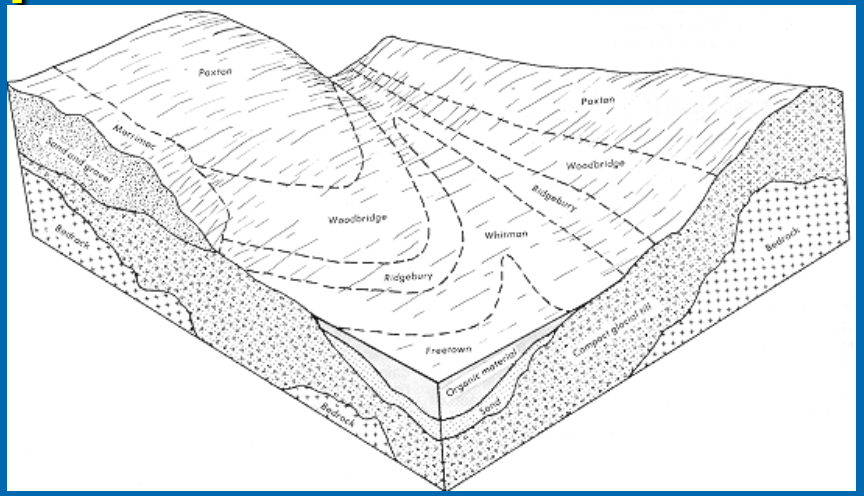
Post Glacial Deposits

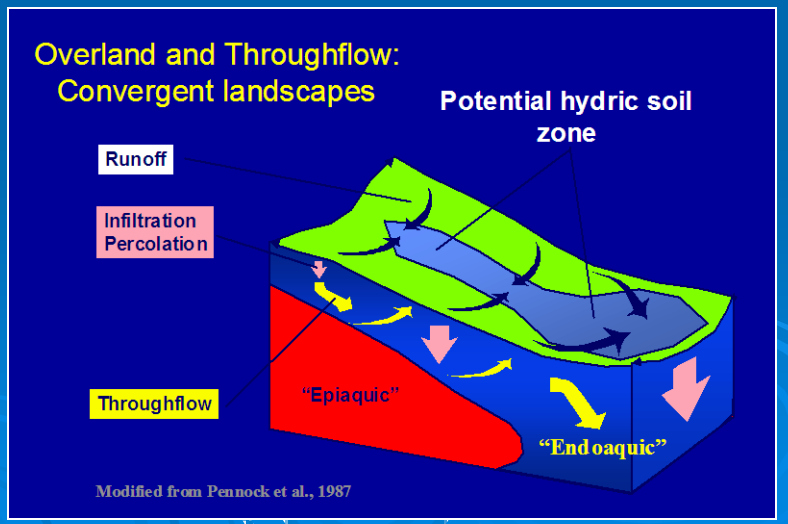
- Anthro-transported material (Cut and Fill)
  - recent sediments deposited or removed by human activity.
  - Lot of areas in the NE have been altered by humans.
  - Difficult morphology, often lacking horizons.



Soil Forming Factor: Relief and Landscape Factors

- Position on the landscape (convex/concave).
- Elevation.
- Aspect.
- Slope.
- Water movement
- Most wetlands on concave landforms.





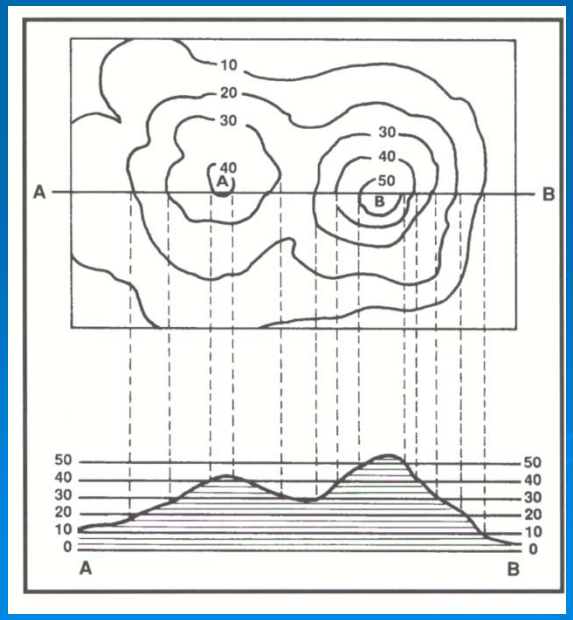
Reading Topographic Maps

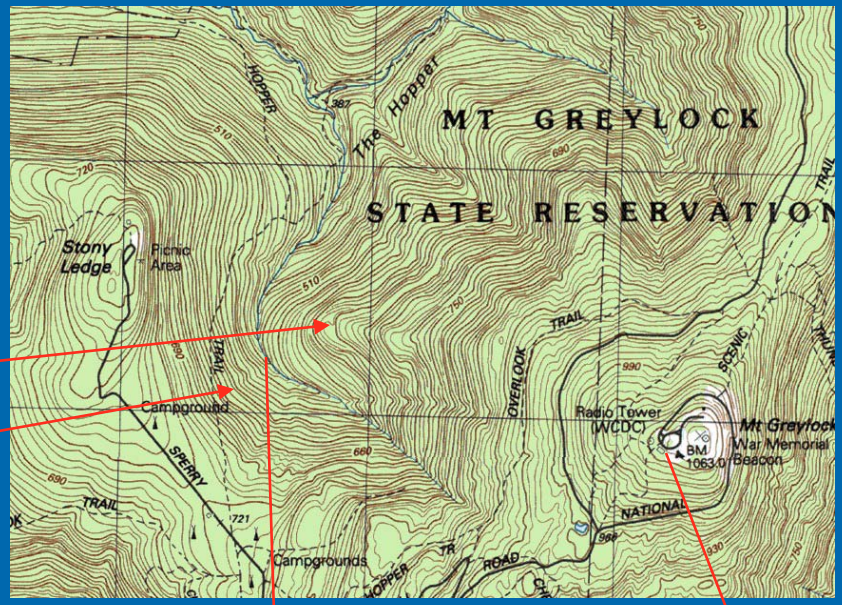
Contour lines – shows areas of equal elevation.

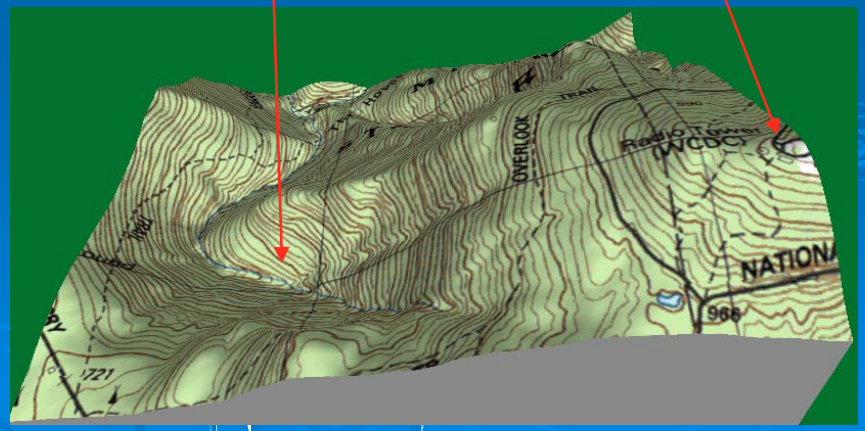
Also shows drainage, cultural features, water, etc.

Convex slope

Concave slope



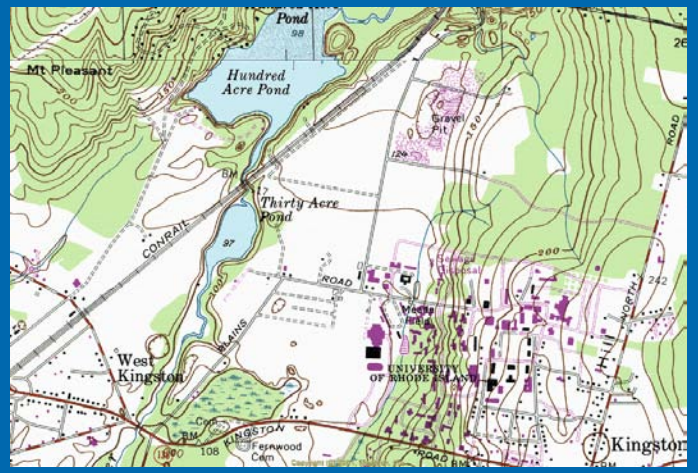


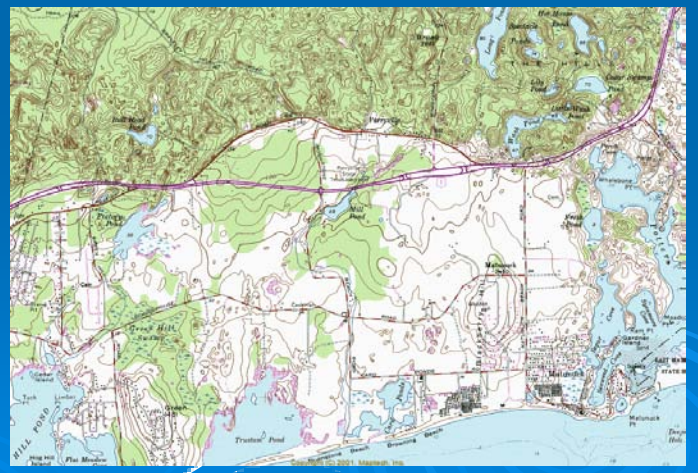


RI Landscapes

Outwash Plains – Level to undulating areas composed of stratified sand and gravel.

End Moraines (outwash heads) – Hummocky to steep areas with bouldery surfaces composed of loose sandy till and ice-contact outwash.





Soil Characteristics & Properties

Landscape Features:

1. Position
2. Slope
3. Stoniness
4. Rockiness
5. Drainage
6. Parent Material

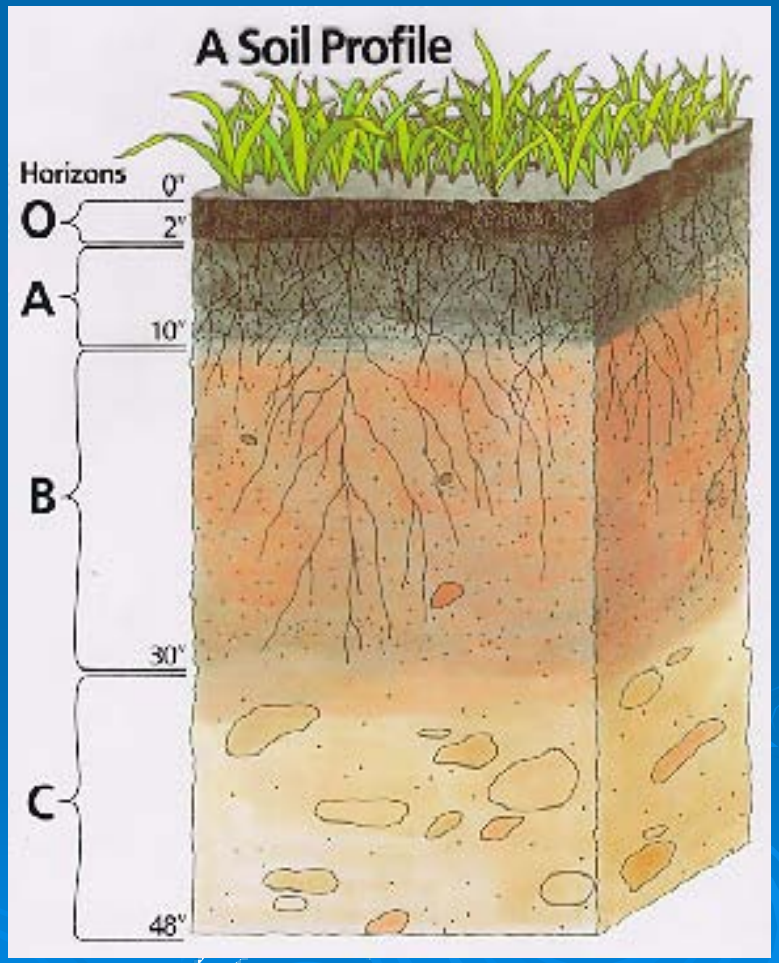
Soil Profile Features:

1. Horizons
2. Color
3. Texture
4. Permeability
5. Structure

Soil Horizons

A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil forming processes.

Used to classify the soil and make interpretations.



Soil Color

- Easily identified property.
- Used to relate chemical/physical properties such as watertable depth, drainage, chemical constituents, formation, horizons.

Color Components

- **Organic Matter (carbon):** Very strong coloring agent. Makes soil dark or black colored such as in an A horizon or topsoil.
- **Compounds and elements:** Such as iron, sulfur, manganese, etc. Iron is a dominant element in soils, when well aerated iron-oxides coat particles giving the soil a yellowish-brown to reddish color.

Soil Properties: Texture

Soil Texture: The relative proportions of sand, silt, and clay particles in a mass of soil (material less than 2mm in size).

Very Coarse Sand	2.0-1.0 mm
Very Fine Sand	0.1-0.5 mm
Silt	0.05-0.002 mm
Clay	< 0.002 mm

Soil Texture (cont.)

- Material larger than 2 mm are coarse fragments (gravel, cobble, stone, boulder).
- **Importance:** Soil formation, mechanics, water movement, erosion, CEC, shrink-swell, etc.
- **Clay:** High specific surface, net negative charge (isomorphic), high pore, expansion.
- Most textures in NE have very little clay.

Soil Texture Triangle

Triangle is used if laboratory data is available:

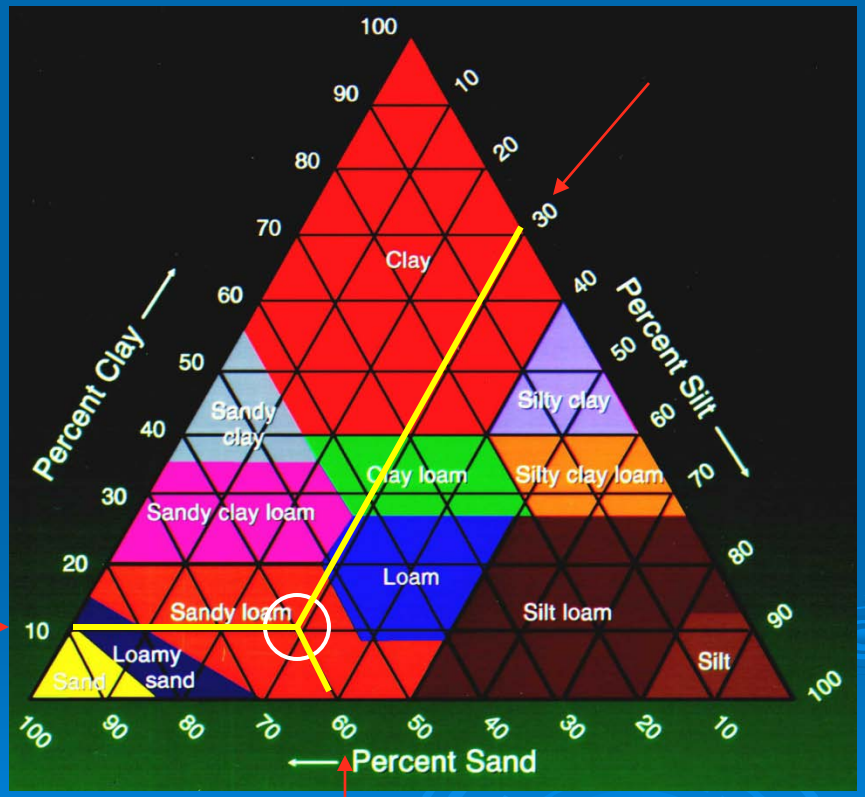
Example:

Sand = 60%

Silt = 30%

Clay = 10%

Soil Texture = Sandy Loam



Soil Properties - related to texture

- **Porosity**: An index of the relative pore volume in the soil.
- **Infiltration:** The downward entry of water into the immediate surface of soil or other material.
- **Erodibility:** In general, large particles are less erodible, exceptions being clay.
- **Available Water Holding Capacity:** Silt loam textures have highest.

Soil Properties - related to texture

- **Shrink-Swell:** High activity clays have high factors.
- **Soil Formation:** **Clayey soils = older**.
- **Permeability:** The quality of the soil that enables water to move downward through the profile. Number of in/hr that water moves downward through saturated soil.

Soil Drainage

- The frequency and duration of periods of saturation or partial saturation during soil formation.
- Depth to water.
- Classes: Excessively, well, moderately well, poorly, very poorly drained.

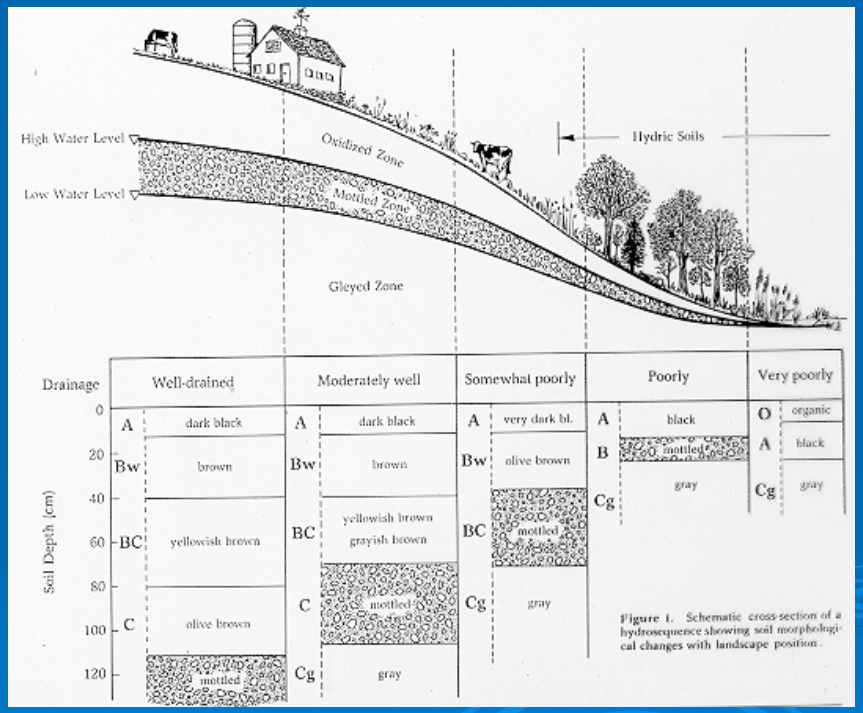
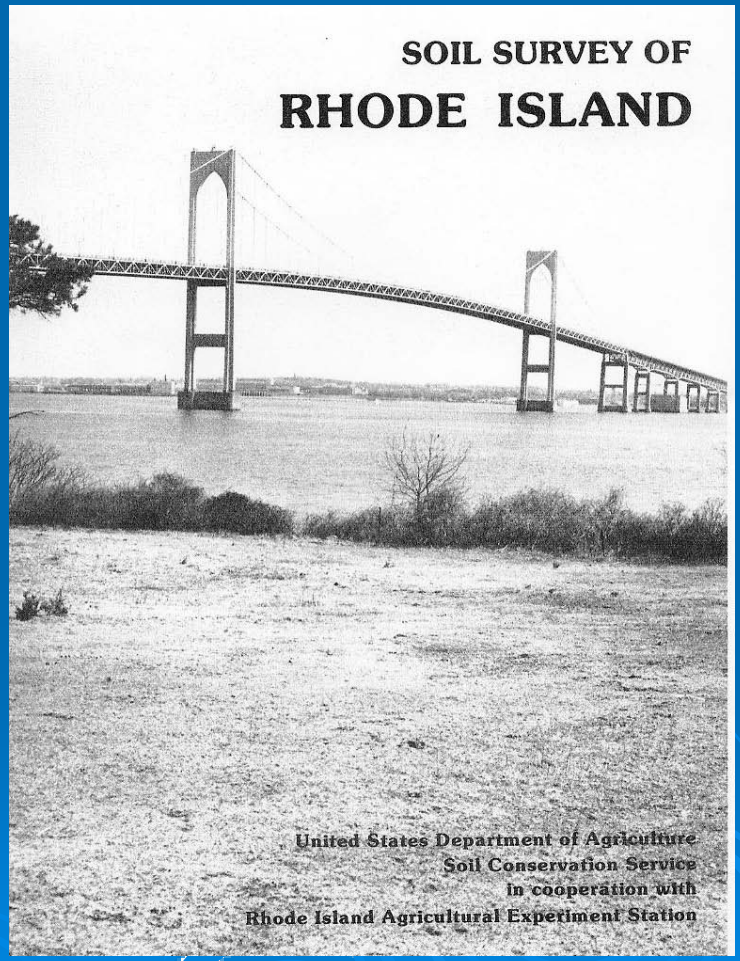


Figure 1. Schematic cross-section of a hydrosequence showing soil morphological changes with landscape position.

Soil Surveys

- A soil survey describes the characteristics of the soils in a given area, classifies the soils according to a standard system of classification, plots the boundaries of the soils on a map, and makes predictions about the behavior of soils.
- Extensive field work!

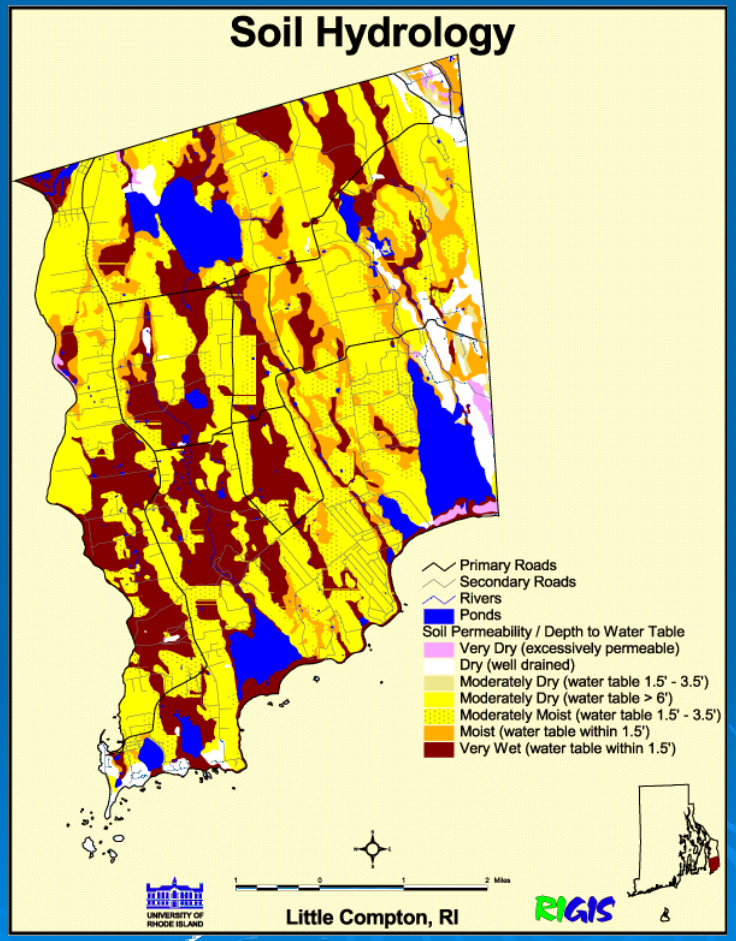


Soil Interpretations

Suitability of a soil for specific land uses such as agricultural, urban, forestry, environmental assessment, and development.

Envirothon Interps:

- Farmland
- Houses
- Septic Systems



Soil Survey Data

Hydric Soils

Physical Soil Properties

State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties

[Entries under "Erosion Factors--T" apply to the entire profile. Entries under "Wind Erodibility Group" and "Wind Erodibility Index" apply only to the surface layer. Absence of a data were not estimated]

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensi-bility	Organic matter	Erosion factors		
										Kw	Kf	T
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*			
BhA:												
Bridgehampton	0-8	---	---	2-6	1.05-1.20	4.23-14.11	0.20-0.26	0.0-2.9	2.0-7.0	.49	.49	3
	8-41	---	---	1-6	1.20-1.45	4.23-14.11	0.20-0.34	0.0-2.9	0.0-2.0	.64	.64	
	41-60	---	---	0-3	1.60-1.80	42.34-141.14	0.01-0.10	0.0-2.9	0.0-0.5	.10	.24	
Co:												
Carlisle	0-66	---	---	---	0.13-0.23	1.41-42.34	0.35-0.45	---	55-75	.05	.05	5
Nt:												
Ninigret	0-10	---	---	3-12	1.00-1.25	4.23-42.34	0.15-0.24	0.0-2.9	2.0-5.0	.32	.37	3
	10-30	---	---	3-12	1.35-1.60	4.23-42.34	0.14-0.22	0.0-2.9	0.5-2.0	.37	.43	
	30-60	---	---	0-2	1.45-1.70	42.34-141.14	0.01-0.10	0.0-2.9	0.0-0.5	.15	.17	
Sb:												
Scarboro	0-5	---	---	1-7	0.70-1.00	14.00-42.00	0.10-0.23	0.0-2.9	8.0-15	.17	.24	5
	5-24	---	---	1-5	1.15-1.35	42.00-705.00	0.04-0.13	0.0-2.9	0.5-2.0	.17	.20	
	24-60	---	---	0-2	1.35-1.55	42.00-705.00	0.02-0.13	0.0-2.9	0.0-0.5	.10	.17	
Wa:												
Walpole	0-7	---	---	2-6	1.00-1.25	14.11-42.34	0.10-0.18	0.0-2.9	2.0-8.0	.20	.24	3
	7-19	---	---	2-6	1.30-1.55	14.11-42.34	0.07-0.15	0.0-2.9	0.5-2.0	.24	.32	
	19-65	---	---	0-2	1.40-1.65	42.34-141.14	0.01-0.10	0.0-2.9	0.0-0.5	.10	.15	

Soil Suitability for Development

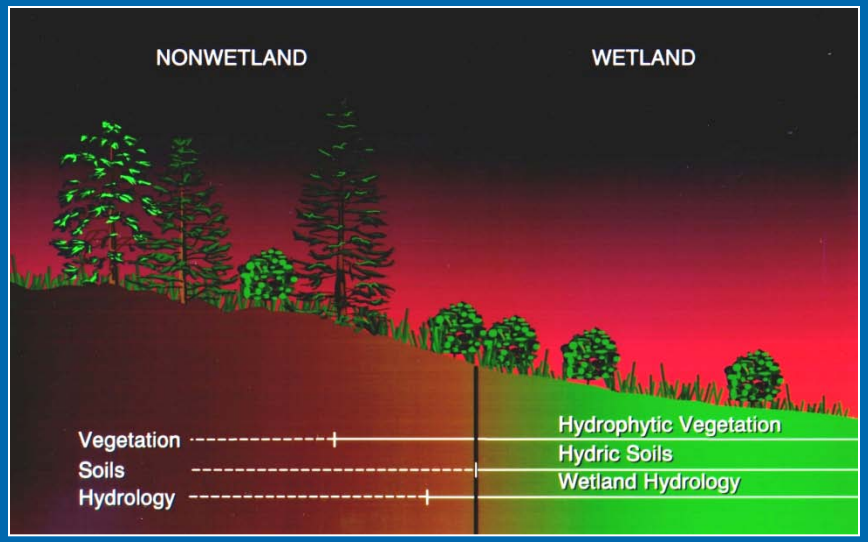
Alluvial Soil

Deep sandy Soil

Organic Soil

Wet till Soil

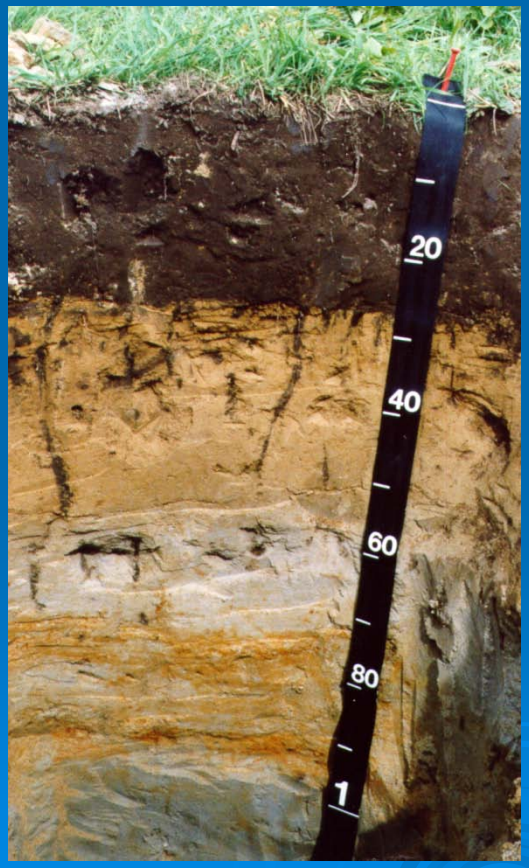
Regulatory Issues Related to Soil



Wetlands, ISDS Septic Systems, Erosion Protection, Stormwater Runoff, Zoning Issues.

Hydric Soils

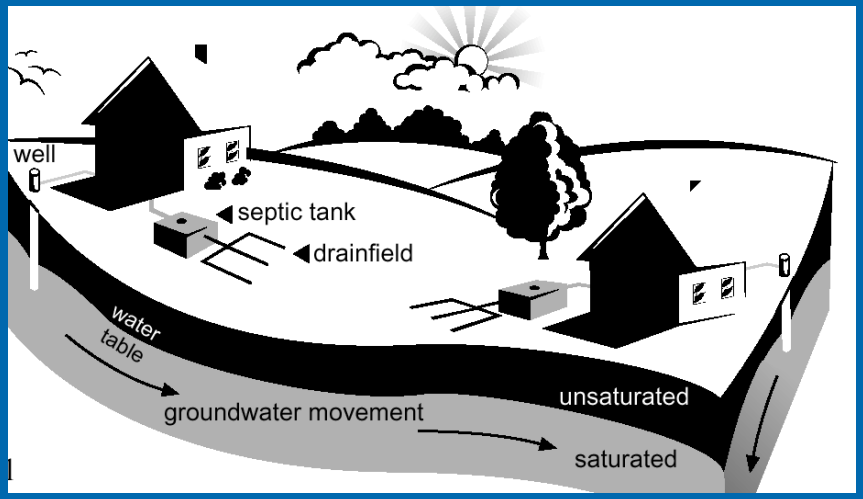
A hydric soil is a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.



Septic System Function

- Treatment of Effluent to remove or reduce:

1. Suspended Solids.
2. Nitrates and Nutrients.
3. Bacteria and Pathogens.
4. Filter effluent before it is returned to ground water.



Farmland Loss

- 14 million acres of prime farmland were developed between 1982 and 2007 (about the size of West Virginia).
- Est. 30,000 acres of Prime Farmland lost in RI 1981-2004

Soil Erosion Concerns

- Types of Erosion:
  Sheet, Rill, Gully
- Highly Erodible Soils:
  - soil texture and slope
- Erosion Control:
  - Ag. - contour plowing, terracing, buffer strips, no till, cover crops in winter.
  - Urban – silt fences, hydro seed, limit stockpile size.

Stormwater Runoff

- Need to control the effects of creating impervious material during the conversion of land use (woodland to sub-urban).
- 1,000 square feet of impervious ground generates 28, 000 gallons of run-off each year!
- Soils are used to determine the size of detention ponds to store run-off (soil hydrologic groups) in drainage calculations.

Impervious Surfaces

- Indicate intensive land uses
  that cause pollution
- Inhibit recharge of groundwater
- Prevent natural processing of pollutants in soil, plants
- Provide a surface for accumulation of pollutants
- Provide an express route for pollutants to waterways

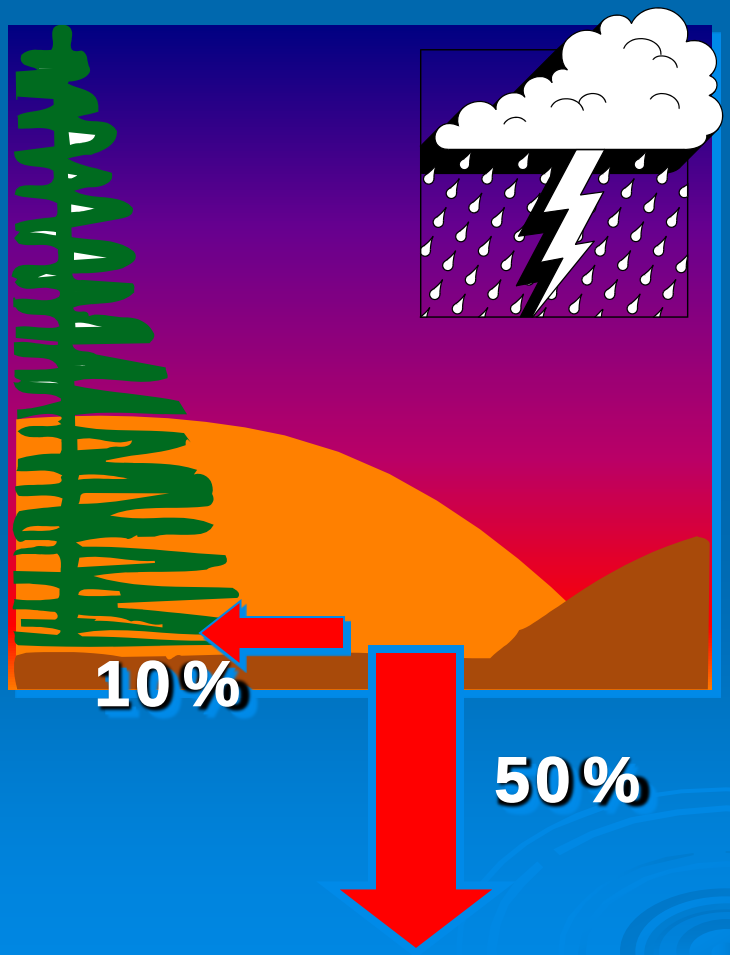
Development Impacts on Water Quality

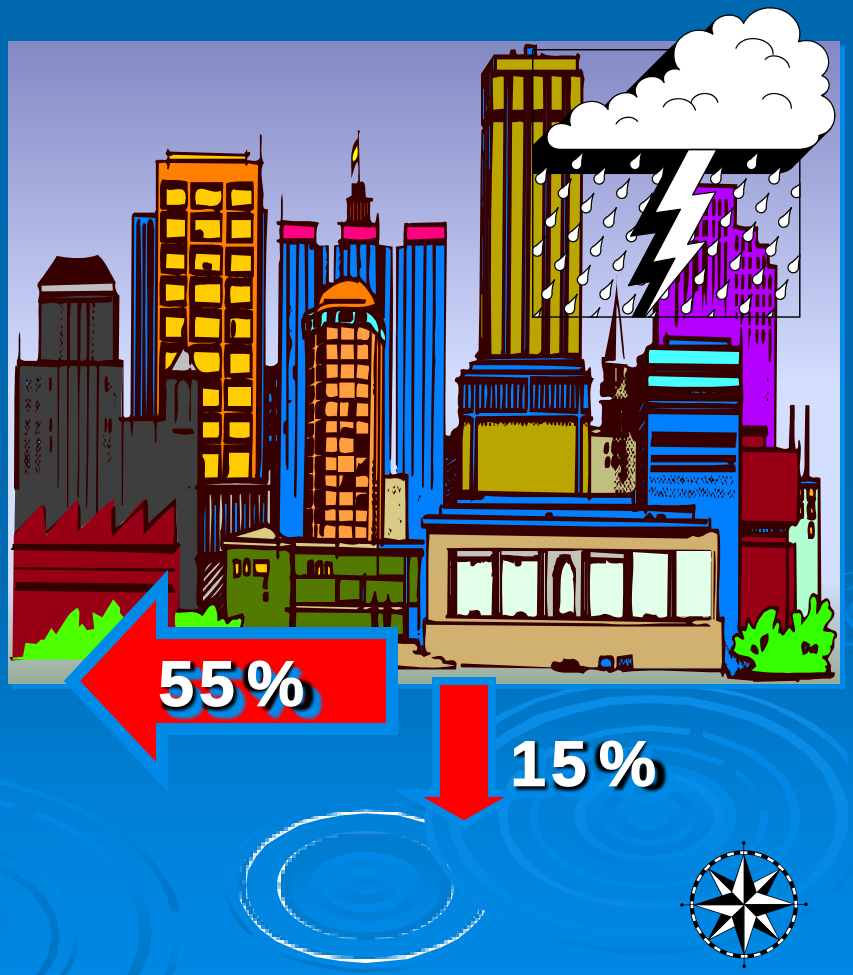
Increased quantity

Decreased quality

- Nutrients
- Pathogens
- Sediment
- Toxic Contaminants
- Debris
- Thermal Stress

Development Impacts on the Water Cycle





How much runoff?

Calculate Runoff:

0.02 square miles or
557,868 sq. ft. of
impervious ground

X 4 feet rain/yr

=2,231,472 cu ft

1 cu ft = 7.4 gal

= 15,640,868 gallons!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Questions