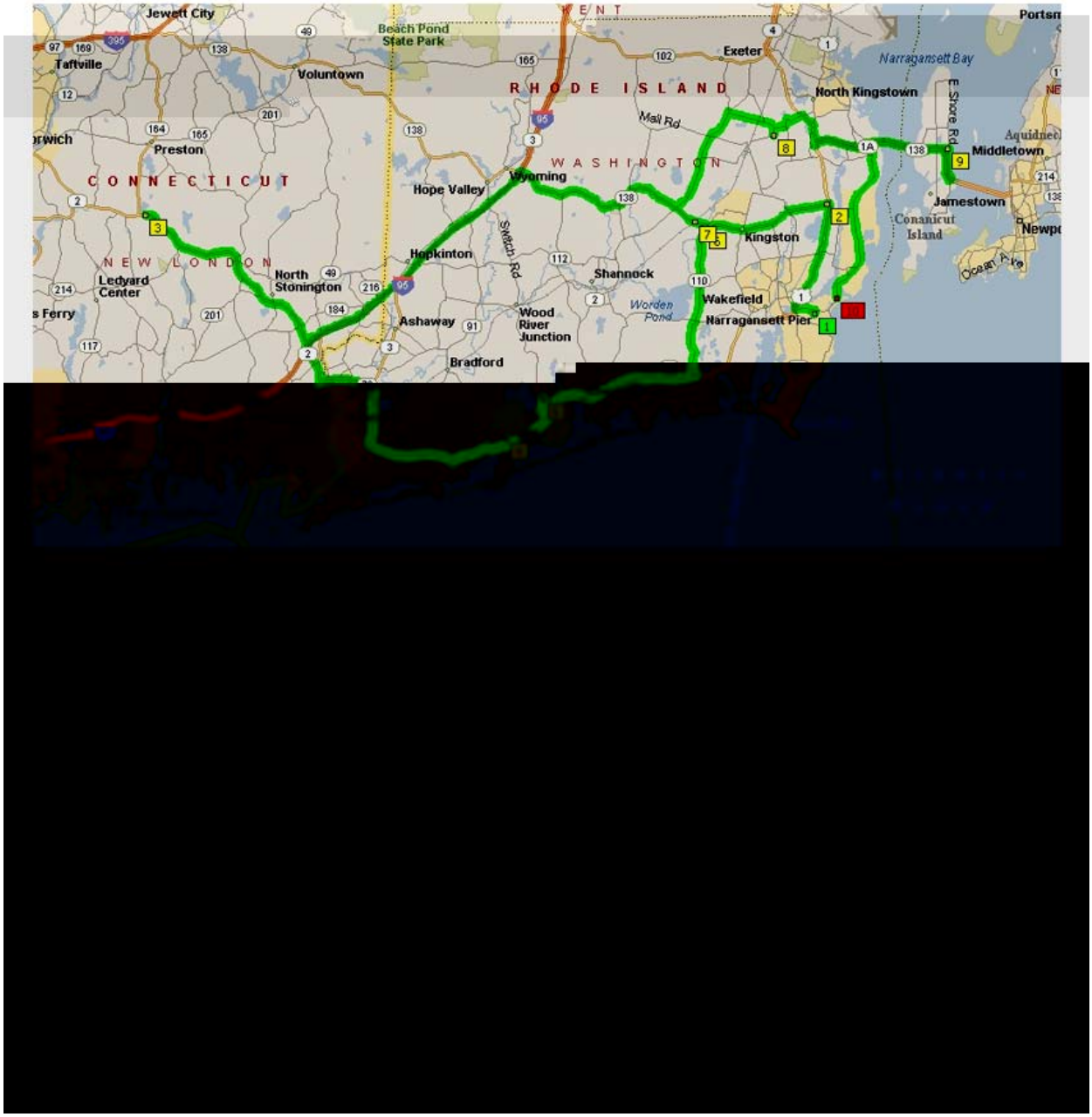
Northeast Regional
National Cooperative Soil Survey Meeting



Acknowledgements

Thanks go to the following for welcoming us on their property and helping with the preparation and presentation of today's tour.

UNIVERSITY OF Rhode Island

University of Connecticut

MASHANTUCKET PEQUOT MUSEUM & RESEARCH CENTER

jamestownri.com

Town of Jamestown, RI

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Ceppi Farm, Jamestown, RI
Robert Sutton, Farm Manager

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Soils Tour of Southern Rhode Island and Connecticut

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Northeast Regional Cooperative Soil Survey Conference

June 2-5, 2008
Narragansett, Rhode Island

Northeast Regional National Cooperative Soil Survey Meeting

Soils Tour

Southern Rhode Island and Connecticut

June 4, 2008

Welcome to Southern New England!

Bedrock Geology

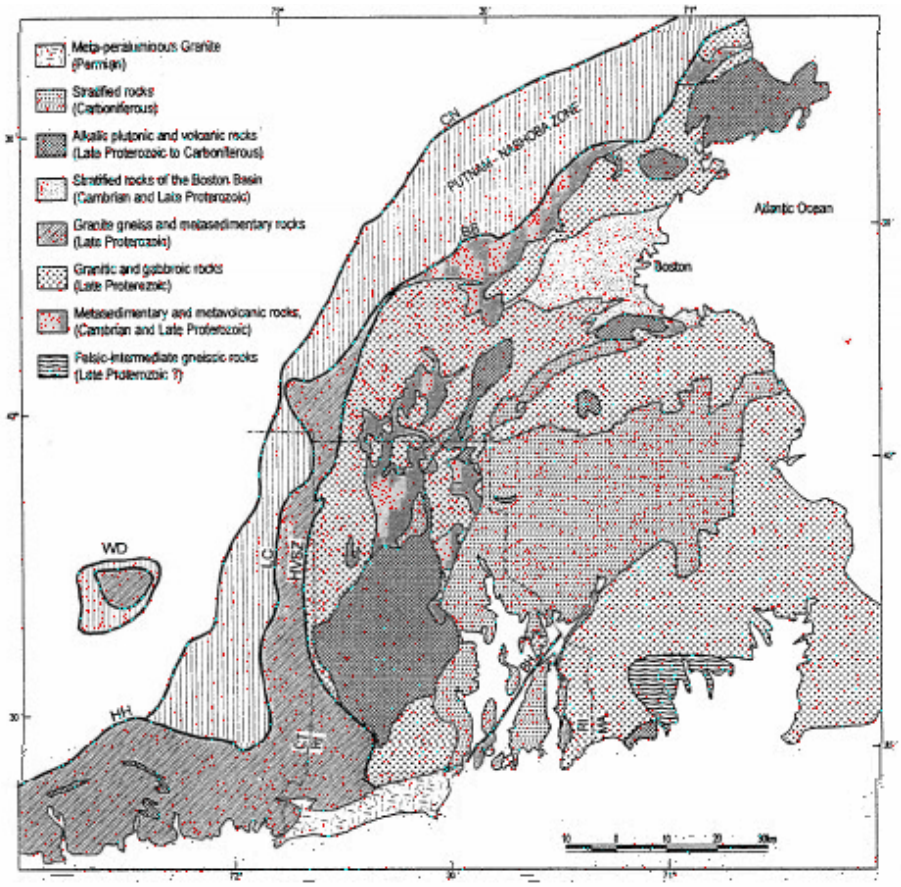

Figure 1: Generalized geologic map of the Avalon zone in southeastern New England. Labeled faults are: HH = Honey Hill, LC = Lake Char, BB = Bloody Bluff, CN = Clinton-Newbury, HVSZ = Hope Valley shear zone. Compiled from Quinn (1971), Zen (1983); O'Hara and Gromet (1985), Rodgers (1985), Hermes and others (1994).

Figure 1 shows the generalized bedrock geology of the region. The bedrock geology of south-eastern New England is predominately acid crystalline igneous and metamorphic rock of late Proterozoic to Paleozoic age. The entire region we will be touring is part of the Avalonian Tectonic Terrain (Milford-Dedham Zone). The Avalon zone is an eastern platform or basement that evolved to some extent independently of the North American continent. The zone existed as an island or microcontinent within the proto-Atlantic (Iapetus) ocean until incorporation into the Appalachians no earlier than early Paleozoic time (O'Hara, 1986). A modern analogy of Avalon is the Island of Japan which geologists believe will some day collide with China and become one landmass. The Alleghanian orogeny (mid to late Paleozoic) in southeastern New England is believed to represent the final amalgamation of Avalonian terrains against Laurentia during the collision between Laurentia and Africa (Burks 1998). Included within the Avalon Terrain is the 1,000 square mile Narragansett Rift Basin consisting of primarily of Pennsylvanian aged (Carboniferous) meta-sedimentary rocks. The rocks of the Narragansett Basin typically consist of highly folded and fractured, dark colored siltstone, shale, graywacke, argillite, and coarse-grained conglomerate. There is an estimated 10,000 feet of coal bearing strata in the Narragansett Basin. We will visit soils that

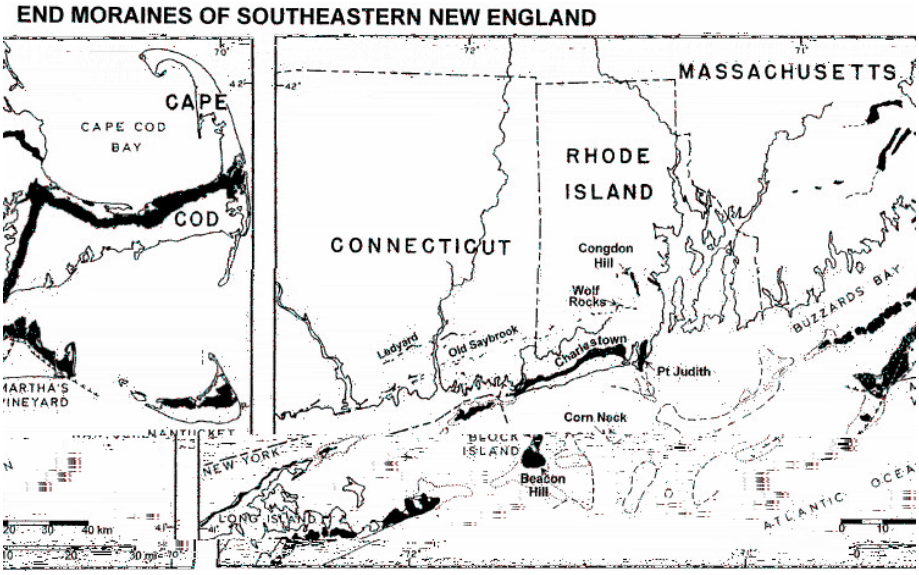

Figure 2: Locations of End Moraines

formed in the basin during the field tour. The youngest rocks in the area are the Permian Aged (Ca 275 million YBP) Narragansett Pier Granite – a walk along Hazard Ave or Black Point is recommended.

Quaternary Geology

Quaternary deposits consisting of till (lodgement and supraglacial), fluvial (ice-contact and proglacial), and lacustrine material were transported and laid down during the late Wisconsinan glaciation. During this advance the Laurentide ice sheet covered all of southern New England, ice was up to 1 mile thick (Mt. Washington in NH was covered by ice) reaching its terminus about 25,000 years BP and forming the terminal moraines along the outer islands of Block Island, Nantucket, Martha's Vineyard, and Long Island. The Charlestown Moraine, along the south coast of Rhode Island, was formed as a recessional moraine around 17,000 years BP. **Figure 2** shows the location of the large end moraines of the various lobes of the Laurentide Ice sheet. **Figure 3** shows the ice retreat positions and dates for New England.

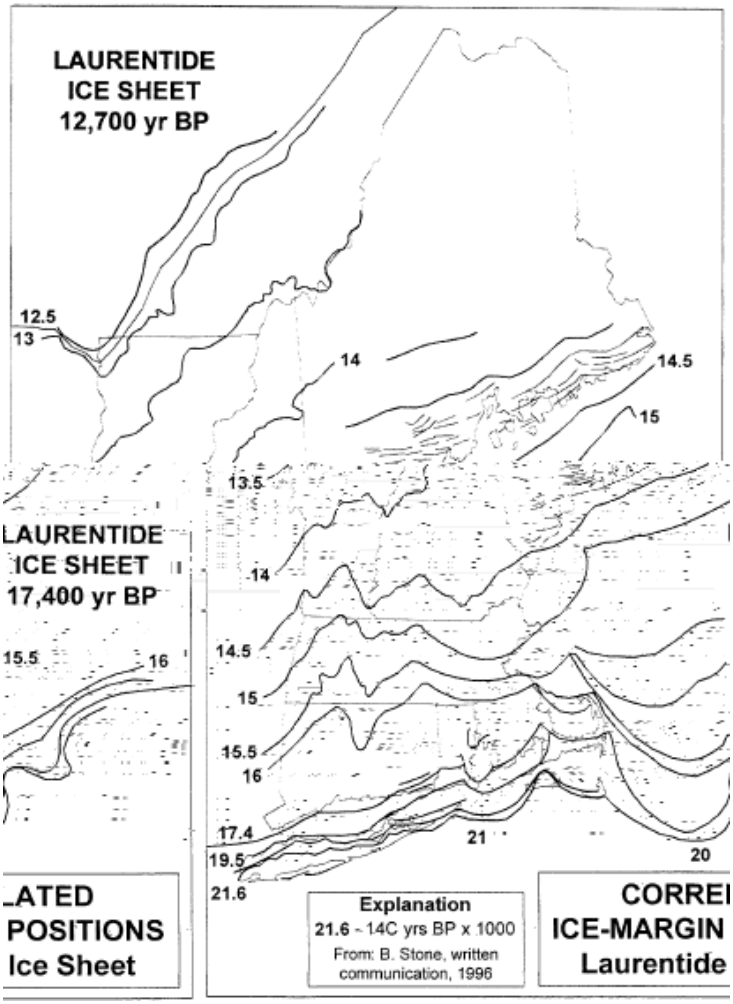

Figure 3: Ice margin positions for New England (B. Stone 1996)

Following de-glaciation was a period of periglacial climate and permafrost conditions (as evident in ice wedge casts). During this period most of the upland soils in the region developed a thin (12-40 inch) “loess cap” or eolian silts and very fine sands atop the glacial deposits. Ocean levels were much lower (depressed by an estimated 300 feet) during the glaciation and most of what is now Rhode Island Sound, Georges Bank, and Long Island Sound was a dry lakebed. This large expanse of unvegetated land is thought to be the source of this eolian material. Because the majority of our geology in this area is so rocky, these loess capped soils create patches of highly prized agricultural land as we will see during this tour.

MLRA:

Rhode Island and Southeastern Connecticut is mostly within MLRA 144A New England and Eastern New York Upland, Southern Part of Region R, a small area of 149B Long Island - Cape Cod Coastal Lowland of Region S is located along southern RI and the offshore Block Island. Under the soil survey reorganization the Windsor, CT office is the MMA for 12-6 covering approximately 14.5 million acres.

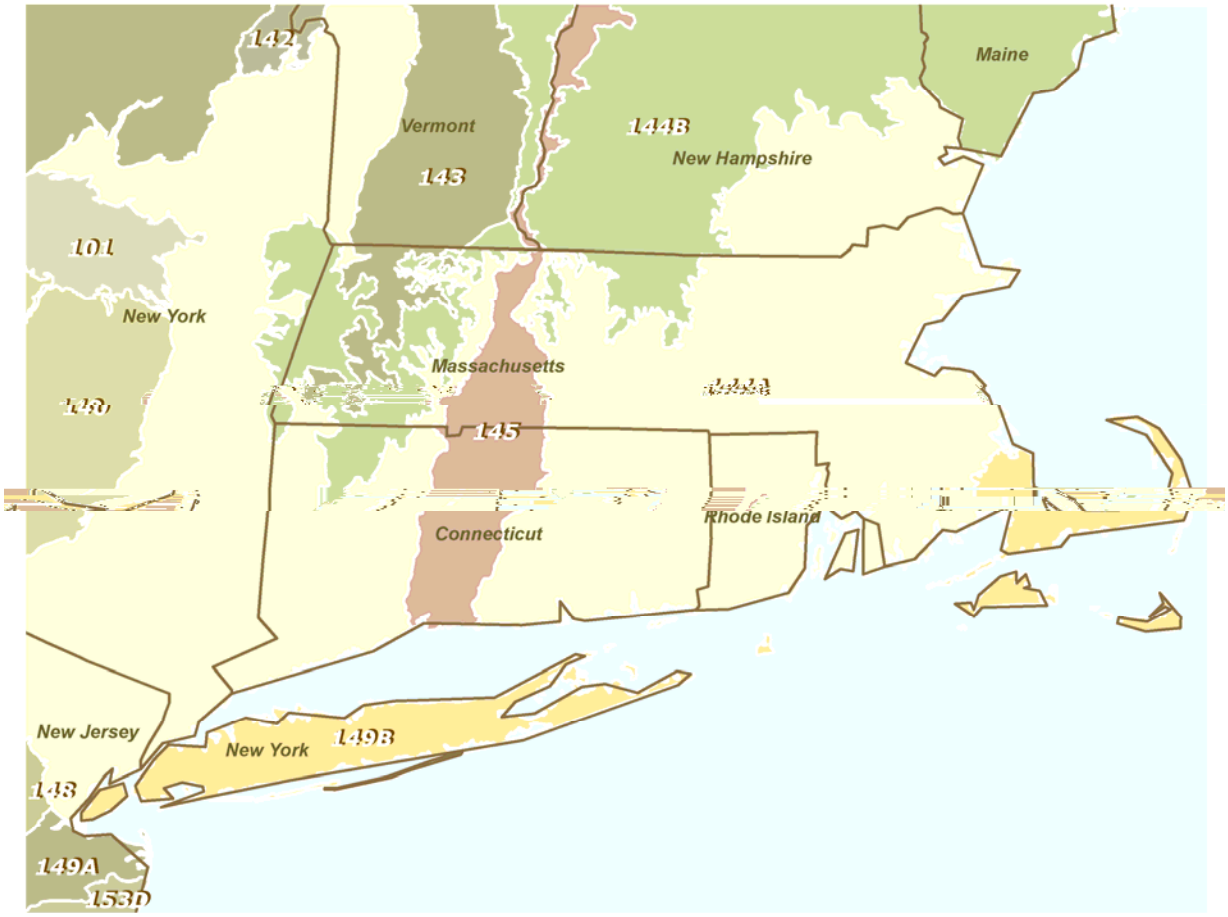

Figure 4: MLRA-12 Northeast Region – Proposed Soil Survey Project Office Areas and Extent in Acres

The dominant soil orders in this MLRA are Entisols, Histosols, and Inceptisols. The soils in the area dominantly have a mesic soil temperature regime, an aquic or udic soil moisture regime, and mixed mineralogy. They generally are very deep, somewhat excessively drained to poorly drained, and loamy or sandy. Udorthents (Hinckley series) and Udipsamments (Windsor series) formed in outwash deposits on outwash plains, terraces, kames, and eskers. Haplosaprists (Freetown series) formed in organic material in depressions on uplands and outwash plains. Dystrudepts formed in till, loamy sediments over till, and dense till on till plains, hills, and ridges (Canton, Charlton, Chatfield, Gloucester, Hollis, Montauk, Paxton, Scituate, Sutton, and Woodbridge series) and in outwash deposits on outwash plains and terraces (Merrimac series). Endoaquepts (Leicester and Ridgebury series) and Epiaquepts (Ridgebury series) formed in till in depressions on hills and in drainageways.

Rhode Island and Providence Plantations Fun Facts:

Figure 5: Rhode Island – The Basics: Size

Coastline:
Over 400 Miles

Relief:
Sea level to summit of Jerimoth Hill at 812 feet.

Population (2005 Census):
1,076,189 (4.5% increase since 1990)

Persons Per Square Mile:
1,003 (2nd most densely populated)

Climate:
Avg. Jan. Temperature - 30°F; Avg. July Temperature - 72° F

Yearly Precipitation:
44-55 inches (avg.)

Number of Farms:
858

Acres in Farms:
61,223

Average Farm Size:
71 Acres

Market Value of Production:
$55.5 Million

Average Market Value Per Farm:
$64,740 (highest sales in: Nursery, Greenhouse, Floriculture & Sod)

Value of Production:
$1,095 per acre (4th)

Average Value of Farmland:
$10,200 per acre (1st)

Value of Agricultural Products Sold Directly to Individuals:
$20,539 per farm (2nd)

Proposed State Soil:
Narragansett

Connecticut Fun Facts:

(From the USDA, Economic Research Service)

Population: 3,502,309 *(2007, ERS)*
Per-Capita Income (2006 dollars): 50,762
Total Land Area *(million acres)*: 3.10
Total Farmland *(million acres)*: 0.36
Cropland *(million acres)*: 0.17
Average Farm Size *(acres)*: 85

Agricultural Cash Receipts *(2000, CT Dept. of Ag.)*

- Ornamental Horticulture: $513 million
- Tobacco: $70.2 million
- Dairy: $67.1 million
- Beef/Cattle: $61.5
- Poultry: $60.5 million
- Chicken Eggs: $40 million
- Aquaculture: $17.8 million
- Other Crops *(mushrooms, shade tobacco, Christmas trees)*: $106 million

Number of People Employed in Agriculture *(2000, CT Dept. of Ag.)*

- Farm Operators/Managers: 1,418
- Workers: 4,123
- Other *(ag, forestry, fishing)*: 16,921
- Animal Caretakers *(non-farm)*: 2,278
- Laborers: 11,851

*Connecticut is first in New England in:

- net farm income
- horse numbers
- mushroom production
- peach and pear production (combined)
- tobacco acreage and production
- density of egg laying poultry
- bedding and garden plant income
- nursery and greenhouse sales
- per acre value per farm
- total potted plants
- herbaceous perennial potted plants

*Connecticut is first in New England, relative to geographic size, in:

- number of farms
- chickens sold
- egg production and value
- other livestock income
- sweet corn
- total farm marketing income
- aquaculture income
- beef cows

*Connecticut is:

1. in the top five for value of oysters
2. 1st in the density of horses
3. 1st in the density of egg laying poultry
4. 5th in mushroom production
5. 8th in the density of dairy cows
6. 10th in maple syrup
7. 10th in milk production per dairy cow

———————————

**Source: Agriculture in Connecticut, 2000, Cowan, (based on NASS numbers).*

Proposed State Soil: Windsor

Stop 1: Preston Plains, Connecticut

Outwash soils, archaeological investigations, and technical soil services.

Presented by:

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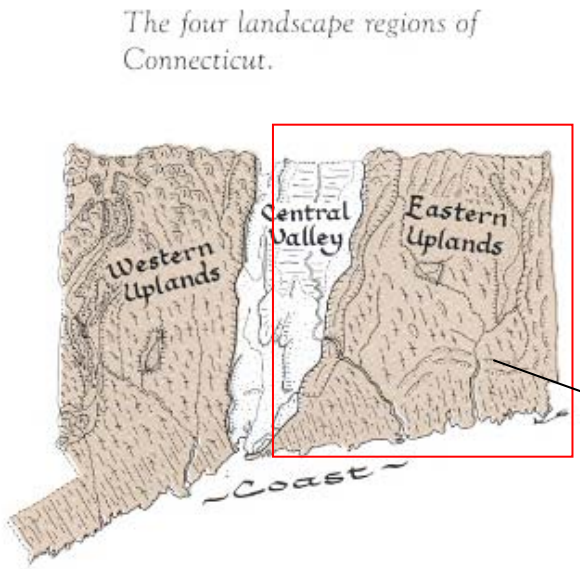
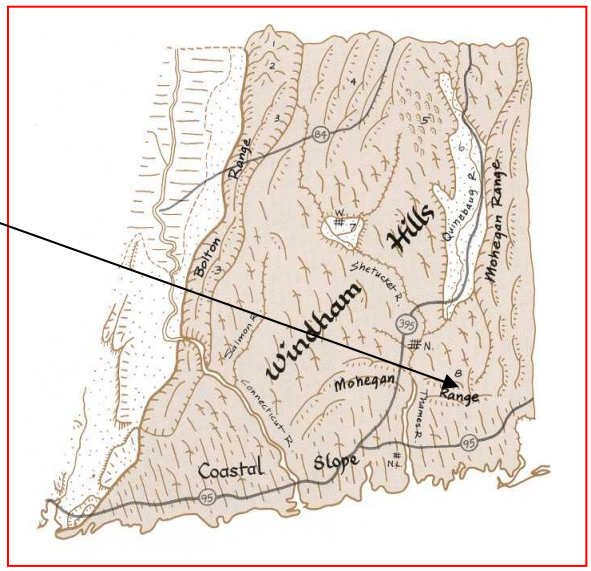


Figure 6: The Four Landscape Regions of Connecticut

We are in an area of Connecticut where the Coastal Slope and the Mohegan Range meet.



We will visit an archaeological site on property of the Mashantucket Pequots. The area is mapped Agawam fine sandy loam, a soil developed in meltwater deposits. The profiles in this field display evidence of a very active post glacial period.

You will have an opportunity to investigate some extensive trenches and get a good view of the variability typical in Connecticut's outwash soils. In this field, differences in profile characteristics originate from everything from geologic activities to disturbances caused by archaeological activities just 2 years ago.

Figure 7: Potential ice cast wedge.

1934

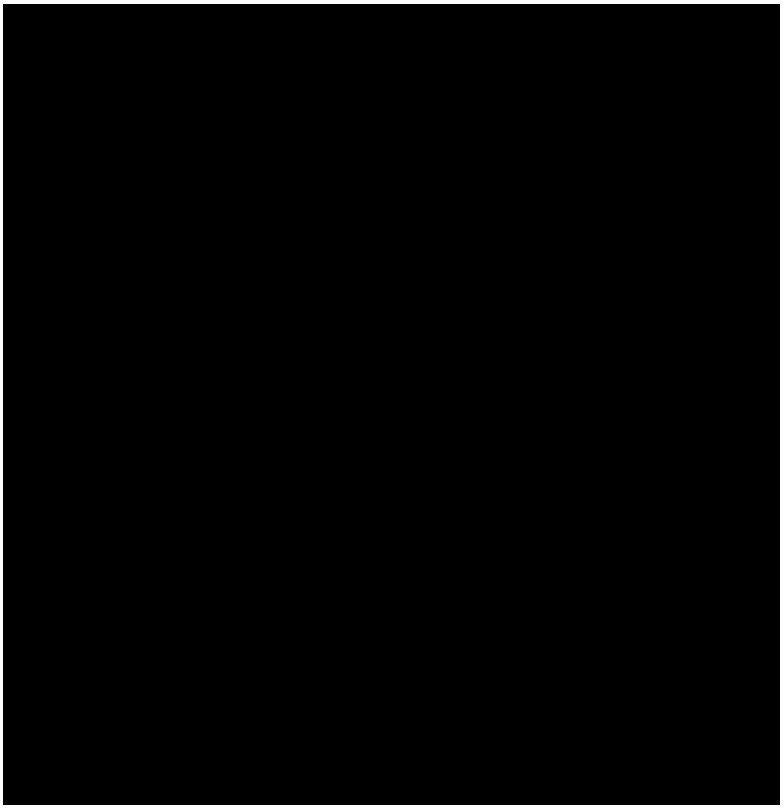


Figure 8a

2006

Figure 8b

Archaeological Activities

Provided by Timothy H. Ives, M.A.
Department of Anthropology
University of Connecticut

The Mashantucket Pequot Tribe has been conducting archaeological investigations at Preston Plains since 1999 as a planning element for a development project. This landform is characterized by significant prehistoric Native American cultural deposits reflecting low-intensity human occupation during most of the Holocene, interrupted by higher intensity use during the Late Archaic Period (ca. 5000-3400 BP)

This higher intensity usage is revealed by artifact concentrations occurring in association with feature clusters. Diagnostic "Laurentian Tradition" and "Narrow-Stemmed Tradition" projectile points have been recovered in significant quantities. Features are highly variable in form, ranging from discrete pit-hearths to massive, enigmatic pits sometimes exceeding one meter in depth. Revealing the nature of Late Archaic land use, including the function(s) of large pit features, has been the primary goal of data recovery efforts at Preston Plains.

As a case study, investigations at Locus 1 have documented an overlapping series of large pit features, hearths and lithic scatters that reveal an accretional formation history.

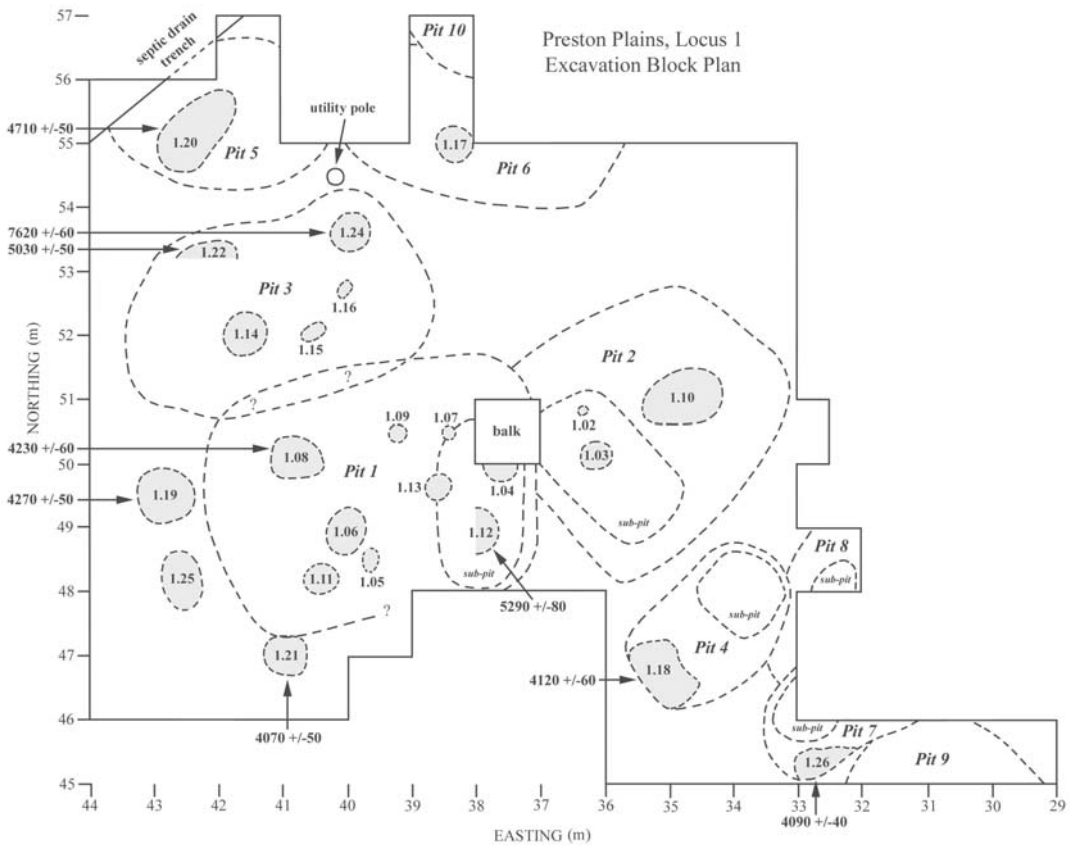


Figure 9

These deposits are concentrated on a well-drained knoll crest, which clearly proved attractive to prehistoric inhabitants. The recovered lithic assemblage suggests residential occupation, where people discarded expired personal gear and intensively manufactured replacement items. The presence of what appear to be human-made features further suggests long term planning for residential purposes.

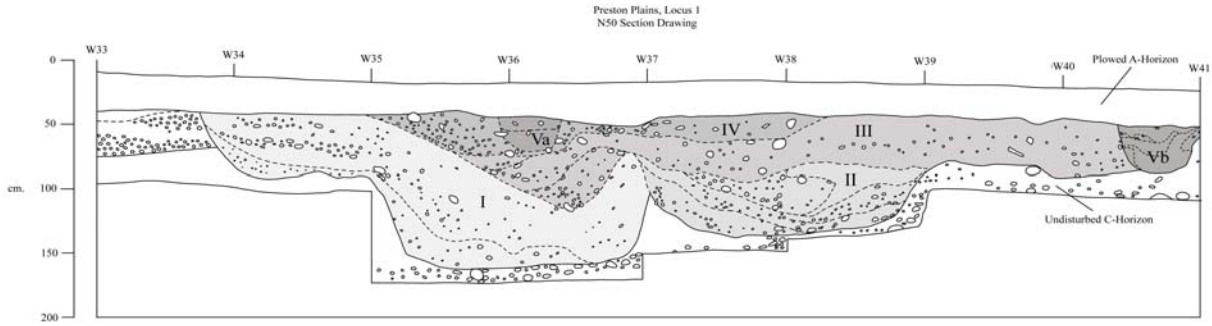


Figure 10

While Locus I appears "busy" at first glance, the radiocarbon chronology indicates that occupations may have been separated by years, decades, or centuries. It is possible that this location was occasionally used for overwintering, where an individual family would camp during the late fall and winter as part of a seasonal round. The presence of charred nutshells in hearth deposits supports this interpretation, and some of the large pit features may have been used for storage. Data analysis is ongoing.

The morphology of large pit features across greater Preston Plains is variable and some are doubtlessly anthropogenic, such as this isolated pit feature containing a stone-filled roasting platform.

Previous machine trenching investigations uncovered one surprisingly dense concentration of cultural pit features.

However, it is critical to note that not all pit features are cultural. One large, and especially deep pit complex appears to have been formed largely (and possibly solely) by woodchucks.

Furthermore, some basin shapes in the coarser C-Horizon outwash appear to have

Figure 11

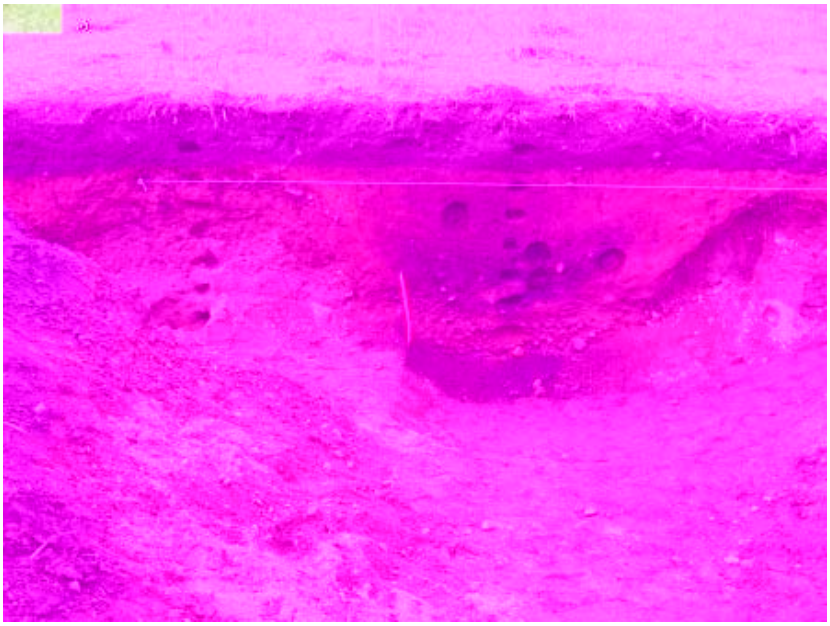


Figure 12

filled in naturally with aeolian sediment. Were such formations capitalized on by prehistoric peoples seeking terrain that was particularly well suited to large pit excavation? The current trenching exhibition at Preston Plains is partially aimed at entertaining such possibilities while refining our ability to distinguish between anthropogenic and natural site/soil formation processes here.

Geophysical Site Analysis

Excerpts from a trip report provided by
James A. Doolittle, Research Soil Scientist, National Soil Survey Center

At the Preston Plains site, several bowl-like depressions were identified on radar records. Based on radar information, bowl-like depressions are more common the western portion of the study site. A 3D pseudo-image of a small grid site provided further evidence supporting the presence of bowl-like depressions and clues as to the internal geometry of these features.

Preston Plains (Mashantucket) Site:
The site is located in cultivated fields (41.4888^{o} N. Latitude, 71.9795^{o} W. Longitude) just off of State Highway 2 near Mashantucket. In one of these fields, several, puzzling, subsurface bowl-like features have been exposed in trenches. These features are 1 to 1.5 m deep, have no surface expression, and contain low density stone tools, flakes and points, which have been dated to 4000 to 5000 Before Present (BP). These earthen, bowl-like features are believed to be the work of human hands, but display no recognizable spatial arrangement or patterns. The fields are mapped as Agawam fine sandy loam, 3 to 8 % slopes, and Haven and Enfield soils, 0 to 3 % slopes. The very deep, well drained Agawam soils formed in sandy, water deposited materials. The Agawam series is a member of the coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts family. The very deep, well drained Haven and Enfield soils formed in loamy over sandy and gravelly outwash. The Haven series is a member of the coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts family. The Enfield series is a member of the coarse-silty over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts family.

Archaeologists have unearthed several puzzling, subsurface bowl-like features in exploratory trenches. These features are 1 to 1.5 m deep, have no surface expression, and contain a low density of stone tools, flakes and points. These artifacts have been dated to 4000 to 5000 Before Present (BP). The bowl-like, earthen features are believed to be the work of human hands, but display no recognizable spatial arrangement or patterns.

Figure 13: The interpreted boundary of a deep, broad, bowl-like feature has been outlined with a white line on this radar record that was obtained at the Preston Plains site.

Figure 14

The radar record shown in Figure 6 contains a conspicuous bowl-like feature. This portion of the radar record was collected in an area of Agawam soil. The Haven soils formed in coarse-loamy over sandy and gravelly outwash. In Figure 13, the contact between the coarse-loamy mantle and the underlying sands and gravels is apparent as a planar reflector at a depth of about 70 cm on either end of the radar record. This contact dives to a depth of about 150 cm in the central portion of the radar record where it has been highlighted by a white-colored line. The depression or *bowl-like feature* is principally filled with similar coarse-loamy sediments, which lack contrast and produce low amplitude (colored red and black) reflections. Within this filled-depression, in places, the boundary between the mostly infilled sediments (there are noticeable inclusions with different signal amplitudes) and the underlying sand and gravel outwash is irregular and difficult to trace laterally. High amplitude (colored white and grey) planar reflectors represent contrasting layers of sands and gravels in the underlying outwash. The irregular surface and discontinuous strata, which are arranged in different orientations, suggest highly turbulent depositional environment or rather extreme post-depositional modifications of these outwash sediments.

Figure 15 is a Google Earth image of the Preston Plains site. In this image, the location of the GPR traverse line is shown. Areas that are colored blue along this traverse lines have been interpreted to contain bowl-like features. For this interpretation, the moderately deep, horizontal contact between

the loamy mantle and the underlying sands and gravel is absent and a bowl-like depression is imaged. The bowl-like depression must be filled with mostly similar sediments, which provide low-amplitude, planar reflections. Based on soil information, bowl-like depressions are more common in the western portion of the site and in areas of Agawam fine sandy loam, 3 to 8 % slopes, and less common in the eastern portion of the site and in areas of Haven and Enfield soils, 0 to 3 % slopes. While conducting the radar traverse, rock fragments were more noticeable on the soil surface in areas of Haven and Enfield soils suggesting a thinner mantle overlying sands and gravels.

Figure 15. The location of a GPR traverse that was conducted in an area of Agawam fine sandy loam, 3 to 8 % slopes, and Haven and Enfield soils, 0 to 3 % slopes at the Preston Plains site is shown on this Goggle Earth image. A blue color is used to indicate the locations of interpreted bowl-like depressions.

Stop 2: Ninigret Pond and Subaqueous Soils

Ninigret Pond is the largest of the coastal lagoons that line the south coast of Rhode Island (Figure 17). The majority of the Rhode Island coastal lagoons were formed following the last glacial period as glaciofluvial plains, glaciofluvial channels, and ice-block basins were inundated by rising sea-level. Ninigret Pond is separated from coastal lagoons to the east and west by glacial headlands comprised of glacial till and glaciofluvial material, and is separated from the open ocean by a barrier spit comprised of Holocene sand deposited by longshore transport. Prior to permanent stabilization, the Ninigret barrier spit often closed the pond off from the ocean, but was naturally breached due to storms allowing intermittent flushing and tidal influence on the pond. In 1952, the Charlestown Breachway was built and remains today as the sole inlet to Ninigret Pond from the ocean. Due to the constricted flow of water through the breachway, the tidal fluctuation within Ninigret Pond ranges from 7 to 16 cm (Boothroyd et al., 1985).

Subaqueous Soils

The study of subaqueous soils is relatively new to the field of soil science. The concept that sediments in shallow water environments undergo soil forming processes, are capable of supporting rooted plants, and meet the definition of soil according to the criteria defined in Soil Taxonomy has been moving soil scientists into a new frontier of soil survey – mapping subaqueous soils.

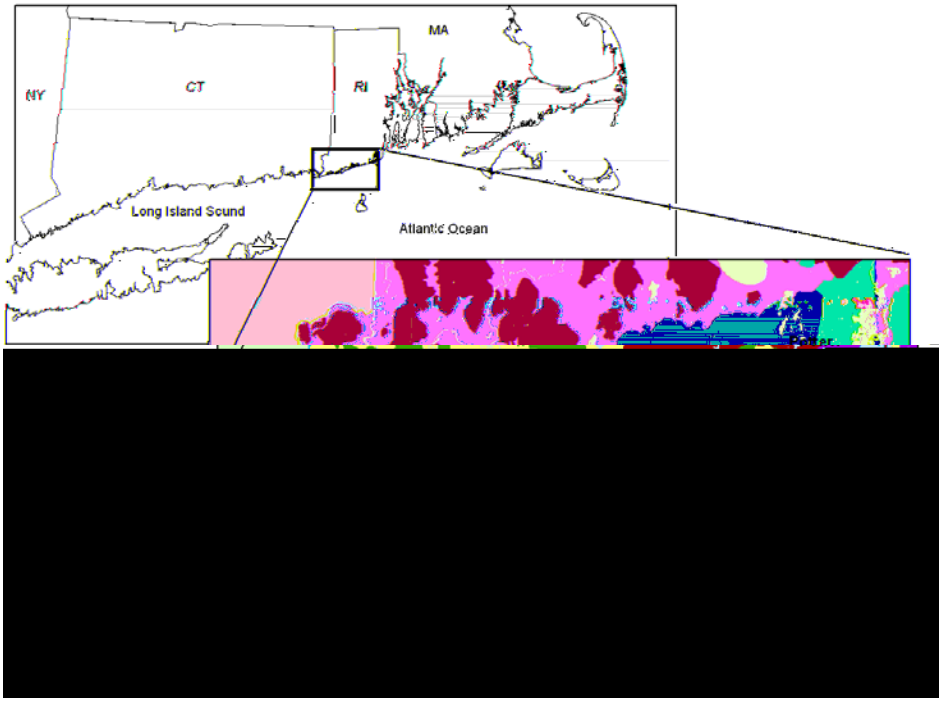


Figure 17: Location and glacial geology of coastal ponds of Rhode Island.

Subaqueous soil mapping is performed in much the same way as terrestrial soil surveys, except the mapper is in water. The difficulty in mapping soils under water is that scientists are unable to see the landscape. Instead of topographic maps to provide landscape position, subaqueous soil mapping uses bathymetric maps to identify landscapes and landforms. Other tools used to view the subaqueous landscapes include the use of side-scan sonar and sub-bottom profile imaging techniques. Instead of shovels, subaqueous soils are collected using augers and other specialized tools such as peat corers and vibracores *(Figure 18)*.

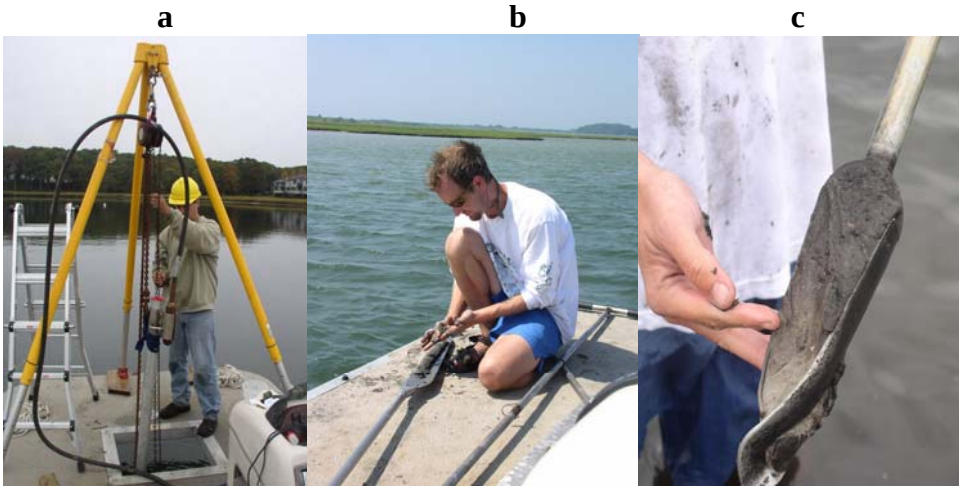
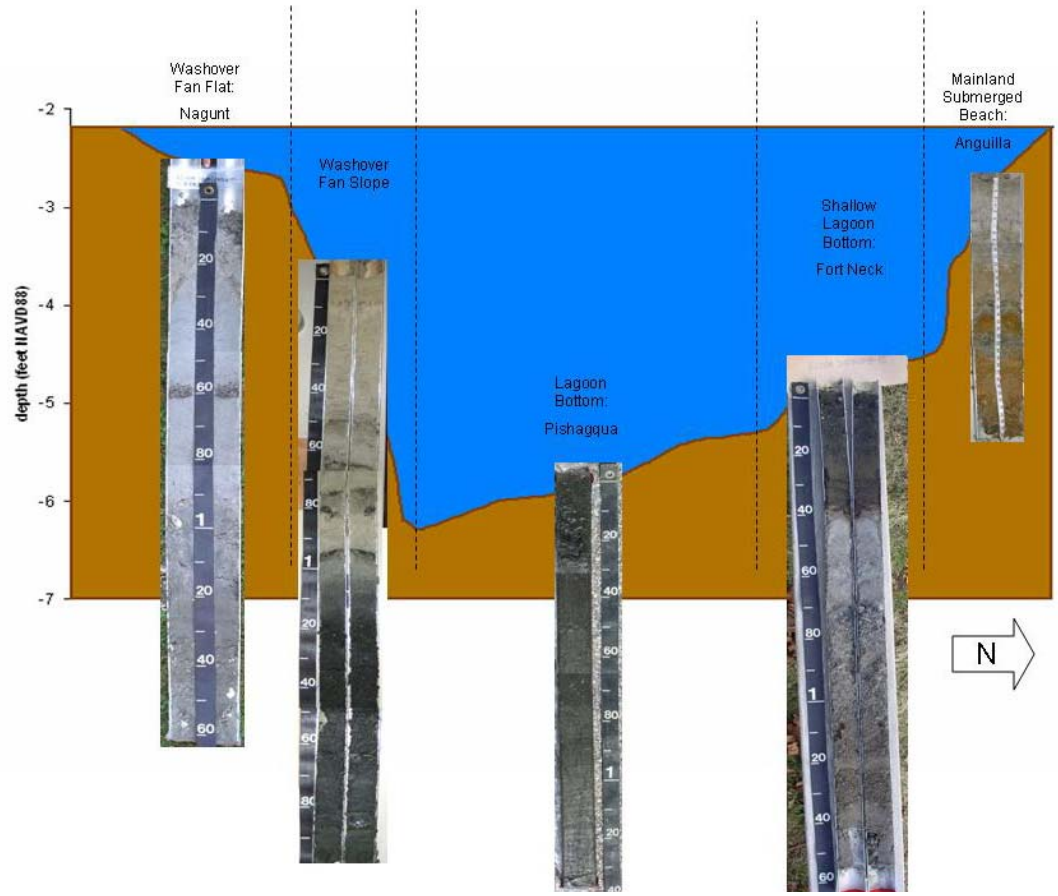


Figure 18: *Tools used for subaqueous soil mapping. a) A vibracore is a vibrator motor that is attached to an aluminum or polycarbonate tube so that the vibrations push the core down into the soil. The tube is then extracted and cut open to describe the soil collected. b) A peat sampler enables scientists to gather undisturbed samples of highly fluid or organic soils. c) Augers can also be used in subaqueous soil mapping.*

Connecticut and Rhode Island NRCS, along with University and state partners, have begun establishing a mapping protocol for subaqueous soils. There are currently three tentative series, the Pishagqua, Rhodesfolly, and Wequetequock Series', and multiple others are currently under development. At this site, you will be able to view some of the vibracores taken in Ninigret as well as other coastal ponds.

Figure 19: Landscape units and soil types delineated in Ninigret Pond

Looking across the water toward the northern shoreline, you can see across five different landscape units in the pond (Figures 20A and 20B). The washover fan flat, closest to the barrier you are standing on, contains Nagunt (proposed) sands that are derived from sands that wash or blow over the barrier during storm events. The washover fan slope is a skinny strip of steeply sloping land directly behind the flat. Lagoon bottom landscapes often contain Pishagqua soils, consisting of deep, highly fluid, sulfidic silt loam soils. Shallow lagoon bottom contains similar material, but is underlain by nonfluid sands or sand and gravel within 1 meter of the soil surface. Finally, submerged mainland beach landscapes are found along the mainland shoreline and consist of a small amount of marine sands over glacial materials. It is common in these units to find bright colors from aerated groundwater inputs



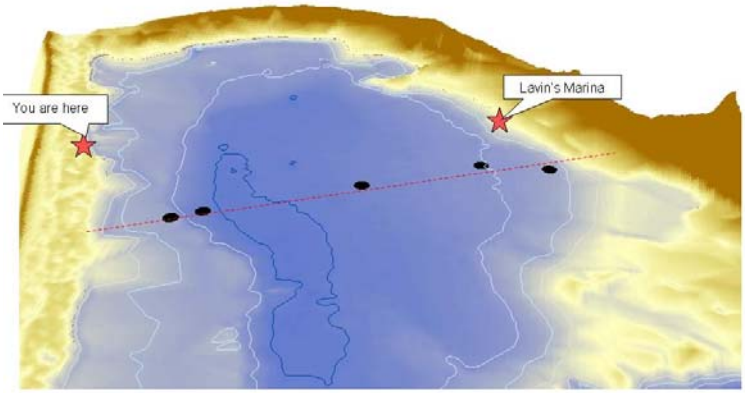


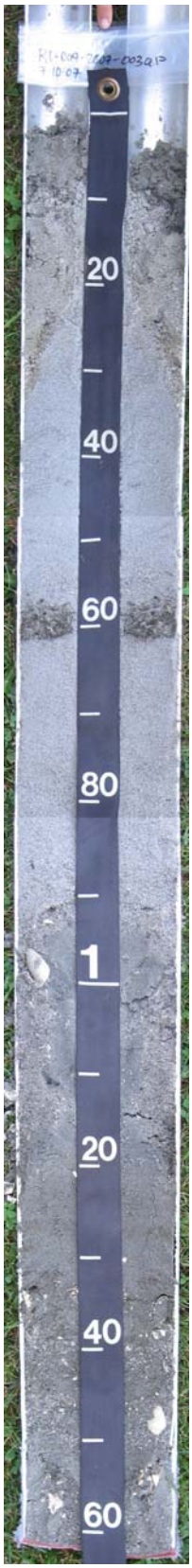
Figure 20A, Figure 20B: The profile above follows the line in the 3D contour map at the left. You can see how the soils change with landscape unit. Sandy marine soils are found directly behind the barrier, while silty Pishagqua soils are found in the low energy central basin. As you reach the opposite shore, glacial outwash materials come in below the marine silts and sands.

Nagunt Series *(Proposed)*
Washover Fan Flat

Mixed, mesic, sandy Haplic Sulfaquents
Mixed, mesic, Sulfic Psammowassents

The Nagunt series consists of very deep, subaqueous soils on washover fan flats in coastal lagoons. Nagunt soils are formed in fine sandy to sandy marine deposits that are deposited as a result of washover events. Buried surface horizons and stratification are often identified. Slope ranges from 0 to 3 percent.

Pedon Description:



Cg1 --- 0 to 8 centimeters; gray (2.5Y 5/1) moist, sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; 1 percent shell fragments; abrupt.

Cg2 --- 8 to 25 centimeters; gray (2.5Y 6/1) moist, sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; well-rounded gravels and coarse sand at bottom of horizon; abrupt.

Cg3 --- 25 to 55 centimeters; gray (5Y 6/1) moist, fine sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; 1 percent shell fragments; abrupt.

Ab --- 55 to 60 centimeters; very dark gray (5Y 3/1) moist, loamy sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; abrupt.

Cg4 --- 60 to 92 centimeters; gray (5Y 6/1) moist, sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; abrupt.

Cg5 --- 92 to 115 centimeters; very fine sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; 10 percent shell fragments; 1-3 cm quahog shells; abrupt.

Cg6 --- 115 to 132 centimeters; dark greenish gray (5GY 4/1) moist, fine sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; 5% very fine plant frags 10YR 3/2; abrupt.

Cg7 --- 132 to 160 centimeters; dark gray (2.5Y 4/1) moist, coarse sand; structureless single grain structure; nonsticky, nonplastic; nonfluid; 20 percent shell fragments; 0.5-2 cm quahog fragments.

Laboratory Data: Nagunt Series (proposed)

Horizon	Depth (cm)	Initial pH	1 month Incubation pH	2 month Incubation pH	%SOM	%SOC	Salinity(ms)	5:1 Salinity (ms)	Salinity after H2O2	Salinity after Incubation
C1	0-8	7.52	7.62	7.7	0.52	0.26	3.06	16.23	8.62	13.27
C2	8-25	7.71	7.56	7.7	0.71	0.35	1.48	7.38	3.48	10.64
C3	25-55	8.12	5.25	3.1	0.28	0.14	0.75	5.73	5.34	10.74
Ab	55-60	7.87	7.6	7.6	1.93	0.97	4.27	13.71	11.62	10.13
C4	60-92	8.31	4.53	3.5	0.28	0.14	1.17	7.37	5.26	10.59
C5	92-115	7.99	7.39	7.4	0.69	0.35	5.56	18.62	11.8	13.67
C6	115-132	8.3	7.53	7.4	0.99	0.50	5.08	23.9	12.04	12.10
C7	135-160	8.3	7.68	7.5	1.16	0.58	4.50	24.2	10.6	11.34

Horizon	%VCS	%CS	%MS	%FS	%VFS	%Sand	%Silt	%Clay	Texture
C1	2	8	57	29	3	99	1	0	Sand
C2	6	10	56	25	2	99	1	0	Sand
C3	0	1	34	63	1	99	1	0	Fine Sand
Ab	1	3	46	42	5	96	3	1	Sand
C4	1	10	64	23	1	99	0	0	Sand
C5	1	3	13	72	8	98	2	0	Fine Sand
C6	2	3	7	59	24	94	6	1	Fine Sand
C7	24	22	21	24	6	98	2	1	Coarse Sand

Figure 21: Laboratory data of the Nagunt Series (proposed).

Coastal Soils:

The coastal soils of Rhode Island are currently mapped as Udipsamments and beach areas. With increasing coastal development, there is a need to investigate wetland indicators for these sandy soils and to re-map these landscapes with more detail. Along with mapping the subaqueous soils in Rhode Island the coastal beaches, dunes, and marshes are also being re-mapped to the series level. Beaches are mapped based on the dominant surface texture (beaches, sandy), stony/boulder/cobbly phases, and presence of ledge. A typical Dune catena is mapped the excessively drained Hooksan series on the foredune, moderately well drained Brockatonorton on the back barrier flats, and a poorly drained coastal soil (currently mapped Sandyhook) in the fringe marshes. A variety of human transported soils and urban land complexes are also mapped.

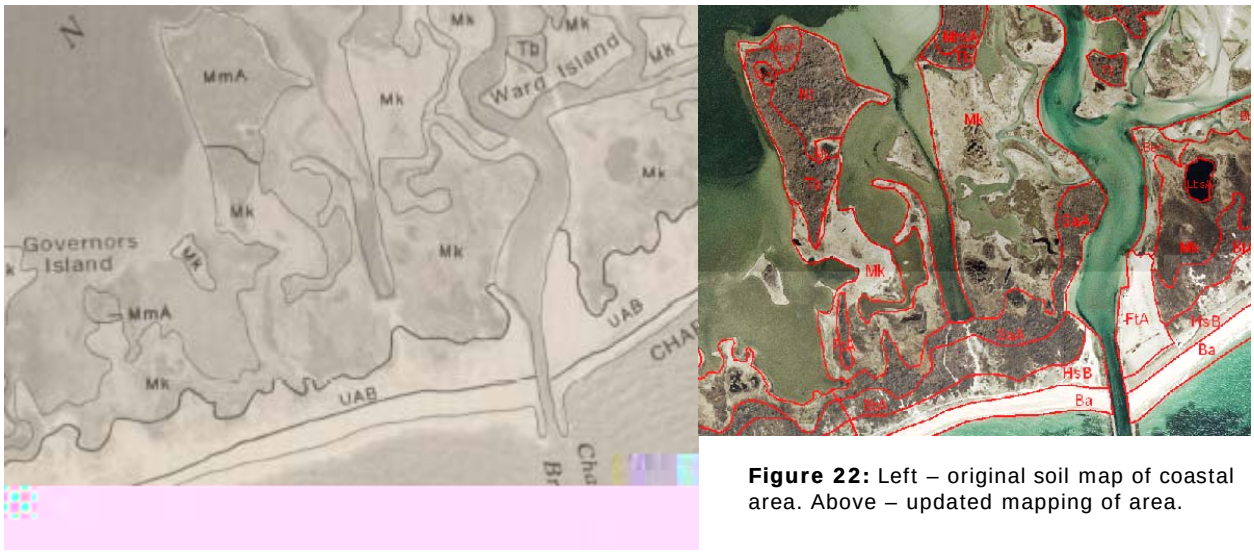


Figure 22: Left – original soil map of coastal area. Above – updated mapping of area.

Several Ad-hoc special features have also been developed including shoreline protection structures, shelly areas, outcrop islands, aquaculture sites, and anthropogenic features.

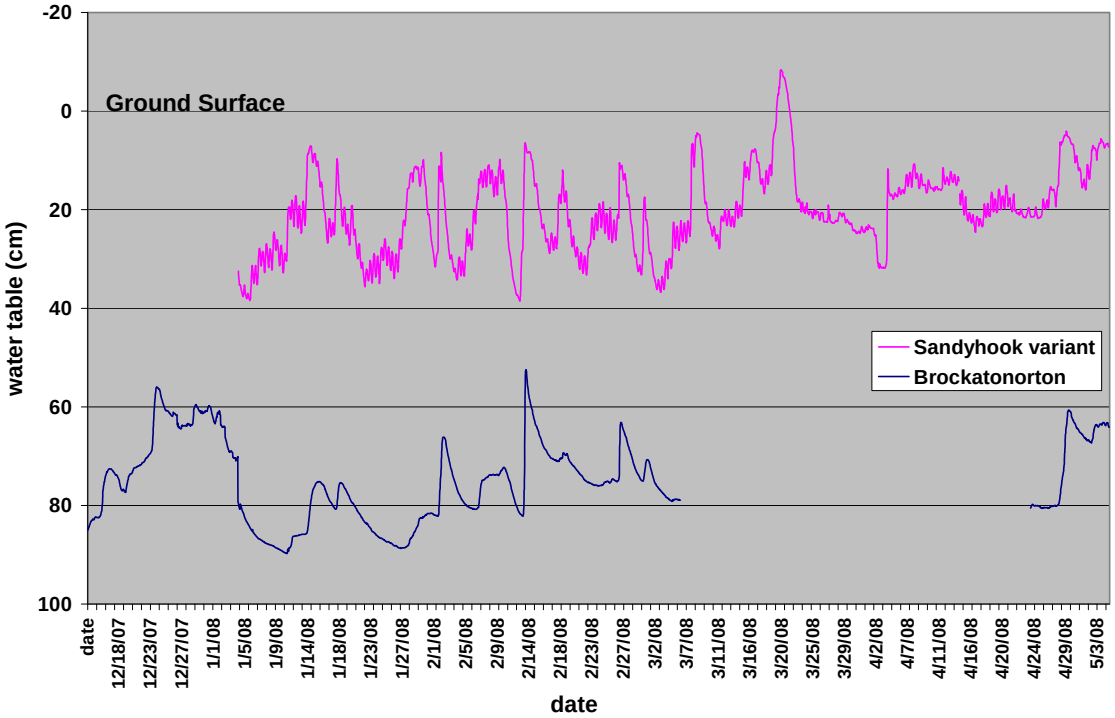


Figure 23: Water table data for two sites on the Ninigret barrier that are currently mapped as Udipsamments demonstrates the differences in these soils.

Proposals Sent in to NSSC for Subaqueous Soils

The following are brief summaries of proposals that have been sent in to the NSSC for adding attribute information to NASIS and Pedon PC for subaqueous soils. A proposal for a subordinate distinction for sulfidic materials is being written and will be proposed shortly.

- Jarosite Proposal
  Jarosite, an iron sulfate mineral, is a kind of diagnostic feature of sulfuric horizons and evidence of acid sulfate weathering.

  Purpose
  Jarosite is a pale yellow mineral deposit which forms in acid sulfate soils under strongly oxidizing, severely acid conditions. Jarosite is used as a morphologic feature to identify active and post active stages of acid sulfate soils.

  The Component Diagnostic Features table lists the typical features, such as ochric epipedon or cambic horizon, for this component in this data mapunit. The rows in this table, as a group, describe the representative situation for this component in this data mapunit.

- Manner of Failure Proposal
  Definition of attribute: The manner in which soil specimens fail under increasing force. (SSM)

  Purpose
  Modified the choice definitions to include the approximate equivalent n-values by Pons and Zonneveld (1965).

  In soil taxonomy, n- values are used as a criterion for the proposed great groups and subgroups in the Wassents.

  Choice List and Choice Definitions (modified)

  - *Nonfluid*: None flows through the fingers after exerting full compression. (SSM) The approximate equivalent n-value is less than 0.7. (Pons and Zonneveld, 1965)
  - *Slightly Fluid*: After exerting full compression, some flows through the fingers, but most remains in the palm of the hand. (SSM) The approximate equivalent n-value is 0.7 to 1. (Pons and Zonneveld, 1965)
  - *Moderately Fluid*: After exerting full pressure, most flows through the fingers; a small residue remains in the palm of the hand. (SSM)The approximate equivalent n-value is 1 to 2. (Pons and Zonneveld, 1965)
  - *Very Fluid*: Under very gentle pressure, most flows through the fingers like a slightly viscous fluid; very little or no residue remains in the palm of the hand. (SSM) The approximate equivalent n-value is equal to or greater than 2. (Pons and Zonneveld, 1965)

- Oxidized pH Proposal

  Definition of Attribute:
  The negative logarithm to the base 10, of the hydrogen ion activity in the soil using the oxidized pH method. A numerical expression to identify the presence of sulfidic materials of a soil sample.

  Purpose

  To identify the presence of sulfidic materials in mineral or organic soil horizons that have a pH value of more than 3.5 and that, if incubated as a layer 1 cm thick under moist conditions (field capacity) at room temperature, show a drop in pH of 0.5 or more units to a pH value of 4.0 or less (1:1 by weight in water or in a minimum of water to permit measurement) within 8 weeks (USDA NRCS, 2006).

  If soil containing sulfidic materials is drained or otherwise exposed to air, the sulfides oxidize and form sulfuric acid. The pH value, which normally is near neutral before drainage or exposure, may drop below 3 (USDA NRCS, 2006). For every ton of sulfidic matter that is oxidized, 1.6 tons of sulfuric acid is produced (NWPASS, 2000).

  pH Oxidized Laboratory Method

  The intent of the method described is to determine if known or suspected sulfidic materials will oxidize to form sulfuric acid. The pH oxidized method can be used in field offices.

In soil taxonomy, oxidized pH values are used as a criterion for proposed great groups and subgroups in the Wassists and Wassents and are evidence of a sulfuric horizon.

Summary of Method

Place 5 grams of soil sample in a beaker and add enough deionized water to make a slurry. Stir the slurry thoroughly to introduce air. Determine the initial pH immediately. Keep at room temperature. Stir occasionally and add more deionized water if needed. After 8 weeks determine the oxidized pH.

Report the initial pH and oxidized pH to the nearest 0.1 pH unit.

- Reaction to Peroxide Proposal (Payne):

Definition of Attribute:

The presence of reduced monosulfides is indicated with a change in color within 10 seconds with the addition of 3% Hydrogen peroxide solution. The color change is usually an increase in value by 2 or more.

Purpose
Sulfidic materials accumulate within a soil that is permanently saturated, generally with brackish water. The sulfates in the water are biologically reduced to sulfides as the materials accumulate. Sufidic materials commonly accumulate in coastal marshes near the mouth of rivers that carry noncalcareous sediments, but they may occur in freshwater marshes if there is sulfur in the water.

Monosulfides, often in the form of Fe(II) monosulfides, are visible in reduced soil as a dark black color. When a sulfidic soil is oxidized, either in place due to oxidized water conditions, or when the soil is drained, Fe(III) is formed, and the typical black color is lost, leaving a gray or brown color (Lyle, 1983). An example of a common monosulfide oxidation reaction: $FeS + O_2 + H_2O = Fe(OH)_3 + H^+ + SO_4$

Sulfidic materials are typically determined in the laboratory using incubation pH measurement in which a soil is kept in incubation for 8 weeks and the initial and final pH measurements are made. Hydrogen peroxide has also been used in determination of the presence of reduced sulfides in soil samples with pH measurements made after complete oxidation with H_2O_2 (Finkelman and Giffin, 1986; Jennings et al., 1999). Hydrogen peroxide speeds up the natural oxidation reaction and can be represented in the following reaction: $FeS + H_2O_2 = Fe(OH)_3 + H^+ + SO_4 + H_2O$

Figure 24: Applying a 3% hydrogen peroxide solution to determine the presence of sulfide.

In the field, the application of 3% hydrogen peroxide solution enables determination of the presence of reduced sulfides as monosulfides are oxidized and quickly change color upon exposure to peroxide. Presence of sulfide is defined as an immediate (within 10 seconds), discernable color change upon addition of H_2O_2, as seen below (Fig. 24).

- Multiple Primes Proposal

Definition of Attribute:

A character used to indicate that this horizon has an identical horizon designation as some overlying horizon. The two horizons in question are separated by at least one other horizon.

Purpose

If two or more horizons of the same kind are separated by one or more horizons of a different kind in a pedon, identical letter and number symbols can be use for these horizons that have the same characteristics, e.g. A-E-Bt-E-Btx-C, identifies two E horizons.

To emphasize this characteristic, the prime symbol is added after the master horizon designation of the lower of the two horizons that have identical designations, e.g. A-E-Bt-E'-Btx-C. The prime symbol, when appropriate is applied to the master horizon designation, and any lowercase letter symbols follow it: Bt: B't. In cases when three to five layers have identical letter symbols, three to five prime symbols can be used for the other horizons, e.g. A, C, Ab, C', A'b, C'', A''b, C'''. These situations exist in soils of the proposed Wassents and Wassists suborders.

- Mean Water Depth Proposal

Definition of Attribute

Mean water depth is the average vertical column of water above the subaqueous soil surface.

Purpose

The mean water depth is used for subaqueous soils that are found in shallow, permanently flooded environments.

In soil taxonomy, soils that have a positive water potential at the soil surface for 90 percent of each day are used as criterion for the proposed Wassents and Wassists suborders.

Relationship to other data, validation, calculations

This property is related to the Surface Water Depth, the observed depth of water on the soil surface, in the Site Observation table.

This soil property should be placed in the Component table, with entries for low, RV, and high. No default value is required, but validation scripts may be required. The following data element explanations are proposed:

Stop 3: Lunch on the Charlestown End Moraine

Figure 2 in the intro section shows the location of the series of end (recessional) moraines in southeastern New England. The ice sheet in this area was comprised of several distinct lobes (Buzzards Bay lobe, Great South Channel lobe, etc.). The Charlestown End moraine is part of the Central Rhode Island-Eastern Connecticut Lobe (CRI). The Charlestown morainal position is correlative with the Fisher Island-Roanoke Point Moraine to the west and the Buzzards Bay moraine to the east (Boothroyd, 1998). The Charlestown End moraine is a hummocky linear belt extending from about 2 kilometers west of Point Judith Pond southwesterly to Watch Hill (Figure 2A above). It is up to 2 kilometers wide and ranges from 40 to 50 meters in relief with some points up to 65 meters. The moraine is comprised of belts of uneven topography containing undulating ridges (ice-fracture fillings) and colluvial ramparts and mounds. Many of these mounds are flat-topped and consist of sand and gravel (Boothroyd, 1998).

Origin of the Moraine:

Unlike the end moraines of the central U.S. which are comprised almost entirely of till (caused by a stationary wasting ice sheet), the moraines of SE New England have been called "push or thrust moraines" that are believed to be formed by an actively advancing and retreating ice sheet depositing material (re-working) over the underlying older deposits. This theory suggest the moraine is comprised of numerous thrust sheets of supraglacial till overtopping stratified deposits as show in figure 24 (taken from *Cape Cod and the Islands, The Geologic Story*, by Robert Oldale). As with most of the upland soils in the region the moraine till and re-worked outwash are capped by an eolian mantle in some areas, the moraine is generally marked by the topographic elevation and the large surface boulders. As we head out of the Burlingame Campsite after lunch we will travel along the southern edge of the moraine on Route 1 then cut across it while travelling north on scenic Ministerial Road (Route 110). As we drop off the moraine we enter the large Great Swamp which is part of glacial Lake Worden.

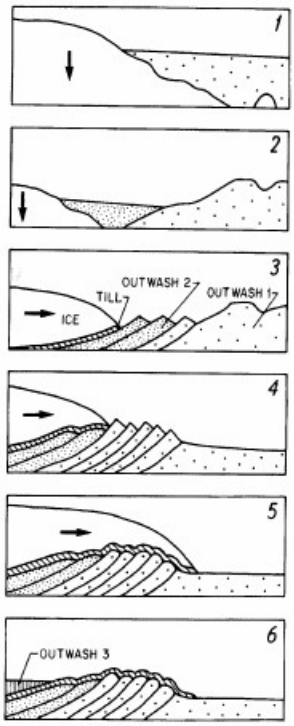


Figure 30. A model for the formation of the coastal end moraines. Steps 1 and 2 represent the formation of outwash plains beyond a downwasting stagnant ice front, shown by the vertical arrows. Steps 3 and 4 represent the formation of the thrust moraine by the advancing ice front, shown by the horizontal arrows. The thrust moraine is formed by adding thrust sheets at the base of the moraine. Step 5 shows the advancing ice front overriding the moraine and depositing a thin veneer of till atop the moraine. The final step represents the end moraine following ice retreat.

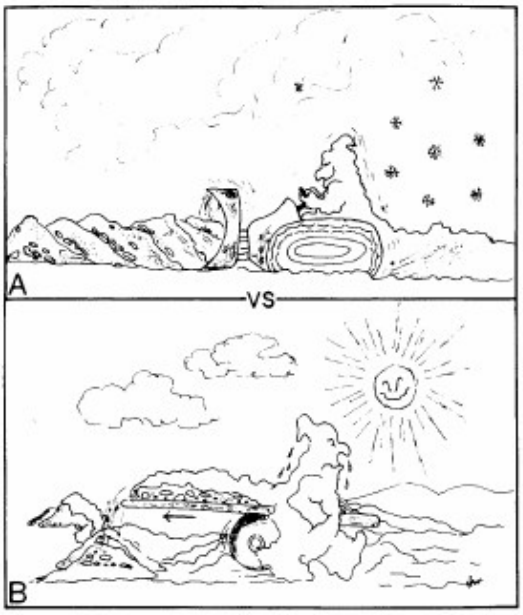


Figure 24: Left – Formation of push moraines. Above – Cartoon of two theories of Moraine formation A-thrust sheets; B-wasting ice.

Mapped on the Moraines:
Due to the complex topography (slope), geology, eolian deposition, and surface fragment classes these moraines are typically mapped as complexes of several series and phases. In Massachusetts the Plymouth and Barnstable series are the dominant soil mapped on the moraines with minor areas of dense till soils, glaciofluvial soils, and lacustrine soil also mapped. In the Rhode Island soil survey Hinckley and Windsor (fluvial), Gloucester (sandy till), Canton and Charlton soils were mapped on the Charlestown moraine. Unfortunately we will not have enough time to see the soils on the Moraine, below are photos of the three soil pits we dug on the moraine for the soil judging contest.

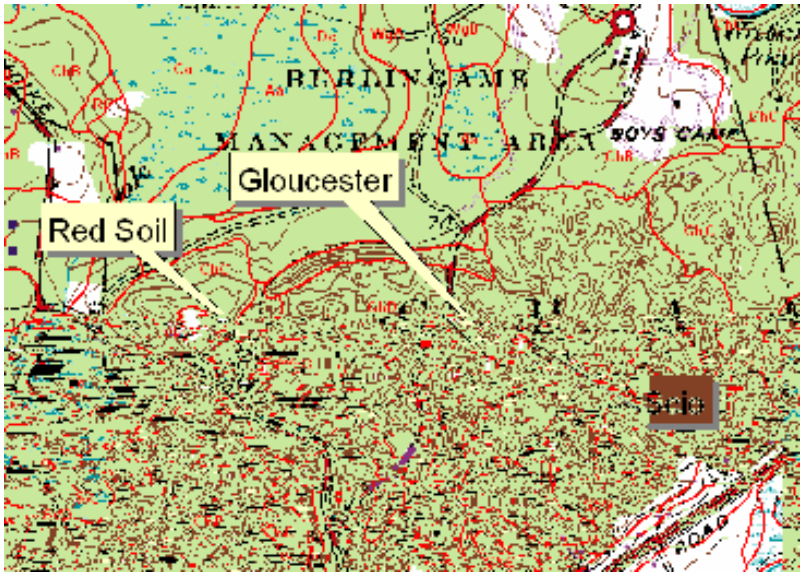


Figure 25: Soils Mapped on the Moraines

Red Plymouth Soil found in Moraine.

An excessively well drained Gloucester (or Plymouth) soil with a thin E and Bs horizon – typical Moraine soil.

A fine textured Scio, silt loam soil located in a depression (kettle hole).

Figure 26

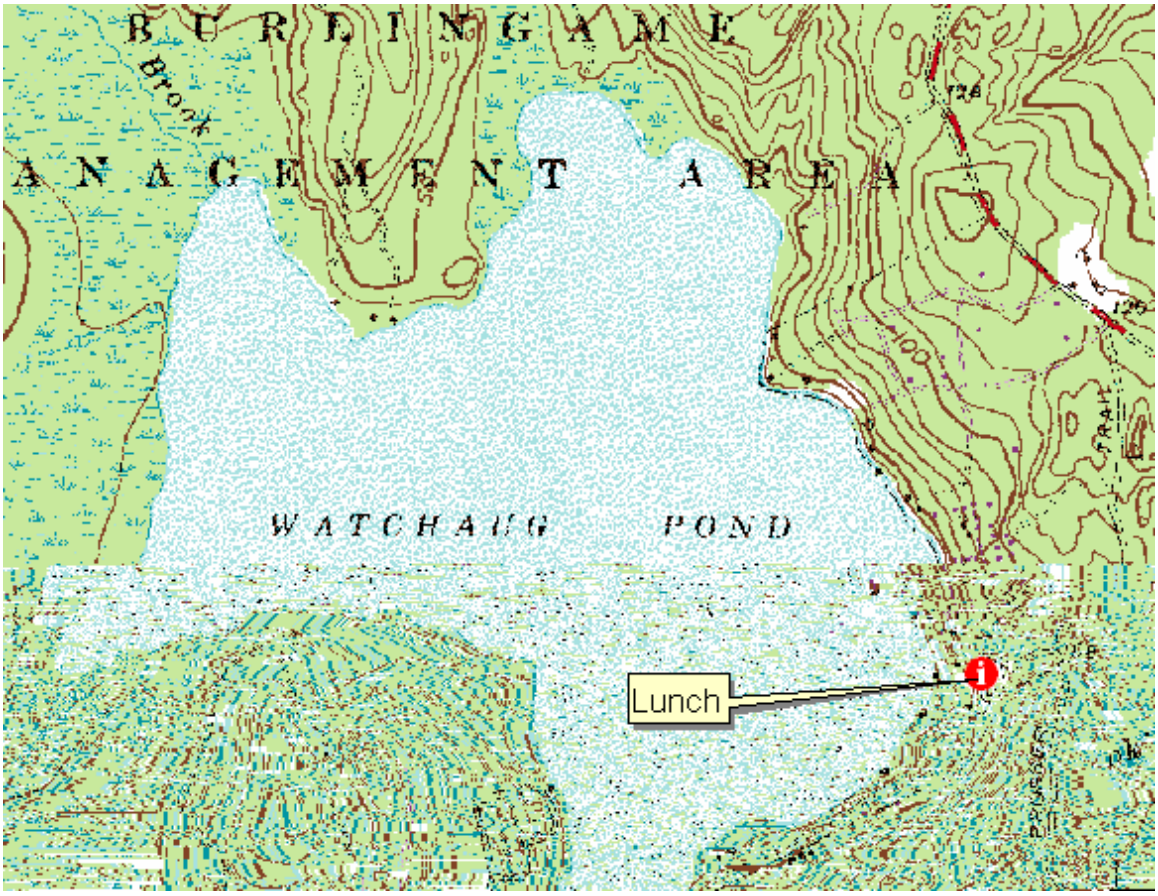


Figure 27: Lunch will be at the Burlingame Campground next to Watchaug Pond.

After lunch we will take a scenic ride on Ministerial Road which drives up and over the Charlestown Moraine and through the Great Swamp, part of glacial Lake Warden.

Stop 4: Bridgehampton Soil, Spectral Analysis, and Sod Farming

Here will make a brief stop to examine the Bridgehampton Coarse-silty, mixed, active, mesic Typic Dystrudepts series. Approximately 20,000 acres of Bridgehampton soils are mapped in Rhode Island and 11,000 acres mapped on Long Island, NY. Bridgehampton soils were formerly mapped the Miami series (classified as Entic Haplorthods) in the 1905 RI survey but were changed to Bridgehampton series shortly after. Bridgehampton soils are well to moderately well drained soils formed in more than 40 inches of silty loess underlain by fluvial deposits. A historic document on the series from 1969 can be found at: http://nesoil.com/muds/Bridgehampon_1967.pdf.

Morphology:

The strongly contrasting particle size between the silty loess and gravelly fluvial/till deposits in these soils causes what has been termed a “hanging” water table at the loess/outwash interface. The soils at this contact encounter near saturated conditions, water can be squeezed out during the wet season but does not enter a monitoring well. Once enough head is built up the water is then forced into the

glacial material (similar to adding water to a fine sponge). As the water moves into the coarse material, iron is precipitated and forms a bright reddish ring along the contact. Above this bright layer is usually a grey colored horizon with redox concentrations, there are two different thoughts on the morphology (and horizon description) of this horizon and the underlying bright horizon. One way is to consider the soil as having a bisequum (Bw1-Bw2-E-B'w1-B'w2) as the current OSD; the other is to consider the gray layer unweathered loess and thus a C1 horizon underlain by bright 2C material. Although redox features are described in the gray horizon it is not usually considered to have a seasonal high water table for septic system evaluations.

Below is the pedon description for this pedon:

PEDON DESCRIPTION: (Colors are for moist soil.)

A--0 to 5 centimeters; dark brown (7.5YR 3/2) silt loam; weak subangular blocky structure; friable; abrupt boundary.

Bw1-- 5 to 33 centimeters; dark yellowish brown (10YR 4/4) silt loam; weak subangular blocky structure; friable; gradual boundary.

Bw2 -- 33 to 63 centimeters; light olive brown (2.5Y 5/4) silt loam; weak subangular blocky structure; friable; gradual boundary.

BC1--63 to 86 centimeters; grayish brown (2.5Y 5/2) silt loam; weak subangular blocky structure; friable; few prominent redoximorphic concentrations; clear boundary.

BC2--86 to 117 centimeters; light olive brown (2.5Y 5/4) silt loam; weak subangular blocky structure; friable; common distinct redoximorphic concentrations; abrupt boundary.

2C--117 to 130+ centimeters; light olive brown (2.5Y 5/3) very gravelly coarse sand; single grain; loose; 40 percent gravels.

Spectral Analysis: E. J. Neafsey will review his data collected at this site using a field spectrometer.

See his paper in the appendix.

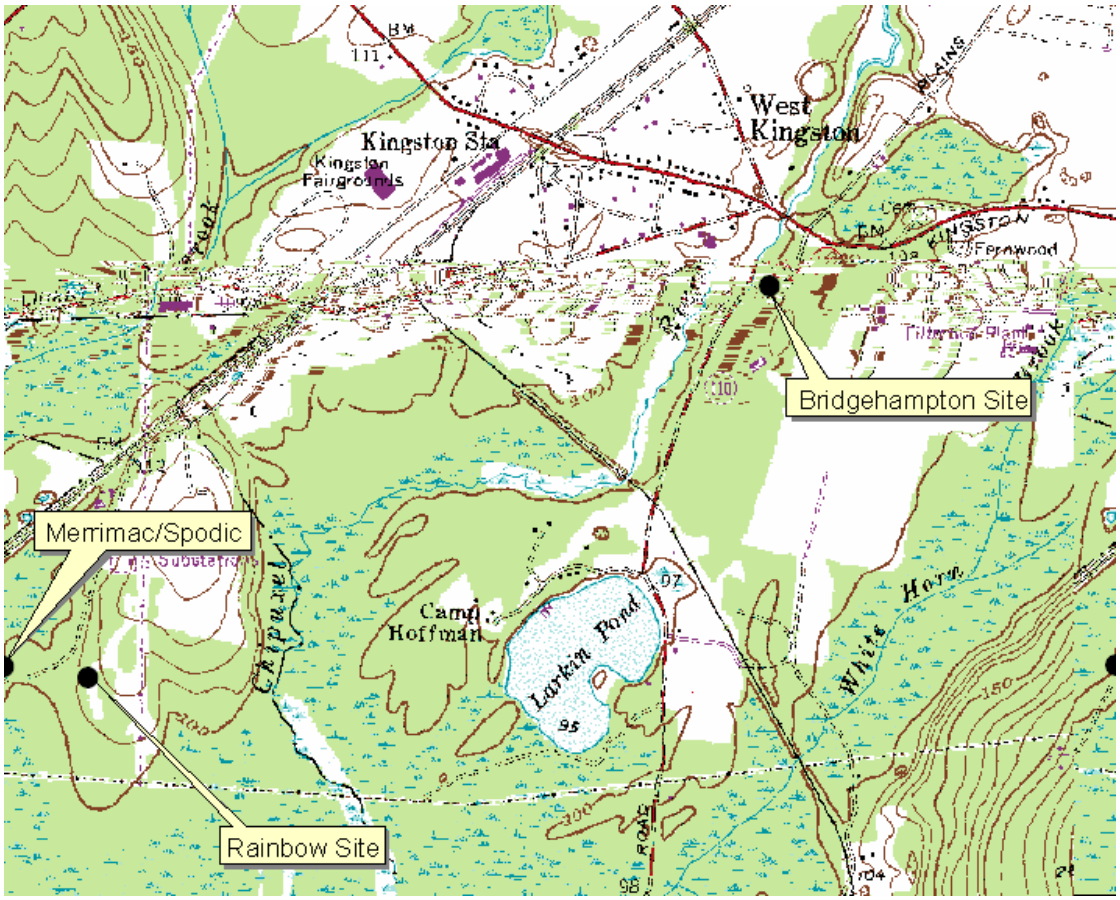


Figure 28

Stop 5: Great Swamp, Drumlin Till, Rainbow Soils, Merrimac and the Mesic Spodic Indicator

The Great Swamp Management Area (Dept. of Environmental Management) covers a total land area of 3,349 acres. Acreage is divided among the following cover types: wetlands (2262 acres), forest cover (897 acres), agricultural land (88 acres), and other lands (102 acres; brush, utilities, etc.). The area contains extensive forested freshwater wetlands, dominated by red maple swamps with some

Rainbow Series

Figure 29

Our first pit in the Great Swamp will be near the summit of a drumloidal landform. Drumlins are oval-shaped streamline hills that are formed as glacial ice deposits lodgement till as they moved into an area. Most drumlins are oriented from NW to NE to SE/SW direction showing the ice came from the north. The exact formation of drumlins is not known but they are generally thought to begin as ice hits a bedrock or older till high and begins to deposit till due to frictional forces.

The Rainbow series consists of moderately well drained loamy soils formed in silty loess overlying subraglacial till. The soils are very deep to bedrock and moderately deep to a densic contact. They are nearly level to strongly sloping soils on till plains, hills and drumlins. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is moderately high or high in the surface layer and subsoil, and low to moderately high in the dense substratum. Mean annual temperature is about 49 degrees F., and mean annual precipitation is about 48 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Aquic Dystrudepts

RAINBOW PEDON DESCRIPTION: (Colors are for moist soil.)

Ap -- 0 to 23 centimeters; very dark brown (10YR 3/2) silt loam; weak subangular blocky structure; friable; abrupt boundary.

Bw1-- 23 to 45 centimeters; dark yellowish brown (10YR 4/6) silt loam; weak subangular blocky structure; friable; clear boundary.

Bw2 -- 45 to 67 centimeters; light olive brown (2.5Y 5/4) silt loam; weak subangular blocky structure; friable; clear boundary.

BC -- 67 to 88 centimeters; light olive brown (2.5Y 5/3) silt loam; weak subangular blocky structure; friable; many distinct redoximorphic depletions and many prominent redoximorphic concentrations; abrupt boundary.

2Cd -- 88 to 120 centimeters; grayish brown (10YR 5/2) silt loam; weak subangular blocky structure; firm; common prominent redoximorphic concentrations; abrupt boundary.

Morphology:

This pit shows an excellent example of the eolian cap or mantle that overlies many of our upland soils in southern New England. Mantles in this area typically range from 15 to 40 inches and consists of silt and sandy loams to coarse sand (depending on the source material, wind force, and topography of the glacial landscape). Redox concentrations and depletions are well expressed in the lower Bw and upper 2Cd horizon. The soil also shows our densic material (lodgement till) that is described as 2Cd

horizons. Debates between fragipans vs. dense till has been going on in the northeast for decades, before the "d" was developed these horizons were described as Cx horizons.

Merrimac and Massasoit Soils:

Our 2nd stop at the Great Swamp will briefly examine the Merrimac (Sandy, mixed, mesic Typic Dystrudepts) and the Massasoit (classification to be discussed in the field) soils.

Merrimac soils are extensively mapped glacial fluvial soils with the thin sandy loam cap overlying stratified sand and gravel. They are somewhat excessively well drained soils on terraces, deltas, and outwash plains. This pit shows nice stratification in the fluvial deposits.

MERRIMAC PEDON DESCRIPTION: (Colors are for moist soil.)

A--0 to 7 centimeters; very dark brown (7.5YR 2.5/2) sandy loam; weak granular structure; very friable; clear boundary.

Ap--7 to 18 centimeters; dark brown (7.5YR 3/2) sandy loam; weak subangular blocky structure; very friable; 2 percent gravel; abrupt boundary.

Bw-- 18 to 38 centimeters; dark yellowish brown (10YR 4/4) sandy loam; weak subangular blocky structure; very friable; 5 percent gravel; gradual boundary.

BC -- 38 to 67 centimeters; olive brown (2.5Y 4/4) coarse sand; single grain; loose; 10 percent gravel; gradual boundary.

C—67 to 115 centimeters; light olive brown (2.5Y 5/4) coarse sand; weak subangular blocky structure; 10 percent gravel; loose.

Massasoit soils are poorly drained soils formed in sandy glaciofluvial deposits. They are shallow to cemented subsoil and very deep to bedrock. They are on outwash plains and deltas, along drainageways and adjacent to swamps and bogs. Slope ranges from 0 to 5 percent. Permeability is rapid or moderately rapid in the surface horizon, slow or very slow in the cemented subsoil (ortstein), and rapid in the substratum. Mean annual temperature is about 48 degrees F. and mean annual precipitation is about 43 inches.

Although no Spodosols were correlated in the RI soil survey they were recognized and described (as the Augres series) but correlated to Walpole soils. During the NEHTSC hydric soils tour in 2004 the committee studied several years of hydrologic data in vernal pools and found that many of these sites were poorly and very poorly drained Spodosols that were not keying out using our Version 3 Field Indicators for Identifying Hydric Soils in New England. About 30 profile descriptions were taken and compared to the vegetative and hydrologic data to show that these were hydric soils. In 2007 another hydric soil tour was run in southern New Hampshire and SE Massachusetts to examine poorly drained Spodosols. At these sites we had several years of data including IRIS tubes, water table readings, and soil temperature. The result of these field examinations lead to the development of a proposed "mesic Spodosol" hydric indicator listed below. This site will show these soils and some of the problems associated with their hydric status.

Proposed Mesic Hydric Indicator:

7. A__. Mesic spodic. For use only in MLRA 144A, 145 of LRR R, and 149B of LRR S. A layer 5 cm (2 inches) or more thick starting within 15 cm (6 in) of the (mineral) soil surface that has value of 3 or less and chroma 2 that is underlain by either: **a)** an illuvial layer(s) 8 cm (3 in) or more thick occurring within 30 cm (12 in) of the surface that has value and chroma 3 or less; or **b)** an eluvial layer(s) 8 cm (3 in) or more thick occurring within 30 cm (12 in) of the surface that has value of 4 or more and a chroma of 2 or less that is directly underlain by an illuvial layer(s) 8 cm (3 in) or more thick that has value and chroma 3 or less.

User Notes: This indicator is used to identify wet soils with spodic morphology in MLRA 144A, 145, and 149B or Region R and S only. The eluvial layer with evidence of translocated organic matter is typically described as an E or Eg horizons (these typically have a color pattern referred to as stripped matrixes). The illuvial layer is typically described as Bh, Bhs, or Bhsm horizons that typically have several color patterns or cementation indicative of translocated iron, manganese, aluminum, and\or organic matter.

Sodco Sod fields and Ice Wedge Casts:
This will just be a drive by (not a stop) the large Slocum outwash plain that is used for sod production. Most of these fields are mapped Bridgehampton and Enfield soils.

Figure 30: Sod Production

Evaluating the Effects of Sod Farming on Soil Quality

David Millar

Abstract

Sod production is one of the largest agricultural enterprises in Rhode Island. Much of the area used for sod production (prime farmland) is under development pressure. One option to minimize the development of these areas is through the transfer of development rights (TDR). Funding for TDR is dependent upon the sustainability of the land under the present use and maintenance of the soil quality. In this study, soil quality and soil loss of land used for sod production were investigated. The objectives were: i) to identify appropriate soil quality indicators to be used for assessing the sustainability of land used for sod production; ii) to establish a range of values for soil quality indicators on successful sod farms to aid future soil quality assessment on sod farming operations; and iii) to determine the overall effect commercial sod production has on soil loss relative to other land use types. Five sod farms and three reference sites (forest, turf plot, and silage corn field) were investigated. All sampling sites were within delineations mapped as Agawam, Bridgehampton, and Enfield soils. These soils have formed eolian deposits overlying glaciofluvial deposits. Bulk density, infiltration rate, soil organic matter (SOM) content, soil organic carbon pools, C:N ratios, pH, extractable NH_4 and NO_3, microbial biomass carbon (C_{mic}), and soil respiration were measured as dynamic indicators of soil quality. Solum thickness and depth to glaciofluvial deposits were measured at three sod farms as indicators of inherent soil quality. In addition, the mineral content of harvested sod and soil bulk density was measured at four sod farms to quantify annual soil loss due to sod production.

A range of soil quality indicators was developed representative of sod farms: bulk density (1.25 – 1.41 g cm^{-3}), infiltration rate (13 – 48 cm hr^{-1}), soil pH (6.1 – 6.8), NO_3 content (0.0 – 2.0 mg kg^{-1}), NH_4 content (0.0 – 2.1 mg kg^{-1}), SOM content (3.38 – 6.09 %), C:N ratios (8 – 50), Soil respiration rates (197.0 – 371.9 kg C ha^{-1} d^{-1}), C_{mic} (93 – 302 mg kg^{-1}). In general, dynamic soil quality indicators

measured in this study reflected positively on sod farms relative to reference sites. This suggests that land management practices associated with sod production do not have a detrimental effect on dynamic aspect of soil quality for these soils.

Soil removal rates ranged from 74 to 114 Mg ha^{-1} yr^{-1}. Differences in solum thickness and depth to glaciofluvial deposits in sod fields in production for 3, 20, and 30 years suggested that after approximately 100 yr of sod production the eolian mantle of these soils would be completely depleted and the soil quality would be severely impaired. These results suggest that sod production is not compatible with long-term soil sustainability.

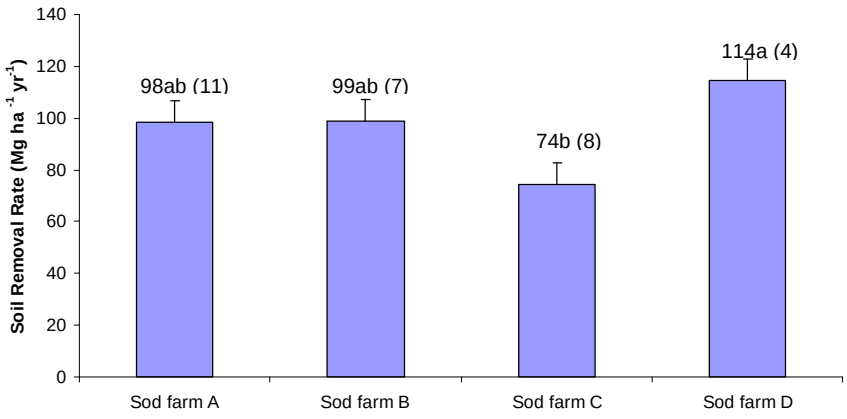


Figure 31

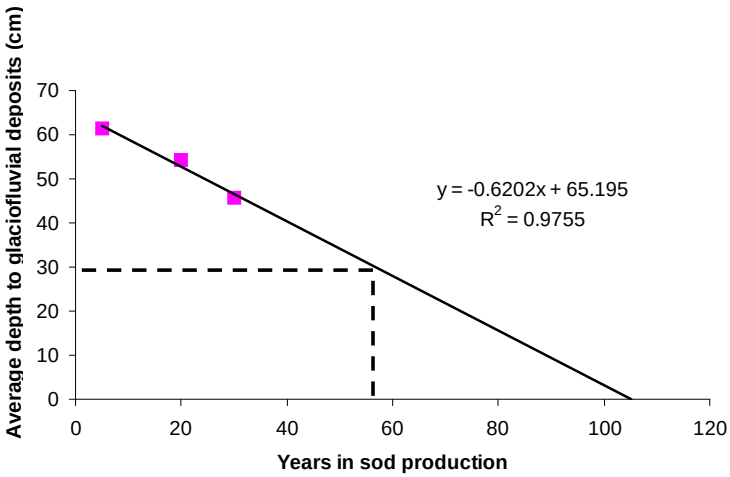


Figure 32

Mean soil removal rates (n=9) at sod farms A, B, C, and D during harvest (additions of mineral materials were accounted for). Coefficients of variation appear in parentheses.

Means with different letters are significantly different ($P \leq 0.05$).

Relationship between average depth to glaciofluvial deposits and years in production. Dashed lines indicate the approximate point in which glaciofluvial deposits will be become incorporated into the eolian mantle through tillage. The linear regression intersects the x-axis at 103 years suggesting the time frame for complete removal of the aeolian mantle.

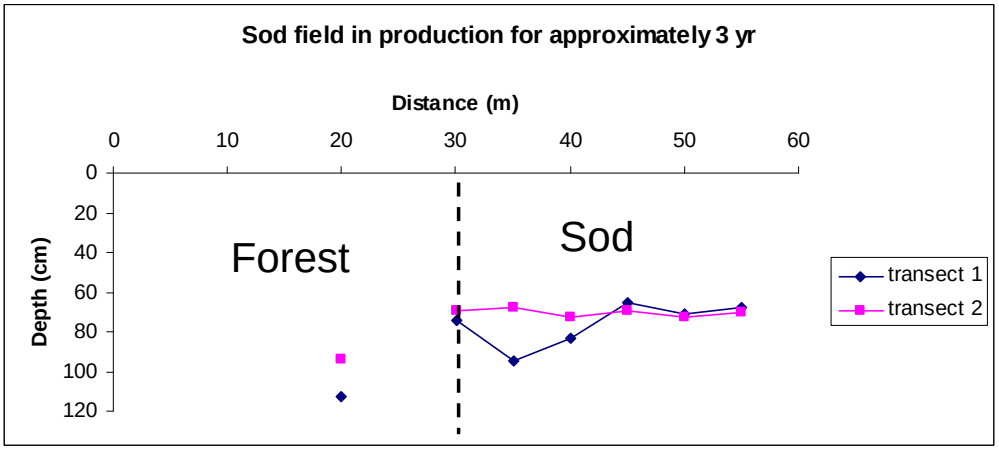


Figure 33A

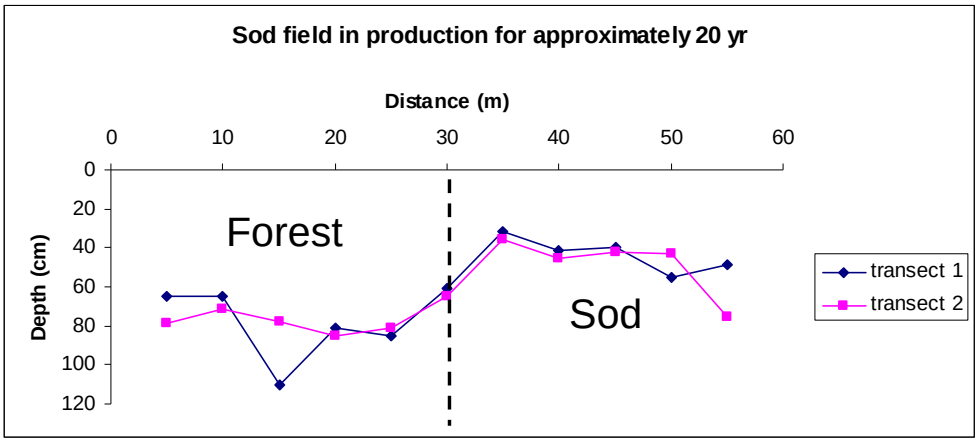


Figure 33B

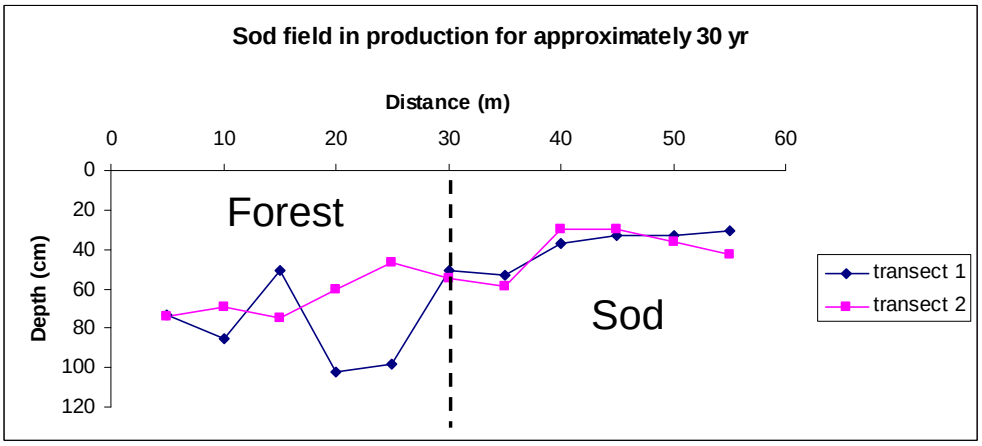


Figure 33C

Cross sections of solum thickness for an Enfield soil from forest to adjacent sod fields in production for approximately 3, 20, and 30 years. Transects were 20 m apart.

Ice Wedge Casts:

There has been much debate over the climatic conditions following deglaciation. Most geologists in the area favor a harsh periglacial climate in which permafrost existed for several thousand years, until after glacial lake Hitchcock had drained. Evidence for this interpretation is in the form of ice-wedge casts, pingo scars, eolian deposition, cryoturbation of clasts and till, and the paleobotanical record (Janet Stone, Gail Ashley, 1992).

Ice wedge casts have been identified in house foundations by Dr. Jon Boothroyd along these fields and also recorded in a gravel pit nearby (access now denied) – figure 34 shows this ice wedge cast. There have been several interpretations to the formation of these wedge-shaped structures including pseudo-

Figure 34: Ice Wedge Cast at Codgdon Hill (photo Boothroyd)

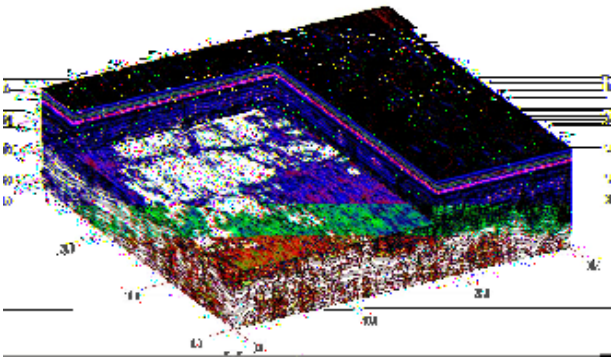


Figure 35: *3Dd Image of GPR profiles showing the polygonal structure of the ice wedges identified by the GPR.*

Ice Wedge Casts, formation by earthquakes, and true Ice Wedge casts. One of the features needed to prove the ice-wedge interpretation is to show these features form the classic pattern ground polygonal structure. In 2006 a grid was established over an area of known ice-wedges and a ground-penetrating radar survey performed. The radar data was combined into one file and 3D time slices were made to view the layers from surface down. Figure 35 is the radar grid showing the polygonal pattern at the site helping to provide this interpretation.

Stop 6: Jamestown Carboniferous Till

As we head onto Route 138 east from Route 1 we will *drop* into the Narragansett Basin. The first signs of the carboniferous bedrock will be at Stook Hill shortly after the on ramp onto Route 138. If you look to the north outcrop you will see the meta-sandstone atop and the black shale at the bottom of the outcrop. We will head through a deep cut showing the east dipping beds of stratified rock just before getting onto the Jamestown Bridge. On the south side of the Jamestown Bridge is the remnant of the old Jamestown Bridge that was recently *blown up* in 2006. Where the toll booth for Newport Bridge is located sits the Beaverhead Fault separating the Cambrian Aged rocks to the south from the Pennsylvanian Aged rocks to the North (a nice outcrop of the Cambrian Aged phyllite can be seen to the east on Taylor Point.)

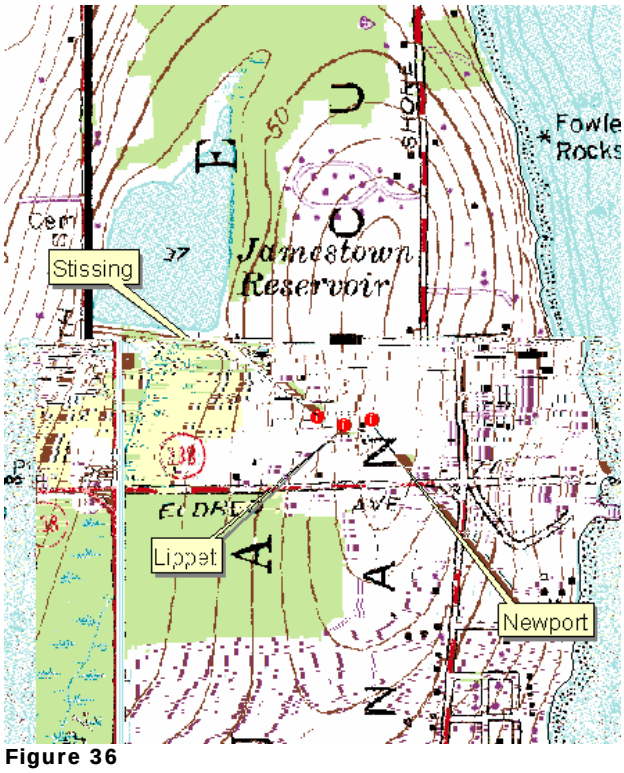


Figure 36

Community Farm – Newport – Pittstown-Stissing Soils

Our final stop is located on a drumlin, the soils in this area formed in till (capped in areas by eolian material ranging from loamy sand to silt loam) derived from the dark colored (lithochromic) carboniferous rocks of the Narragansett Basin. The Newport-Pittstown-Stissing-Mansfield soils are mapped on these drumlins which make up about 6% of the state. The site is part of the Jamestown Community Farm that provides its harvest of organic vegetables to local food banks. Last year over 14,000 pounds of produce was harvested from these fields.

Newport Coarse-loamy, mixed, active, mesic Typic Dystrudepts are well drained (sort of) soils formed in lodgement till derived from dark colored parent rock. Newport soils are a benchmark series; this pit was recently sampled and sent to the National Soil Survey Lab in Lincoln for full characterization. Below is the pedon description for this site.

NEWPORT PEDON DESCRIPTION: (Colors are for moist soil.)

Ap1--0 to 17 centimeters; very dark gray (10YR 3/1) fine sandy loam; weak granular structure; friable; 5 percent gravel; clear boundary.

Ap2--17 to 33 centimeters; dark brown (10YR 3/2) fine sandy loam; weak subangular blocky structure; friable; 5 percent gravel; clear boundary.

Bw-- 33 to 58 centimeters; very dark grayish brown (2.5Y 3/2) gravelly fine sandy loam; weak subangular blocky structure; friable; 18 percent gravel; clear boundary.

C1 -- 58 to 82 centimeters; very dark gray (N 3/) fine sandy loam; massive structure; friable; 5 percent gravel; clear boundary.

C2 -- 82 to 97 centimeters; dark olive gray (5Y 3/2) sandy loam; massive structure; friable; 14 percent gravel; abrupt boundary.

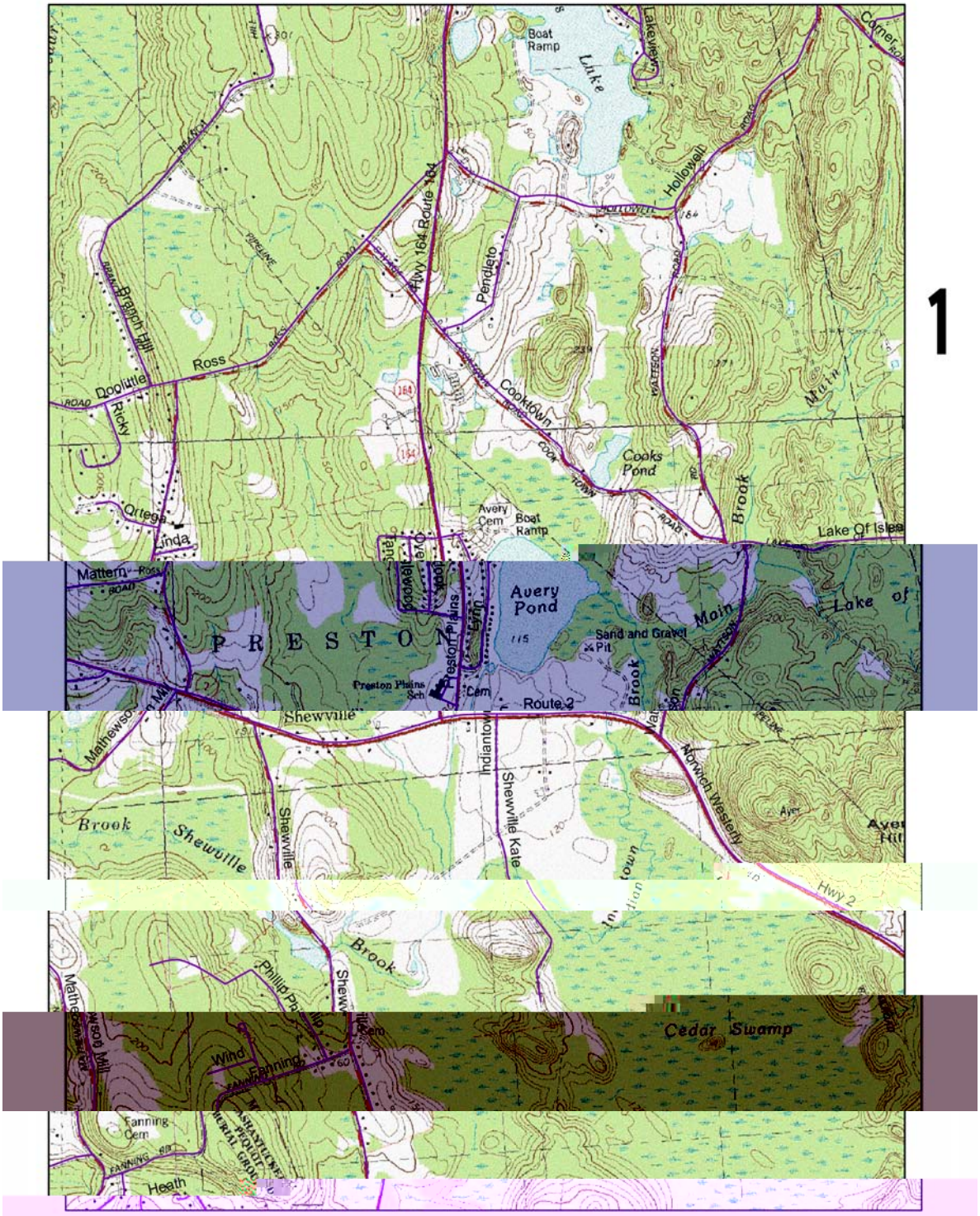
Cd—97 to 105+ centimeters; black (N 2.5/) channery silt loam; massive structure; firm; 20 to 30 percent channers.

Pittstown Coarse-loamy, mixed, active, mesic Aquic Dystrudepts soils are moderately well drained soils formed in loamy dense till derived primarily from carboniferous rocks and minerals dominated by sandstone, slate, schist, phyllite, and shale. The dark colored till is due to the high carbon contained in minerals within the parent rocks. The dark colors of the soil cause some difficulty in the determination of the depth to estimated average seasonal high water table. This pit encountered a 2Cr horizon within the control section which makes it an inclusion of Lippit (Loamy-skeletal, mixed, active, mesic Typic Dystrudepts) (moderately deep to bedrock).

Stissing (Loamy, mixed, semiactive, acid, mesic, shallow Typic Epiaquepts) are poorly drained hydric soils. This site is one of the study sites u

Appendix

Preston Plains



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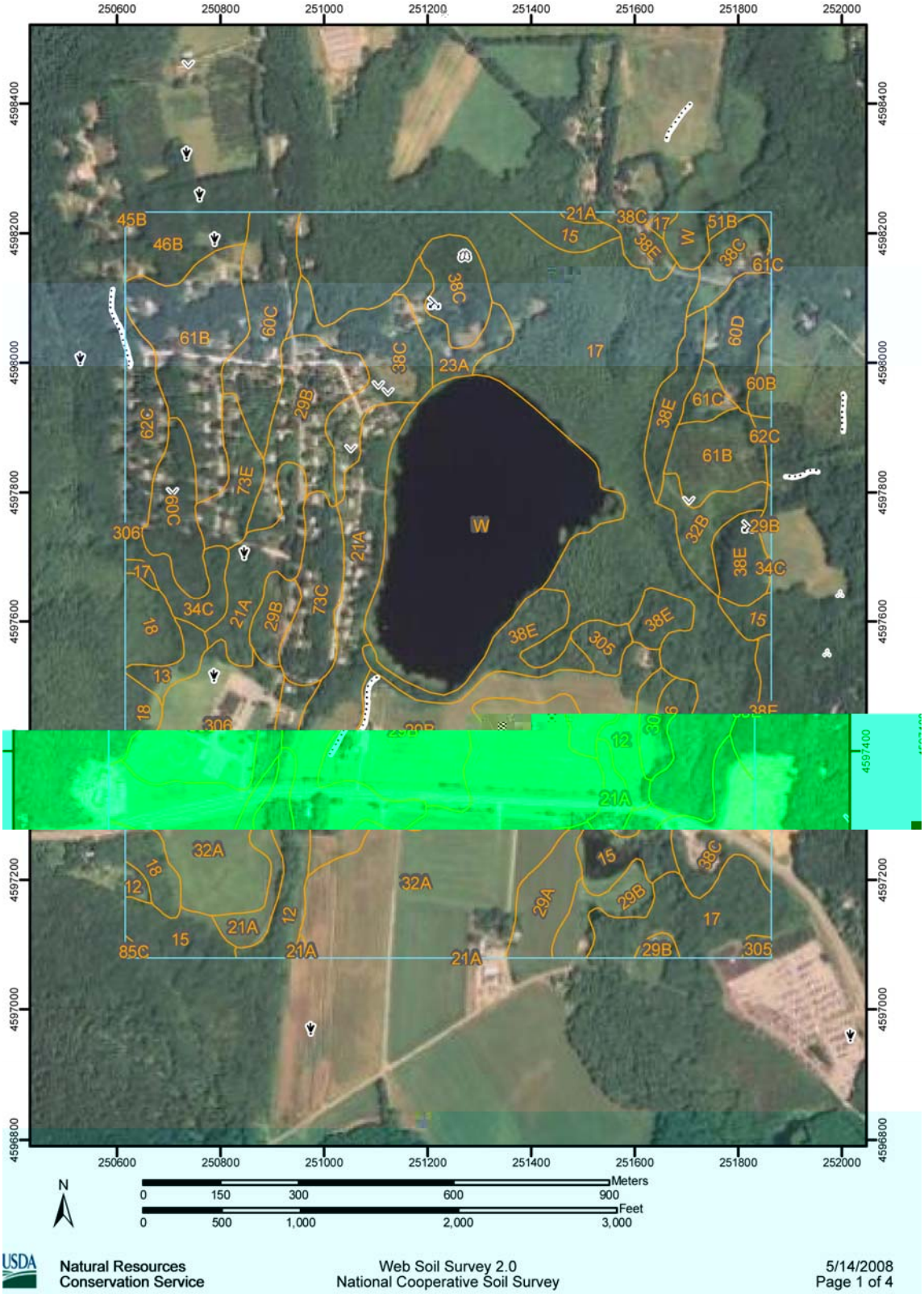
Soil Map–State of Connecticut
(Preston Plains Soils)



USDA Natural Resources Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

5/14/2008
Page 1 of 4

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 19N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 6, Mar 22, 2007

Date(s) aerial images were photographed: 3/18/1992

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

State of Connecticut (CT600)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
12	Raypol silt loam	9.7	2.2%
13	Walpole sandy loam	2.2	0.5%
15	Scarboro muck	12.9	2.9%
17	Timakwa and Natchaug soils	80.6	18.1%
18	Catden and Freetown soils	8.7	1.9%
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	33.5	7.5%
23A	Sudbury sandy loam, 0 to 5 percent slopes	4.2	1.0%
29A	Agawam fine sandy loam, 0 to 3 percent slopes	5.1	1.2%
29B	Agawam fine sandy loam, 3 to 8 percent slopes	37.7	8.5%
32A	Haven and Enfield soils, 0 to 3 percent slopes	55.3	12.4%
32B	Haven and Enfield soils, 3 to 8 percent slopes	4.6	1.0%
34C	Merrimac sandy loam, 8 to 15 percent slopes	3.9	0.9%
38C	Hinckley gravelly sandy loam, 3 to 15 percent slopes	27.0	6.1%
38E	Hinckley gravelly sandy loam, 15 to 45 percent slopes	20.8	4.7%
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	0.2	0.0%
46B	Woodbridge fine sandy loam, 2 to 8 percent slopes, very stony	6.1	1.4%
51B	Sutton fine sandy loam, 2 to 8 percent slopes, very stony	0.8	0.2%
60B	Canton and Charlton soils, 3 to 8 percent slopes	1.3	0.3%
60C	Canton and Charlton soils, 8 to 15 percent slopes	16.3	3.7%
60D	Canton and Charlton soils, 15 to 25 percent slopes	5.8	1.3%
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	21.3	4.8%
61C	Canton and Charlton soils, 8 to 15 percent slopes, very stony	1.9	0.4%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	6.5	1.4%

State of Connecticut (CT600)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	7.4	1.7%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	5.0	1.1%
85C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes, very stony	0.3	0.1%
305	Udorthents-Pits complex, gravelly	2.6	0.6%
306	Udorthents-Urban land complex	16.0	3.6%
W	Water	47.5	10.7%
Totals for Area of Interest (AOI)		445.1	100.0%

Taxonomic Classification of the Soils

State of Connecticut

[An asterisk by the soil name indicates a taxadjunct to the series]

Soil name	Family or higher taxonomic classification
Agawam	Coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts
Canton	Coarse-loamy over sandy or sandy-skeletal, mixed, semiactive, mesic Typic Dystrudepts
Catden	Euic, mesic Typic Haplosaprists
Charlton	Coarse-loamy, mixed, active, mesic Typic Dystrudepts
Chatfield	Coarse-loamy, mixed, superactive, mesic Typic Dystrudepts
Enfield	Coarse-silty over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts
Freetown	Dysic, mesic Typic Haplosaprists
Haven	Coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts
Hinckley	Sandy-skeletal, mixed, mesic Typic Udorthents
Merrimac	Sandy, mixed, mesic Typic Dystrudepts
Montauk	Coarse-loamy, mixed, subactive, mesic Oxyaquic Dystrudepts
Natchaug	Loamy, mixed, euic, mesic Terric Haplosaprists
Ninigret	Coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Aquic Dystrudepts
Paxton	Coarse-loamy, mixed, active, mesic Oxyaquic Dystrudepts
Raypol	Coarse-loamy over sandy or sandy-skeletal, mixed, active, acid, mesic Aeric Endoaquepts
Scarboro	Sandy, mixed, mesic Histic Humaquepts
Sudbury	Sandy, mixed, mesic Aquic Dystrudepts
Sutton	Coarse-loamy, mixed, active, mesic Aquic Dystrudepts
Timakwa	Sandy or sandy-skeletal, mixed, euic, mesic Terric Haplosaprists
Tisbury	Coarse-silty over sandy or sandy-skeletal, mixed, active, mesic Aquic Dystrudepts
Udorthents	Udorthents
Walpole	Sandy, mixed, mesic Aeric Endoaquepts
Woodbridge	Coarse-loamy, mixed, active, mesic Aquic Dystrudepts

Interpretations using Subaqueous Soil Surveys

Moorings: An Interpretation from the Coastal Zone Soil Survey of Little Narragansett Bay, Connecticut and Rhode Island

Deborah A. Surablan

In the last decade, the boating population has exploded, and moorings are increasing in number. The demand for mooring locations in Connecticut has grown, while the number of vessels most harbors can accommodate is fairly fixed. A mooring refers to a structure or anchor used to hold secure a boat in a certain area, with a float or buoy attached. Years ago, only *inner* harbors were used for mooring areas. Now, *outer* harbors and even bays and ocean-front properties have moorings that are very exposed (INAMAR, 2000). Safety of a boat on a mooring depends on a number of elements—one of them is the type of bottom or soil surface layer materials.

The Subaqueous Soil Survey

Traditional soil mapping is conducted by a field soil scientist trained to understand the interaction of soil forming processes and soil–landscape relations. Mapping soil typically involves field work with the soil scientist traversing the landscape and digging many holes to observe the soil condition and classify the soil. Subaqueous soil mapping is performed in much the same way, except the soil is under water. Instead of topographic maps to provide landscape position, subaqueous soil mapping uses bathymetric maps to identify landscapes and landforms. Shovels are replaced by augers and special tools such as peat corers and vibracores to obtain the soil samples.

Soil samples are described to depths up to 200 cm. If the soils are very soft and fluid (high *n* value soils) or high in organic material, the peat sampler or push tubes are used. The *n* value is a measure of the amount of water a soil can hold relative to the clay and organic matter content. It was originally applied to very young alluvial marine or fluvial soils in the Netherlands and derived as a measure of soil "ripening" (Pons and Zonneveld (1965). Its application in *Soil Taxonomy* (Soil Survey Staff, 1999) is for a prediction of load support or degree of subsidence once a soil is drained. On the basis of these descriptions, representative soils are sampled for laboratory analysis from each land-

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Fig. 1. Photograph of a boat mooring area in Little Narragansett Bay. In the last decade, the boating population has exploded and moorings are increasing in number.

form unit using a vibracore. Field observations and laboratory analyses indicate significant differences in such characteristics as particle size class, organic carbon content, pH, and fluidity (n value). The boundaries of these soils are drawn on aerial photos and digitized for use with multiple types of data.

Moorings

After Hurricanes Gloria (1997) and Bob (1991), studies made it painfully evident that present moorings are inadequate. In New England, prevailing winds set the anchors in the westerly direction. A roaring northeaster or hurricane opposite the westerly set spins the anchor around 180° and it rolls out of the bottom. Away goes the vessel—mooring and all (INAMAR, 2000).

One fact that stood out about these particular storms is that a significant number of mooring failures are vessels driven ashore with their moorings. Why then do these vessels drag their moorings ashore fully intact? Is the wrong type of anchor used for the soil type? Without type of soil material in the surface layers has a great deal to do with the holding power of anchors.

There are two primary classes of anchors—temporary and permanent. A permanent anchor is often called a mooring, and is rarely moved. It is quite possible the vessel cannot hoist it aboard, but must hire a service to move or maintain it (Fig. 1). The anchor needs to hold the vessel in all weathers, including the most severe storms, but only occasionally, or never, needs to be lifted (Answers, 2007). Two common types of permanent anchors are the mushroom and deadweight anchors. These two types are the focus of this soil interpretation.

Mushroom Anchors

A mushroom anchor is shaped like an inverted mushroom; the head becoming buried in the soil (Fig. 2). These anchors work best in loamy to organic soils with high n value surface layers or soft bottom types of material when they are left in and allowed to set. These anchors work on the principle of surface area and suction effect. Cohesion of the bottom material is very important. Rocks, gravel, or coarse sand lack good cohesive properties and allow the anchor to pull free. Mushroom anchors in sand will not bury completely. They will only sink to displace an equal weight of sand. Their large round dish design is not well-suited to pen-

Soils rated for mooring type using the mushroom anchors are either "not limited" or "very limited" (Table 1, Fig. 3). Not limited means the soil is a soft bottom type of material in which the mushroom anchor works the best. Very limited means the soil is a hard bottom type of material in

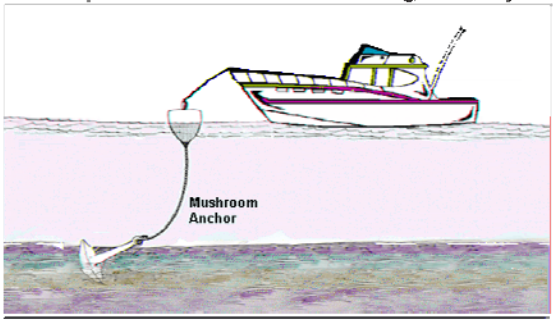

Fig. 2. Mushroom anchors work best in soft bottom materials, loamy to organic soils characterized by high *n* value soil surface layers.

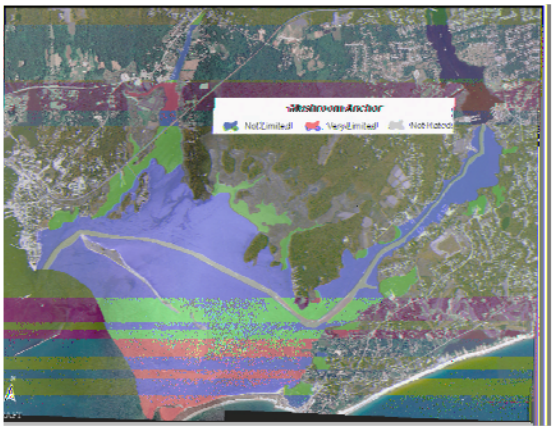

Fig. 3. A map of the mooring interpretation for mushroom anchors in Little Narragansett Bay based on the bottom type of soil material.

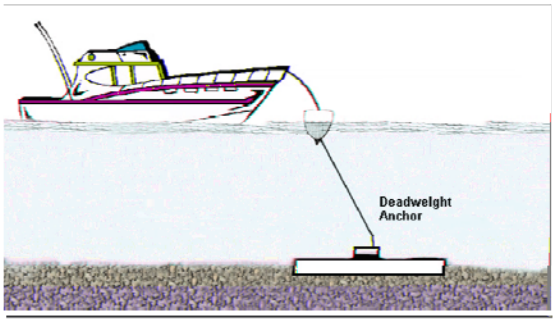

Fig. 4. Deadweight anchors work best in hard bottom materials such as gravel and coarse sands, low *n* value soil surface layers.

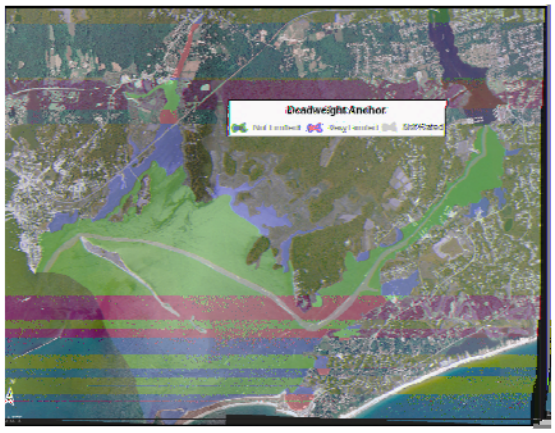

Fig. 5. A map of the mooring interpretation for deadweight anchors in Little Narragansett Bay based on the bottom type of soil material.

which the use of a mushroom anchor is not suitable. Navigational channels are not rated because boats cannot anchor in a channel unless circumstances require the boat to anchor, such as being broken down.

Deadweight Anchors

Deadweight anchors work on the principle of being heavy. Whether the anchor is a block of stone, concrete, or iron, its holding power is weight (Fig. 4). Deadweight anchors provide the greatest reliability. They are the best choice for rocky, gravelly, or sandy soils with low *n* value soil surface layers or hard bottom types of material. If they are dragged, they will reset with constant force. By contrast, once a mushroom anchor breaks free, it will not reset and will simply skip along the bottom. Granite is a common choice of material for deadweight anchors in the Northeast because it is readily available and inexpensive. It is a bit awkward to handle, but once in position, it will not move. The further one travels south from northern New England, concrete and iron become more common (INAMAR, 2000).

Deadweight anchors are used where mushroom anchors are unsuitable. An advantage of a deadweight anchor over a mushroom is that if it does become dragged, it continues to provide its original holding force. The disadvantage of using deadweight anchors in conditions where a mushroom anchor could be used is that it needs to be around ten times the weight of the equivalent mushroom anchor (Answers, 2007).

Soils rated for mooring type using deadweights are either "not limited" or "very limited" (Table 1, Fig. 5). Not limited means the soil is sandy with low *n* value surface layers or a hard bottom type of material in which deadweights work the best. Very limited means the soil is loamy with high *n* value surface layers or a soft bottom type of material in which the use of deadweights is not suitable.

Table 1. Moorings (Surabian, 2007).

Map symbol and soil name	Mooring type	
	Mushroom anchor	Deadweight
301		
Beaches	–	–
Udipsamments	–	–
800		
Wamphassuc	Not limited	Very limited soft bottom
Wequetequock	Not limited	Very limited soft bottom
810		
Napeague	Very limited hard bottom	Not limited
820		
Quonaduck	Not limited	Very limited soft bottom
830		
Anguilla	Not limited	Very limited soft bottom
840		
Rhodesfolly	Very limited hard bottom	Not limited
850		
Sandy, mixed, mesic Hapic Sulfaquents (bay bottom)	Very limited hard bottom	Not limited
860		
Histosols (submerged tidal marsh)	Not limited	Very limited soft bottom
880		
Typic Psammequents (shore complex)	Very limited hard bottom	Not limited
900		
Navigational Channel	Not rated	Not rated
910		
Sandy, mixed, mesic Hapic Sulfaquents (river bottom)	Very limited hard bottom	Not limited

Summary and Conclusions

Soil surveys have much to offer the coastal zone community and boating enthusiasts. Our ability to describe, classify, and compare soil details enables us to recognize the need for and how to develop specific soil interpretations such as moorings. Over the years, demand for this type of soil interpretation, and others such as the presence of sulfidic materials and potential for submerged aquatic vegetation restoration, will increase in the coastal states.

The need for coastal zone mapping to inform policymakers and management is widely recognized as critical for mitigating hazards, creating resource inventories, and tracking environmental changes (National Research Council, 2004). Developing soil interpretations for these areas will encourage new partnerships and assist all of us in making wise decisions concerning our natural resources.

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Building Use and Management Interpretations

Over the last 10 years, methods and procedures have been developed for identifying, classifying, and mapping subaqueous soils and landscapes. Our studies, and those completed by our colleagues in Maryland (see Demas and Rabenhorst), spawned a wide array of interest in subaqueous soils such that projects are underway or have been completed in Maine, Massachusetts, Connecticut, New York, Delaware, Florida, and Texas. Over the last several years regional and national committees and working groups focused on subaqueous soils within the National Cooperative Soil Survey (NCSS) were established. In addition, a multi-state Cooperative Agricultural Experiment Station project was established in the northeastern US having considerable emphasis on subaqueous soils.

The growing interest in subaqueous soils is being driven by the need for a tool to manage shallow coastal systems and resources at an ecosystem scale. Local, state, and federal agencies have posed a large number use and management questions related to subtidal wetlands and subaqueous soils. Some of the most important for Rhode Island include:

- What are the best soils for hard-shell clams, soft-shell clams, bay scallops, and oysters;
- What are the best soils for aquaculture;
- What soils could most easily support eelgrass as part of estuary restoration efforts;
- What effect would dredging have on the benthic habitats;
- Can these dredge materials be placed on the land with minimal environmental impact;
- How much carbon is sequestered in these soils; at what rate is the carbon sequestered;
- Will the soils support moorings or dock pilings?

Because the initial subaqueous soils efforts have focused on understanding soil-landscape relationships and developing the methods and procedures for conducting a subaqueous soil survey, little is known regarding the relationship between the physical, chemical, and morphologic properties of subaqueous soils and the use and management of these resources. Now that the foundation has been set, we believe we are in the position to begin to build the subaqueous soil-use and management relationships that the coastal managers are calling for.

Our current soil interpretation research is focused on carbon, dredge materials placement, eelgrass restoration, and oyster and hard-shell clam productivity. The work focused on dredge material placement has been in progress for about a year. On the next page is a summary of the methods we are using to examine the effects of placing dredged materials on the subaerial landscape. On the next page are graphs from the Ninigret Pond mesocosms showing changes in salinity, sulfate content, and pH of the leachate over time. There are no data for the fall and winter because of minimal rainfall in the fall and freezing conditions during the winter. The soil materials dredged from the Flood-Tidal Delta (FTD) and Washover Fan Flat (WF) are sandy. The soil materials dredged from the Lagoon Bottom (LB) and Inland Cove (IC) are silt loam or silty clay loam in texture.

Dredge Materials Mesocosm Experiment

Alex Salisbury and Mark Stolt

Overview

The goal of this experiment is to investigate the long term (i.e. years) effects of placing dredge materials upon the subaerial soil surface. We collected dredge samples from four subaqueous soil-landscape units, from two coastal ponds and two embayments.

Study Locations

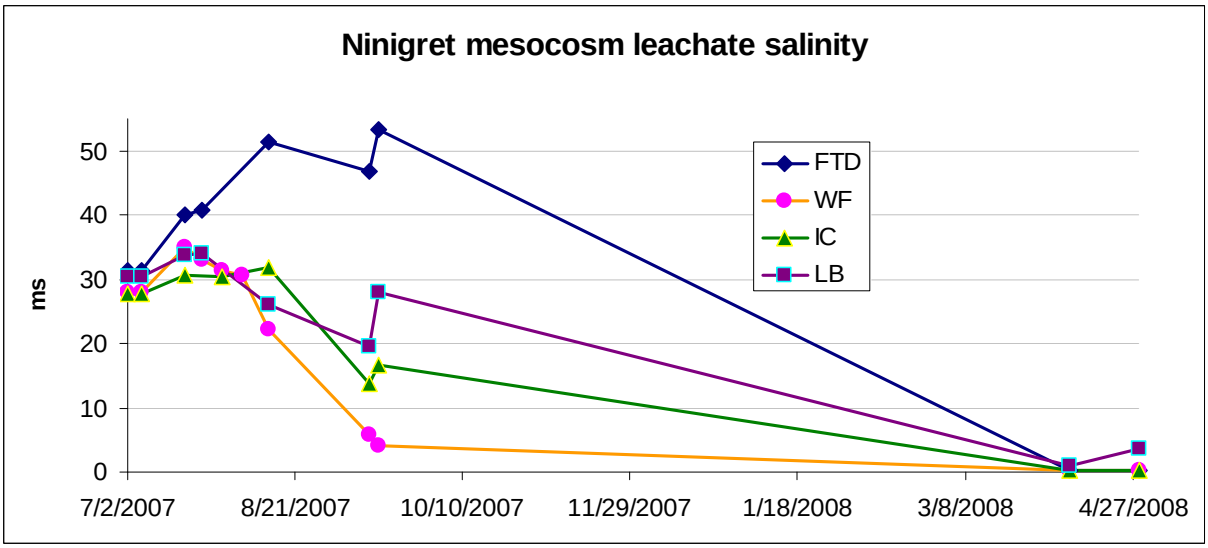
Our study sites are Ninigret Pond, Quonochontaug Pond, Wickford Cove, and Greenwich Bay. Four samples were collected from each site. Two primarily silty samples (8-33 % sand, 51-78 % silt, 12- 24 % clay) and two primarily sandy samples (83-99 % sand, 1-14 % silt, 0-3 % clay) were collected using a bucket auger and McCauley peat sampler to a depth of 25 cm. The subaqueous soil landscape units used were: flood tidal delta (FTD), washover fan flat (WF), lagoon bottom (LB), and inland cove (IC) for the coastal ponds; and beach, sandy shoal, bay bottom, and inland cove for the embayments.

Mesocosms

Mesocosms were constructed of 30 cm x 10 cm PVC pipes and placed upright onto platforms. A funnel, filter, and collection bottle were attached at the bottom, while the top is left open for rain collection. The dredge samples were mixed and placed into the mesocosms and left outside. There are a total of 64 mesocosms, with four representing each soil type.

Analysis

Leachate is analyzed for pH, salinity, and sulfate content. The dredge samples will be analyzed for: incubation pH, salinity (saturated paste, 5:1), particle size distribution, loss on ignition (carbon, calcium carbonate), chromium reducible sulfides (CRS), and acid volatile sulfides (AVS).


Ninigret mesocosm leachate salinity
ms
50
40
30
20
10
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7/2/2007
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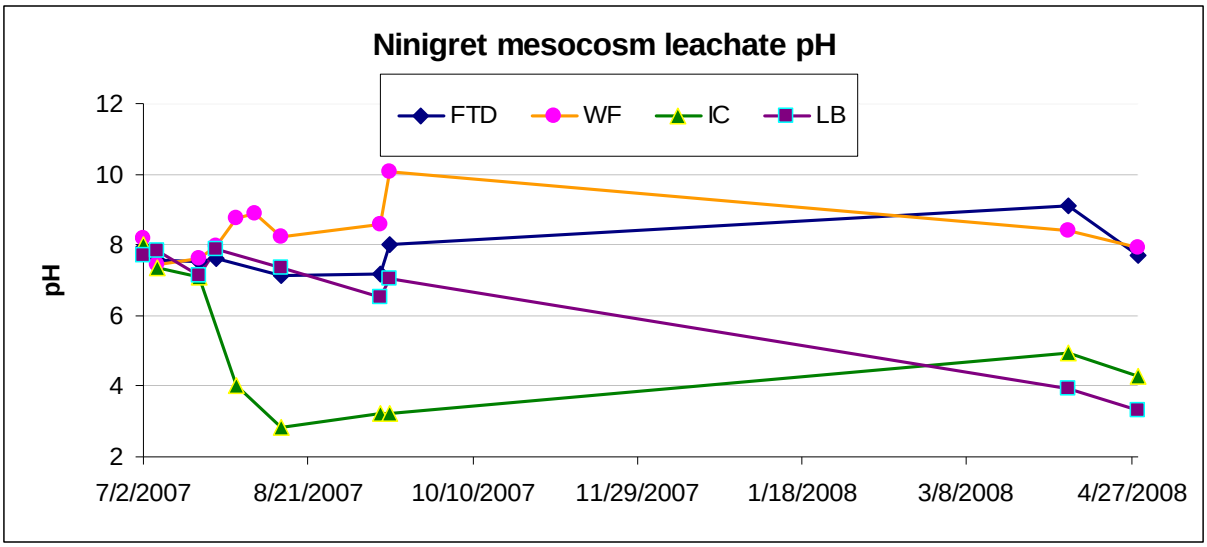
4/27/2008
FTD
WF
IC
LB


Ninigret mesocosm leachate pH
pH
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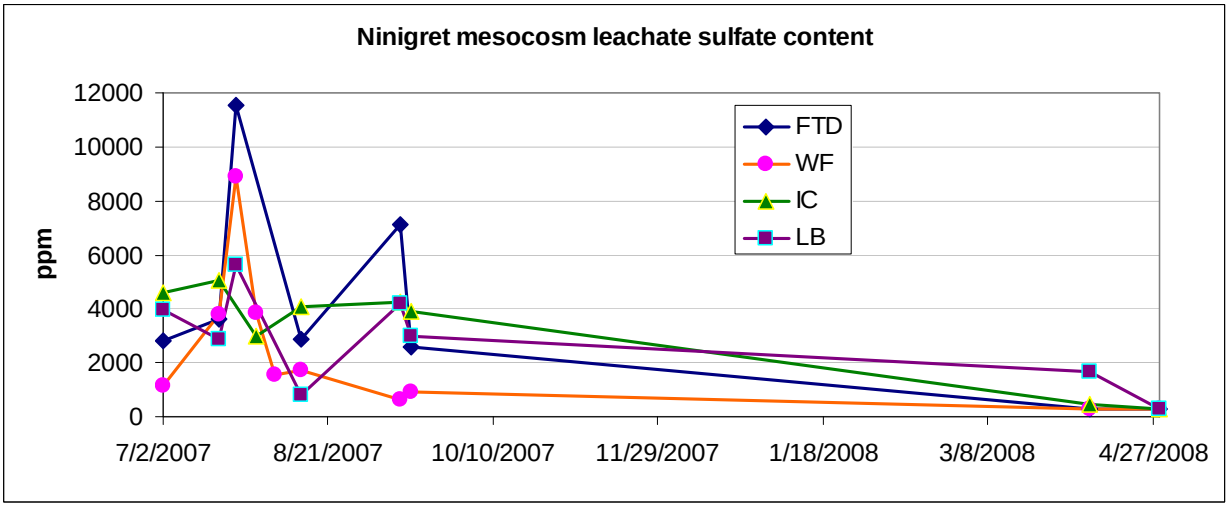
Ninigret mesocosm leachate sulfate content
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8000
6000
4000
2000
0
7/2/2007
8/21/2007
10/10/2007
11/29/2007
1/18/2008
3/8/2008
4/27/2008
FTD
WF
IC
LB

U.S. Department of Agriculture
Natural Resources Conservation Service

Ecological Site Description

Ecological Site Characteristics

Site Type: Subaqueous

Site ID: 144AY001CT

Site Name: Subaqueous Flat

Precipitation or Climate Zone: Mesic Temperature Regime and Peraquic Moisture Regime

Physiographic Features

Narrative:

These nearly level subaqueous soils are in shallow to deep water flats. The very deep, subaqueous soils are permanently submerged with strongly saline water on unstable flood tidal delta flats, washover fans and shore faces. The soils formed in sandy deposits with numerous buried horizons from catastrophic storm events that breeched the barrier island or spit. The soil is subject to depositional change due to severe storm events. Wave action and strong currents influence the formation of these soils. Water depths are up to 2.5 meters. Slopes are nearly level. This site is near the transitional margin of the Barrier Islands and Subaqueous Grass Slopes.

Land Form: (1) flood tidal delta flat
(2) washover-fan flat
(3) shore face

A flood tidal delta flat is a relatively flat, dominant component of the flood-tidal delta. At extreme low tide this landform may be exposed for a relatively short period (modified from Boothroyd et al., 1985). Most classify as Typic Psammaquents (Fluventic Psammowassents) due to multiple buried surface horizons. Sediment carried from barrier island beach and dune deposits give these soils a sandy texture. The soil surface is firID 1.0009 8 Tod (sandy)-8.( )]TJEMC /P <</MCID 64 >>BDC 0 Tc 0 Tw T(*)TjEM
sto men (ft)-5((m)8l thesz)-4eawa

Dramatic changes can occur in this mapping unit over time resulting from severe storm events. Wave action and strong currents promote the formation of Typic Psammaquents (Fluventic Psammowassents) in this environment. The soil surface is firm and sandy.

	Minimum	Maximum
Elevation (m):	-2.5	0
Slope (percent):	0	1
Water Table Depth (m):	0	2.5

Climatic Features

Narrative:

Five intense hurricanes have occurred in this region in 1635, 1638, 1815, 1869, and 1938. Historical records indicate that these storms produced storm surges greater than 3 meters in southern Connecticut (Donnelly et. al, 2001). Storm surges of this magnitude can overtop barrier islands, remove sediments from beaches and nearshore environments, and deposit materials on back-barrier marshes, lakes and lagoons. Smaller hurricanes are more frequent and have since struck in 1944, 1954, 1955, 1960, 1976 and 1985.

Influencing Water Features

Narrative:

The continued rise in sea level is important. As deglaciation proceeded, sea level rose in response to the return of water to the oceans; from about 8000 to about 100 years ago, the ocean swelled an average of four inches every century. But over the last century, sea level has risen twelve to sixteen inches (Bell, 1985).

As the earth warms, New England will face a growing risk of storms with extreme levels of rain or snowfall. New England saw storms with extreme precipitation levels increase in frequency by 61 percent. The consequences of increasingly intense rainstorms may include flooding, agricultural damage, pollution of waterways with runoff, erosion, and other environmental and economic damage (Madsen et. al, 2007).

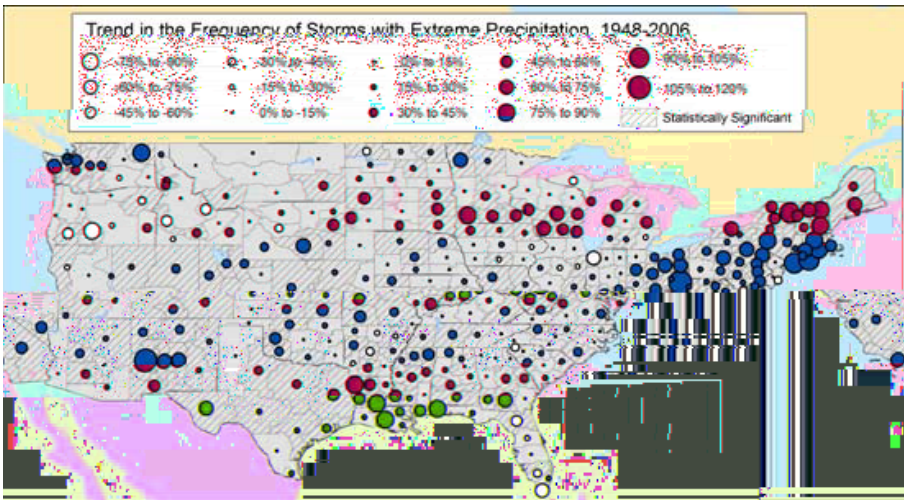

Figure 1. A map of the trend in frequency of extreme precipitation by Climate Division (Madsen et. al, 2007).

In Long Island Sound, wave energy is fairly low and wave action has not greatly modified the shore. The Connecticut coast is very much a reflection of the shape of the land before it was drowned by the sea. However, even with a sheltered coastline of calm winds and waters, Connecticut's coast keeps realigning and reshaping. Change on the coast comes about through erosion and deposition of sediments by winds, waves, and tides.

Representative Soil Features

Soil Series: (1) Rhodesfolly

The Rhodesfolly series consists of very deep, subaqueous soils that formed in sandy marine deposits. Typically, this Rhodesfolly soil has a firm, very dark gray fine sand surface layer, 0 to 23 cm thick. The substratum is dark gray or very dark gray sandy deposits with numerous buried horizons.

Figure 2. A 2003 oblique photograph taken in Little Narragansett Bay. The light brown area submerged underwater is the Subaqueous Flat ecological site where the Rhodesfolly series is mapped.

The Rhodesfolly soils are permanently submerged with salt to brackish water. All horizons have a pH of neutral through strongly alkaline and a pH of very strongly acid through slightly alkaline after 8 weeks incubation. Electrical conductivity is >16 mmhos/cm and salinity is >25 ppt (strongly saline) throughout the profile. This soil has a peraquic moisture regime and high to very high saturated hydraulic conductivity.

Parent Material Kind: sandy marine deposits
Parent Material Origin: sandy marine deposits
Surface Texture: (1) loamy fine sand to coarse sand
Surface Texture Modifier: (1) none or gravelly
Subsurface Texture Group: sandy
Drainage Class: subaqueous

	Minimum	Maximum
Surface Fragments <=3" (% Cover):	0	0
Surface Fragments >3" (% Cover):	0	0
Subsurface Fragments <=3" (%Volume):	0	25
Subsurface Fragments >3" (%Volume):	0	0
Permeability Class:	high	very high
Depth (cm):	0	200

Electrical Conductivity (mmhos/cm):	39		55	
Salinity Level (ppt):		25		35
Soil Reaction (1:1 Water Initial pH):	6.6		9.0	
Soil Reaction (1:1 Water Oxidized pH):		4.5		7.8
Sulfidic Materials:		None		None

Figure 3. A vibracore sample of the tentative Rhodesfolly series.

Plant Communities

Ecological Dynamics of the Site:

The Southern New England coastline is composed of barrier islands, peninsulas, bays and estuaries, and natural man-made passes. These mobile environments, constantly reshaped by the process of erosion and accretion are shown on the cross-sketch below. Hurricane activity can significantly change this environment.

Figure 4. Generalized cross-sketch of the shore face to till upland landforms in Little Narragansett Bay. Proposed ecological site names are italicized.

In LIS, eelgrass is found at depths between 0.5 and 3.7 meters below mean low water (Koch and Beer, 1996). In the Subaqueous Flat ecological site, water depths range from 0 to 2.5 meters below mean sea level.

SAV commonly grows in beds. These beds are sparse or nonexistent on the Subaqueous Flat ecological site and contain one species. Factors influencing SAV distribution and growth include light penetration, nutrients, substrate, temperature, current velocity, wave energy, and salinity. Other

disturbances in this area that can severely impact or damage eelgrass beds are trawls, nets, mooring chains, motorboat propellers, feeding herbivores (such as Canada geese (*Branta canadensis*) and the introduced mute swan (*Cygnus olor*)), and the placement of fill or dredged materials (TSCHR, 2003).

Plant Community Name: Subaqueous Flat Dominant Community

Plant Community Narrative:

The historic community for this site has submerged soils supporting a sparse subaqueous rooted vegetative community. Some areas have sparse to almost no vegetation.

Ground Cover and Structure: sparse cover, less than 10% ground coverage by vascular plants.

Figure 6. A 2003 oblique photograph taken in Little Narragansett Bay of the Subaqueous Flat ecological site on both sides of the barrier island. Notice the shallow light brown color of the shore face landform with little or no vegetation.

Ecological Site Interpretations

Animal Community:

A partial listing of species associated with Subaqueous Flats is as follows:

- bay scallop (*Argopecten irradians)*
- northern quahog (*Mercenaria mercenaria)*
- softshell clam (*Mya arenaria)*
- common clamworm (*Nereis virens)*
- sand shrimp (*Crangon septemspinosa)*
- blue crab (*Callinectes sapidus)*
- hermit crab (*Pagurus longicarpus)*
- horseshoe crab (*Limulus polyphemus)*
- bluefish (*Pomatomus saltatrix)*
- striped bass (*Morone Americana)*
- winter flounder (*Pleuronectes americanus)* (TSCHR, 2003)
- american oystercatcher (*Haematopus palliatus*)

Hydrology Functions:

Little Narragansett Bay is a semi-enclosed estuary on the southern shore of Rhode Island and Connecticut. The average depth of the bay is two meters with a tidal range of 80 centimeters. The bay is well-flushed, with an approximate flushing time of three days (Fulweiler and Nixon, 2005).

Recreational Uses:

The Subaqueous Flat ecological site is used by both recreational and commercial shell fishermen for the harvest of hard clams, small populations of bay scallops, and soft shell clams. In addition, fishing is commonplace and the species found in the area are smelt, small cod, winter flounder, eel, summer fluke, tautog, bluefish, scup, menhaden, striped bass, and white perch.

Supporting Information

Associated sites:

Site Name	Site ID	Site Narrative
Subaqueous Grass Slope		Occurs on the transitional margin between Subaqueous Flat and Algae Bottom ecological sites. Soils are completely submerged throughout the year.
Barrier Island		Occurs on the transitional margin of the Subaqueous Flat ecological site. Soils are not submerged throughout the year, only during extreme weather events.

Data Source

Scientists made on-site field visits to evaluate the soils and vegetation present on this to provide this technical Ecological Site Description.

State Correlation:

This site has been correlated with the following states: Connecticut and Rhode Island

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NECSS Conference

Proximal Diffuse Reflectance Spectroscopy

Narragansett, RI
2008-06-02 – 2008-06-05
E. J. Neafsey
2008-05-23

Abstract

Proximal sensing using visible-near infrared (VNIR) diffuse reflectance spectroscopy (DRS) has demonstrated substantial potential for rapid, accurate estimation of key soil properties. Many of these soil properties are diagnostic for the purpose of soil classification and survey including % C, pH and % Clay. Key soil fertility indicators such as % N and % organic matter (OM) may also be estimated using this technology. As many of the soil surveys in the United States approach 40-50 y in age, there is an interest and need to supplement the current methodologies employed in the soil survey update process. Two field pedons (Newport and Bridgehampton) and three subaqueous soil cores (Pishagqua, Billington and Nagunt) were scanned for the 2008 NECSS field guidebook.

Materials and Methods

Hyperspectral Measurements: Field

Soil pits were excavated to provide access for soil profile description and sampling. While the soil pits varied slightly, typical dimensions were 2.5 m (length) by 0.5 m (width) by 1.75 m (depth). These dimensions are larger than most soil pits and were designed to accommodate the ASD FieldSpec Pro FR spectrometer (Analytical Spectral Devices, Inc., Boulder, CO; www.asdi.com) and two or three people needed for soil spectra collection. The pedon face was then cleaned to reduce any soil mixing effects caused by the excavation equipment. While the soil profile was being prepared for description and sampling, the spectrometer was prepared to acquire spectral data. A dark current was measured for calibration purposes. The instrument was also calibrated to a white reference before each soil profile was scanned.

Soil surveyors typically analyze soil pedons by horizon, so most spectral data were collected by horizon as well. To accomplish this, NRCS soil surveyors physically marked each soil horizon boundaries. To mitigate any periodicity in the soil profile, a random starting point between 0 – 5 cm from the left side of the excavated and prepared pedon was chosen near the middle of each horizon in the vertical dimension. Three sets of spectra were collected for each horizon, with the random starting point and the second and third points located 10 cm and 20 cm away from the first point, respectively.

Figure 1: Field Instrument Setup – Side View

To prevent damage to the contact probe, spectra were collected at a distance of 1 – 2 mm from the soil profile (see Figures 1 and 2). Initially in previous studies, 10 spectra were collected for each sample point. However, at this sampling rate the light source was generating heat that caused some soil moisture to evaporate and then condense on the lens of the probe, which may have degraded signal quality. The number of spectra was then reduced to five to ameliorate this effect. In

addition, a white reference was taken after each soil horizon to keep the instrument calibrated throughout the scanning of each soil pedon.

Figure 2: Field Instrument Setup – Rear View

Hyperspectral Measurements: Subaqueous Soils

Subaqueous soil core spectra were measured in a similar manner as field collection, using a contact probe at a distance of 1 – 2mm from the soil profile. In Figure 3, the laptop computer on the right was connected to the spectrometer in the same manner as in the field. A white reference was used to optimize the instrument before each session and to recalibrate it after samples from each soil pedon's horizons had been scanned. In addition, only one set of five spectra is taken for each horizon, as the soil cores are approximately 10 cm in width.

Figure 3: Subaqueous Soils Instrument

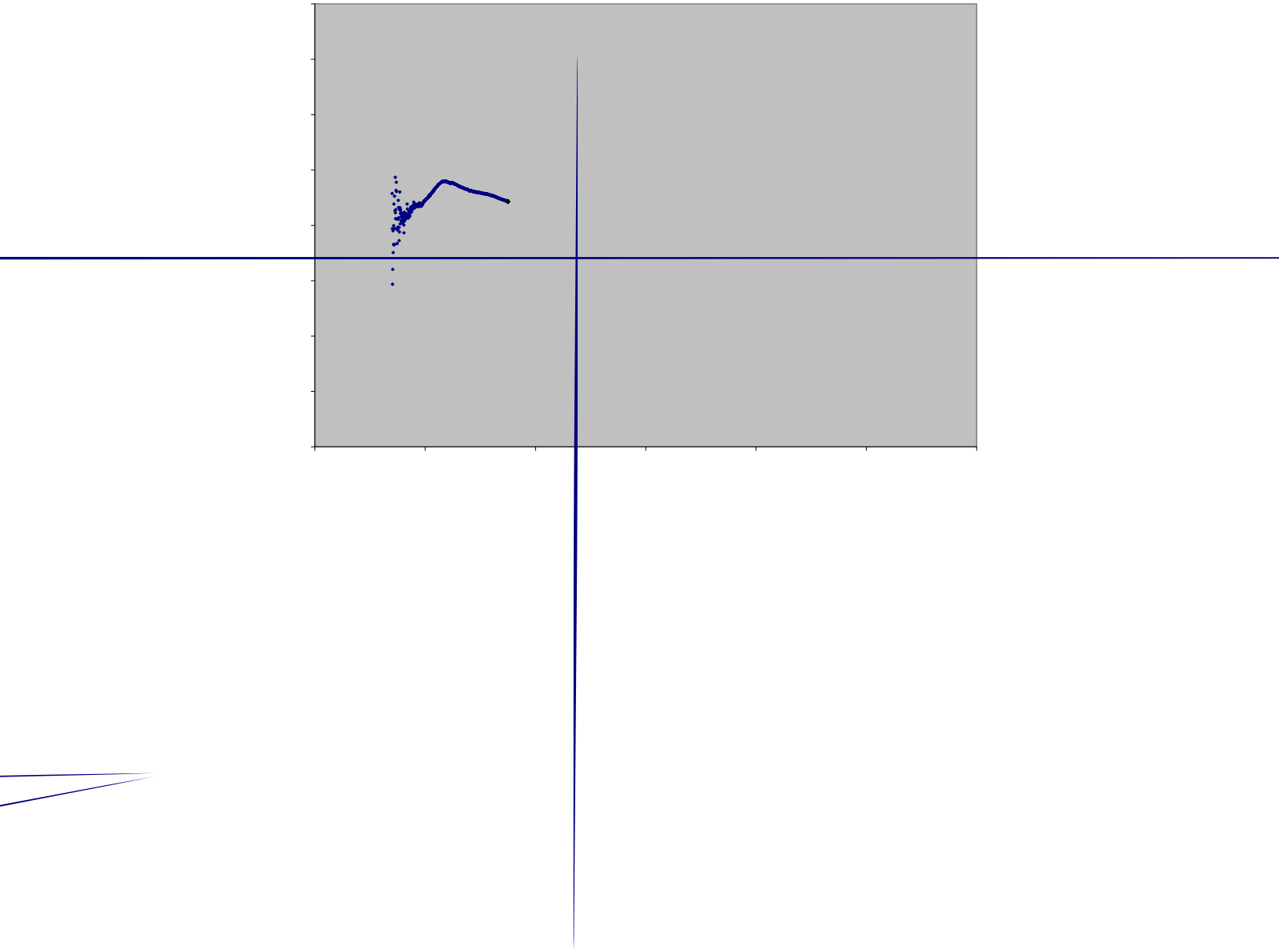
Data Analysis

To facilitate data analysis, the native files were imported into the Unscrambler (CAMO PROCESS AS, Oslo, Norway) applications program. The Unscrambler is a multivariate data analysis tool which can aid in the investigation of potential relationships between spectral reflectance and lab-acquired data. The resulting file was averaged by a factor of 15 (representing the 15 spectra acquired per horizon), yielding one spectrum for each horizon.

Results

The following plots (Figures 4-8) display the spectra, by horizon, for field- and subaqueous soils-based hyperspectral measurements. Features at 1 400 and 1 900 nm correspond with sample moisture content. Deeper features indicate higher sample moisture content. This moisture content may have reduced the amplitude of spectral features in a nonlinear fashion (Whiting et al., 2004), many of which are diagnostic in terms of critical soils properties. This is especially apparent in the Newport pedon (Figure 4), as well as all of the subaqueous soils. The use of derivatives can help mitigate this effect, so that lab and field based measurements can be accurately compared (Tsai and Philpot, 1998). Derivatives emphasize spectral features rather than amplitudes, so that chemical and physical differences in lab and field samples can be identified. Second, water can have a smoothing effect on the signal. This may be the more challenging adversity to overcome in terms of spectral processing. Where water reduces the amplitude of spectral features, the general shapes of spectral features are preserved, whereas when water has a smoothing effect on the signal they are often modified beyond usefulness. This smoothing effect is most readily apparent when soil is saturated, so the spectra will exhibit features characteristic of water. Moisture effects are best addressed by scheduling spectral acquisition soon after soil pit excavation. When this is not possible, limiting rainwater entry can be achieved by covering the pit (Neafsey, 2008). Elevated levels of organic matter, as a result of current or historical agricultural operations or non-anthropogenic materials deposition, may be responsible for some additional degradation of spectral information.

Field



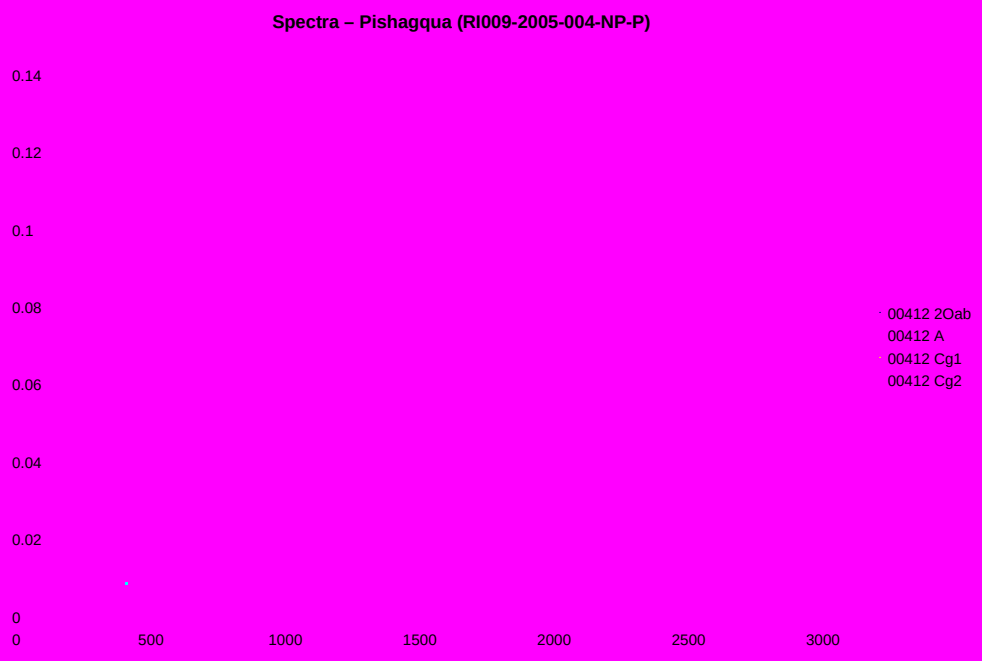
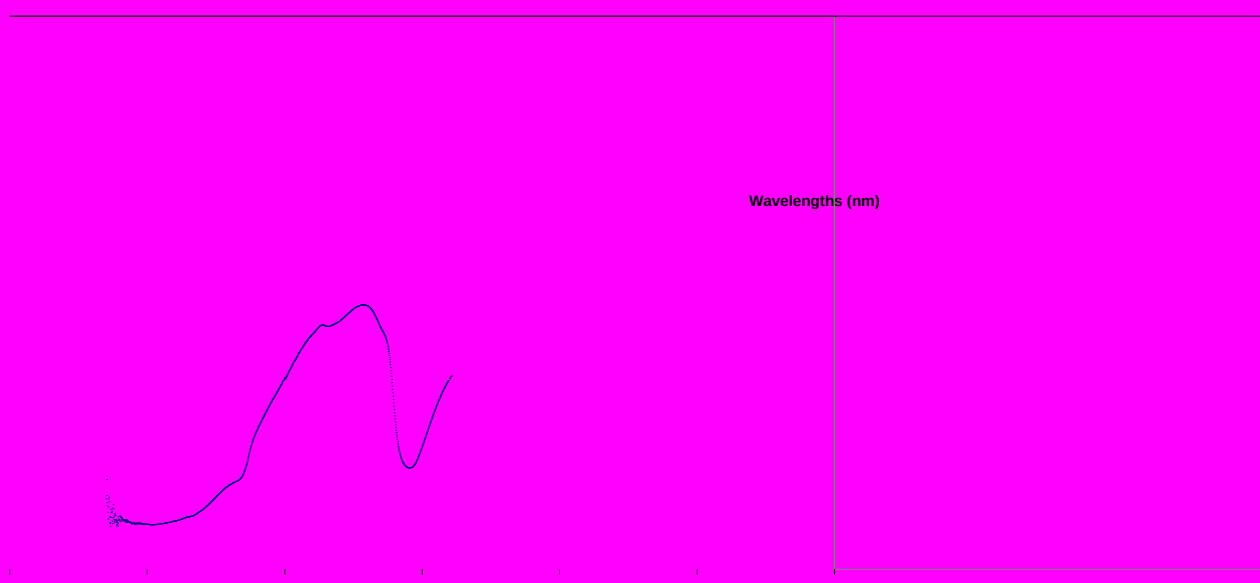
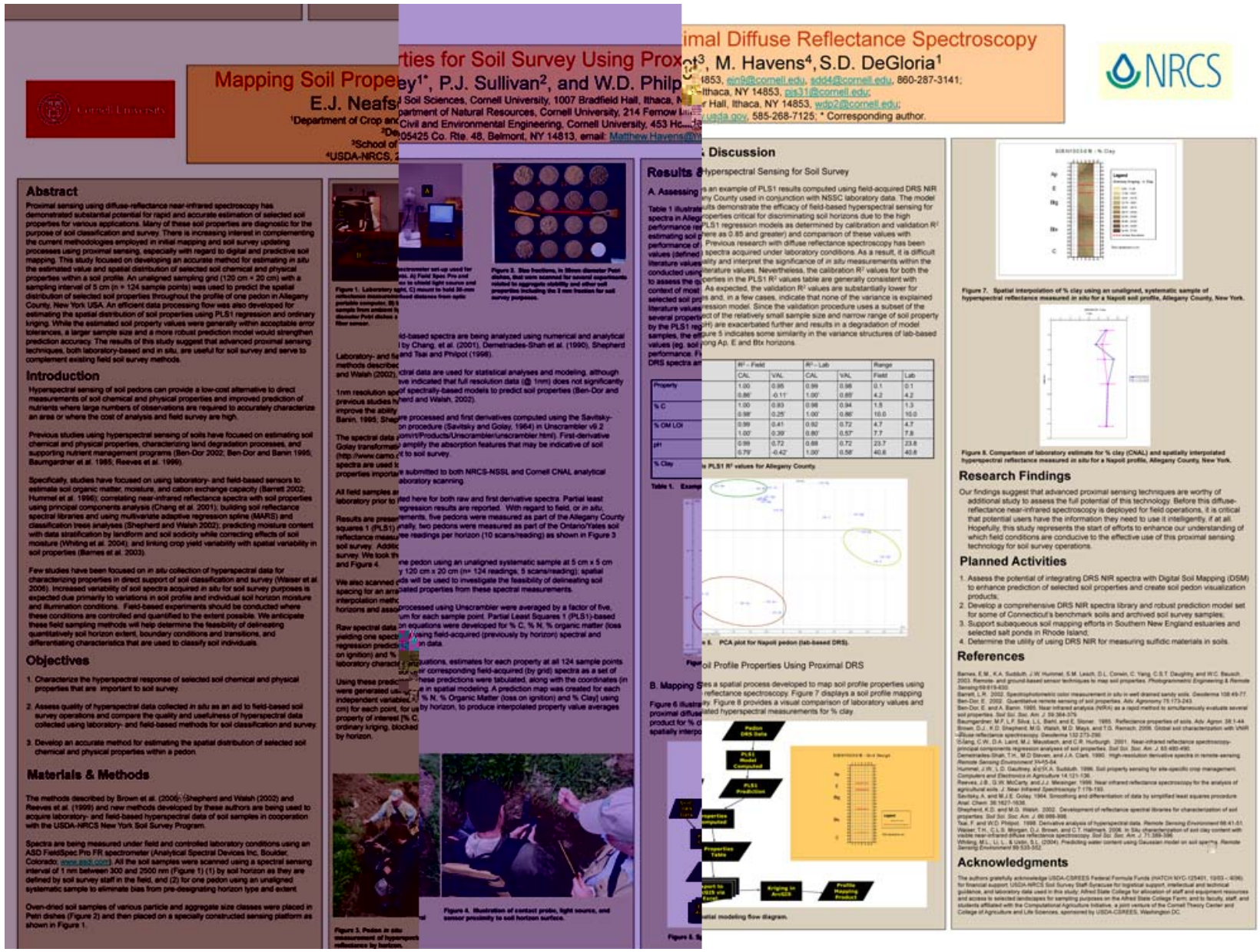


Figure 6: Spectra – Pishagqua (RI009-2005-004-NO-O) – Lagoon Bottom




Mapping Soil Prope
E.J. Neafs
Abstract
Introduction
Objectives
Materials & Methods
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Discussion
Research Findings
Planned Activities
References
Acknowledgments
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NRCS

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MICROMORPHOLOGY OF SEASONALLY SATURATED SOILS IN CARBONIFEROUS GLACIAL TILL

M. H. Stolt, B. C. Lesinski, and W. Wright

Soils formed in dark-colored glacial till (chroma 3, value < 4) are common in southern New England. The low chroma, low-value colors reflect the carboniferous nature of the sedimentary and metasedimentary rocks that compose the till. Much of this till is very dense, resulting in soils with seasonal high water tables. The inherent dark colors of the soils make it difficult to use hydromorphic features to estimate depths of seasonal saturation. We examined thin sections to determine if micromorphology could be used to elucidate the apparent lack of hydromorphic features in seasonally saturated Bw horizons formed in dark till. Observation wells were monitored for 18 months to establish water table seasonal fluctuations in soils on shoulder positions. Hydromorphic features were examined in the field and in thin sections to correlate with the seasonal water table levels. Soils showed seasonal saturation and were classified as Humic Epiaquepts and Typic Humaquepts. Water levels frequently rose into the upper Bw horizons. One of the soils examined met hydric soil criteria based on hydrology. Hydric soil indicators such as a depleted matrix (F3) were absent. The dark parent materials were most likely preventing the observation of morphologic indicators of reducing conditions. Redoximorphic features were not identified by field observations in the seasonally saturated upper Bw horizons. Thin sections of the upper Bw horizons revealed redoximorphic features that were too faint, fine, or had boundaries too diffuse to be observed in the field. Identifying hydromorphic features in lower horizons and, with the aid of magnification, tracing these features carefully into overlying horizons may help identify the depth to aquic conditions in low chroma-low value seasonally saturated soils. (Soil Science 2001;166:406–414)

Key words: Redoximorphic features, episaturation, hydric soils, aquic conditions.

AQUIC conditions in soils are often associated with redoximorphic features (Vepraskas, 1992; Soil Survey Staff, 1998). The depths at which the features occur are often used as an indicator of the location of the seasonal high water table (Boersma, et al., 1972; Simonson and Boersma, 1972; Mausbach and Richardson, 1994; Vepraskas and Sprecher, 1997; Veneman, et al., 1998). In general, the formation of redox concentrations such as Fe and Mn masses and nodules are the result of fluctuating water tables and the consequent alternating oxidizing and reducing conditions (Daniels, et al., 1971). Under reduced conditions, the Fe and Mn are mobile within the landscape, pedon, or soil horizon (Daniels et al., 1962; Yaalon et al., 1972; Mausbach and Richardson, 1994). Accumulations form during subsequent oxidizing conditions or when the Fe and Mn reach an oxidizing environment. Nodules are thought to form when oxidation is rapid (Vepraskas, 1992) or when there are short periods of saturation (Veneman et al., 1976), such as in near surface horizons. Masses are thought to form when air reaches the reduced Fe and Mn forms much more slowly (Blume, 1988).

The usefulness of redoximorphic features to mark the location of the seasonal high water table is limited in soils with low chroma-low value par-

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ent materials. These soils are often considered "problem soils" (Environmental Laboratory, 1987; NEHSTC, 1998; USDA-NRCS, 1998). Low chroma-low value parent materials are known to mask soil indicators of wetness, such as redoximorphic features, or they may indicate aquic conditions falsely (USDA-NRCS, 1998). These dark-colored soils (chroma 3, value < 4) are common in southern New England (Rector, 1981; Lesinski, 1994). The dark colors can be attributed to the till receiving carboniferous sedimentary and metasedimentary rocks as source material (Melvin, et al., 1992; Wright and Sautter, 1988). These tills are very dense and show seasonal saturation in the upper part of the soil even though most of them occur on the upper landscape positions of drumlins or drumlin-like stream-lined hills (Rector, 1981). Because the soils occur on upper sloping landscapes, such as shoulder positions, the U.S. Army Corp of Engineers (Environmental Laboratory, 1987) considers such areas to be a class of wetland delineation problem areas called "wetlands on drumlins." These are problem areas because wetlands on shoulders are contrary to our concept of the location of a wetland on the landscape, and these areas rarely show indicators of wetland hydrology at the surface (Environmental Laboratory, 1987). Minimal information is available documenting hydrologic patterns and indicators of aquic conditions in these soils; however, developing an understanding of these relationships is critical for soil use interpretations such as locating septic tank absorption fields or delineating wetlands. Thus, the objectives of this research were: (i) to document the seasonal fluctuation of water table levels in soils on shoulder positions formed in dark-colored dense till; (ii) to evaluate the effectiveness of field observed redoximorphic features and hydric soil indicators to ascertain the seasonal high water level in these soils; and (iii) to use micromorphology to develop field guidelines for recognizing hydromorphic features indicative of the seasonal high water table in soils formed in low value-low chroma parent materials. Our working hypothesis was that micromorphology would prove to be a useful tool in establishing that morphologic features indicative of saturation and reduction are present in the upper portion of the dark till soils even though the features can not be observed under typical field conditions.

MATERIALS AND METHODS

This study examined soils in the Narragansett Basin that were formed in glacial till with a thin aeolian mantle. The Narragansett Basin encompasses an area of approximately 2800 km^2 from southeastern Massachusetts to the mouth of Narragansett Bay in eastern Rhode Island (Quinn, 1971; Mosher, 1983; Skehan et al., 1986; Pickart, 1987). Glacial materials are underlain by sedimentary and medisedimentary rocks of Pennsylvania age (Quinn, 1971; Hermes et al., 1994). The Rhode Island Formation is the most extensive pre-glacial rock unit in the Narragansett Basin. These rocks are primarily dark gray to black sandstone, conglomerate, shale, and meta-anthracite (Quinn, 1971; Hermes et al., 1994). Most of the physical, chemical, and mineralogical characteristics of the glacial materials can be traced to the underlying bedrock (Melvin et al., 1992; Lawson, 1995). The gray to black color of the rocks reflect their carboniferous nature and impart a similar color to the till, locally derived aeolian mantle, and associated soils in the Narragansett Basin (Rector, 1981; Wright and Sautter, 1988).

In a reconnaissance survey, soils on stream-lined hills and drumlin-till landscapes in the Narragansett Basin were examined to find representative sites for detailed studies. Reconnaissance sites were limited to forested landscapes. Soils on the upper portion of the landscapes were mapped as either the Pittstown (Aquic Dystrudepts) or Newport (Typic Dystrudepts) series. On the lower portion of the till landscapes, soils were mapped as either Stissing (Typic Epiaquepts) or Mansfield (Typic Humaquepts) series. Two representative sites located on shoulder landscape positions were selected for study. Shoulder positions were chosen because this portion of the dense till landscape is considered a problem area for wetland delineation (wetlands on drumlins, Environmental Laboratory, 1987). Sites were named for near-by communities. Jamestown is located on Conanicut Island and Sakonnet is located in extreme eastern Rhode Island. Land surface shapes of both sites are convex-linear. The Jamestown site is located on a shoulder adjacent to the summit. The distance from the shoulder to the toeslope on this landscape is approximately 130 m, with a change in elevation of 6 m. The Sakonnet site is situated on a shoulder position between two backslopes. The distance from the shoulder to the beginning of the toeslope on this landscape is 100 m, with a change in elevation of approximately 2.5 m.

At each site, soils were described in detail (Soil Survey Staff, 1993) from soil pits and bulk and undisturbed samples were collected for soil

analysis. Sand fractions were determined after mechanical sieving. Percent silt and clay were determined by pipette (Gee and Bauder, 1986). Dithionite-citrate-bicarbonate (DCB)-extractable Fe and Mn were determined by atomic absorption spectophotometry following extractions (Mehra and Jackson, 1960; Jackson et al., 1986). The Walkley-Black wet oxidation method was used to determine percent organic carbon (Nelson and Sommers, 1982). Bulk density was determined from saran-coated undisturbed clods (Brasher et al., 1966). Undisturbed samples were collected in Kubiana tins from representative areas of selected horizons for thin section construction. Two thin sections, 50 × 50 mm in area, were constructed from separate samples from each of the selected adjacent horizons. The upper horizons were chosen because periods of saturation were observed in these horizons, but redoximorphic features were not observed in the field. The adjacent, and lower horizons, were selected because these horizons had redoximorphic features and were also seasonally saturated. Descriptions of the thin sections were made following the terminology of Bullock et al. (1985). Point counts were made along transects to estimate percent coarse fragments and redoximorphic features in each of the thin sections. Percentages were determined from 300 point counts (Stolt et al., 1994). Colors of the redoximorphic features in thin section were observed and recorded under incident light. Water table levels were monitored at both locations using 4-cm-diameter polyvinyl chloride observation wells. Wells were 200 to 250 cm long and screened below 100 cm. The wells were back-filled with sand and capped with bentonite to ensure that surface water did not enter around the base of the well. At a depth of 30 cm, Pt electrodes were installed at each well. The Pt electrodes (with welded junctions) were constructed and monitored following the procedures described by Faulkner et al. (1989). A calomel reference electrode was used in the field for redox measurements. Redox data were corrected for the standard electrode by adding +244 mV to the measurements. Soil redox potential was measured during the spring, summer, and fall of 1993. Soil temperature was measured at a 50-cm depth with temperature probes. Water table levels and soil temperature were measured and recorded 2 to 4 times a month from July 1992 to December 1993. Preliminary water table data were collected for the Sakonnet site for the first 6 months of 1992 from a well located 60 m from the primary study location and on the same convex shoulder landscape position.

RESULTS

Soils

Soils were derived from glacial materials originating primarily from the Narragansett Basin. The lower parent materials are dense till having a

TABLE 1

Profile descriptions for the Sakonnet and Jamestown Sites. Descriptions of redoximorphic features are based on field observations

Horizon	Depth (cm)	Color	Texture	Structure	Redoximorphic features
Sakonnet Pedon (Typic Humaquept, Convex Land Surface Shape, Shoulder Landscape Position, 3% slope)					
Ap	0–14	10YR 2/1	Silt Loam	Weak subangular blocky	
Bw1	14–28	2.5Y 3/2	Silt Loam	Weak subangular blocky	
Bw2	28–49	5Y 3/1	Channery Silt Loam	Weak subangular blocky	Common prominent 1 mm 2.5YR 4/8 Fe pore linings
2BCd	49–63	N3/0	Channery Sandy Loam	Massive	Common distinct 5Y 5/4 and common prominent 10YR 4/6 Fe masses
2Cd	63–99	5Y 3/1	Sandy Loam	Massive	Many prominent 10YR 4/4 Fe masses
Jamestown Pedon (Humic Epiaquept, Convex Land Surface Shape, Shoulder Landscape Position, 5% slope)					
Ap	0–22	10YR 3/1	Fine Sandy Loam	Weak subangular blocky	
Bw	22–47	2.5Y 3/2	Silt Loam	Weak subangular blocky	
2BC	47–78	2.5Y 3/2	Fine Sandy Loam	Weak subangular blocky/massive	Many faint 2.5Y 3/3 Fe masses
2Cd	78–108	N 3/0	Sandy Loam	Massive	Many distinct 2.5Y 5/3 and common prominent 2.5YR 4/8 Fe masses

very dark gray (5Y 3/1 or N 3/0) color (Table 1). The dense till is capped with a thin veneer of silt loam and fine sandy loam materials. Silt contents range from 41 to 71%, with the highest concentrations occurring in the upper 49 cm of the Sakonnet soil (Table 2). These materials are likely aeolian in origin (Wright and Sautter, 1988). The aeolian materials are similar in color to the underlying till, suggesting a local source. The boundary between the two materials is marked by the abrupt change in bulk density (Table 2).

Field observations of the Jamestown soil revealed faint Fe masses (soft bodies of concentrated Fe of variable shape in the matrix) within 47 cm of the soil surface (Table 1). Common fine Fe pore linings were observed in the field within 28 cm of the soil surface of the Sakonnet soil. Many Fe masses were observed in the 2Cd horizon. Granitic material can be found with the dark till that was carried in from outside of the Narragansett Basin. The majority of the Fe masses that were observed could be found within the granitic inclusions of the till. Low chroma colors, associated with the dark-colored parent materials, were observed in both of the soils. Iron depletions were not identified in the field because of the inherited low chroma-low value colors of the soil matrix. The Jamestown and Sakonnet soils are classified as Humic Epiaquepts and Typic Humaquepts, respectively.

Redox Potential and Water Table Levels

Water table levels fluctuated from season to season at both sites (Figs. 1 and 2). In both sites the water table level reached into the Ap horizons on numerous occasions and into the upper Bw horizons 9 of the 18 months the water levels were monitored (Figs. 1 and 2). During the summer months of the first year at the Jamestown site, and at both sites during the summer of the second year, water table levels dropped below the bottom of the observation wells. Although precipitation varied compared with the 30-year mean (Fig. 3), the total amount of precipitation over the monitoring period was only slightly higher (200 cm to 190 cm) than the 30-year average. The months of August, September, and December of 1992 and March of 1993 were the only months in which total amounts of rainfall exceeded the 30-year average by more than 5 cm. In May and August of 1993, there was a greater than 5-cm deficit in precipitation compared with the 30-year average. Monthly Palmer Drought Severity Indices (Palmer, 1965) averaged 0.7 for 1992 and 0.0 for 1993. Palmer Indices of zero are considered normal and indices between 0.5 and 1.0 indicate an incipient wet spell (Palmer, 1965). For 20 of the last 50 years, Palmer Indices in Rhode Island have averaged more than 0.7 (NOAA, 2000). This suggests that although the precipitation patterns observed in 1992 are not considered normal, similar patterns occur over extended periods as often as 40% of the time. Therefore, the water table levels observed likely represent commonly occurring patterns in these soils.

Redox potentials were measured for the growing season of 1993 (Figs. 1 and 2). Although these data are not comprehensive, redox potentials below 300 mV were recorded in the spring at both of these sites.

Micromorphology

Two thin sections were constructed for the upper Bw and underlying Bw2 or 2BC horizons. Although small in number, redoximorphic features do occur in each thin section (Tables 3 and 4). Masses of Fe located in ped interiors are the

TABLE 2

Soil properties and characteristics for the Sakonnet and Jamestown profiles

Horizon	Depth cm	DCB-Fe g/kg	DCB-Mn g/kg	Bulk Density g/cm³	Organic Carbon g/kg	Sand %	Silt %	clay %
				Sakonnet Pedon				
Ap	0–14	6.8	trace	1.18	58.4	26	71	3
Bw1	14–28	11.5	trace	1.44	11.6	35	59	6
Bw2	28–49	10.4	trace	1.48	8.5	36	58	6
2BCd	49–63	5.2	trace	2.11	2.1	52	45	3
2Cd	63–99	6.7	0.1	2.07	2.2	52	45	3
				Jamestown Pedon				
Ap	0–22	8.7	trace	1.41	29	46	49	5
Bw	22–47	4.4	0.1	1.38	5	45	52	3
2BC	47–78	2.4	trace	1.91	2	56	41	3
2Cd	78–108	4.5	trace	1.94	1	44	52	3

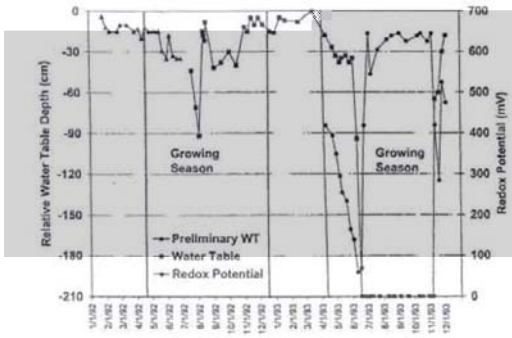

Fig. 1 Water table levels for the Sakonnet soil and preliminary water table levels from a well located on the same convex shoulder 60 meters away. Levels shown at −210 cm represent the bottom of the 210-cm well. Growing season is defined as the portion of the year that soil temperatures at 50 cm are above 5 °C. Redox potentials were measured at 30 cm below the soil surface.

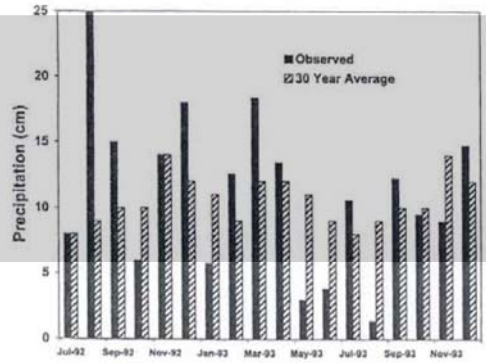

Fig. 3 Observed precipitation during the study period and 30-year average precipitation data for Kingston, RI.

most common feature. Coarse fragments coated with Fe have the same colors as many of the smaller Fe nodules. Most of the pore linings are very thin (0.1–0.2 mm). Depletions were observed in Bw2 and 2BC horizons but not in the overlying Bw horizons.

DISCUSSION

Water table levels in both soils showed seasonal changes (Figs. 1 and 2). For example, the lowest water table depth in August of the first year for the Jamestown soil was below the depth of the observation well (>200 cm below the soil surface), whereas the highest level was 50 cm from the soil surface or at the dense till contact (Fig. 2). Similar abrupt changes in the water table level were observed between spring and summer of the second year. In June of the second year, the water level in the Sakonnet soil dropped from a depth of 32 cm to depths greater than 210 cm (Fig. 1). Water table levels were near or above 30 cm for most of the period between August and May in the Sakonnet soil and from November through May in the Jamestown soil. These sites occur on shoulder landscape positions, have convex land-surface shapes, have slopes ranging from 3 to 5%, and are more than 100 m away from the base of the landscape. Such positions on the landscape rarely show indicators of wetland hydrology, and are considered problem areas for wetland delineation (Environmental Laboratory, 1987). Therefore, developing an understanding on how to use soil morphology to identify the depth to aquic conditions is critical.

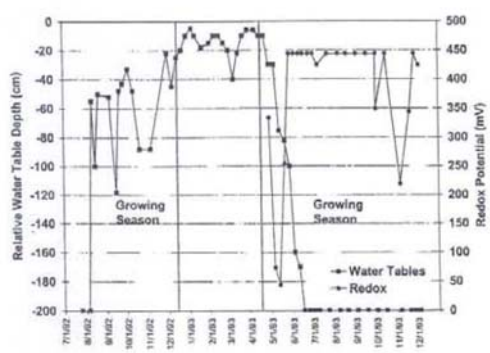

Fig.2 Water table levels for the Jamestown soil. Levels shown at −200 cm represent levels below the depth of 200-cm wells. Growing season is defined as the portion of the year that soil temperatures at 50 cm are above 5 °C. Redox potentials were measured at 30 cm below the soil surface.

Redoximorphic features such as Fe depletions and accumulations are often used to identify aquic conditions in soils (Vepraskas, 1992; Soil Survey Staff, 1998; USDA-NRCS, 1998). In the field, redoximorphic features such as Fe concentrations or depletions were not observable in the upper Bw horizons (Table 1) even though the seasonal high water tables reached well into these horizons and reducing conditions were recognized in the early part of the growing season (Figs. 1 and 2). However, redoximorphic features were observed in the thin sections (Tables 3 and 4). The nodules and pore linings were generally small in number and very fine in size, making them difficult to see in the field. Masses were much coarser (up to 10 mm), but their contrast relative to the matrix was distinct at best. In addition, boundaries between the masses and matrix

TABLE 3

Thin section descriptions for selected horizons from the Sakonnet and Jamestown profiles. Colors for the coated coarse fragments and redoximorphic features were determined with incident light under the microscope

Horizon and matrix color	Coated coarse fragments	Masses	Nodules	Pore linings	Depletions
		Sakonnet Pedon			
Bw1 2.5Y 3/2	2–4 mm, 2.5YR 4/6 and 5YR 5/8, partially coated	2–10 mm, 2.5Y 5/6, diffuse boundaries	0.2–1.5 mm, 2.5YR 4/6 and 2.5YR 3/2, sharp boundaries	0.1 mm, 10YR 5/6, diffuse boundaries	absent
Bw2 5Y 3/1	2–4 mm, 2.5YR 4/6 and 5YR 5/8, all or parts coated	2–10 mm, 10YR 4/6, 5Y 5/4, 2.5Y 5/6, 5YR 5/8, clear to diffuse boundaries	0.2–1.5 mm, 2.5YR 4/6, some are 2.5 YR 3/2 with 2.5YR 4/6 halos, sharp boundaries	0.1–0.2 mm, 2.5YR 4/8 and 10YR 5/6, sharp to clear boundaries, 30% of pores are lined	2–5 mm, 2.5Y 4/1, within matrix, irregular shape, sharp boundaries
		Jamestown Pedon			
Bw 2.5Y 3/2	2–5 mm, 10YR 5/6 and 5YR 5/8, partially coated	2–5 mm, 2.5Y 5/6 and 5/4, diffuse boundaries	0.5–1.5 mm, 5YR 5/8 and 2.5YR 3/2, sharp to clear boundaries	absent	absent
2BC 2.5Y 3/2	2–5 mm, 10YR 5/6 and 5YR 5/8, partially coated	2–10 mm, 2.5Y 3/3, 5/4, and 5/6, clear to diffuse boundaries	0.5–1.0 mm, 5YR 5/8, sharp boundaries	0.1 mm thick along 0.5 to 1.0 mm voids, 2.5Y 5/6, clear boundaries	2–5 mm, 2.5Y 4/1, within matrix, irregular shape, sharp boundaries

were diffuse in the upper Bw horizons, making them difficult to discern as they faded into the dark gray matrix.

The presence of the redoximorphic features and the redox potential data indicate that reducing conditions exist within the upper Bw horizons of these soils during a time of year when biological activity is occurring. Concentrations of Fe in the underlying Bw2 or 2BC horizons occurred in larger numbers, generally showed more

TABLE 4

Percent redoximorphic features and coarse fragments for the Sakonnet and Jamestown profiles. Two thin sections (a and b) were constructed for the selected horizons. The thin sections were 5 cm × 5 cm in area. Percentages are based on 300 point counts for each thin section

Horizon	Depth cm	Dark coarse fragments* %	Coated coarse fragments# %	Masses %	Nodules %	Pore linings %	Depletions %
			Sakonnet Pedon				
Bw1-(a)	14–28	3	1	9	0	1	0
Bw1-(b)	14–28	1	6	6	1	0	0
Bw2-(a)	28–49	3	1	4	2	2	0
Bw2-(b)	28–49	7	6	15	0	6	2
			Jamestown Pedon				
Bw-(a)	22–47	6	1	2	1	0	0
Bw-(b)	22–47	4	1	2	0	0	0
2BC-(a)	47–78	5	3	7	1	0	2
2BC-(b)	47–78	7	0	7	0	1	1

*The dark coarse fragments are N 2/0 and are derived from carboniferous rocks.

#The coated coarse fragments are composed primarily of quartz with Fe coatings.

contrast, and had clear boundaries making their observation in the field possible. Depletions were not observed in the field in any of the horizons but could be found in the thin sections of the Bw2 and 2BC horizons. Their contrast relative to the matrix was faint and could be observed only under magnification because of the features sharp boundaries.

The hydrologic pattern of these sites (Figs. 1 and 2) suggests that these may be hydric soils. To be considered hydric (USDA-NRCS, 1991), a soil needs to be saturated within its upper part (generally upper 30 cm) for 5 to 12% of the growing season, which is considered 2 or more continuous weeks in New England (NEHSTC, 1998). Such soils should show one of many hydric soil indicators (USDA-NRCS, 1998; NEHSTC, 1998). Soil temperature measurements at these sites indicate that the growing season, defined as the time the soil temperature at 50 cm is > 5 °C (Environmental Laboratory, 1987; NEHSTC, 1998), extends from the second week in April to the first week in December. Similar time frames for the defined growing season were reported for Rhode Island by Owenby and Ezell (1992) and Sokoloski (1989). Water table levels in the Jamestown soil fluctuated within 5 cm of the soil surface during the growing season, but it did not remain within 30 cm of the soil surface continuously over a 2-week period (Fig. 2). The short duration of saturation in the upper B horizon during the growing season may explain why there are so few redoximorphic features in the this horizon (Table 4). Coombs et al. (1985) studied soils overlying dense till and found that short periods of saturation occurred in the upper profile that did not have corresponding redoximorphic features. These authors concluded that the time and duration of the saturation was likely the most important factor in the formation of hydromorphic indicators. If saturation occurs when temperatures are below 5 °C, Fe reduction may not occur because of the inactivity of the microbes driving the redox processes.

Water table levels in the Sakonnet soil were well within the upper 30 cm of the soil during the growing season (Fig. 1). Hydric soil indicators, however, are absent. The indicators matching the soil morphology most closely are those labeled F3 and F4 in the Field Indicators of Hydric Soils in the United States (USDA-NRCS, 1998). These indicators identify soils with a depleted matrix below an A or dark A horizon or surface. The depleted matrix is defined by a horizon having a matrix with a color value of at least 4 and a low chroma (2 or less). In these soils, colors below the Ap horizons have values of 3. The dark parent materials are likely masking the light gray colors indicative of strongly reducing conditions in this soil, and the Sakonnet soil should, therefore, be identified as hydric.

Because both of these soils have low chroma and value colors, hydric soil indicator F13 (umbric surface) criteria seem to be met. The use of this indicator, however, is restricted to depressions and concave landforms in Land Resource Regions P and T (USDA-NRCS, 1998). The soils we examined occurred on convex shoulders in Land Resource Region R. Restricting the use of F13 to depressions and concave landforms is critical for soils with low chroma-low value parent materials because even moderately well drained and some well drained soils formed in these parent materials have apparent thick, dark surfaces. These dark surfaces, however, are a function of the dark parent material and not of wetness.

Micromorphology provides a means to identify the presence of hydromorphic features that may otherwise be missed in the field if only the naked eye is used. The observation of hydromorphic features in thin sections suggests that careful observations in the field, using a hand lens, may increase the likelihood of identification of horizons in problem soils with aquic conditions. The best way to apply this approach is to identify features in lower horizons that are indicative of aquic conditions and then use the hand lens to look for features exactly like, or very similar to, those in the overlying horizons. The features can be traced from the bottom up until they no longer are observed. Fe nodules may be one of the easiest diagnostic features to find because they have sharp boundaries. However, these small features appear very similar to Fe-coated coarse fragments, and, in addition, nodules with sharp boundaries are often interpreted as relict features (Vepraskas, 1992). Therefore, the use of nodules with sharp boundaries may result in misinterpretations. Iron masses and pore linings are probably the best hydromorphic feature to use to assess whether aquic conditions occur within these dark colored glacial materials.

A number of soils in the U.S. pose a problem with identifying the depth to aquic conditions (Veneman, et al., 1998). Common problem soils that have this problem to a considerable extent are the red-Triassic soils discussed by Elless et al. (1996), the soils formed in red till, and lacustrine and floodplain sediments (USDA-NRCS, 1998). High chroma accumulations in these soils are often masked by the red-colored parent materials (Niroomand and Tedrow, 1990). The techniques

described in this paper should be applied to these problem soils to evaluate the effectiveness of micromorphology to distinguish indicators of saturation and to develop further field guidelines for recognizing seasonal saturation.

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OSEDS:

LOCATION AGAWAM MA+CT NH NY RI VT
Established Series
REV. WHT-CAW-SMF
07/2004

AGAWAM SERIES

The Agawam series consists of very deep, well drained soils formed in sandy, water deposited materials. They are level to steep soils on outwash plains and high stream terraces. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is high in the upper solum and high or very high in the lower solum and substratum. Mean annual temperature is about 48 degrees F. and mean annual precipitation is about 47 inches.

TAXONOMIC CLASS: Coarse-loamy over sandy or sandy-skeletal, mixed, active, mesic Typic Dystrudepts

TYPICAL PEDON: Agawam fine sandy loam in a nearly level cultivated field at an elevation of about 124 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam; light brownish gray (10YR 6/2) dry; weak medium and coarse subangular blocky structure; very friable; common fine and medium roots; strongly acid; abrupt smooth boundary. (5 to 14 inches thick)

Bw1--11 to 16 inches; dark yellowish brown (10YR 4/4) fine sandy loam; weak medium and coarse subangular blocky structure; very friable; common fine and medium roots; strongly acid; abrupt smooth boundary.

Bw2--16 to 26 inches; light olive brown (2.5Y 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; common fine and medium roots; strongly acid; clear smooth boundary. (Combined thickness of the Bw horizons is 10 to 30 inches)

2C1--26 to 45 inches; olive(5Y 5/3) loamy fine sand; massive; very friable; few fine roots; strongly acid; clear smooth boundary.

2C2--45 to 55 inches; olive brown (2.5Y 4/4) loamy fine sand; massive; very friable; strongly acid; abrupt smooth boundary.

2C3--55 to 65 inches; olive (5Y 5/3) loamy sand; single grain; loose; strongly acid.

TYPE LOCATION: Hampshire County, Massachusetts; Town of Hatfield; 700 feet north of Elm Street at a point 1,600 feet west of its intersection with Prospect Street. USGS Mt. Holyoke quadrangle; Lat. 42 degrees 22 minutes 00 seconds N. and 72 degrees 36 minutes 42 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 15 to 35 inches. Coarse fragments range from 0 to 10 percent by volume in the surface, 0 to 30 percent in the B and C

horizons above a depth of 40 inches and 0 to 60 percent below. The soil ranges from very strongly acid to slightly acid, unless limed.

The Ap horizon has hue of 7.5YR to 2.5Y, value of 3 or 4, and chroma of 2 to 4. Dry value is 6 or more. It is fine sandy loam, very fine sandy loam, or loam. Undisturbed pedons have an A horizon that has hue of 7.5YR to 2.5Y, value of 2 to 3, and chroma of 1 to 3. It is 1 to 4 inches thick. Some pedons have a thin E horizon directly below the A.

The upper part of the Bw horizon has hue of 5YR to 10YR, value of 4 to 7, and chroma of 3 to 8. The lower part has hue of 10YR to 5Y with value and chroma ranges the same as the upper part. Texture is fine sandy loam, very fine sandy loam, or loam in the upper part and fine sandy loam or very fine sandy loam in the lower part. Structure is very weak, weak or moderate granular or subangular blocky or the horizon is massive.

A BC horizon of sandy loam or loamy sand is present in some pedons. Color and texture ranges are the same as the lower part of the Bw. Structure is very weak, weak or moderate granular or the horizon is massive. It is up to 5 inches thick.

The C horizon has hue of 10YR to 5Y, value of 3 to 7, and chroma of 1 to 4. It is stratified loamy fine sand, loamy sand, fine sand, sand, or their gravelly analogues and is very gravelly below a depth of 40 inches in some pedons. Consistence is very friable or loose.

COMPETING SERIES: These are the Barnstable, Branford, Haven, and Narragansett series. Barnstable soils formed in till over outwash and have rock fragments in the solum that are dominantly angular. Branford soils have hue of 5YR or redder throughout the B and C horizons. Narragansett soils lack stratified layers and have coarse fragments that are dominantly angular. Haven soils typically have more than 40 percent silt in the lower part of the Bw horizon.

GEOGRAPHIC SETTING: Agawam soils are level to steep soils on outwash plains and high stream terraces. Most areas are on slopes that are less than 15 percent. Steeper slopes are on terrace escarpments and steep sides of gullies in dissected outwash plains. The soils formed in sandy water deposited material derived principally from schist, granite, gneiss, and phyllite. Mean annual precipitation ranges from 28 to 55 inches and mean annual air temperature from 45 degrees to 50 degrees F. The mean growing season ranges from 120 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Enfield, Hadley, Hartland, Hinckley, Merrimac, Ninigret, Occum, Walpole, and Windsor soils on nearby landscapes. The excessively drained Hinckley and Windsor, somewhat excessively drained Merrimac, and well drained Enfield and Hartland soils are on associated outwash terraces and glacial lake plains. Well drained Hadley and Occum soils are on nearby floodplains. The moderately well drained Ninigret and poorly drained Walpole soils are associated in a drainage sequence with Agawam soils.

DRAINAGE AND PERMEABILITY: Well drained. Runoff and internal drainage are negligible to low. Saturated hydraulic conductivity is high in the upper solum and high or very high in the lower solum and substratum.

USE AND VEGETATION: Most areas are used for growing cultivated hay, silage corn, tobacco, potatoes, and truck crops. Some areas are used for growing pasture. Native vegetation is forest composed mainly of white pine, gray birch, red maple, red, white, black, and scarlet oaks.

DISTRIBUTION AND EXTENT: Connecticut, Massachusetts, New Hampshire, eastern New York, and Rhode Island; MLRA's 101, 142, 144A, and 145. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Hampden and Hampshire Counties, Massachusetts, 1928.

REMARKS: It should be noted that as a competing series, Haven soils typically have soil temperatures that may be slightly warmer but a precise difference could not be quantified based on available data and historical use.

Diagnostic horizons and other features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 11 inches (Ap horizon).
2. Cambic horizon - the zone from 11 to 26 inches (Bw horizons).
3. Contrasting particle-size - the coarse-loamy material contains less than 50 percent fine or coarser sand and the transition zone is less than 12.5 cm thick.

ADDITIONAL DATA: Reference samples from pedons S54MA023006, S58MA011002, S57NH013003, S70CT003001, S85VT027017, S85VT027018, S91MA011008, S93MA011003, S93MA011003, S93MA011004 from numerous counties and states, by NSSL, Lincoln, NE, various years. Pedon S70 CT-3-1 sampled in Hartford, Connecticut. Analysis by Beltsville soil survey laboratory.

National Cooperative Soil Survey
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LOCATION BRIDGEHAMPTON RI
Established Series
Rev. RAS-EHS-SMF
07/2000

BRIDGEHAMPTON SERIES

The Bridgehampton series consists of very deep, well drained and moderately well drained soils formed in thick silty deposits over glacial drift. They are nearly level to steep soils on outwash terraces and glaciated uplands. Slope ranges form 0 to 35 percent. Permeability is moderate in the surface layer and subsoil, and moderately rapid to very rapid in the substratum. Mean annual temperature is about 49 degrees F., and mean annual precipitation is about 48 inches.

TAXONOMIC CLASS: Coarse-silty, mixed, active, mesic Typic Dystrudepts

TYPICAL PEDON: Bridgehampton silt loam - idle field, 1 percent slope. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; very friable; few pebbles; strongly acid; abrupt smooth boundary. (6 to 12 inches thick)

Bw1--8 to 16 inches; dark yellowish brown (10YR 4/4) silt loam; weak medium subangular blocky structure; very friable; few pebbles; strongly acid; clear wavy boundary.

Bw2--16 to 24 inches; brown (10YR 5/3) silt loam; weak medium subangular blocky structure; very friable; strongly acid; clear wavy boundary. (Combined thickness of the Bw horizons is 12 to 20 inches.)

E--24 to 32 inches; grayish brown (2.5Y 5/2) silt loam; massive; very friable; few fine distinct yellowish brown (10YR 5/6) masses of iron concentration; strongly acid; clear wavy boundary. (4 to 11 inches thick)

B'w1--32 to 38 inches; strong brown (7.5YR 5/8) silt loam; massive; very friable; strongly acid; clear wavy boundary.

B'w2--38 to 41 inches; light olive brown (2.5Y 5/4) very fine sandy loam; massive; very friable; few fine distinct grayish brown (2.5Y 5/2) iron depletions; strongly acid; clear wavy boundary. (Combined thickness of the B'w horizons is 4 to 25 inches.)

2C--41 to 65 inches; grayish brown (2.5Y 5/2) very gravelly sand; single grain; loose; 40 percent gravel and 15 percent cobbles; common silt caps on rock fragments; strongly acid.

TYPE LOCATION: Washington County, Rhode Island; town of Charlestown, on the eastern edge of the U.S. Naval Air Station auxiliary landing field.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 56 inches and corresponds closely to the depth to contrasting glacial drift. Depth to bedrock is commonly more than 10 feet.

Rock fragments less than 3 inches in diameter range from 0 to 5 percent by volume in the solum. Stony pedons have 5 to 15 percent cobbles and stones in the solum. Rock fragments range from 5 to 70 percent by volume in the substratum and are mostly gravel. Unless limed, reaction ranges from very strongly acid through moderately acid.

The Ap horizon has hue of 10YR, value of 2 through 4, and chroma of 2 or 3. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 or 2. The Ap or A horizon is silt loam or very fine sandy loam. Consistence is friable or very friable.

The Bw horizon has hue of 7.5YR through 2.5Y, value of 4 or 5, and chroma of 3 through 6. It is silt loam, very fine sandy loam, or silt. Structure is weak subangular blocky or the lower part of the horizon is massive. Consistence is friable or very friable.

The E horizon has hue of 10YR through 5Y, value of 5 or 6, and chroma of 1 through 3. Some pedons have faint or distinct mottles. Texture is silt loam, very fine sandy loam, or silt. Structure is weak subangular blocky or the horizon is massive. Consistence is friable or very friable.

The B'w horizon has hue of 5YR through 2.5Y, value of 4 through 7, and chroma of 4 through 8. Some pedons have faint or distinct mottles. Texture is silt loam, very fine sandy loam, or silt. Consistence is friable or very friable.

The 2C horizon has hue of 5YR through 5Y, value of 4 through 7, and chroma of 2 through 6. Many pedons have high chroma iron stains on rock fragments in the upper part of the horizon. Fine-earth texture ranges from sandy loam through sand. Sandy loam and loamy sand are typical textures in glacial till materials and loamy sand and sand are typical in stratified glaciofluvial materials. The horizon is massive or single grain, and is loose, very friable, or friable. Some pedons have thin firm layers.

COMPETING SERIES: These are the Hitchcock, Poocham, and Unadilla series. Hitchcock, and Poocham soils have a solum thickness less than 40 inches thick. Unadilla soils have a reaction class that typically is neutral and ranges to slightly alkaline in the substratum and also do not have a bisequal horizon sequence, Bw-E-B'w in the subsoil.

GEOGRAPHIC SETTING: Bridgehampton soils are nearly level to steep and are on outwash terraces, plains, and upland glaciated landforms. Slope ranges from 0 to 35 percent, but commonly are 0 to 8 percent. These soils formed in thick silty deposits underlain by stratified sand and gravel or coarse-textured glacial till. Parent materials are derived mainly from gneiss, granite, and schist rocks with some sandstone, conglomerate, and shale. Mean annual temperature ranges from 47 to 54 degrees F., mean annual precipitation ranges from 42 to 50 incont4[COMgrcac[lay)-8(.1 son ranges)]TJ0.0021 Tc-0.0

Canton, Charlton, and Riverhead

_____ soils are coarser-textured. Raynham soils are poorlay ay

DRAINAGE AND PERMEABILITY: Well drained and moderately well drained. Surface runoff is slow to rapid. Permeability is moderate in the siltay solaym and moderately rapid tay veray rapid lay the

coarse-textured substratum. Because of the strongly contrasting texture of the substratum, the solum is commonly saturated in the lower part in the winter, spring, and after heavy rains.

USE AND VEGETATION: Much of the acreage is used for cultivated crops, hay, and pasture. Common crops are potatoes and silage corn. Some areas are used for sod farming and for nursery stock. A few areas are in community development or are wooded. Common trees are red, white, and black oak, white ash, red maple, white pine, and red pine.

DISTRIBUTION AND EXTENT: Southern Rhode Island; MLRA 144A. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Suffolk-Nassau Counties, New York, 1928.

REMARKS: Diagnostic horizons and features recognized in this pedon include:

1. Ochric epipedon - the zone from 0 to 8 inches (Ap horizon).
2. Cambic horizon - the zone from 8 to 41 inches (Bw, E, and B'w horizons).
3. Albic horizon - the zone from 24 to 32 inches (E horizon).
4. Coarse-silty particle-size class - average of the control section from 10 to 40 inches.
5. Bisequal horizon sequence - the zone from 8 to 41 inches (Bw-E-B'w).

ADDITIONAL DATA: Characterization data are available for two pedons S58RI-5-2 and S58RI-5-3. Engineering test data are available for three pedons S67NY-52-3, S67NY-52-4, and S67NY-52-5.

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BROCKATONORTON SERIES

TAXONOMIC CLASS: Mixed, mesic Aquic Udipsamments

TYPICAL PEDON: Brockatonorton sand on an undulating 1 percent slope in a back dune area of a barrier island. (colors are for moist soil)

A--0 to 8 cm (0 to 3 inches); light gray (2.5Y 7/2) sand; single grain; loose; very strongly acid; non-saline; clear wavy boundary. (2.5 to 15 cm thick)

C--8 to 61 cm (3 to 24 inches); pale yellow (5Y 7/3) sand; single grain; loose; common 1 to 2 mm (1/32 to 1/16 inch) layers of black (N 2/) sand; very strongly acid; non-saline; abrupt wavy boundary. (48 to 76 cm thick)

Cg--61 to 127 cm (24 to 50 inches); gray (5Y 6/1) sand; single grain; loose; very strongly acid; non-saline; clear, wavy boundary. (30 to 61 cm thick).

2Oe--127 to 152 cm (50 to 60 inches); dark brown (7.5YR 3/2) mucky peat; hemic soil material; fiber content is one-fourth by volume after rubbing; 10 percent soft wood fragments; common medium gray (5Y 5/1) sand lenses evidencing iron depletion; neutral; very slightly saline; abrupt, smooth boundary. (5 to 41 cm thick)

3C'g--152 to 183 cm (60 to 72 inches); gray (5Y 5/1) sand; single grain; loose; few very fine and fine dead roots; neutral; very slightly saline.

RANGE IN CHARACTERISTICS:
Depth to Seasonal High Water Table: 50 to 102 cm (20 to 40 inches); throughout the year. The water table may be tidally influenced.

LOCATION HOOKSAN NJ+MA
Established Series
CSL/Rev. JAK
11/2002

HOOKSAN SERIES

MLRA(S): 149A, 149B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Excessively drained
PERMEABILITY: Very rapid
SURFACE RUNOFF: Very slow
PARENT MATERIAL: Sandy marine sediments
SLOPE: 0 to 35 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 56 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 44 inches

TAXONOMIC CLASS: Mesic, uncoated Typic Quartzipsamments

TYPICAL PEDON: Hooksan sand, on rolling topography with beach grass and brush cover. (Colors are moist soils, unless otherwise noted.)

A--0 to 6 inches; grayish brown (10YR 5/2) sand; single grain; loose; few fine and medium roots; about 5 percent dark opaque grains; strongly acid, clear smooth boundary. (0 to 8 inches)

Cl--6 to 36 inches; pale yellow (2.5Y 7/4) sand; single grain; loose; few fine and few medium roots; about 5 percent dark opaque grains; strongly acid; diffuse wavy boundary.

C2--36 to 50 inches; light yellowish brown (2.5Y 6/4) sand; single grain; loose; few fine and medium roots; about 5 percent dark opaque grains; slightly acid; gradual wavy boundary.

C3--50 to 90 inches; pale yellow (2.5Y 7/4) sand; single grain; loose; about 5 percent dark opaque grains; neutral.

TYPE LOCATION: Monmouth County, New Jersey; Sandy Hook State Park, 500 feet east of road to north beach, 0.5 mile from intersection with the main road located 1.2 miles north from the entrance building.

RANGE IN CHARACTERISTICS:
Thickness of the Underlying Material: Greater than 72 inches
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: Greater than 72 inches
Rock Fragments: 0 to 5 percent, by volume throughout the profile, mostly shells. Some pedons may contain individual layers lees 1 foot thick with up to 10 percent fragments.
Soil Reaction: Strongly acid to slightly alkaline A or AC horizon and moderately acid to slightly alkaline in the C horizon

RANGE OF INDIVIDUAL HORIZONS:
O horizon (if it occurs):
Color--hue of 5YR to 10YR, value of 2 to 4, chroma of 1 to 3
Texture--highly decomposed to slightly decomposed plant material

A horizon:
Color--hue of 10YR or 2.5Y, value of 2 to 7, chroma of 1 or 2
Texture--fine sand, sand, or coarse sand

AC horizon (if it occurs):
Color--hue of 10YR or 2.5Y, value of 5 to 7, chroma of 1 or 2
Texture-fine sand, sand, or coarse sand

C horizon (upper part):
Color--hue of 10YR to 2.5Y, value of 5 to 8, chroma of 3 to 8
Texture-fine sand, sand, or coarse sand

C horizon (lower part):
Color--hue of 10YR to 5Y, value of 4 to 8, chroma of 1 to 8
Texture-fine sand, sand, or coarse sand. Some pedons have common 0.25 to 0.5 inch thick, roughly horizontal bands, with high proportion of dark minerals.

COMPETING SERIES:
Boone soils--are moderately deep to paralithic contact and are underlain by weathered sandstone
Carver soils--have a B horizon and formed in outwash plains and moraines
Tarr soils--have a B horizon and formed in alluvium derived from sandy siliceous sandstone
Tint soils--moderately well drained and have redoximorphic features within 72 inches, commonly within 40 inches

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Dunes commonly adjoining coastal beaches
Elevation: 0 to 25 feet
Parent Material: Sandy marine sediments
Mean Annual Air Temperature: 52 to 58 degrees F.
Mean Annual Precipitation: 42 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Carver soils--have a B horizon of loamy coarse sand or coarser material and formed in glacial outwash, on adjacent landforms
Downer soils--well drained and have a coarse-loamy particle-size control section, on higher landforms
Eastchop soils--have a B horizon and formed in glacial outwash, on adjacent landforms
Evesboro soils--have a B horizon and contain more silt and clay in the particle-size control section, on higher landforms
Hammonton soils--moderately well drained and have a coarse-loamy particle-size control section, on adjacent landforms
Klej soils--somewhat poorly drained, on adjacent landforms

Plymouth soils--have a B horizon and formed in glacial outwash or deltaic deposits, on adjacent landforms

USE: Most of these soils are used for recreation, urban development, beach cottages, and wildlife.

VEGETATION: Native vegetation consists of beach grasses, poison ivy, beach plum, American holly, red cedar, black cherry, smooth sumac, green briar, and prickly pear cactus.

DISTRIBUTION: Mainly bordering the North Atlantic Coast in New Jersey, New York, Rhode Island, and Massachusetts

EXTENT: Moderate

SERIES ESTABLISHED: Monmouth County, New Jersey; 1983

REMARKS: Hooksan soils were previously mapped as Fripp, Udipsamments, or Coastal Beach. The Hooksan series was previously classified as siliceous, uncoated Typic Udipsamments.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the soil surface to a depth of 6 inches (A horizon)

SOIL INTERPRETATION RECORD: NJ0075, NJ0211

National Cooperative Soil Survey
U.S.A.**,**

LOCATION MERRIMAC MA+CT NH NY RI VT
Established Series
Rev. DGG-WHT-MFF
03/2005

MERRIMAC SERIES

The Merrimac series consists of very deep, somewhat excessively drained soils formed in glacial outwash. They are nearly level to very steep soils on outwash terraces and plains and other glaciofluvial landforms. Slope ranges form 0 to 35 percent. Saturated hydraulic conductivity is high or very high. Mean annual temperature is about 48 degrees F. and mean annual precipitation is about 42 inches.

TAXONOMIC CLASS: Sandy, mixed, mesic Typic Dystrudepts

TYPICAL PEDON: Merrimac fine sandy loam cultivated, at an elevation of about 122 meters. (Colors are for moist soil.)

Ap--0 to 10 inches; very dark grayish brown (10YR 3/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine and medium granular structure; very friable; many fine roots; 10 percent fine gravel; strongly acid; abrupt smooth boundary. (6 to 14 inches thick)

Bwl--10 to 15 inches; brown (7.5YR 4/4) fine sandy loam; weak fine and medium granular structure; very friable; common fine roots; 10 percent fine gravel; strongly acid; clear wavy boundary.

Bw2--15 to 22 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam; weak fine and medium granular structure; very friable; few fine roots; 15 percent gravel; strongly acid; clear wavy boundary.

Bw3--22 to 26 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; very weak fine granular structure; very friable; few fine roots; 25 percent gravel; moderately acid; clear wavy boundary. (Combined thickness of the Bw horizons is 6 to 34 inches thick.)

2C--26 to 65 inches; 80 percent yellowish brown (10YR 5/4) and 20 percent dark grayish brown (10YR 4/2) very gravelly sand; single grain; loose; stratified; few fine roots in upper 4 inches; 40 percent gravel, 10 percent cobbles; moderately acid.

TYPE LOCATION: Franklin County, Massachusetts; Town of Leverett, 2.75 miles south-southeast of Montague Village, 0.13 miles southeast of Cranberry Pond, just west of Route 63. USGS Williamsburg quadrangle, Latitude 42 degrees, 29 minutes, 51 seconds N. and longitude 72 degrees 31 minutes 14 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 18 to 30 inches. Rock fragments are mainly granite or gneiss, but up to 25 percent are flat, fine-grained slate, shale, or phyllite fragments. The upper part of the solum commonly has 5 to 20 percent gravel but includes cobbles in some pedons and the lower part 5 to 30 percent. The substratum contains 25 to 55 percent gravel and 5 to 15 percent cobbles. Total volume of rock fragments in the particle-size control section is less than 35 percent. Clay content is less than 18 percent. Reaction ranges from extremely acid to moderately acid unless limed.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. Undisturbed areas have an A horizon with value of 2 to 3, and chroma of 1 or 2 that is 1 to 4 inch thick. Some pedons have a thin, light colored E horizon below the A. The Ap, A and E horizons are fine sandy loam, sandy loam, or very fine sandy loam in the fine-earth fraction.

The Bw horizon has hue of 7.5YR or 10YR in the upper part and 7.5YR to 2.5Y in the lower part. Value ranges from 3 to 6 and chroma from 3 to 8. Texture of the upper part of the Bw horizon is fine sandy loam, sandy loam, or very fine sandy loam in the fine-earth fraction. It has granular or subangular blocky structure or the horizon is massive. The lower part of the B horizon is sandy loam, coarse sandy loam, loamy coarse sand, or loamy sand in the fine-earth fraction. Sandy loam textures do not extend below a depth of 27 inches, but a minimum thickness of 5 inches of sandy loam overlies any lower B or 2C horizon that is loamy fine sand or coarser. The B subhorizon that lies above the 2C horizon in many pedons is single grain. Some pedons have a BC horizon that is similar to the lower part of the Bw.

The 2C horizon has hue of 10YR to 5Y and ranges widely in value and chroma. It consists of stratified coarse sand, sand, gravel, and cobbles and has a weighted texture of gravelly or very gravelly sand or coarse sand. Some pedons have thin lenses of loamy fine sand or fine sand.

COMPETING SERIES: These are the Hartford and Knickerbocker series. Hartford soils have hues of 5YR or redder in the Bw horizon. Knickerbocker soils have fewer rock fragments than Merrimac soils.

GEOGRAPHIC SETTING: Merrimac soils are level to very steep soils on glacial outwash plains and valley trains, and associated kames, eskers, stream terraces and water deposited parts of moraines. The steeper slopes are on the margin escarpments of terraces and plains, and on eskers and kames. Slope ranges from 0 to 35 percent. The soils formed in water sorted gravelly and sandy material derived mainly from granitic, gneissic and some schistose rocks. Mean annual precipitation ranges from 28 to 55 inches; mean annual air temperature ranges from 45 to 50 degrees F., mean growing season ranges from 120 to 200 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Agawam, Hinckley, Sudbury, Scarboro, Walpole and Windsor soils on nearby landscapes. The well drained Agawam soils are coarse-loamy over sandy or sandy-skeletal. The excessively drained Hinckley soils are sandy-skeletal. The very poorly drained Scarboro soils are in depressions. The moderately drained Sudbury soils are on adjacent, slightly lower landforms. The somewhat poorly drained poorly and drained Walpole soils are in drainageways and on low landforms. The excessively drained Windsor soils are have loamy fine sand to sand textures in the Bw horizon and lack rock fragments.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained. Runoff is negligible to medium. Saturated hydraulic conductivity is high or very high.

USE AND VEGETATION: Most areas are cultivated and used for growing hay, pasture, silage, corn, or truck crops. Some areas are used to grow tobacco in the Connecticut River Valley in Massachusetts and Connecticut. Some areas are forested with mostly white pine, gray birch, hemlock, red maple, and red, black, white, and scarlet oaks.

DISTRIBUTION AND EXTENT: Massachusetts, Connecticut, New Hampshire, New York, Vermont and Rhode Island (MLRAs 142, 144A, and 145). The series is extensive.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Merrimack County, New Hampshire, 1906.

REMARKS: Diagnostic horizons and other features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 10 inches (Ap horizon).
2. Cambic horizon - the zone from 10 to 26 inches (Bw horizon).

National Cooperative Soil Survey
U.S.A.**,**

LOCATION NEWPORT RI+MA
Established Series
Rev. RAS-EHS
02/2000

NEWPORT SERIES

The Newport series consists of very deep, well drained loamy soils formed in compact glacial till on uplands. The soils are moderately deep to dense basal till. They are nearly level to moderately steep soils on till plains, low ridges, and drumlodial landforms. Permeability is moderate or moderately rapid in the surface layer and subsoil and slow or very slow in the dense substratum. Mean annual temperature is 49 degrees F., and mean annual precipitation is 48 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Typic Dystrudepts

TYPICAL PEDON: Newport silt loam - cultivated field. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 8 inches; very dark brown (10YR 2/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; very friable; many fine and medium roots; 5 percent channers and gravel; strongly acid; clear smooth boundary. (6 to 10 inches thick)

Bw1--8 to 18 inches; olive brown (2.5Y 4/4) channery silt loam; weak medium subangular blocky structure; friable; common fine and medium roots; 15 percent channers and gravel; strongly acid; clear wavy boundary.

Bw2--18 to 24 inches; olive (5Y 4/3) channery silt loam; weak medium and coarse subangular blocky structure; friable; few roots; 15 percent channers and gravel; strongly acid; clear wavy boundary. (Combined thickness of the Bw horizon is 14 to 37 inches.)

Cd--24 to 65 inches; olive gray (5Y 4/2) channery loam; few dark yellowish brown (10YR 3/4) pockets in the upper 6 inches; weak thick platy structure; very firm, brittle; few silt films on rock fragments; 25 percent channers and gravel; strongly acid.

TYPE LOCATION: Newport County, Rhode Island; town of Middletown, 690 feet north of the junction of Green End Avenue and Indian Avenue, and 160 west of Indian Avenue.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 20 to 40 inches and typically corresponds to the depth to the dense substratum. Depth to bedrock is commonly more than 6 feet. Rock fragments range from 5 to 30 percent by volume in the solum and from 10 to 35 percent in the substratum. Except where the surface is stony, the fragments are mostly flat and less than 6 inches in diameter. Channers and gravel typically make up 75 percent or more of the total rock fragments. Unless limed, reaction ranges from very strongly acid through moderately acid. Low chroma colors in the B and C horizons are lithochromic.

The Ap horizon has hue of 10YR through 5Y, value of 2 through 4, and chroma of 1 through 3. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 or

2. The Ap or A horizon is silt loam, very fine sandy loam, loam, or fine sandy loam in the fine-earth fraction. It has weak or moderate granular structure and is friable or very friable.

The Bw horizon has hue of 2.5Y or 5Y, value of 2 through 5, and chroma of 1 through 4. Some pedons have few faint mottles just above the Cd horizon. The Bw horizon is silt loam, very fine sandy loam, loam, or fine sandy loam in the fine-earth fraction. It has weak subangular blocky or granular structure, or the horizon is massive. Consistence is friable or very friable.

The Cd horizon has hue of 2.5Y or 5Y, value of 2 through 5, and chroma of 1 through 3. It is silt loam, very fine sandy loam, loam, or fine sandy loam in the fine-earth fraction. The horizon has weak or moderate, thin to thick plates, or it is massive. Consistence is firm or very firm.

COMPETING SERIES: These are the Amostown, Ashe, Bernardston, Broadbrook, Brookfield, Cardigan, Charlton, Chatfield, Cheshire, Chestnut, Ditney, Dutchess, Edneyville, Fedscreek, Hazel, Lordstown, Maplecrest, Marrowbone, Maymead, Montauk, Nantucket, Paxton, Pollux, Riverhead, Satsop, Scituate, St. Albans, Steinsburg, Valois, Wethersfield, and Yalesville series in the same family. Amostown and Pollux soils are underlain by stratified very fine sand or silt within a depth of 40 inches. Ashe, Cardigan, Chatfield, Ditney, Hazel, Lordstown, Marrowbone, Steinsburg, and Yalesville soils are 20 to 40 inches deep to bedrock. Bernardston, Broadbrook, Montauk, and Paxton soils have hue of 10YR or 7.5YR in at least part of the B horizon. Brookfield, Charlton, Cheshire, Dutchess, Maplecrest, St. Albans, and Valois soils do not have a dense substratum. Chestnut soils formed in residuum and have weathered bedrock at a depth of 20 to 40 inches. Edneyville soils formed in residuum and do not have a dense substratum. Fedscreek and Maymead soils formed in colluvium and do not have a dense substratum. Nantucket soils have a lithologic discontinuity and more clay in the substratum. Riverhead soils have a stratified sand and gravel C horizon within a depth of 40 inches. Satsop soils receive 60 to 80 inches of precipitation annually. Scituate soils are mottled in the lower part of the B horizon. Wethersfield soils have 5YR or redder hue in the B and C horizons.

The Pittstown, Rainbow, and Woodbridge series are similar soils in related families. All of these soils have low chroma mottles within a 24 inch depth.

GEOGRAPHIC SETTING: Newport soils are nearly level to moderately steep and are on till plains, low ridges, and drumlodial landforms. Slopes range from 0 to 25 percent. The soils formed in acid glacial till derived mainly from dark sandstone, conglomerate, argillite, and phyllite. Mean annual temperature ranges from 45 to 52 degrees F., mean annual precipitation ranges from 40 to 50 inches, and the growing season ranges from 135 to 185 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Broadbrook, Pittstown, and Rainbow soils and the Birchwood, Mansfield, Narragansett, Poquonock, Quonset, Stissing, Wapping, and Warwick soils. The moderately well drained Pittstown, poorly drained Stissing, and the very poorly drained Mansfield soils are associated in a drainage sequence. Birchwood and Poquonock soils have a sandy over loamy particle-size control section. Narragansett and Wapping soils have hue of 7.5YR or 10YR in the upper part of the B horizon and a friable substratum. Quonset and Warwick soils are on nearby terraces and are underlain by stratified coarse-textured deposits.

DRAINAGE AND PERMEABILITY: Well drained. Surface runoff is medium to rapid. Permeability is moderate or moderately rapid in the solum and slow or very slow in the substratum.

USE AND VEGETATION: Many areas are cleared and used for cultivated crops, hay, pasture, and nursery stock. Scattered areas are used for community development. Some areas are wooded. Common trees are red and white oak, gray birch, red maple, sugar maple, and white pine.

DISTRIBUTION AND EXTENT: Eastern Rhode Island and southeastern Massachusetts. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Washington-Kent Counties, Rhode Island, 1934.

REMARKS: Newport soils were previously classified as Typic Fragiochrepts. Diagnostic horizons and features recognized in this pedon are:
1. Ochric epipedon - the zone from 0 to 8 inches (Ap horizon).
2. Cambic horizon - the zone from 8 to 24 inches (Bw horizon).
3. Dense basal till substratum - the zone from 24 to 65 inches (Cd horizon).

National Cooperative Soil Survey
U.S.A.**,**

LOCATION PISHAGQUA RI
Tentative Series
JDT, MPB, MS
03/2007

PISHAGQUA SERIES

The Pishagqua series consists of very deep, subaquic soils that are permanently submerged in low energy depositional basins, estuaries and coastal lagoons. The Pishagqua soils formed in silty estuarine deposits. Estimated saturated hydraulic conductivity is moderately high to high. Slopes range from 0 to 3 percent, mean annual air temperature is 10 degrees C, and mean annual precipitation is 1320 mm.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, nonacid, mesic Typic Sulfaquents

TYPICAL PEDON: Pishagqua silt loam on a south facing 1 percent, concave slope in an Eelgrass (Zostera marina) bed of a lagoon bottom channel under 2 meters (Na

The Ag horizon, where present, has hue of 2.5Y to 5Y moist or dry, value of 2.5 to 3 moist, 5 to 7 dry and chroma 2 or less moist or dry. Textures range from silt loam to silty clay loam with mucky analogs in some pedons. Consistence is moderately to very fluid wet, very friable to loose moist, soft dry, and non-sticky to slightly sticky and plastic. Sulphurous odor is present.

Cg layers have hue of 5Y to N moist or dry, value 2.5 to 4 moist, 5 to 7 dry and chroma 2 or less moist or dry. Textures of the Cg layers include very fine sandy loam, silt loam and silty clay loam with mucky analogs in some pedons. Some pedons have thin strata of sandy material. Consistence is slightly to very fluid wet, very friable to loose moist, soft dry, and non-sticky to slightly sticky and plastic. Sulphurous odor is present.

Some pedons are underlain at a depth greater than 100 cm by buried organic deposits, sandy estuarine material, loess, and/or glaciofluvial sand and gravel.

COMPETING SERIES: There are no competing series. The Appoquinimink, Boxiron, Broadkill, and Southpoint soils are in related families. Appoquinimink, Boxiron and Broadkill soils are flooded twice daily by tidal water. Appoquinimink and the subaqueous Southpoint soils are underlain by organic horizons within a depth of 100 cm. Boxiron soils have a histic epipedon. Broadkill soils have a ratio of cation exchange activity to clay of 0.40 to 0.60 within the cation exchange activity control section.

GEOGRAPHIC SETTING:
The Pishagqua soils are permanently submerged with salt or brackish water in low energy (little affected by wave energy, deposition of sandy material, or storm events) basins and channels of coastal lagoons. The soils formed in silty estuarine sediments in water depths of 1 to 5 meters. Most areas have slope less than 3 percent and are slightly concave to nearly level. The mean annual air temperature is 10 degrees C, and mean annual precipitation is 1320 mm.

GEOGRAPHICALLY ASSOCIATED SOILS:
These are the Matunuck, Pawcutuck, Quanaduck(T) and Wamphassuc(T) soils. Matunuck and Pawcutuck soils are on tidal marshes. Wamphassuc soils have coarser textures and occur in submerged valleys and terraces in bays. Quanaduck soils are underlain by coarse textured material within 100 cm of the soil surface.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Subaqueous soil, peraquic soil moisture regime, moderately high to high saturated hydraulic conductivity. The soil is permanently submerged with salt or brackish water. Runoff is negligible.

USE AND VEGETATION:
Uses include shell fishing, marinas, moorings and aquaculture. Benthic fauna such as tubeworms, clams, juvenile blue crabs, scallops and juvenile finfish are associated with this soil. Native vegetation includes eelgrass (Zostera marina) and widgeon grass (Ruppia maritima). Many areas have a mat of floating macroalgae at the soil/water interface. Vegetative cover ranges from 0 to 100 percent.

DISTRIBUTION AND EXTENT: Rhode Island, U.S.A.; MLRA 144A. This series is of small extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES PROPOSED: Washington County, Rhode Island, 2007.

REMARKS: Series name was taken from Algonquian word for mud and/or dirt. Pishagqua soils were formerly included in mapping with miscellaneous areas of water.

Upon drying and exposure to air common, fine and medium 5Y 5/4 mottles appeared throughout some pedons.
Horizon boundary is not included due to the method of sampling (core).

Applying the proposed Wassents suborder, this soil classifies as a Fine-silty, mixed, superactive, nonacid, mesic Typic Sulfiwassent.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:

1. Ochric epipedonthe zone from the surface to a depth of 15 cm (Ag horizon).

2. Aquic conditions--the soil is permanantly submerged, the zone from 0 to 200 cm has positive soil water potential. When described, all layers reacted positively to alpha-alpha' dipyridyl.

3. Sulfidic feature--The zone from 0 cm to 100 cm contains sulfidic materials in all horizons (verified by moist incubation).

4. High n-valuethe zone from the surface to 100 cm has an n-value greater than 0.7

ADDITIONAL DATA:
This pedon was sampled as S04-RI009-001 by the University of Rhode Island. Support pedons used to develop this series description include S05-RI-009-004 (sampled by the NSSL), S04-RI-009-002 (Sampled by the University of Rhode Island), S05-RI-009-013B, S05-RI-009-005 (sampled by the NSSL), and 00NP056 (sampled by University of Rhode Island for graduate thesis).

National Cooperative Soil Survey
U.S.A.**,**

LOCATION PITTSTOWN MA+NH NY RI VT
Established Series
Rev. DGG-WHT-SMF
10/1999

PITTSTOWN SERIES

The Pittstown series consists of moderately well drained soils formed in subglacial till derived mainly from slate, phyllite, shale, and schist. These soils are very deep to bedrock and moderately deep to a densic contact. They are nearly level to moderately steep soils on uplands. Slope ranges from 0 to 25 percent. Permeability is moderate in the solum and slow in the substratum. Mean annual temperature is about 49 degrees F. and mean annual precipitation is about 45 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Aquic Dystrudepts

TYPICAL PEDON: Pittstown loam, cultivated field. (Colors are for moist soil.)

Ap--0 to 10 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; 10 percent phyllite fragments; very strongly acid; abrupt smooth boundary.

Bw1--10 to 18 inches; olive brown (2.5Y 4/4) loam; weak medium granular structure; friable; 10 percent phyllite fragments; very strongly acid; abrupt smooth boundary.

Bw2--18 to 29 inches; olive (5Y 4/3) channery loam; massive; friable; 15 percent phyllite fragments; common medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulations and common medium distinct gray (5Y 5/1) iron depletions; very strongly acid; abrupt smooth boundary.

Cd--29 to 65 inches; olive (5Y 5/3) channery loam; massive; very firm, brittle; 20 percent phyllite fragments; many coarse prominent dark yellowish brown (10YR 4/4) masses of iron accumulation and many coarse distinct olive gray (5Y 5/2) iron depletions; very strongly acid.

TYPE LOCATION: Bristol County, Massachusetts; Town of Somerset, 400 feet north of Wilbur Avenue, and 900 feet east of Brayton Point Road. Fall River quadrangle: Lat. 41 degrees 43 minutes 25 seconds N. and long. 71 degrees 10 minutes 35 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 15 to 30 inches. The depth to densic materials commonly is 20 to 30 inches but the range includes 15 to 30. Depth to redoximorphic features ranges from 15 to 24 inches. The solum in the fine earth fraction is silt loam, loam, or very fine sandy loam with more than 65 percent silt plus very fine sand. Rock fragments consist of dark phyllite, slate, and schist. Rock fragments, by volume, larger than 10 inches range from 0 to 20 percent in the surface and 0 to 5 percent in the subsoil and substratum. Three to 10 inch size fragments range from 0 to 15 percent in surface, 0 to 10 percent in the subsoil and 0 to 15 percent in the substratum. Fragments less than 3 inches range from 5 to 25 percent in the surface, 5 to 25 percent in the subsoil and 15 to 30 percent in the substratum. The soil, below the A or Ap horizon and above a depth of 30 inches, is very strongly acid to moderately acid where not limed, and ranges from very strongly acid to slightly acid below a depth of 30 inches.

Unplowed areas have 0 horizons l to 4 inches thick underlain by a thin A horizon with hue of 10YR, value of 2 to 3 and chroma of l to 3.

The Ap horizon has hue of 10YR, value of 2 to 4, and chroma of 2 or 3. Structure is weak or moderate fine or medium granular. Consistence is friable or very friable.

Some pedons have a thin E horizon.

The upper part of the Bw horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. The lower part of the Bw horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 3 to 6. Redoximorphic depletions and concentrations are few or common in the upper part of the Bw and from few to many in the lower part. Structure commonly is weak or moderate blocky but the range includes weak or moderate granular or massive. Consistence is friable or very friable.

Some pedons have a friable C horizon above the Cd horizon. It has hue of 10YR to 5Y, value of 4 or 5, and chroma of 2 to 3. Texture is similar to the Cd horizon.

The Cd horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 2 to 4. It is silt loam, very fine sandy loam, or loam in the fine-earth fraction. It is firm to extremely firm. The horizon is normally massive but may have weak platy structure.

COMPETING SERIES: Currently, these are the Chautauqua, Rainbow, Sutton, Wilbraham, and Woodbridge series. Ludlow, Pompton, Wapping, and Watchaug series are similar soils in related families.

Chautauqua, Pompton, Sutton, Wapping, and Watchaug soils do not have densic materials in the substratum. Ludlow soils have hue of 5YR or redder in the Bw horizon. Rainbow soils have a lithologic discontinuity. Woodbridge

DISTRIBUTION AND EXTENT: Glaciated uplands in Massachusetts, New Hampshire, Rhode Island, Vermont, and eastern New York: MLRA 144A. The series is of moderate extent; estimated to be about 20,000 acres.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES ESTABLISHED: Sullivan County, New York, 1938.

REMARKS: Pittstown soils were previously classified as Fragiochrepts in earlier editions of Soil Taxonomy. Cation exchange activity class was determined from a review of available data and similar soils.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 10 inches (Ap horizon).

2. Cambic horizon - the zone from 10 to 29 inches (Bw1 and Bw2 horizons).

3. Densic materials (basal till) at 29 inches (Cd horizon).

4. Aquic subgroup - presence of low chroma iron depletions at 18 inches (Bw1 horizon).

National Cooperative Soil Survey
U.S.A.**,**

LOCATION RAINBOW CT +MA RI
Established Series
Rev. MFF-SMF
10/2005

RAINBOW SERIES

The Rainbow series consists of moderately well drained loamy soils formed in silty mantled lodgement till. The soils are very deep to bedrock and moderately deep to a densic contact. They are nearly level to strongly sloping soils on till plains, hills and drumlins. Slope ranges from 0 to 15 percent. Saturated hydraulic conductivity is moderately high or high in the surface layer and subsoil, and low to moderately high in the dense substratum. Mean annual temperature is about 49 degrees F., and mean annual precipitation is about 48 inches.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, mesic Aquic Dystrudepts

TYPICAL PEDON: Rainbow silt loam in a grassy field at an elevation of about 195 feet. (Colors are for moist soil unless otherwise noted.)

Ap--0 to 6 inches; dark brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; many fine roots; few pebbles; strongly acid; clear wavy boundary. (6 to 10 inches thick)

Bw1--6 to 18 inches; yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; very friable; few fine roots; few pebbles; strongly acid; clear wavy boundary.

Bw2--18 to 26 inches; light yellowish brown (10YR 6/4) silt loam; weak fine and medium subangular blocky structure; very friable; few fine roots; few pebbles; common medium prominent light gray (5Y 7/1) iron depletions and distinct strong brown (7.5YR 5/6) masses of iron concentrations; strongly acid; clear wavy boundary. (Combined thickness of the Bw horizons is 12 to 37 inches.)

2Cd--26 to 65 inches; pale brown (10YR 6/3) gravelly fine sandy loam; very firm, brittle; common silt films on rock fragments; 15 percent gravel; common medium faint light olive brown (2.5Y 5/4) and common distinct brownish yellow (10YR 6/6) masses of iron concentrations; strongly acid.

TYPE LOCATION: New London County, Connecticut; town of Montville, 1,600 feet west along Haley Road from the intersection with Jerome Road, 100 feet south of Haley Road, and 100 feet north of the Montville-Waterford town line. USGS Uncasville topographic quadrangle, latitude 41 degrees 25 minutes 33 seconds N., longitude 72 degrees 7 minutes 8 seconds W., NAD 27.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 18 to 40 inches. Depth to the densic contact commonly ranges from 20 to 40 inches but the range currently includes 18 to 40 inches. Depth to bedrock is commonly more than 6 feet. Rock fragments range from 0 to 20 percent by volume in the solum and from 5 to 35 percent in the substratum. Except where the surface is stony, the fragments are mostly subrounded gravel and typically make up 60 percent or more of the total rock fragments. Unless limed, reaction ranges from very strongly acid to moderately acid.

The Ap horizon has hue of 7.5YR or 10YR and value and chroma of 2 to 4. Dry value is 6 or more. Undisturbed pedons have a thin A horizon with value of 2 or 3 and chroma of 1 or 2. The Ap or A horizon centers on silt loam or very fine sandy loam in the fine-earth fraction, but includes loam high in silt. It has weak or moderate granular structure and is friable or very friable.

Some pedons have a thin E horizon below the A horizon. It has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 3. Texture, structure, and consistence are like the A horizon.

The upper part of the Bw horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The lower part of the Bw horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. Iron depletions are within a depth of 24 inches. The Bw horizon is silt loam, very fine sandy loam, or loam with more than 65 percent silt plus very fine sand. It has weak granular or subangular blocky structure, or the horizon is massive. Consistence is friable or very friable.

Some pedons have a thin BC horizon.

Some pedons have an E horizon up to 3 inches thick below the B horizon. It has hue of 10YR to 5Y, value of 5 or 6, chroma of 2 or 3, and has redoximorphic features. Typically, it is coarser-textured than the overlying horizon.

The 2Cd horizon has hue of 2.5YR to 5Y and value and chroma of 2 to 6. It typically has redoximorphic features. Texture ranges from loam to sandy loam in the fine-earth fraction. The horizon has weak or moderate, medium to very thick plates, or it is massive. Consistence is firm or very firm.

COMPETING SERIES: These are the Chautauqua, Pittstown, Pompton, Sutton, Wapping, Watchaug, Wilbraham and Woodbridge soils. Chautauqua, Sutton, Wapping, and Watchaug soils do not have a densic contact. Pittstown soils do not have a lithologic discontinuity in the substratum. Pompton soils are wetter with iron depletions throughout the B horizon. Poorly drained Wilbraham soils have iron depletions throughout the B horizon. Woodbridge soils have less than 65 percent silt plus very fine sand in the solum.

GEOGRAPHIC SETTING: Rainbow soils are nearly level to strongly sloping and are on till plains, hills, and drumlins. Slope commonly ranges from 0 to 8 percent but the range includes 0 to 15 percent. The soils formed in a silty mantled acid till derived mainly from gneiss, schist, sandstone, conglomerate, and basalt. Mean annual temperature ranges from 45 to 52 degrees F., mean annual precipitation ranges from 37 to 50 inches, and the growing season ranges from 120 to 190 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Pittstown, Sutton, Wapping, Watchaug, Wilbraham, and Woodbridge soils and the Agawam, Belgrade, Birchwood, Bridgehampton, Broadbrook, Canton, Charlton, Cheshire, Enfield, Haven, Hollis, Leicester, Ludlow, Merrimac, Montauk, Narragansett, Newport, Paxton, Poquonock, Ridgebury, Scio, Scituate, Stissing, Sutton, Tisbury, Wethersfield, soils on nearby landscapes. The well drained Broadbrook soils are associated in a drainage sequence. Agawam, Enfield, Haven, Merrimac, and Tisbury soils are on nearby outwash terraces and are underlain by stratified sand and gravel. Birchwood and Poquonock soils have coarse-textured solums. Bridgehampton and Scio soils are coarse-silty and do not have a dense substratum. Canton, Charlton, Cheshire, and Narragansett soils are well drained and do not have a dense substratum. Hollis soils have bedrock within a depth of 10 to 20 inches. Leicester, Ridgebury, and Stissing soils are poorly drained. Newport and Paxton soils are well drained. Scituate

soils have a loamy sand substratum. Wethersfield soils are well drained and have 5YR or redder hue in the B horizon.

DRAINAGE AND PERMEABILITY: Rainbow soils have a seasonal high water table and are moderately well drained. Surface runoff is slow to medium. Saturated hydraulic conductivity is moderately high or high in the surface layer and subsoil, and low to moderately high in the dense substratum.

USE AND VEGETATION: Cleared areas are used mostly for cultivated crops, hay, or pasture. Some areas are used for vegetables, nursery stock, and other specialty crops. Scattered areas are used for community development. Stony areas are mostly wooded. Common trees are ash, hemlock, white pine, hickory, red and white oak, red maple, and sugar maple.

DISTRIBUTION AND EXTENT: Glaciated uplands in Connecticut, Massachusetts, and Rhode Island; MLRAs 144A and 145. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Hartford County, Connecticut, 1959.

REMARKS: Rainbow soils were previously classified as Aquic Dystrochrepts and before that as Typic Fragiochrepts. Cation exchange activity class placement determined from a review of limited lab data and similar or associated soils.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 6 inches (Ap horizon);
2. Cambic horizon - the zone from 6 to 26 inches (Bw horizon);
3. Aquic feature - iron depletions are within a 24 inch depth (Bw2 horizon);
4. Lithologic discontinuity at a depth of 26 inches (2Cd horizon);
5. Dense till substratum - the zone from 26 to 65 inches (2Cd horizon).

National Cooperative Soil Survey
U.S.A.**,**

LOCATION RHODESFOLLY CT
Tentative Series
Rev. DAS-SJM
12/2007

RHODESFOLLY SERIES

The Rhodesfolly series consists of very deep, subaqueous soils on bay bottoms, flood tidal delta flats, washover fans and shore faces. The Rhodesfolly soils are formed in sandy marine deposits. Slope ranges from 0 to 5 percent, mean annual air temperature is about 10 degrees C. and mean annual precipitation is about 1142 mm.

TAXONOMIC CLASS: Mixed, mesic Typic Psammaquents

TYPICAL PEDON: Rhodesfolly fine sand on a north facing, nearly level slope in a shoreface under 1.3 m of estuarine water. Tidal range is 80 cm. (Colors are for moist soil).

Ag--0 to 13 cm; very dark gray (N 3/) fine sand; white (5Y 8/1) dry; single grain; nonfluid; 4 percent gravel; 2 percent shell fragments; sulphurous odor; strongly; slightly alkaline (pH 7.6), slightly alkaline (pH 7.6) after 8 weeks; abrupt boundary. (0 to 23 cm thick)

Cg--13 to 20 cm; dark gray (5Y 4/1) coarse sand; light greenish gray (10Y 7/1) dry; single grain; nonfluid; 12 percent gravel; 20 percent mixed white and blue mussel shell fragments sulphurous odor; strongly saline; moderately alkaline (pH 8.0), slightly alkaline (pH 7.8) after 8 weeks; abrupt boundary. (Thickness of the Cg horizon is 6 to 68 cm.)

Agb--20 to 29 cm; black (N 2.5/) coarse sand; greenish gray (10Y 6/1) dry; single grain; nonfluid; 5 percent herbaceous fibers, 0 percent rubbed; 6 percent gravel; 50 percent shell fragments; sulphurous odor; strongly saline; moderately alkaline (pH 8.2), slightly alkaline (pH 7.6) after 8 weeks; abrupt boundary. (Thickness of the Agb horizon is 4 to 22 cm.)

C'g1--29 to 39 cm; very dark gray (2.5Y 3/1) coarse sand; greenish gray (10Y 6/1) dry; single grain; nonfluid; 7 percent gravel; 10 percent white mussel shell fragments; strongly saline; moderately alkaline (pH 8.4), slightly alkaline (pH 7.6) after 8 weeks; clear boundary.

C'g2--39 to 61 cm; gray (N 5/) coarse sand; light gray (N 7/) dry; single grain; nonfluid; 1 percent gravel; 2 percent shell fragments; sulphurous odor; strongly saline; strongly alkaline (pH 8.6), slightly alkaline (pH 7.5) after 8 weeks; clear boundary.

A'gb--61 to 72 cm; very dark gray (2.5Y 3/1) coarse sand; gray (N 6/) dry; single grain; nonfluid; 3 percent herbaceous fibers, 0 percent rubbed; 3 percent gravel; 20 percent mussel shell fragments; sulphurous odor; strongly saline; strongly alkaline (pH 8.7), slightly alkaline (pH 7.6) after 8 weeks; clear boundary.

C''g--72 to 78 cm; dark gray (2.5Y 4/1) coarse sand; gray (N 6/) dry; single grain; nonfluid; 11 percent gravel; sulphurous odor; strongly saline; strongly alkaline (pH 8.6); slightly alkaline (pH 7.7), after 8 weeks; abrupt boundary.

A''gb1--78 to 82 cm; very dark gray (2.5Y 3/1) gravelly coarse sand; gray (N 6/) dry; single grain; nonfluid; 1 percent herbaceous fibers, 0 percent rubbed; 22 percent gravel; 25 percent soft shell clam fragments; sulphurous odor; strongly saline; moderately alkaline (pH 8.4), slightly alkaline (pH 7.6) after 8 weeks; abrupt boundary.

A''gb2--82 to 92 cm; greenish black (10Y 2.5/1) fine sand; gray (5Y 5/1) dry; single grain; nonfluid; 2 percent herbaceous fibers, 0 percent rubbed; 22 percent gravel; sulphurous odor; strongly saline; moderately alkaline (pH 8.3), slightly acid (pH 6.3) after 8 weeks; abrupt boundary.

C'''g--92 to 150 cm; dark gray (5Y 4/1) fine sand; gray (5Y 6/1) dry; single grain; nonfluid; sulphurous odor; strongly saline; moderately alkaline (pH 8.4), slightly acid (pH 6.2) after 8 weeks.

TYPE LOCATION: New London County, Connecticut; located about 8825 feet southeast from the intersection of the Providence and Worcester Railroad and Island Road, and 6900 feet southwest of Barn Island boat launch, south of Sandy Point, USGS Mystic topographic quadrangle; lat. 41 degrees 19 minutes 6.3 seconds N. and long. 71 degrees 52 minutes 38.8 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The soils are permanently submerged. All horizons have a pH of neutral through strongly alkaline and a pH of very strongly acid through slightly alkaline after 8 weeks incubation. The soil is strongly saline throughout the profile.

The Ag horizon has hue of 10Y or is neutral, value of 2.5 or 3, and chroma of 0 or 1. Texture ranges from loamy fine sand to coarse sand. It is massive or single grain. Organic matter is 0 to 2 percent. Gravel content is 0 to 10 percent. Shell fragment content is 0 to 10 percent. Consistence is nonfluid. Some pedons have an ACg horizon with characteristics similar to the Ag horizon. It is 0 to 43 cm thick. Some pedons have a CAg horizon with hue of 5Y, value of 3 to 6, and chroma of 0 to 2. Texture ranges from sandy loam to sand. It is massive or single grain. Gravel content is 0 to 5 percent. Consistence is nonfluid. It is 0 to 29 cm thick.

The Agb horizon has hue of 7.5YR, 5Y, 10Y, 2.5Y, or is neutral, value of 2.5 or 3, and chroma of 0 to 2. Texture is very fine sandy loam, fine sand, mucky sand, sand, or coarse sand in the fine earth fraction. It is massive or single grain. Gravel content is 0 to 25 percent. Shell fragment content is 0 to 50 percent. Herbaceous fibers are 0 to 10 percent unrubbed and 0 to 5 percent rubbed. Consistence is nonfluid.

The Cg horizon has hue of 5Y, 10Y, 2.5Y, or is neutral, value of 2.5 to 5 and chroma of 0 to 2. Texture ranges from loamy sand to coarse sand in the fine earth fraction. It is massive or single grain. Gravel content is 0 to 20 percent. Shell fragment content is 0 to 40 percent. Consistence is nonfluid.

The 2Cg horizon, where present, has hue of 5Y, value of 2 to 5, and chroma of 0 to 2. Texture ranges from sandy loamy to sand. It is massive or single grain. Gravel content is 0 to 5 percent. Consistence is nonfluid.

COMPETING SERIES: These are the Arloval, Barren, Carrolls, Conrad, Dair, Forbar, Gothenburg, Jamaica, Junius, Norway, Stafford, Tihonet (T), Tryon, Tyre, and Wanswer. These soils do not have a positive water potential at the soil surface for 90 percent of each day.

GEOGRAPHIC SETTING: The Rhodesfolly soils are permanently submerged with strongly saline water on unstable bay bottoms, flood tidal delta flats, shore faces and washover fans that are sandy. Slope ranges from 0 to 5 percent. The soils formed in sandy deposits with numerous buried horizons from catastrophic storm events that breeched the barrier island or spit. The shore face and washover fan landforms are nearly level to gently sloping with steeper edges leading into deeper waters. The soil is subject to depositional change due to severe storm events. Wave action and strong currents influence the formation of these soils. These soils occur in water depths of up to 2.5 meters.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Anguilla (T) and Napatree (T) soils. Anguilla soils are in mainland coves and have sulfidic materials within 50 cm of the soil surface. Napatree soils are in submerged headlands and are underlain by glacial deposits.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Subaqueous, peraquic soil moisture regime, and high to very high saturated hydraulic conductivity. Soil is permanently submerged with salt or brackish water.

USE AND VEGETATION: These soils are used for recreation and support benthic wildlife habitat. Fishing is commonplace and the species found in the area are smelt, small cod, flounder, scup, menhaden, and white perch. Shellfish farming and recreational harvesting are common. Some areas are vegetated with native algae and eelgrass (Zostera marina). Vegetative cover ranges from 0 to 35 percent.

DISTRIBUTION AND EXTENT: The soils of this series are of small extent, approximately 445 acres (180 hectares) mapped in Little Narragansett Bay, New London County, Connecticut, MLRA 144A.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES PROPOSED: New London County, Connecticut, 2007. The name originates from the local legend of Rhodes Folly in Stonington, CT.

REMARKS: The Keys to Soil Taxonomy, Tenth Edition, 2006 states that the horizontal boundaries of soil are areas where the soil grades into deep water (typically less than 2.5 m). This series is proposed to recognize some subaqueous soil areas previously mapped water in the Soil Survey of Connecticut.
The pedon was sampled and described to refusal. The described depth is sufficient for classification of family and series control sections. Using the proposed taxonomy for subaqueous soils, the series classifies as mixed, mesic Fluventic Psammowassents.

Diagnostic horizons and features in this pedon include:
1. Peraquic moisture regime - positive soil water potential (permanently submerged) at the soil surface (under 126 cm of salt water at the time of coring).
2. Ochric epipedon - the zone from 0 to 13 cm (Ag horizon).
3. Aquic conditions - continuous saturation and reduction in the zone from 0 to 150 cm.
4. Fluvic feature - irregular decrease in organic carbon content in the zone from 20 to 92 cm (the Agb, A'gb, A"gb1, and A"gb2 horizons). This is diagnostic within the proposed classification scheme for Wassents.

ADDITIONAL DATA: Characterization data for the typical pedon, S05RI0009007 and additional pedon data, S05RI0009008 analyzed by the NSSL, Lincoln, NE. Additional pedon data, RI003-2006-003-GR, and RI003-2006-007-GR Kent County, Rhode Island, analyzed by the University of Rhode Island.

National Cooperative Soil Survey
U.S.A.

SANDYHOOK SERIES:

The Sandyhook series consists of very deep, very poorly drained soils with rapid permeability. The soil formed in thick sandy sediments subject to tide flooding adjoining beaches along the Atlantic coast. The soils are nearly level to gently sloping. Slope ranges from 0 to 8 percent. Mean annual temperature is about 56 degrees, and mean annual precipitation is about 44 inches.

TAXONOMIC CLASS: Sandy, mixed, mesic Typic Sulfaquents

TYPICAL PEDON: Sandyhook mucky fine sandy loam, on gently sloping topography with smooth cordgrass. (Colors are moist soils unless otherwise stated.)

A-- 0 to 3 inches; dark gray (2.5Y 4/1) mucky fine sandy loam; weak fine granular structure; very friable; many fine and medium roots; neutral; abrupt smooth boundary. (0 to 8 inches thick.)

AC-- 3 to 12 inches; gray (2.5Y 6/1) fine sandy loam; common fine prominent dark yellowish brown (10YR 4/4) oxidized rhizospheres; weak fine granular structure; very friable; common fine and medium roots; neutral; clear smooth boundary. (0 to 10 inches thick.)

C1-- 12 to 16 inches; gray (5Y 5/1) sand; few fine prominent dark yellowish brown (10YR 4/4) oxidized rhizospheres; single grain; loose; few medium roots; neutral; gradual smooth boundary.

C2-- 16 to 26 inches; gray (5Y 5/1) sand; single grain; loose; moderately alkaline; gradual smooth boundary.

C3-- 26 to 72 inches; gray (N 5/0) sand; single grain; loose; moderately alkaline.

LOCATION STISSING MA+NH RI
Established Series
Rev. DGG-SMF
03/2004

STISSING SERIES

The Stissing series consists of poorly drained soils formed in dense till derived principally from dark phyllite, slate, shale, and schist. These soils are very deep to bedrock and shallow to a densic contact. They are nearly level to strongly sloping soils on glaciated uplands. Slope ranges from 0 to 15 percent. Permeability is moderate in the solum and slow in the dense substratum. The mean annual temperature is about 49 degrees F. and the mean annual precipitation is about 45 inches.

TAXONOMIC CLASS: Loamy, mixed, semiactive, acid, mesic, shallow Typic Epiaquepts

TYPICAL PEDON: Stissing silt loam - on a 3 percent slope in a hay field at an elevation of about 275 meters. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, gray (10YR 6/1) dry; fine streaks of very dusky red (2.5YR 2/2) in root channels; moderate fine granular structure; very friable; many grass roots; about 10 percent channers; moderately acid; abrupt smooth boundary. (5 to 10 inches thick)

Bg--8 to 16 inches; gray (5Y 5/1) silt loam; massive; firm in place, friable when removed; few roots in upper 2 or 3 inches, none below; about 10 percent channers; many medium prominent dark reddish brown (5YR 3/2) iron concentrations; strongly acid; clear, wavy boundary. (5 to 15 inches thick)

Cdg--16 to 65 inches; gray (N 5/0) silt loam; moderate thick platy structure; very firm; about 10 percent channers; many coarse prominent dark brown (7.5YR 3/2) iron concentrations; strongly acid.

TYPE LOCATION: Franklin County, Massachusetts; Town of Bernardston, about 2 miles west of village of Bernardston, 3/4 north intersection of Eden Trail Rd. and Eden Trail Branch Rd., 200 feet west of Eden Trail Rd.. USGS Bernardston quadrangle; latitude 42 degrees 40 minutes 9 seconds N. and longitude 72 degrees 35 minutes 28 seconds W.; NAD 27.

RANGE IN CHARACTERISTICS: Solum thickness and depth to the dense substratum commonly is less than 20 inches but ranges up to 20 inches in some places. The soil ranges from extremely acid to strongly acid except where limed. Texture of the fine-earth fraction is silt loam or loam throughout the soil. Rock fragments range from 5 to 50 percent in the A, from 5 to 35 percent in the B and from 10 to 40 percent in the C horizon. Stones range from 0 to 15 percent in the surface and from 0 to 5 percent in the subsoil and substratum. Flagstones range from 0 to 10 percent in the surface and from 0 to 5 percent in the subsoil and substratum. Channers range from 5 to 25 percent in the solum and from 10 to 30 percent in the substratum.

The A horizon has hue of l0YR to 5Y, value of 2 to 4, and chroma of l or 2. It has weak or moderate, very fine to medium, granular or subangular blocky structure.

The B horizon has hue of l0YR to 5Y, value of 4 or 5, and chroma of l or 2. It has few to many distinct or prominent iron concentrations. It is structureless or has weak thin or medium platy or weak or moderate very fine to medium subangular blocky structure. It is friable or firm.

The Cd horizon is neutral or has hue of 2.5Y or 5Y, value of 3 to 6, and chroma of 0 to 3. Chroma of 3 is below 30 inches. It has common or many, medium or coarse, distinct or prominent iron concentrations which decrease in abundance and contrast with depth. It is structureless or is geogenically derived, appearing in the form of weak or moderate plates.

COMPETING SERIES: Stissing is the only series in the same family.

Fredon, Lamson, Leicester, Lyme, Mansfield, Massena, Menlo, Newstead, Raynham, Raypol, Red Hook, Ridgebury, Sun, and Whitman are similar soils in related families. Fredon, Lamson, Red Hook, and Raynham soils formed in water sorted materials, do not have a dense substratum and are nonacid. Leicester soils do not have a dense substratum. Lyme soils are in a frigid family. Mansfield, Menlo, and Whitman soils are very poorly drained. Massena, Newstead, Ridgebury, and Sun soils are nonacid. Raypol soils are coarse-loamy over sandy or sandy-skeletal.

GEOGRAPHIC SETTING: Stissing soils are nearly level soils in slight depressional areas and on the lower parts of concave slopes. Slope ranges from 0 to 15 percent. The soils formed in loamy till derived principally from dark gray phyllite, slate, shale, and schist. Mean annual temperature ranges from 45 to 52 degrees Fahrenheit. Mean annual precipitation ranges from 40 to 50 inches. The frost-free period ranges from 120 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bernardston, Cardigan, Dutchess, Kearsarge, Mansfield, Nassau, Newport, Pittstown, Quonset, and Warwick soils. Bernardston, Pittstown, Mansfield, and Newport soils are associated in a drainage sequence. Dutchess, Cardigan, Kearsarge, and Nassau soils are on nearby uplands. Cardigan and Dutchess soils are well drained and Cardigan soils are moderately deep. Kearsarge and Nassau soils are shallow to bedrock. Quonset and Warwick soils are on nearby outwash plains, terraces, eskers, and kames.

DRAINAGE AND PERMEABILITY: Poorly drained. Permeability is moderate in the solum and slow in the substratum. Saturated hydraulic conductivity ranges from moderately high to high in the solum and moderately low to moderately high in the substratum. Runoff is negligible to very low.

USE AND VEGETATION: Mostly forested. About 10 percent is cleared and used mainly for growing pasture. Native vegetation is red maple, elm, ash, willow, gray birch, white pine, alders, and hemlock.

DISTRIBUTION AND EXTENT: MLRAs 144A, 145 and mesic areas within MLRA 144B in Massachusetts, New Hampshire, and Rhode Island. The series is of moderate extent; estimated to be about 15,000 acres.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts

SERIES ESTABLISHED: Dutchess County, New York, 1946.

REMARKS: Cation-exchange activity class is presumed from a review of data for similar soils. Changes in competing series may result from updates in classification.

Diagnostic horizons and features recognized in this pedon are:

1. Ochric epipedon - the zone from 0 to 8 inches (Ap horizon).
2. Cambic horizon - the zone from 8 to 16 inches (Bg horizon).
3. Dense till substratum at 16 inches (Cdg horizon).

National Cooperative Soil Survey
U.S.A.**,**

Wassents

Wassents are subaqueous Entisols. Defined as Entisols that have a positive water potential at the soil surface for more than 21 hours of each day. These soils are the first suborder to classify out under Entisols. The formative element Wass is derived from the German (Swiss) word “wasser” for water.

Key to Great Groups
LAA. Wassents that have, in all horizons within 100 cm of the mineral soil surface, an electrical conductivity of <0.2 dS/m in a 5/1 by volume mixture of water and soil. **Frasiwassents**
LAB. Other Wassents that have less than 35 percent (by volume) rock fragments and a texture of loamy fine sand or coarser in all layers within the particle-size control section. **Psammowassents**
LAC. Other Wassents that have sulfidic materials within 50 cm of the mineral soil surface.

Sulfiwassents
LAD. Other Wassents that have, in all horizons at a depth between 20 and 50 cm below the mineral soil surface, both an *n* value of more than 0.7 and 8 percent or more clay in the fine earth fraction.

Hydrowassents
LAE. Other Wassents that have *either* 0.2 percent or more organic carbon of Holocene age at a depth of 125 cm below the mineral soil surface *or* an irregular decrease in content of organic carbon from a depth of 25 cm to a depth of 125 cm or to a densic, lithic, or paralithic contact if shallower.

Fluviwassents
LAF. Other Wassents. **Haplowassents**

Fluviwassents

Key to Subgroups
LAEA. Fluviwassents that have sulfidic materials within 100 cm of the mineral soil surface. **Sulfic**

Fluviwassents
LAEB. Other Fluviwassents that have a lithic contact within 100 cm of the mineral soil surface.

Lithic Fluviwassents
LAEC. Other Fluviwassents that have a buried layer of organic soil materials, 20 cm or more thick, that has its upper boundary within 100 cm of the mineral soil surface. **Thapto-Histic Fluviwassents**
LAED. Other Fluviwassents that have a chroma of 3 or more in 40% or more of the matrix of one or more horizons between a depth of 15 and 100 cm from the soil surface. **Aeric Fluviwassents**
LAEE. Other Fluvawassents. **Typic Fluviwassents**

Frasiwassents

Key to Subgroups
LAAA. Frasiwassents that have, in all horizons at a depth between 20 and 50 cm below the mineral soil surface, both an *n* value of more than 0.7 and 8 percent or more clay in the fine earth fraction.

Hydric Frasiwassents
LAAB. Other Frasiwassents that have a lithic contact within 100 cm of the mineral soil surface.

Lithic Frasiwassents
LAAC. Other Frasiwassents that have less than 35 percent (by volume) rock fragments and a texture of loamy fine sand or coarser in all layers within the particle-size control section. **Psammentic**

Frasiwassents
LAAD. Other Frasiwassents that have a buried layer of organic soil materials, 20 cm or more thick, that has its upper boundary within 100 cm of the mineral soil surface. **Thapto-Histic Frasiwassents**
LAAE. Other Frasiwassents that have *either* 0.2 percent or more organic carbon of Holocene age at a depth of 125 cm below the mineral soil surface *or* an irregular decrease in content of organic carbon from a depth of 25 cm to a depth of 125 cm or to a densic, lithic, or paralithic contact if shallower.

Fluvic Frasiwassents
LAAF.Other Frasiwassents that have a chroma of 3 or more in 40% or more of the matrix of one or more horizons between a depth of 15 and 100 cm from the soil surface. **Aeric Frasiwassents**
LAAG. Other Frasiwassents. **Typic Frasiwassents**

Haplowassents

Key to Subgroups
LAFA. Haplowassents that have a sulfidic materials within 100 cm of the mineral soil surface. **Sulfic**

Haplowassents
LAFB. Haplowassents that have a lithic contact within 100 cm of the mineral soil surface. **Lithic**

Haplowassents
LAFC. Other Haplowassents that have a chroma of 3 or more in 40% or more of the matrix of one or more horizons between a depth of 15 and 100 cm from the soil surface. **Aeric Haplowassents**
LAFD. Other Haplowassents **Typic Haplowassents**

Hydrowassents

Key to Subgroups
LADA. Hydrowassents that have sulfidic materials within 100 cm of the mineral soil surface. **Sulfic**

Hydrowassents
LADB. Other Hydrowassents that have, in all horizons at a depth between 20 and 100 cm below the mineral soil surface, both an *n* value of more than 0.7 and 8 percent or more clay in the fine earth fraction.
Grossic Hydrowassents
LADC. Other Hydrowassents that have a lithic contact within 100 cm of the mineral soil surface.

Lithic Hydrowassents
LADD. Other Hydrowassents that have a buried layer of organic soil materials, 20 cm or more thick, that has its upper boundary within 100 cm of the mineral soil surface. **Thapto-Histic Hydrowassents**
LADE. Other Hydrawassents. **Typic Hydrowassents**

Psammowassents

Key to Subgroups
LABA. Psammawassents that have sulfidic materials within 100 cm of the mineral soil surface. **Sulfic**

Wassists
Wassists are subaqueous Histosols. Defined as Histosols that have a positive water potential at the soil surface for more than 21 hours of each day. These soils are the second suborder to classify out under Histosols after Folists. The formative element Wass is derived from the German (Swiss) word "wasser" for water.

Key to Great Groups
BBA. Wassists that have, in all horizons within 100 cm of the mineral soil surface, an electrical conductivity of <0.2 dS/m in a 5/1 by volume mixture of water and soil. **Frasiwassists**
BBB. Other Wassists that have sulfidic materials within 50 cm of the mineral soil surface.

Sulfiwassists
BBC. Other Wassists. **Haplowassists**

Frasiwassists

Key to Subgroups
BBAA. Other Frasiwassists that:
1. Have more thickness of fibric soil materials than any other kind of organic soil material either:
   a. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or
   b. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; and
2. Do not have a sulfuric horizon that has its upper boundary within 50 cm of the soil surface; and
3. Do not have sulfidic materials within 100 cm of the soil surface.

Fibric Frasiwassists
BBAB. Other Frasiwassists that have more thickness of sapric soil materials than any other kind of organic soil materials either:
1. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or
2. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier.

Sapric Frasiwassists
BBAC. Other Frasiwassists.

Typic Frasiwassists

Sulfiwassists

Key to Subgroups
BBBA. Other Sulfiwassists that have more thickness of fibric soil materials than any other kind of organic soil material either:
1. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or

2. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier;

Fibric Sulfiwassists
BBBB. Other Sulfiwassists that have more thickness of sapric soil materials than any other kind of organic soil materials either:

1. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or
2. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier.

Sapric Sulfiwassists
BBBC. Other Sulfiwassists.

Typic Sulfiwassists

Haplowassists

Key to Subgroups
BBCA. Other Haplowassists that have more thickness of fibric soil materials than any other kind of organic soil material either:

1. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or
2. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier;

Fibric Haplowassists
BBCB. Other Haplowassists that have more thickness of sapric soil materials than any other kind of organic soil materials either:

1. In the organic parts of the subsurface tier if there is no continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier; or
2. In the combined thickness of the organic parts of the surface and subsurface tiers if there is a continuous mineral layer 40 cm or more thick that has its upper boundary within the subsurface tier.

Sapric Haplowassists
BBCC. Other Haplowassists.

Typic Haplowassists

LOCATION WEQUETEQUOCK CT

Tentative Series
Rev. DCP-DAS-SJM
12/2007

WEQUETEQUOCK SERIES

The Wequetequock series consists of very deep, subaqueous soils in submerged stream valleys and terraces. The Wequetequock soils are formed in loamy marine deposits. Slope ranges from 0 to 2 percent, mean annual air temperature is about 10 degrees C., and mean annual precipitation is about 1142 mm.

TAXONOMIC CLASS: Coarse-loamy, mixed, active, nonacid, mesic Typic Sulfaquents

TYPICAL PEDON: Wequetequock silt loam on a south facing, concave slope in a submerged stream valley under 1.3 m of estuarine water. Tidal range is 80 cm. (Colors are for moist soil).

Ag--0 to 15 cm; black (N 2.5/) silt loam; massive; very fluid, 5 percent unrubbed and 5 percent rubbed herbaceous fibers; sulphurous odor; strongly saline; slightly acid (pH 6.3), very strongly acid (pH 4.7) after 8 weeks; clear boundary. (0 to 15 cm thick)

Cg1--15 to 40 cm; black (N 2.5/) silt loam; massive; very fluid; 1 percent unrubbed and 0 percent rubbed herbaceous fibers; sulphurous odor; strongly saline; moderately acid (pH 5.8), very strongly acid (pH 4.9) after 8 weeks; clear boundary.

Cg2--40 to 60 cm; very dark gray (2.5Y 3/1) silt loam; massive; moderately fluid; sulphurous odor; strongly saline; very strongly acid (pH 4.9), extremely acid (pH 4.0) after 8 weeks; clear boundary.

Cg3--60 to 105 cm; very dark gray (2.5Y 3/1) sandy loam; massive; moderately fluid; 6 percent gravel; sulphurous odor; strongly saline; ultra acid (pH 3.1), ultra acid (pH 2.6) after 8 weeks; abrupt boundary. (20 to 90 cm thick)

2Oa--105 to 150 cm; dark brown (7.5YR 3/3) muck, broken face sapric material, very dark gray (10YR 3/1) rubbed; massive; very fluid; about 48 percent mineral content; 16 percent unrubbed and 2 percent rubbed herbaceous fibers; 2650 +/- 40 BP measured and 2600 +/- 40 BP conventional radiocarbon age; sulphurous odor; neutral (pH 6.6), neutral (pH 6.6) after 8 weeks; strongly saline (0 to 45 cm thick)

TYPE LOCATION: New London County, Connecticut; located about 600 feet south of the Providence and Worcester Rail Road Bridge and 1000 feet northeast of Goat Island in Wequetequock Cove, USGS Mystic topographic quadrangle; lat. 41 degrees 20 minutes 61 seconds N. and long. 71 degrees 53 minutes 3.8 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: The soils are permanently submerged. One or more horizons within 50 cm have a pH of 4.0 or less after 8 weeks incubation. The soil is typically strongly saline throughout the profile.

The Ag horizon, where present, has hue of 2.5Y or is neutral, value of 2.5Y, and chroma of 0 or 1. Texture is mucky silt loam or silt loam. It is massive. Organic matter is 5 to 15 percent. Consistence is very fluid. Reaction is very strongly acid to slightly alkaline and ultra acid to moderately acid after 8 weeks incubation.

Some pedons have an ACg horizon with similar characteristics to the Ag horizon. It is 0 to 25 cm thick.

The Cg horizon has hue of 2.5Y or 5Y, value of 2 to 3, and chroma of 1 or 2. Texture ranges from mucky silt loam to sandy loam. It is massive. Gravel content is 0 to 20 percent. Consistence is slightly fluid to very fluid. Reaction is ultra acid to moderately alkaline and ultra acid to slightly acid after 8 weeks incubation.

Some pedons have 2Cg and 3Cg horizons with consistence of nonfluid to slightly fluid. Other characteristics are similar to the Cg horizon. Thickness is 0 to 50 cm.

The 2O horizon, where present has hue of 10YR to 5YR, value of 2 or 3, and chroma of 1 to 3. It is muck or mucky peat. It is massive. Consistence is moderately fluid or very fluid. Reaction is neutral to moderately alkaline and extremely acid to moderately alkaline after 8 weeks incubation.

Some pedons have a 2C horizon with hue of 2.5Y, value of 4, and chroma of 3. Texture is sandy loam to loamy coarse sand. It is massive or single grain. Gravel content is 0 to 15 percent. Consistence is nonfluid. Reaction is ultra acid to moderately alkaline and ultra acid to slightly acid after 8 weeks incubation. It is 0 to 55 cm thick.

COMPETING SERIES: There are no competing series. The Broadkill and Pishagqua soils are in related families. They have 18 to 35 percent clay in the particle size control section. Broadkill soils are flooded twice daily by tidal water.

GEOGRAPHIC SETTING: The Wequetequock soils are permanently submerged with salt or brackish water in submerged stream valleys and terraces subject to minimal currents and wave action. Slope ranges from 0 to 2 percent. The soils formed in loamy marine deposits and occur under water up to 1.5 meters in depth.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Anguilla (T), Napatree (T), Quanaduck (T) and Wamphassuc (T) soils. Anguilla soils are on mainland coves and have a sandy particle-size class. Napatree soils are on submerged headlands, are sandy in the upper part, and lack sulfidic materials. Quanaduck soils are on mainland coves and have a sandy substratum within the particle size control section. The Wamphassuc soils have an n-value of 0.7 or less in some horizon at a depth between 20 and 50 cm below the mineral soil surface.

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY: Subaqueous, peraquic moisture regime, moderately high to high saturated hydraulic conductivity due to low bulk density. Soil is permanently submerged with salt or brackish water.

USE AND VEGETATION: This soil supports submerged aquatic vegetation and wildlife habitats. The area is used for the harvest of crabs. In addition fishing is commonplace and the species found in the area are smelt, small cod, flounder, scup, menhaden, and white perch. Some areas are vegetated with native rooted and floating algae and eelgrass (Zostera marina). Vegetative cover ranges from 0 to 15 percent.

DISTRIBUTION AND EXTENT: The soils of this series are not extensive; approximately 124 acres (50 hectares) is mapped in Little Narragansett Bay, New London County, Connecticut, MLRA 144A.

MLRA OFFICE RESPONSIBLE: Amherst, Massachusetts.

SERIES PROPOSED: New London County, Connecticut, 2007. The name is taken from Wequetequock Cove located in Stonington, Connecticut.

REMARKS: The Keys to Soil Taxonomy, Tenth Edition, 2006 states that the horizontal boundaries of soil are areas where the soil grades into deep water (typically less than 2.5 m). This subaqueous series is being proposed in some areas previously mapped as water in the Connecticut Soil Survey. The pedon was sampled and described to refusal. The described depth is sufficient for classification of family and series control sections. Using the proposed taxonomy for subaqueous soils, the series classifies as coarse-loamy, mixed, active, nonacid, mesic Fluvic Sulfiwassents.

Diagnostic horizons and features in this pedon include:
1. Peraquic moisture regime - positive soil water potential (permanently submerged) at the soil surface (under 1.3 m of water at the time of coring).
2. Ochric epipedon - the zone from 0 to 15 cm (Ag horizon)
3. Sulfidic materials - the zone from 40 to 105 cm (Cg2 and Cg3 horizon).
4. Fluvic feature - irregular decrease in the content of organic carbon from a depth of 25 cm to a depth of 125 cm. This is diagnostic within the proposed classification scheme for Wassents.
5. High n-value - the zone from 0 to 150 cm has an n-value greater than or equal to 0.7, as surmised by the very fluid and moderately fluid manner of failure.
6. Aquic conditions - continuous saturation and reduction in the zone from 0 to 150 cm.
7. Buried soil feature - the zone from 105 to 150 cm (the 2Oa horizon). This is diagnostic within the proposed classification scheme for Wassents.

ADDITIONAL DATA: Characterization data for the typical pedon, S05CT011006, additional pedon data from S06CT011002 New London County, Connecticut , and S06RI009002 Washington County, Rhode Island analyzed by NSSL, Lincoln, NE. Additional pedon data from RI009-2006-006-GR and LN12MC Washington County, Rhode Island analyzed by the University of Rhode Island.

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