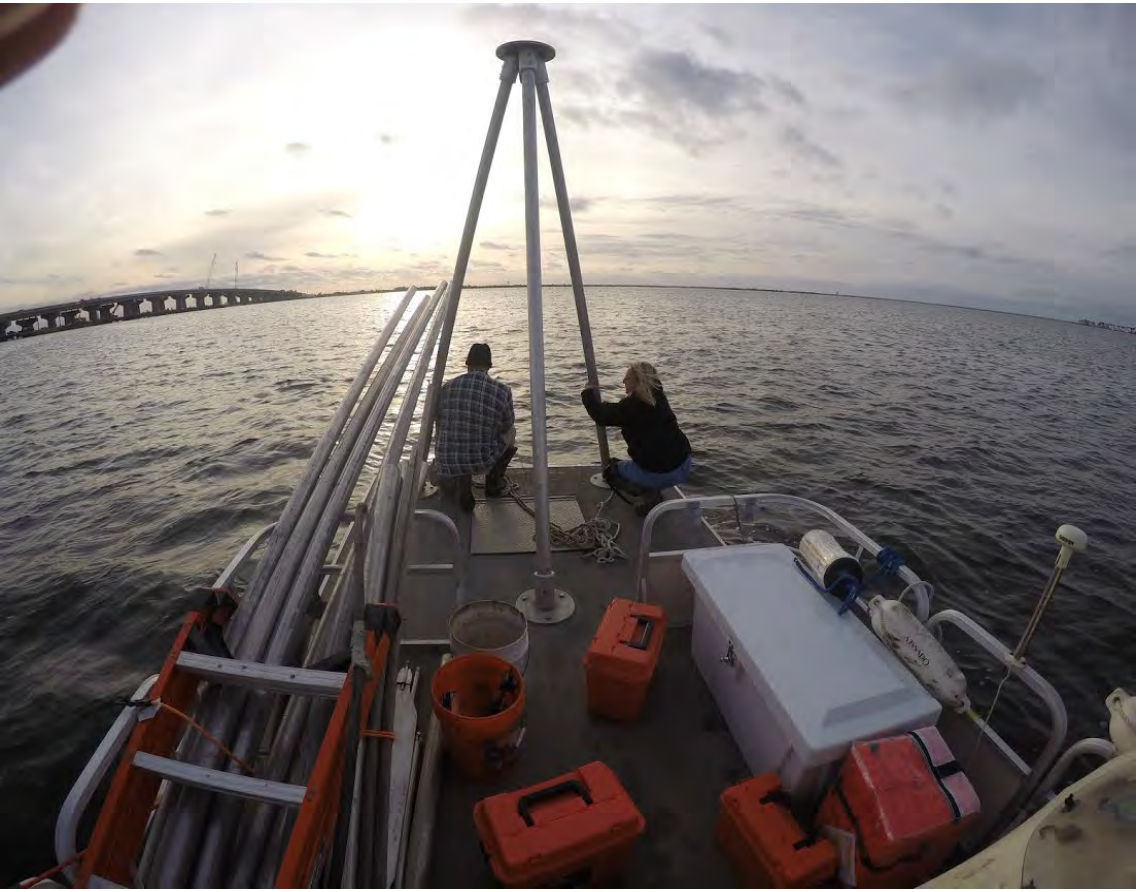
USDA

United States Department of Agriculture



Connecticut

Natural Resources Conservation Service

Coastal Zone Soil Survey

Debbie Surabian, State Soil Scientist, Connecticut & Rhode Island

Natural Resources Conservation Service

nrcs.usda.gov/

As a member of the National Cooperative Soil Survey, NRCS is the lead federal agency for the mapping and interpretations of the nation's soil resources.

The well established standards, techniques, and protocols used to map and interpret the nation's soil resources have been applied to subaqueous soil survey projects.

What is Soil?

It is characterized by [either]

- **Horizons**, or **layers**, that are distinguishable from the initial material as a result of **additions**, **losses**, **transfers**, and **transformations** of energy and matter

or

- The ability to **support rooted plants** in a natural environment

The **upper limit of soil** is the boundary between soil and air, shallow water, live plants, or plant materials that have not begun to decompose.

Areas are not considered to have soil if the surface is permanently covered by water too deep for the growth of rooted plants (typically more than 5 meters).

The **lower limit of soil** is arbitrarily set at 200 cm.

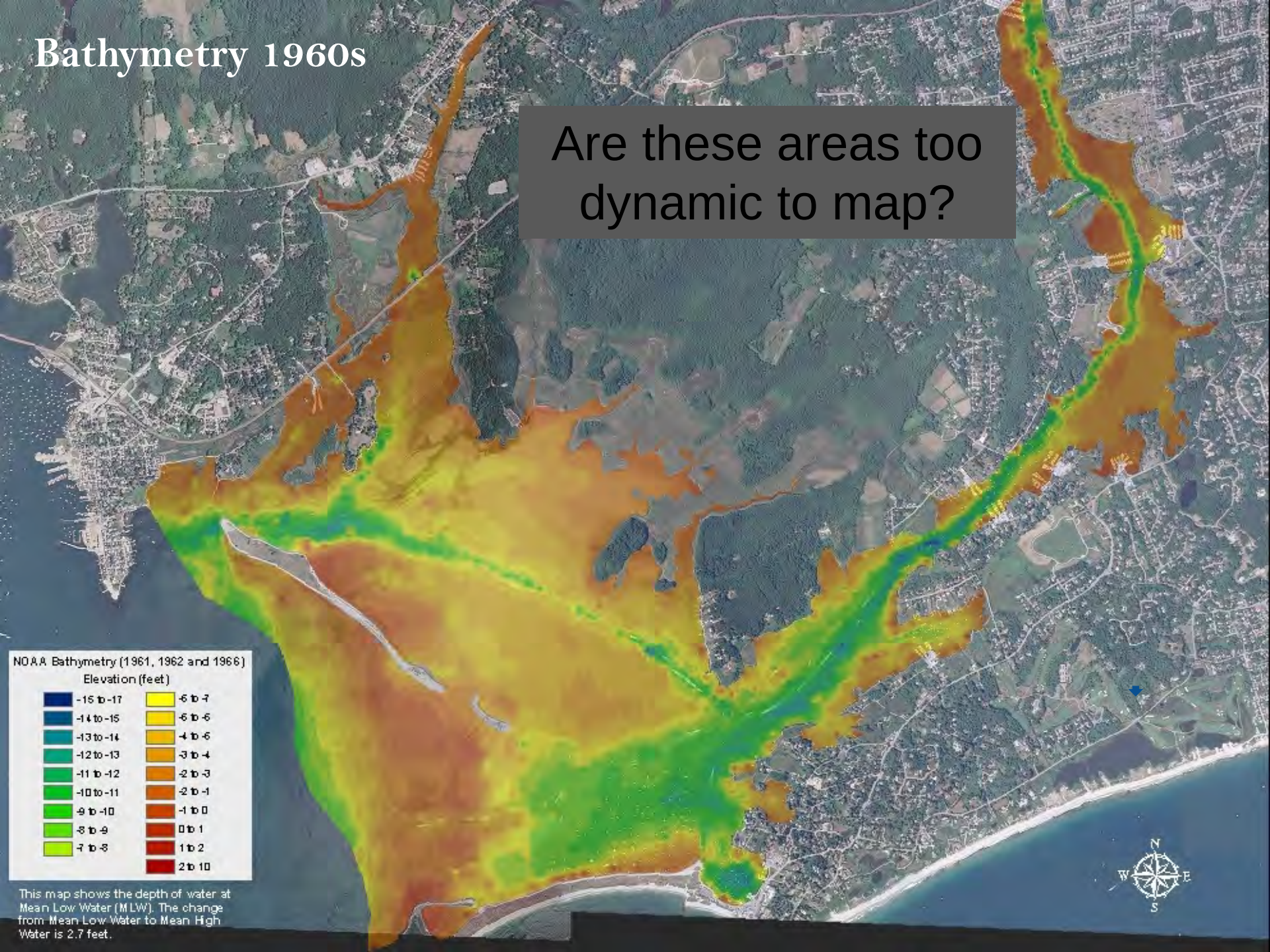
Subaqueous soils form under a continuous water column (their sediments may have originated from an upland area such as a dune).

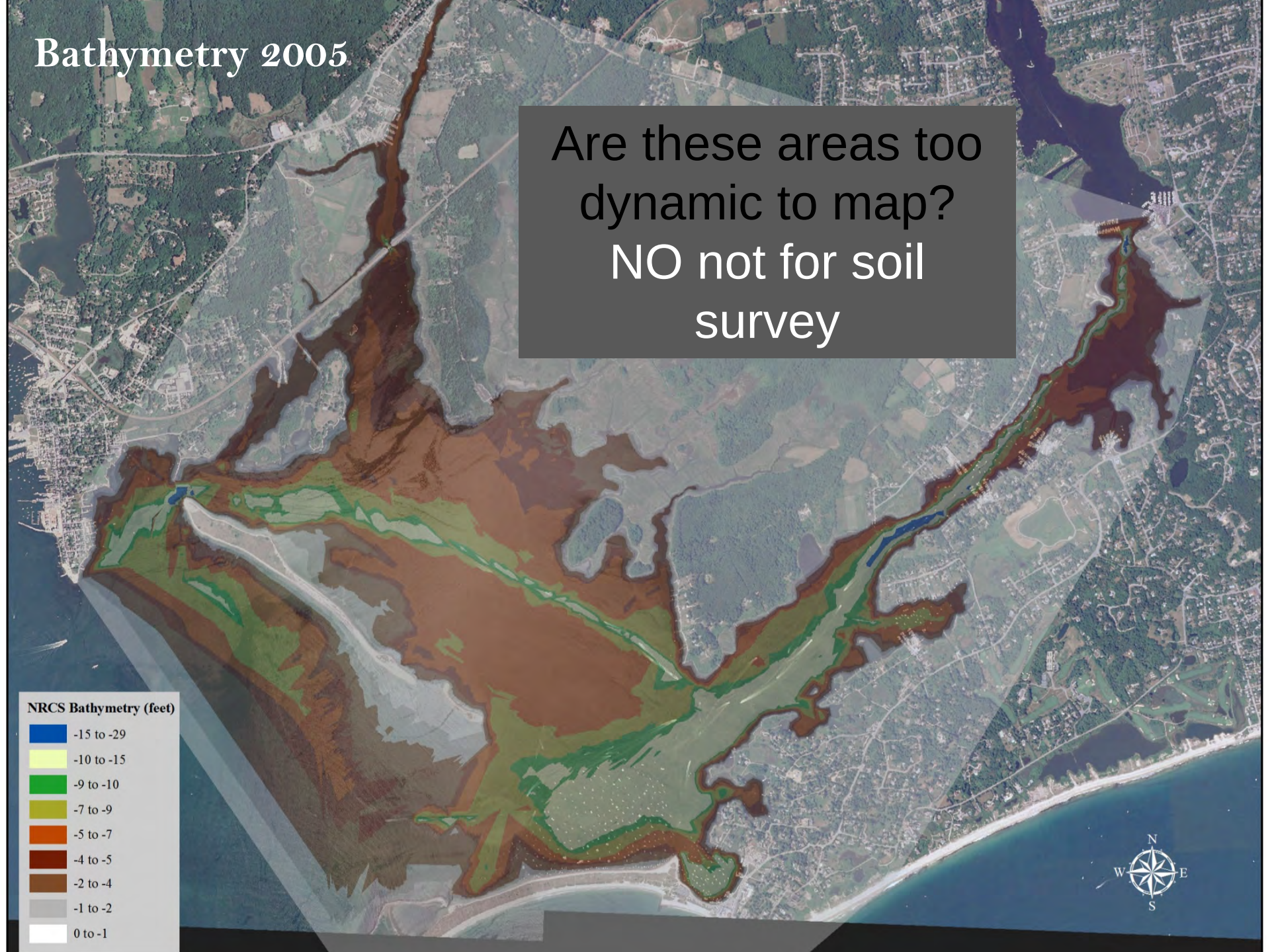
Submerged soils form in an upland environment but are now underwater. Submerged soils became submerged as a result of rising water tables (dam), flooding events, or sea level rise.

For USDA-NRCS purposes, both subaqueous and submerged soils are considered subaqueous soils.

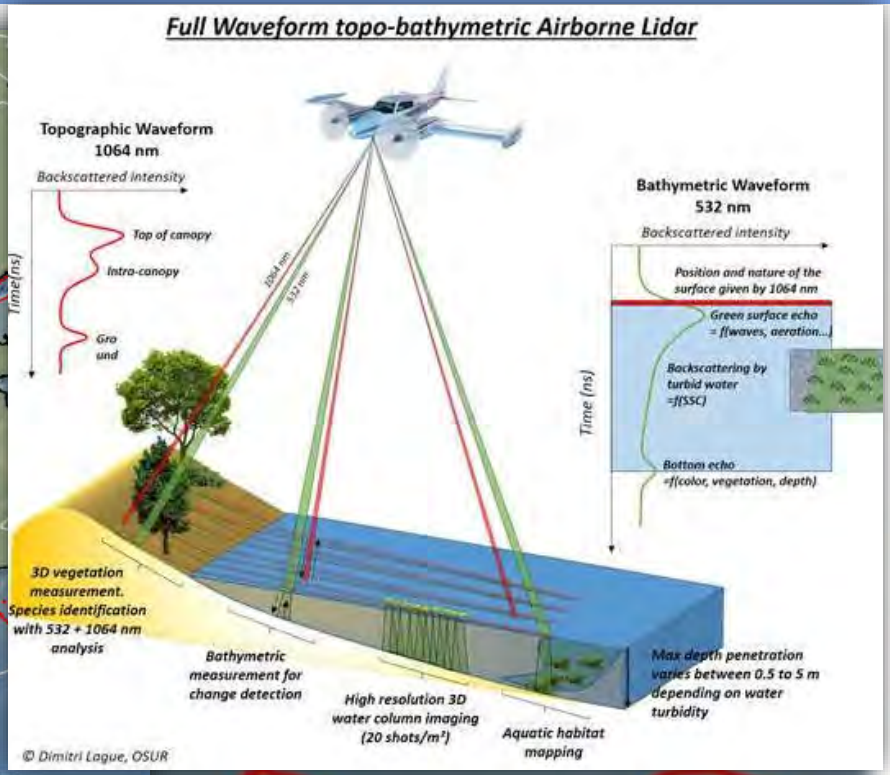
Bathymetry 1960s

Are these areas too dynamic to map?




Bathymetry 2005
Are these areas too dynamic to map? NO not for soil survey
NRCS Bathymetry (feet)
-15 to -29
-10 to -15
-9 to -10
-7 to -9
-5 to -7
-4 to -5
-2 to -4
-1 to -2
0 to -1
N
W
E
S

Topo Bathy LIDAR
A Quality Base Map



Best

Legend
- Proposed Additional Coring L
- Existing Pedon (Core) Data
- -5 meter elevation (NAVD88)
- 0 meter elevation (NAVD88)

Shoal

Dredge

Mid Lagoon Channel

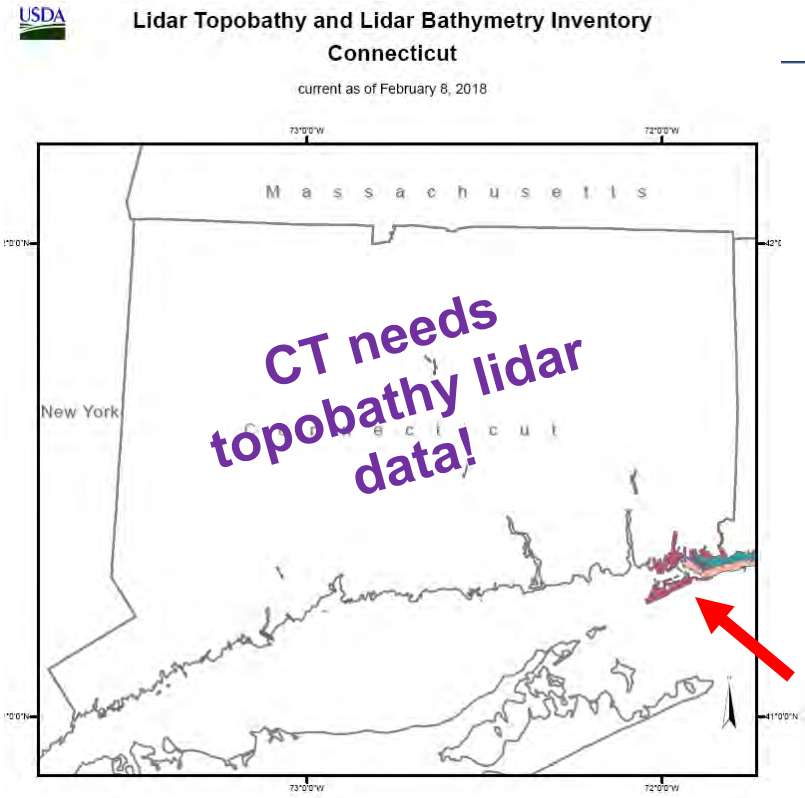
Good

Washover Fan Slope

Flood Tidal Delta

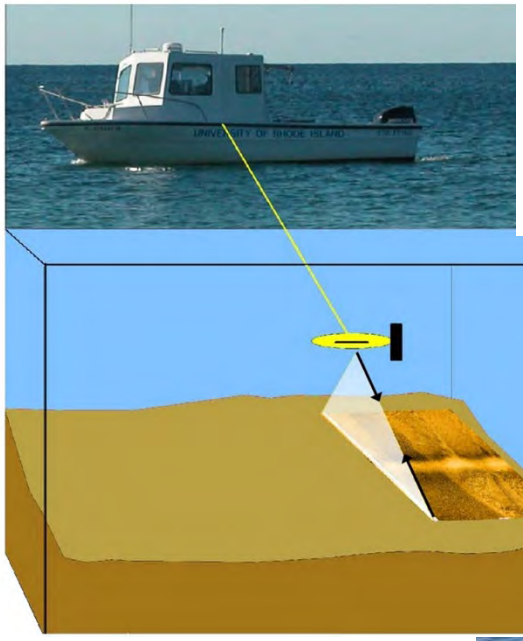
Washover Fan Flat

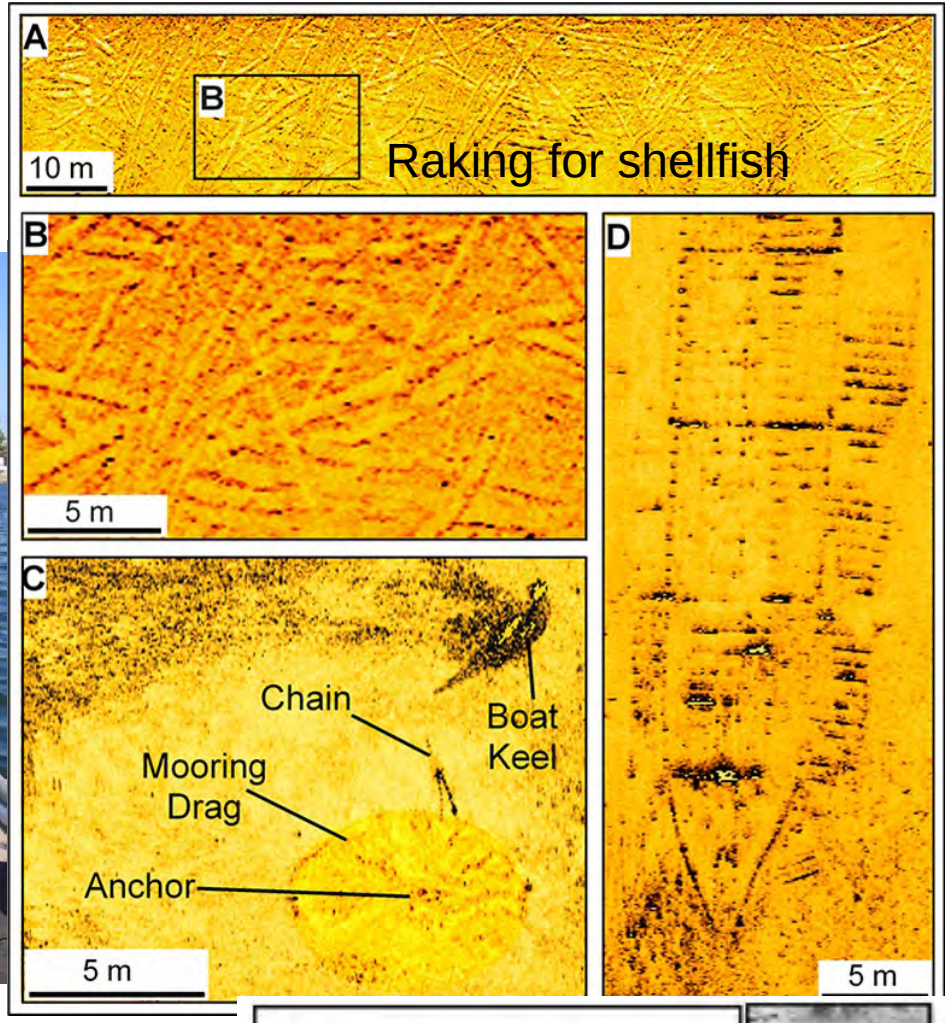
Acquisition of Coastal Topobathy Lidar



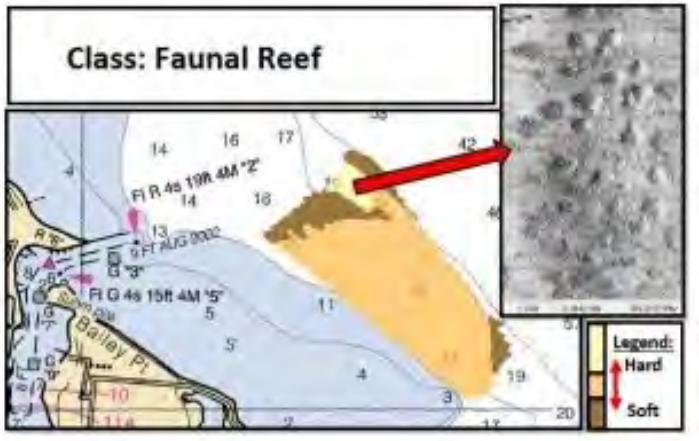
The Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) is a working group of the Subcommittee on Ocean Science and Technology (SOST). SOST serves as the Ocean Science and Technology Interagency Policy Committee under the National Ocean Council. The IWG-OCM was established in 2006 to "facilitate the coordination of ocean and coastal mapping activities and avoid duplicating mapping activities across the Federal sector as well as with State, industry, academic and non-governmental mapping interests." (National Ocean and Coastal Mapping Strategic Action Plan 2009).

Side-Scan Sonar





Side-scan sonar is a method of surveying the ocean floor. Side-scan sonar creates an image of the sea floor using sonar pulses emitted from a sonar device. It can be partnered with soil survey samples to understand the different materials and textures of the sea floor.




Navigational Channel
Shore Complex
Shore Face
Washover-Fan Flat
Bay Bottom


Mainland Cove
Submerged Headlands
Bay Bottom


Submerged Stream Valley

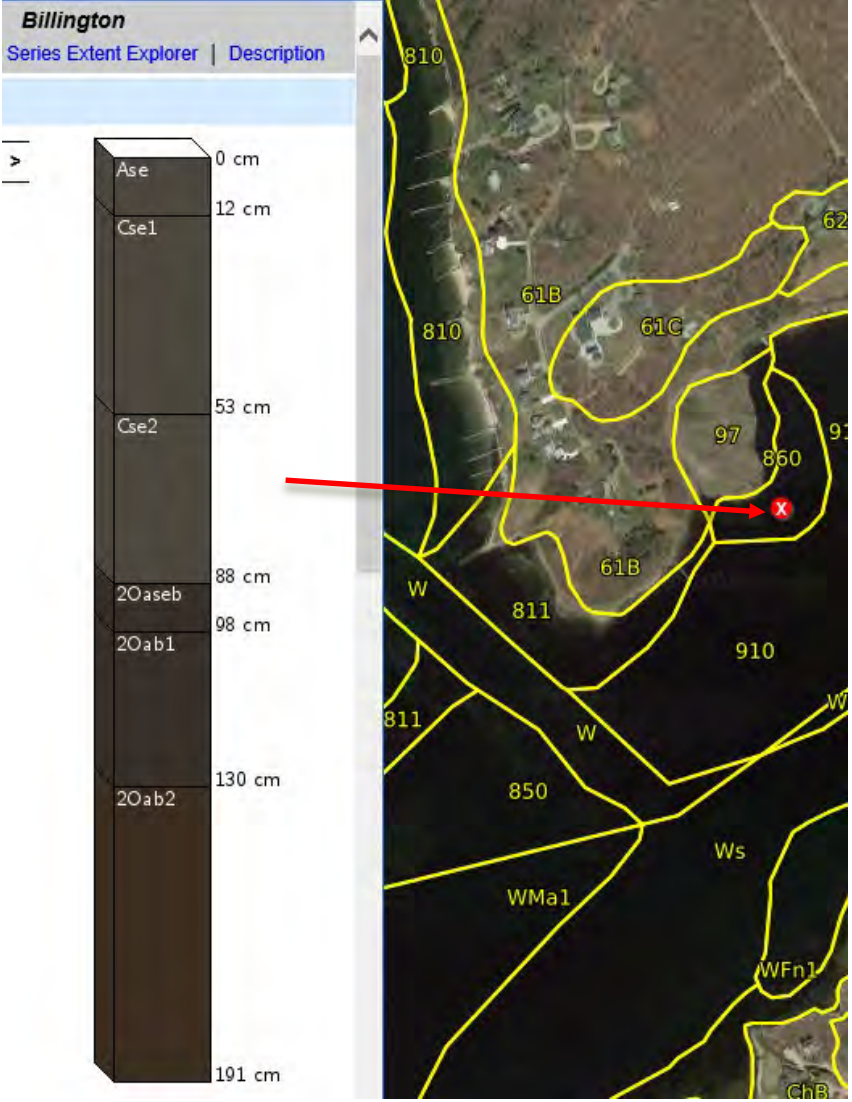
Major Soil Landform Legend

BI	Barrier Island
BB	Bay Bottom
NC	Navigational Channel
MCLo	Mainland Cove Loamy
MCSa	Mainland Cove Sandy
RB	River Bottom
SS	Shoal Sandy
SC	Shore Complex
SF	Shore Face
SH	Submerged Headlands
SSV	Submerged Stream Valley
STM	Submerged Tidal Marsh
TI	Tidal Inlet
WFF	Washover-Fan Flat


KEEPER
Caplugs


RI 9404

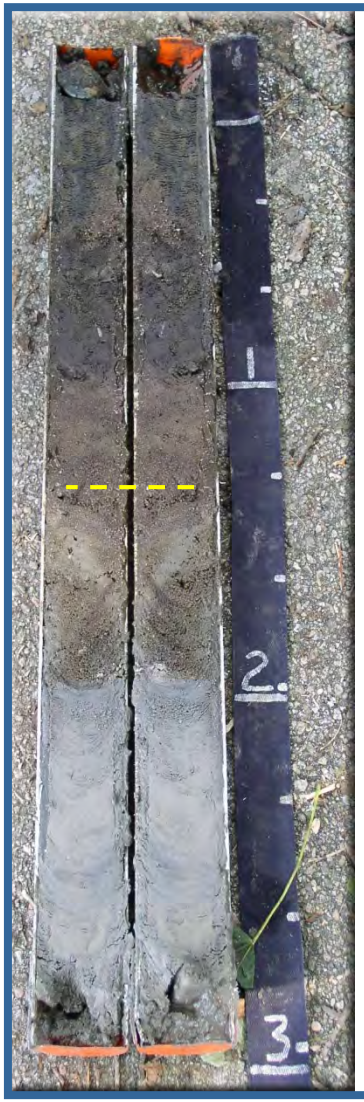

S06 CTD11-006
LNB
S06 CTD11-007
Sandy Shoal
LNB
S06 CTD11-009
LNB
S06 CTD11-010
LNB
S06 CTD11-011
Sec 1
LNB
S06 CTD11-011
Sec 2
LNB
S06-CTD11-012
Subsequent stream
LNB



silty marine and estuarine deposits over buried organic material

Series	Sample #	Horizon	Depth (cm)	Measured Radiocarbon Age	Conventional Radiocarbon Age
Rhodesfolly	S05RI009008	Ab2	44–55	620 +/- 40 BP	650 +/- 40 BP
Rhodesfolly	S05RI009008	Ab4	140-150	610 +/- 40 BP	710 +/- 40 BP
Quanaduck	S05CT011005	2Ab	58-66	3470 +/- 40 BP	3450 +/- 40 BP
Wequetequock	S05CT011006	Oab	105-150	2650 +/- 40 BP	2600 +/- 40 BP

Napatree

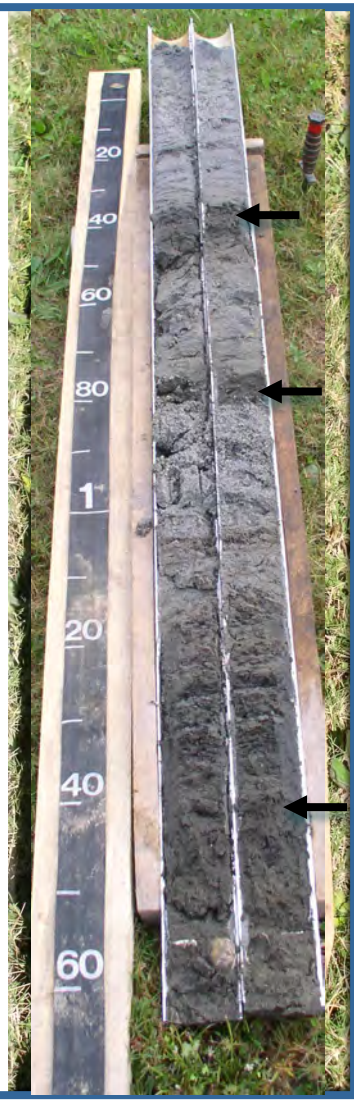


sandy marine deposits overlying submerged terrestrial loess or till deposits

Anguilla

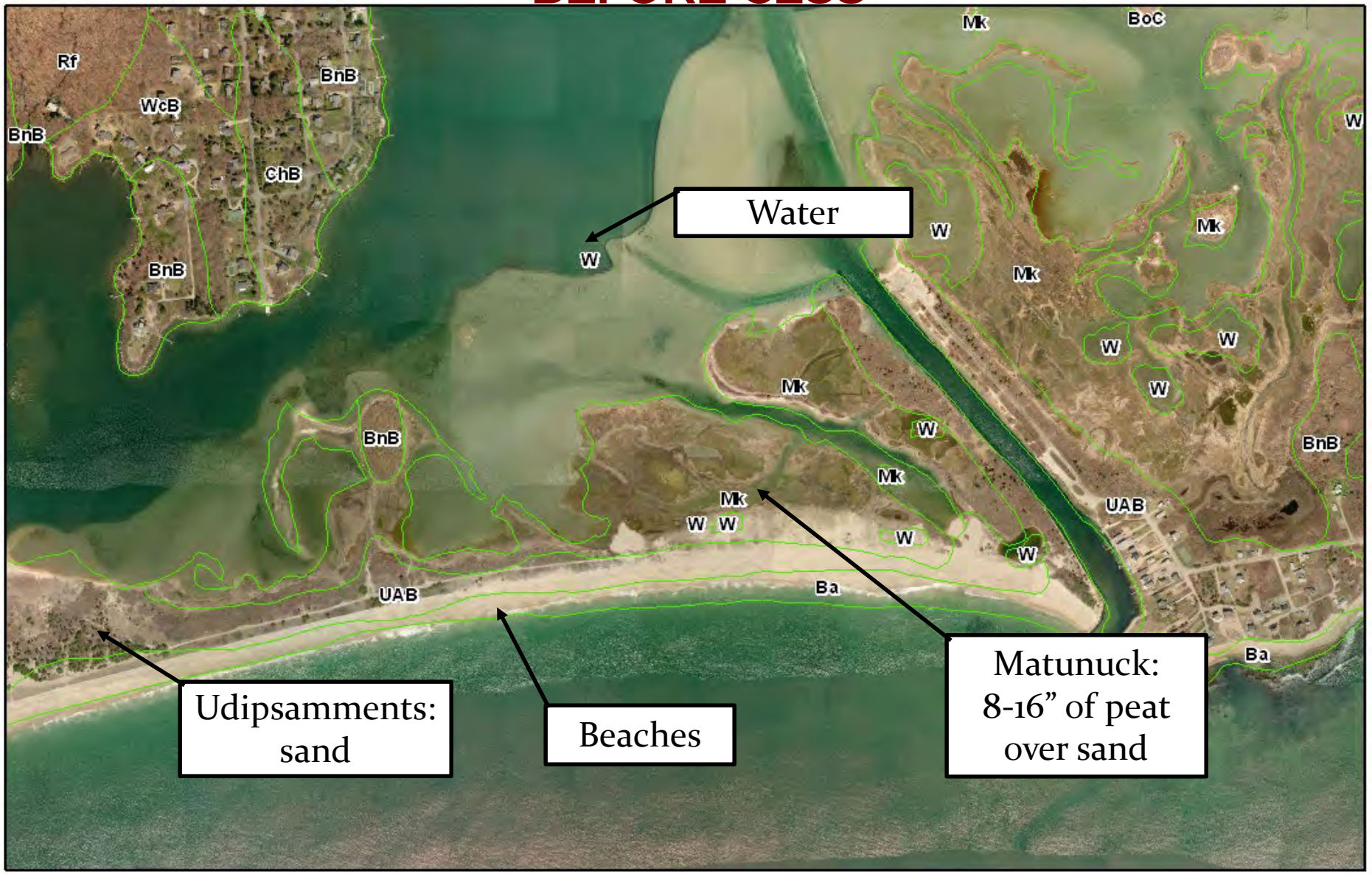
sandy marine deposits over sandy and gravelly glaciofluvial deposits

Rhodesfolly



sandy marine deposits

BEFORE CZSS



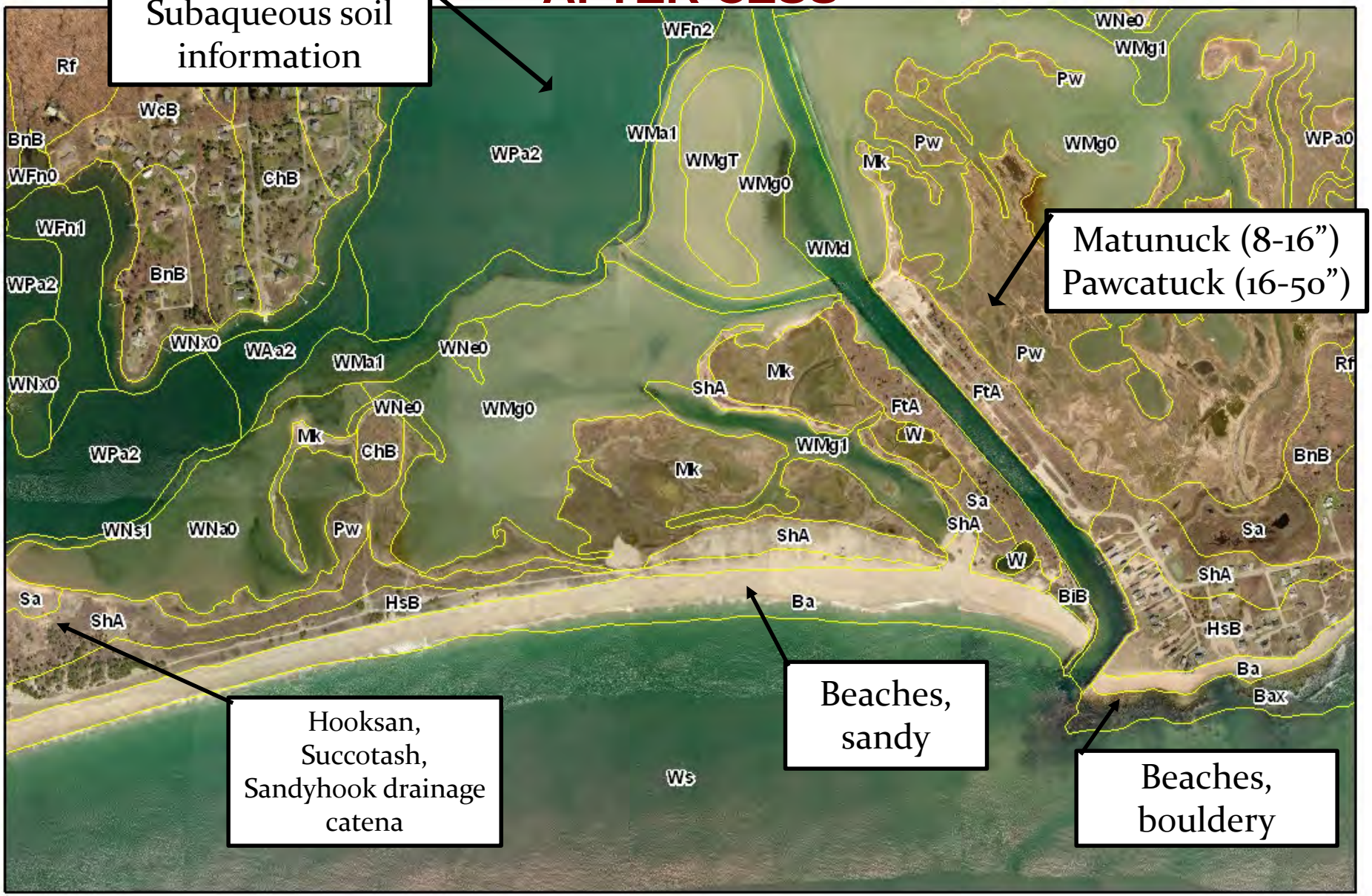
N
W E
S

0 0.25 0.5 0.75 1

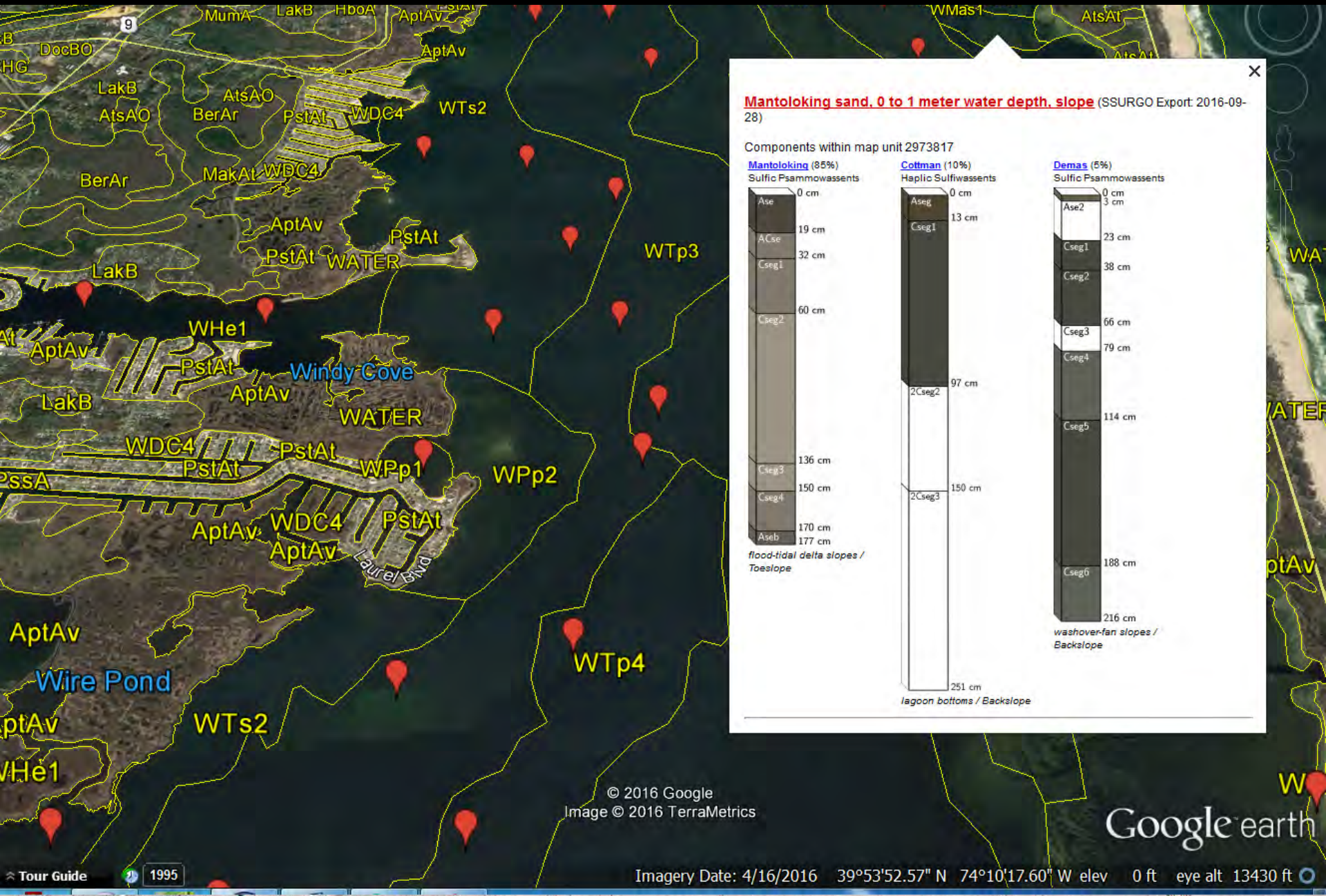
Kilometers

NRCS

AFTER CZSS



NRCS



Mantoloking sand, 0 to 1 meter water depth, slope (SSURGO Export: 2016-09-28)

Components within map unit 2973817

Mantoloking (85%)
Sulfic Psammowassents

flood-tidal delta slopes / Toeslope

Cottman (10%)
Haplic Sulfiwassents

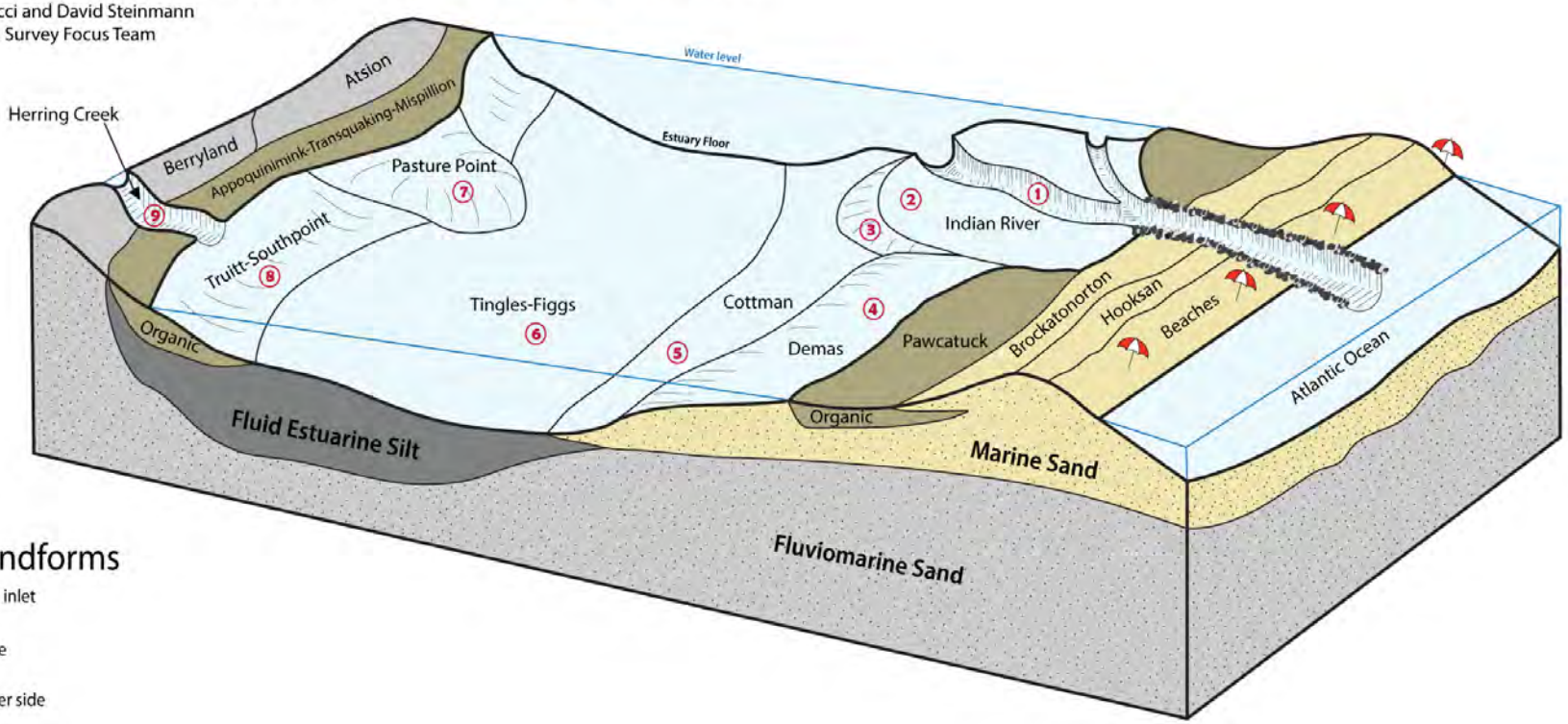
lagoon bottoms / Backslope

Demas (5%)
Sulfic Psammowassents

washover-fan slopes / Backslope

MLRA 153D: Coastal and Subaqueous Soils of the Mid-Atlantic

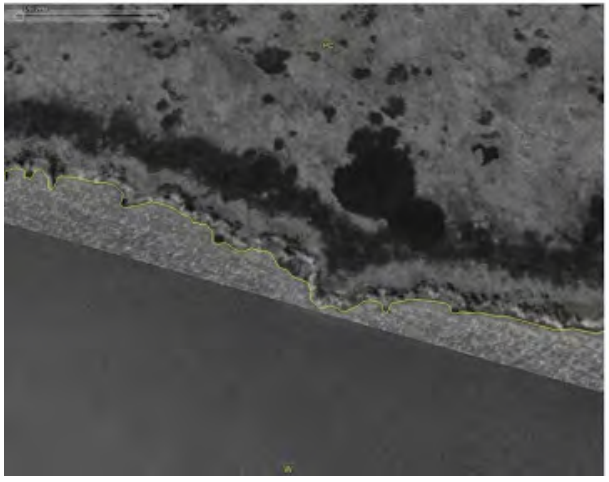
Created by Andy Paolucci and David Steinmann
Coastal Zone Soil Survey Focus Team



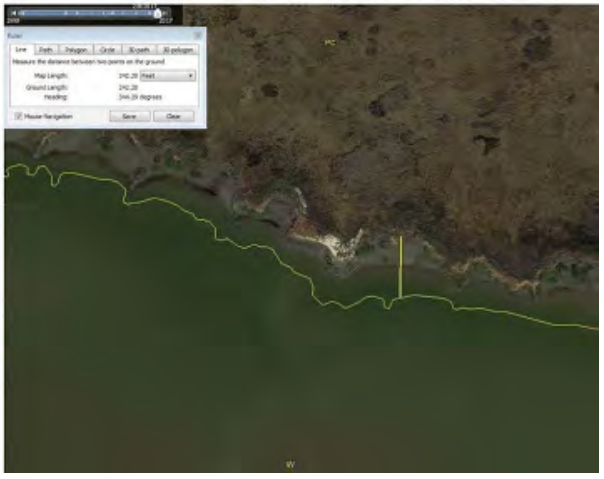
Subaqueous Landforms

1. Flood tidal delta tidal inlet
2. Flood tidal delta flat
3. Flood tidal delta slope
4. Washover fan flat
5. Lagoon bottom barrier side
6. Lagoon bottom
7. Submerged wave cut platform
8. Mainland cove
9. Estuarine tidal creek

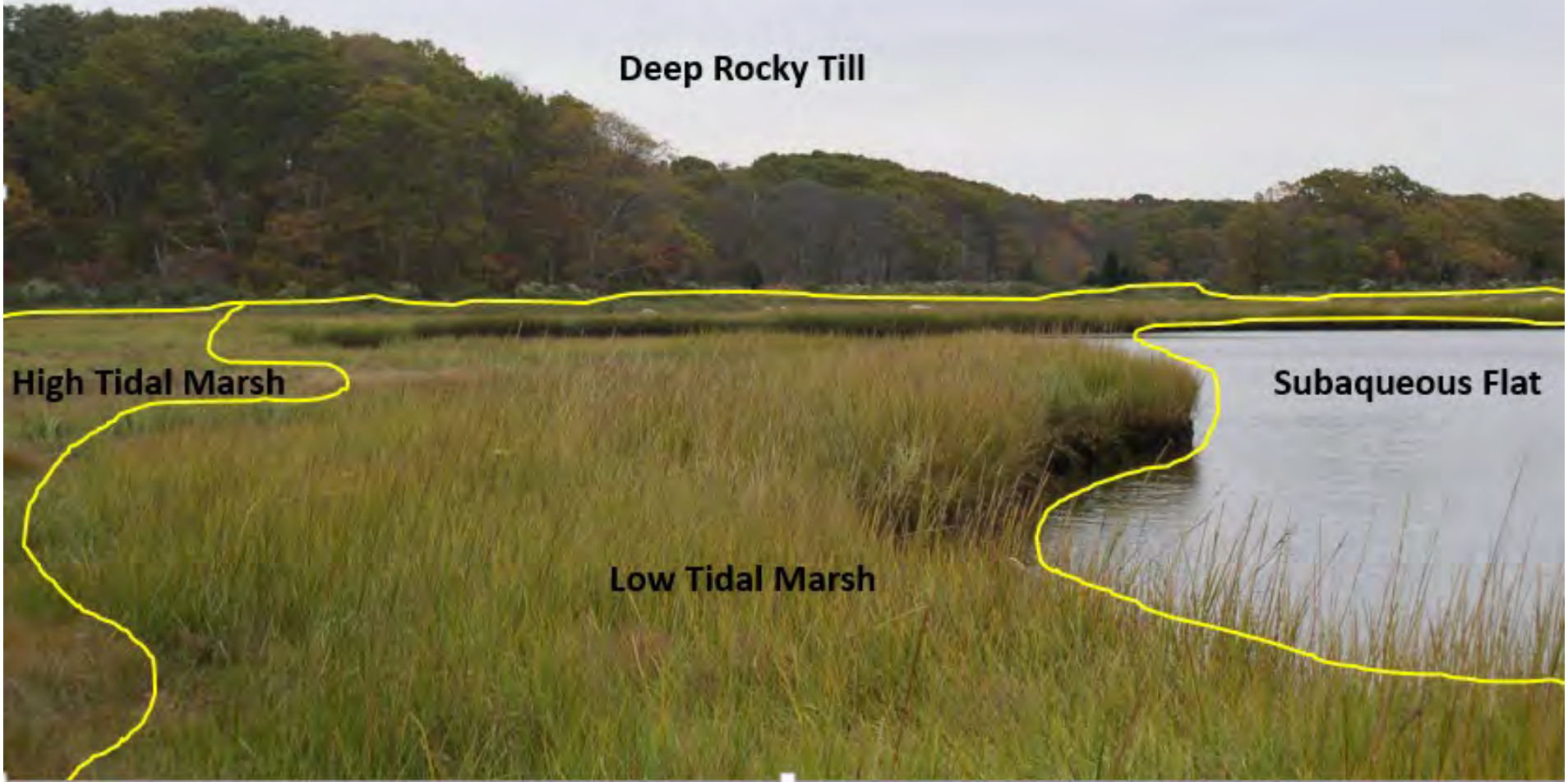
1998



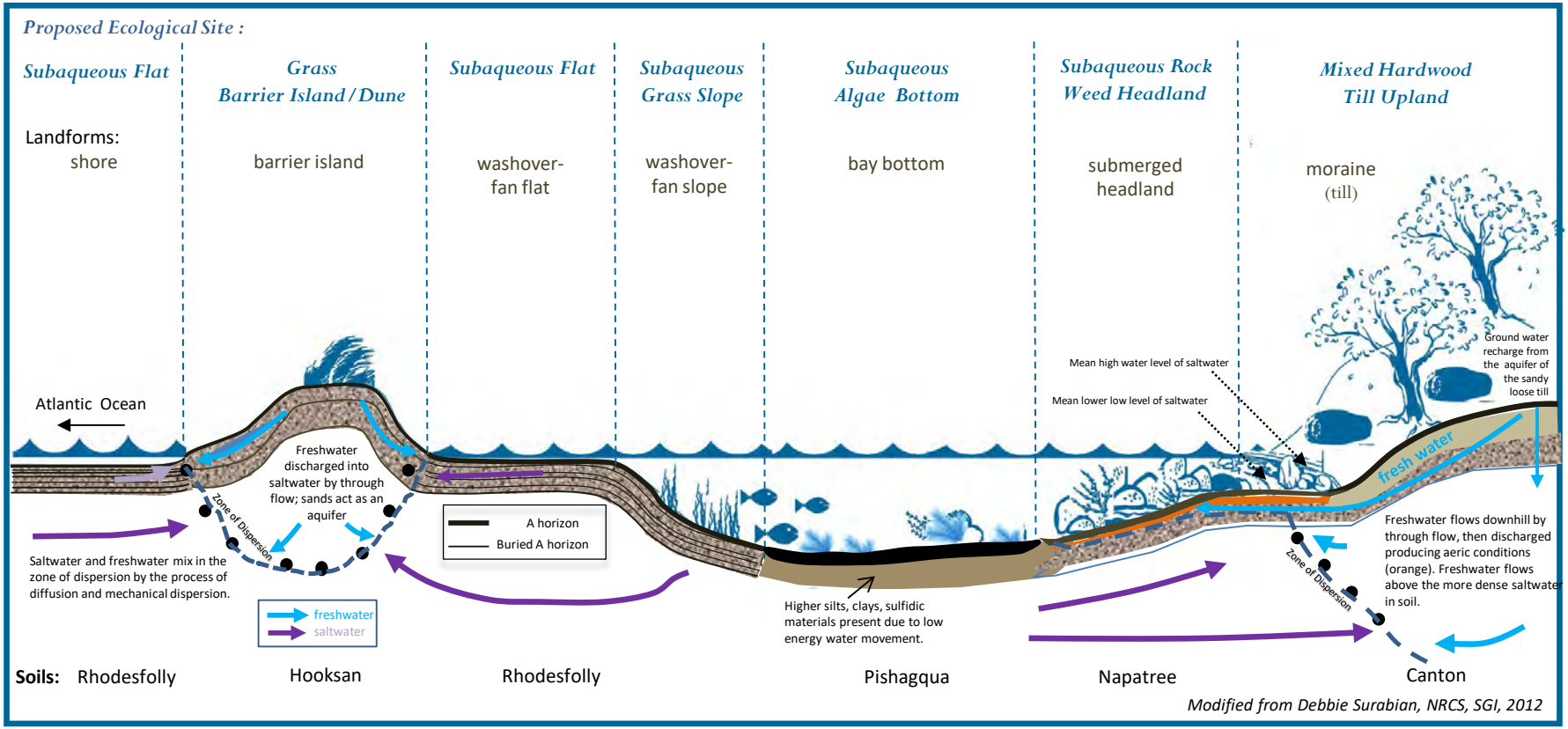
2017



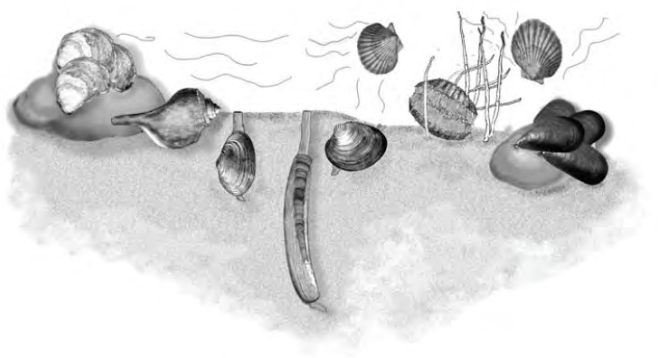
An **ecological site** is a conceptual landscape division defined by recurring soil, landform, geological, and climate characteristics. A site produces distinctive kinds, amounts, and proportions of vegetation and **responds similarly to management actions and natural disturbances.**



The shore-to-upland Ecological Sites, Landforms, Soil Types and Hydropedology of Little Narragansett Bay.



Soil based interpretations for subaqueous soils:

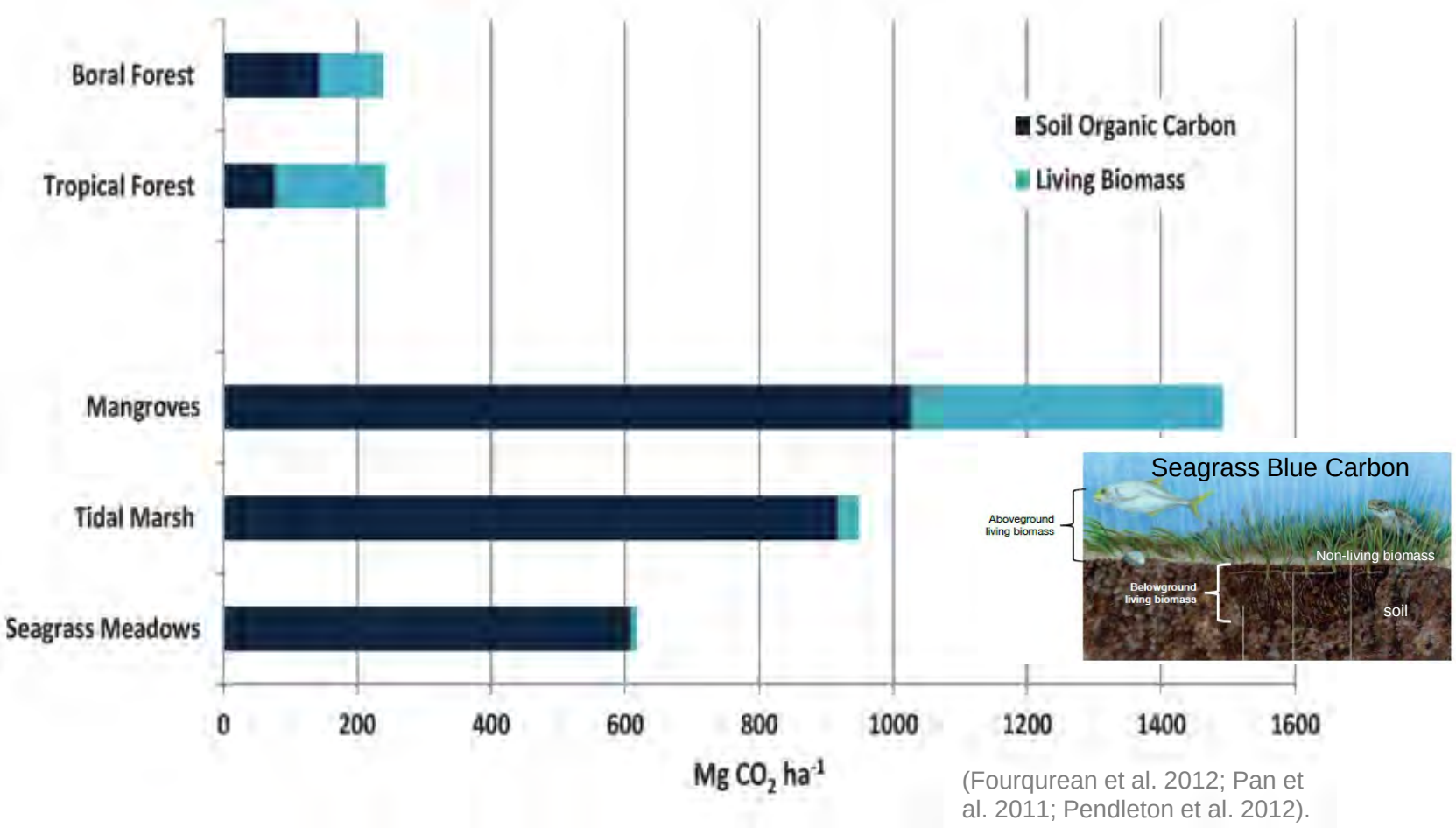


- Soil Suitability for Hard Clam Habitat**
- Soil Suitability for Eastern Oyster Habitat Restoration**
- Soil Suitability for Eelgrass Restoration**
- Moorings – Deadweight and Mushroom Anchors **
- Land Utilization of Dredge Materials**
- CMECS sediment surface type**
- Shoreline and Streambank Erosion
- Salinization due to Coastal Inundation
- Soil Potential for Coastal Acidification
- Living Shorelines
- Groundwater discharge – freshwater inputs
- Carbon Sequestration
- Climate Change vulnerability
- Shoreline Cleanup (oil spill response)
- Tidal Marsh Protection and Creation – Thin Layer Deposition
- Crab/ Horseshoe Crab/ Scallop/ Lobster Habitat
- Diamondback Terrapin Nesting Areas
- Wading Shore Birds and Migratory Waterfowl, Nurseries/Spawning Areas
- Navigational Channel Creation/Maintenance
- Dune and Beach Maintenance/Replenishment
- Dock Development and Maintenance

**currently developed

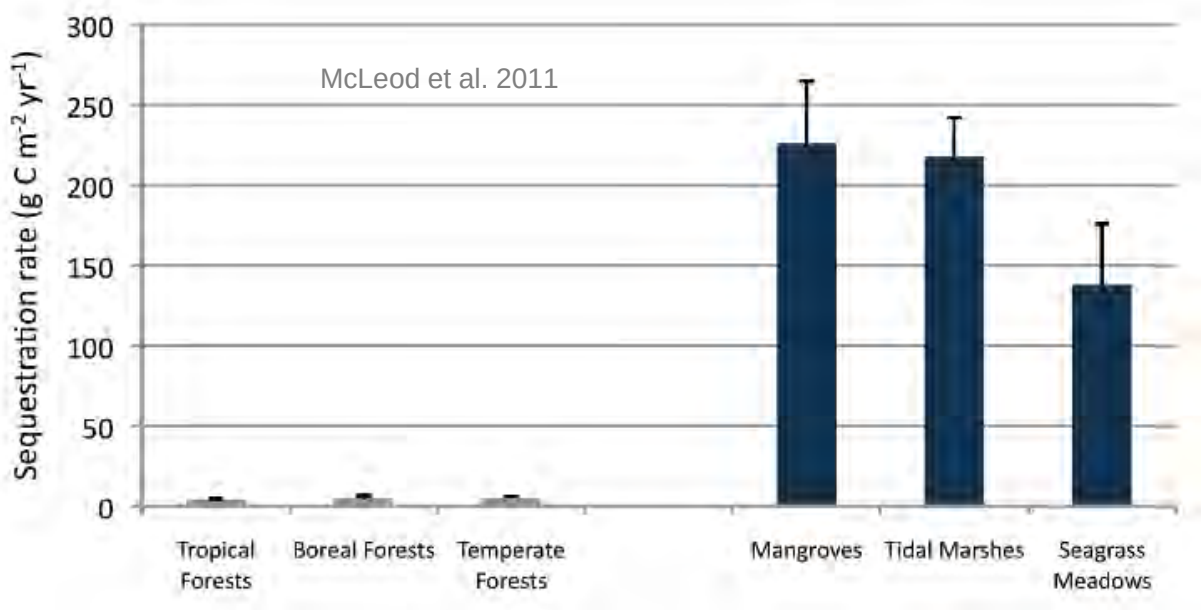
Blue carbon is the carbon stored in mangroves, salt tidal marshes, and seagrass meadows within the soil, the living biomass aboveground (leaves, branches), the living biomass belowground (roots), and the non-living biomass (litter) (Mcleod *et al*. 2011).

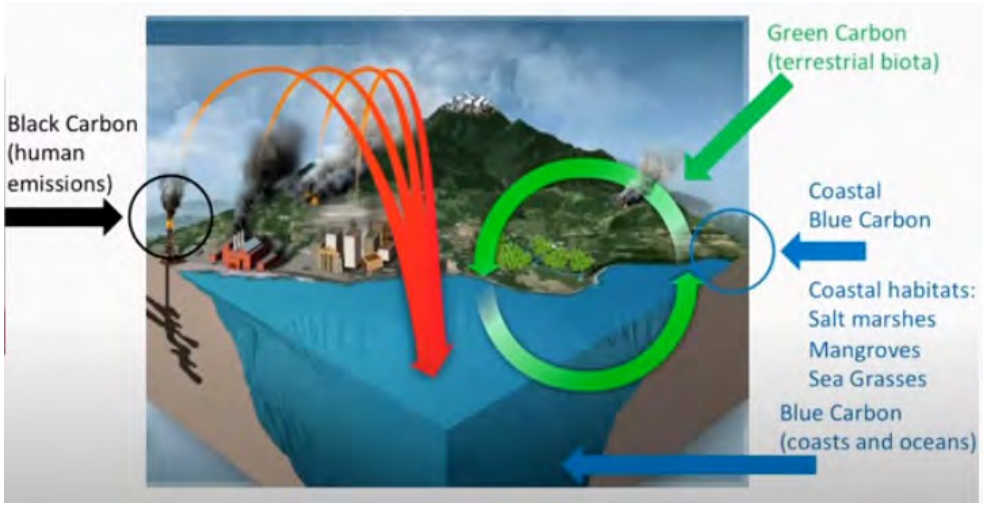
Mean carbon storage above and below ground in coastal ecosystems versus terrestrial forests.



(Fourqurean et al. 2012; Pan et al. 2011; Pendleton et al. 2012).

Annual mean carbon sequestration rates for blue carbon habitats per unit area compared to terrestrial forest habitats.





What about blue carbon inventories of subaqueous soils?

URI research suggests that subaqueous SOC pools and sequestration rates are equal to or greater than comparable upland pools.

Hydropedology Symposium: 10 Years Later and 10 Years into the Future

Estuarine Subaqueous Soil Organic Carbon Accounting: Sequestration and Storage

Christina M. Miilar
Adiza Ama Owusu Aduomih
Brett Still
Mark H. Stolt*
Dep. of Natural Resources Science
Coastal Institute–Kingston
Univ. of Rhode Island
Kingston, RI 02881

Subaqueous soils have largely been overlooked in soil C accounting studies. Recent work suggests that shallow, subtidal soils along the Atlantic Coast contain soil organic C (SOC) pools that are equal to or greater than comparable upland pools. In this study, we investigated the spatial relationships between SOC pool size and subaqueous soil landscape units in three coastal lagoons in Rhode Island and estimated SOC sequestration rates for these soils. Fifty-two pedons were sampled to 1 m and analyzed for SOC content and bulk density to calculate SOC pools. Pools varied significantly among soil landscape units and subaqueous soil Great Groups. Average SOC pools for the upper

	Soil Classification (subgroup)	n	Mean SOC (Mg ha^{-1})	CV (%)	Reference
Upland soils	Typic Udipsamments	20	110	15	Davis et al., 2004
	Typic Dystrudepts	29	136	29	Davis et al., 2004
	Aeric Endoaquepts	20	187	31	Davis et al., 2004
	Aeric Endoaquepts	29	246	39	Ricker et al., 2013
	Typic Haplosaprists	30	586	20	Davis et al., 2004
Subaqueous	Fluventic Psammowassents	9	47	43	This Study
	Sulfic Psammowassents	5	57	82	This Study
	Typic Fluviwassents	5	109	50	This Study
	Haplic Sulfiwassents	10	123	43	This Study
	Typic Sulfiwassents	5	141	42	This Study
	Fluventic Sulfiwassents	5	196	28	This Study
	Thapto-Histic Sulfiwassents	3	494	35	This Study

What about blue carbon inventories of coastal zone soils?

There is no national standard for collecting, analyzing and reporting soil organic carbon.

BLUE CARBON ACCOUNTING

Mark Stolt, Department of Natural Resouces Science, University of Rhode Island, Kingston, RI and Martin C. Rabenhorst, Environmental Science & Technology, University of Maryland-College Park, College Park, MD

EMBRACING THE DIGITAL ENVIRONMENT
2019 ASA-CSSA-SSSA
INTERNATIONAL ANNUAL MEETING

Embracing the Digital Environment

Nov. 10-13 | San Antonio, Texas

https://scisoc.confex.com/scisoc/2019am/videogateway.cgi/id/36780?recordingid=36780

Soil Carbon Stock

Measured

- SOC content
- Bulk density
- Horizon thickness

SOC x Bulk Density x Horizon Thickness = mass/area

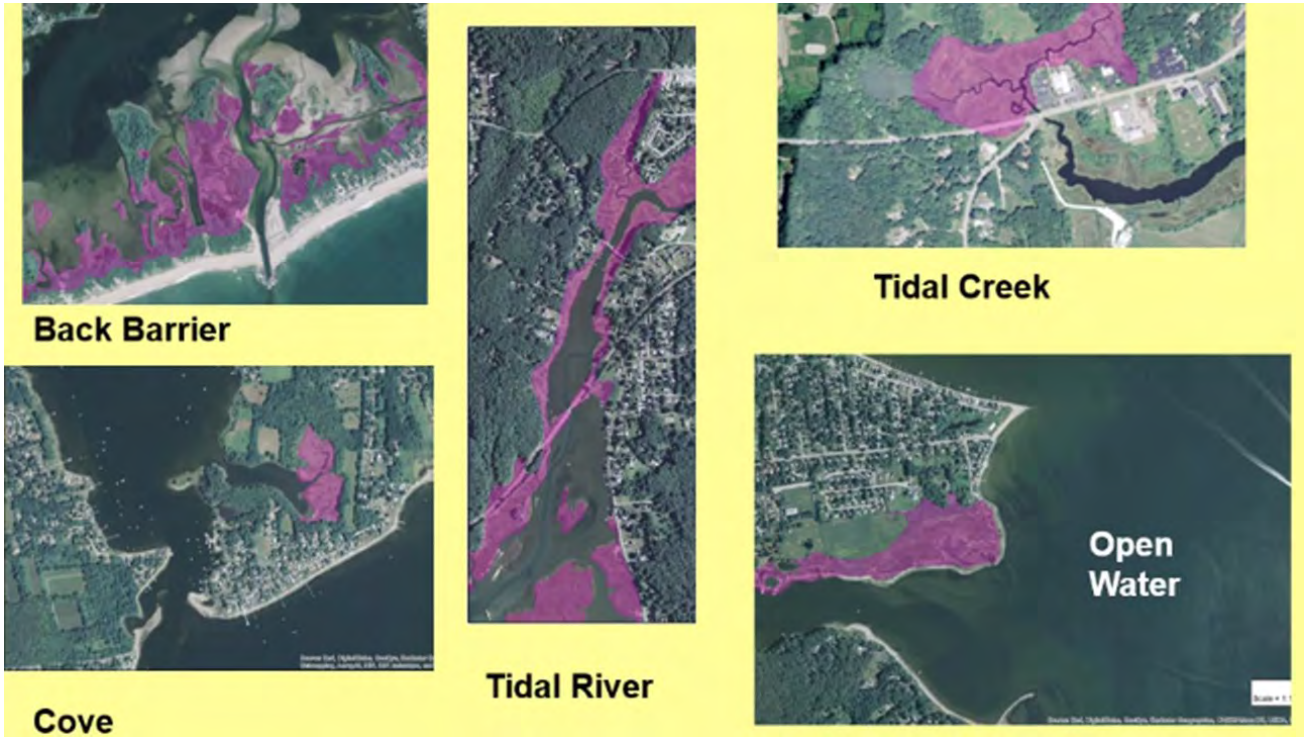
∑ for a certain depth

But---- it is really more complicated than this…

- How was the soil sampled?
- What part of the sample was analyzed?
- How was SOC determined?
- How was bulk density determined?
- How were coarse fragments accounted for?

URI - Blue Carbon Accounting using a Soils/Landscape Perspective

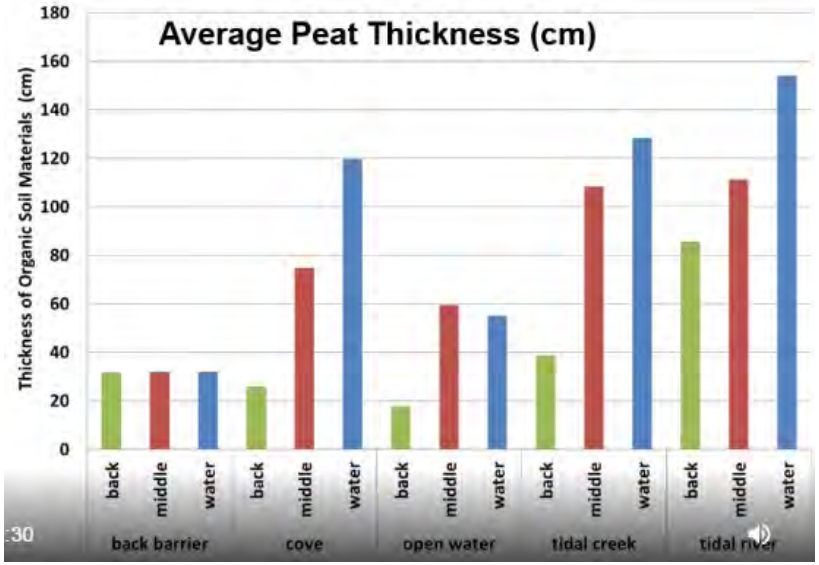
five geomorphic settings



The Message

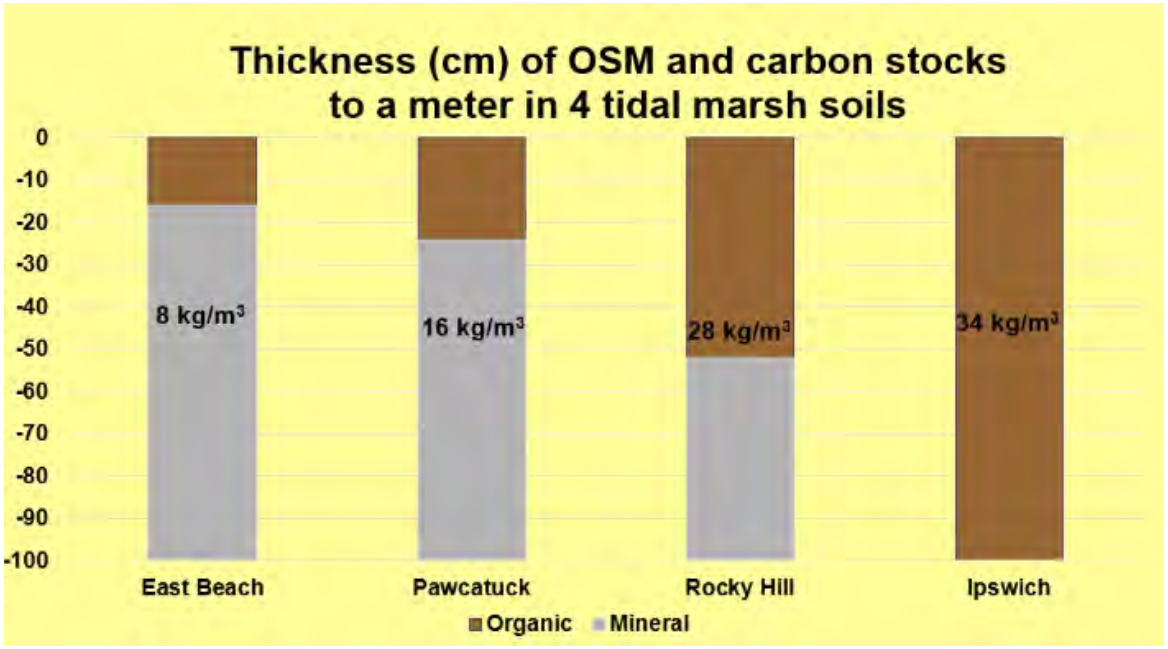
Carbon stocks in salt marshes, vary depending on peat thickness which is dependent upon geomorphic setting

For Blue Carbon accounting we need to model by marsh geomorphic setting and not by average carbon density



What about blue carbon inventories of coastal zone soils?

The **National Coastal Blue Carbon Assessment** project is a nationwide effort by the National Cooperative Soil Survey (NCSS) to inventory blue carbon soil stocks in coastal ecosystems to provide accurate soil carbon stock data for blue carbon pools through the Coastal Zone Soil Survey.

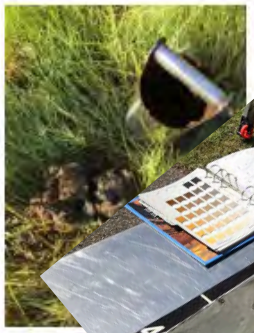


What about blue carbon inventories of coastal zone soils?

The NCSS aims to standardize soil sampling protocols across agencies, increase the accuracy of coastal soil mapping, and improve public accessibility to coastal wetland blue carbon data.

The statistical and scientific project would be a defensible soil carbon stock inventory on coastal wetland ecosystems (tidal marshes, mangroves, subaqueous, and near shore wetlands).

Wilson's Hole Saw Sampler



Whole core

Dorman's Hole Saw Sampler

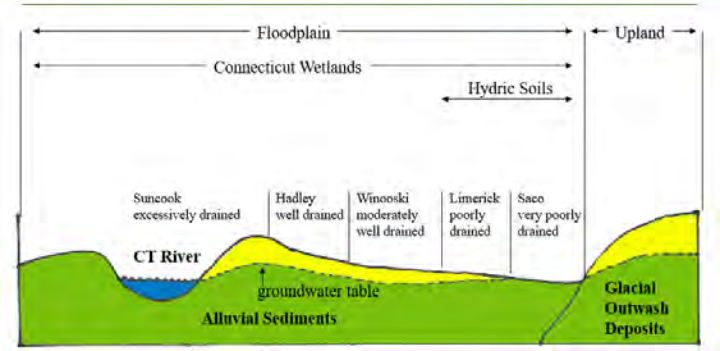
McCauley

Green Carbon – Freshwater Soil Surveys

Green Carbon – CT Inland Wetlands

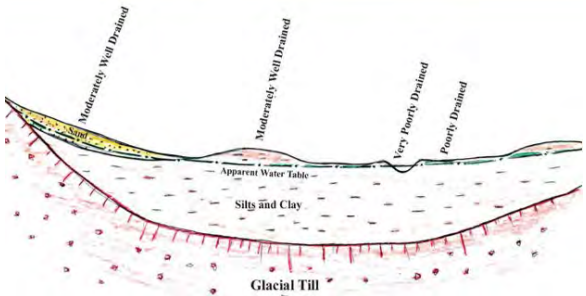
The state of Connecticut defines inland wetlands based on soils. The Connecticut Inland Wetlands and Watercourses Act defines wetland soils to include any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soil Survey, as may be amended from time to time, of the Natural Resources Conservation Service of the United States Department of Agriculture.

A Topodrainage Sequence on the Connecticut River Floodplain

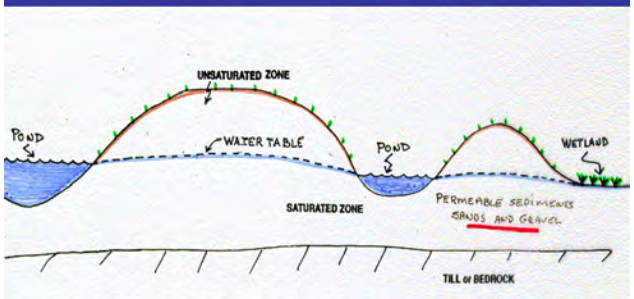


Hydrology in Bedrock Controlled Till

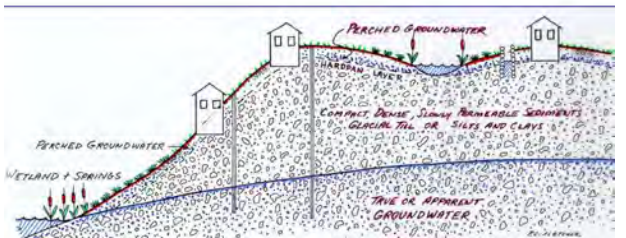
Lacustrine Hydrology



Outwash Hydrology

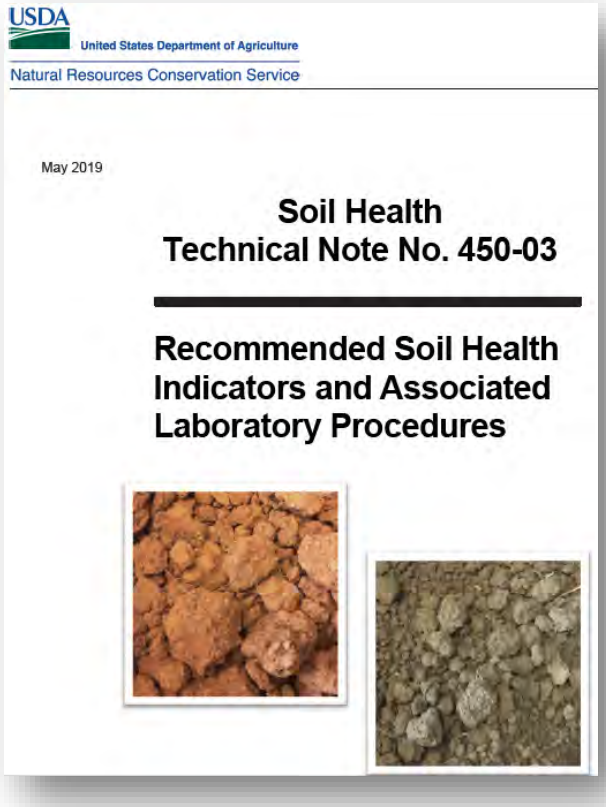


Hydrology in Tills



Green Carbon – Soil Health Analyses

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.


USDA
United States Department of Agriculture
Natural Resources Conservation Service

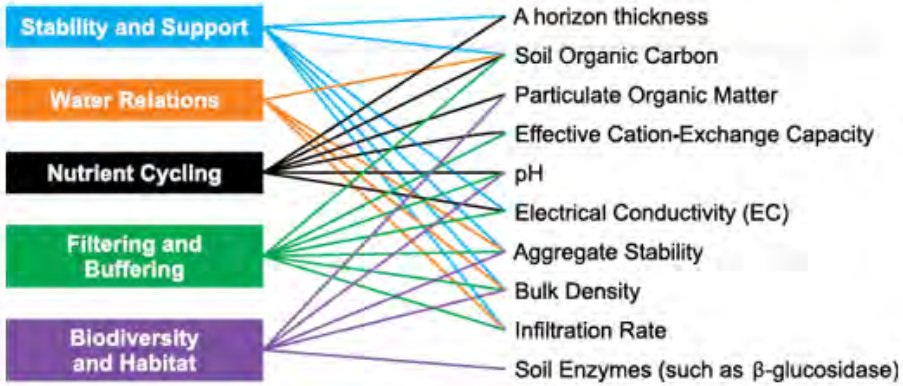
May 2019

Soil Health
Technical Note No. 450-03

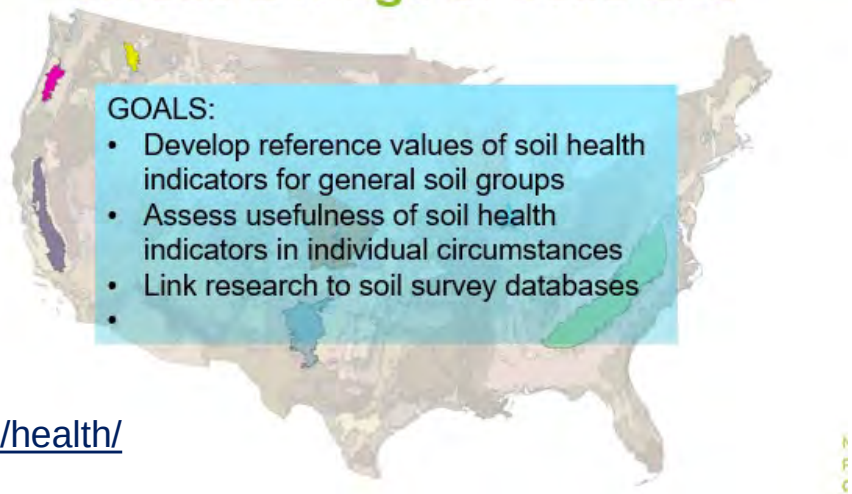
Recommended Soil Health Indicators and Associated Laboratory Procedures

We are not developing a minimum dataset – that's been done.

We expect that different soils will have different 'best' minimum dataset.



Assess a common set of laboratory/field indicators measures across a range of soils and



https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

USDA United States Department of Agriculture

Natural Resources Conservation Service

Soil

A notice of funding opportunity has been announced for the potential availability of funding for agreements with the NRCS Soil and Plant Science Division and university cooperators on significant national issues.

Research proposals are sought for national scale projects aligned with the following priorities:

- Novel techniques to leverage big data for applications in soil survey
- Spatial and temporal variability of dynamic soil properties
- Inventory of blue carbon soil stocks in coastal ecosystems
- Incorporation of technologies to enhance soil survey –geospatial focus on fine scale –urban, proximal sensing, Mid-Infra Red (MIR) Spectra in biological context.

Eligibility is limited to institutions of higher education in the Cooperative Ecosystem Studies Unit (CESU) network (http://www.cesu.psu.edu/). Proposals are requested for competitive consideration of awards for projects 1-2 years in duration with $200,000 to $500,000 in total costs. Proposals should provide for technology transfer and training for Soil and Plant Science Division staff and assist in training of students in soil science and related fields.

For more information see grants.gov: https://www.grants.gov/web/grants/view-opportunity.html?oppId=326575.

RaCA - SOC stocks - Mg/ha to 100cm
LUGR means on gSSURGO grid

0 50 100 200 300
Miles

0 125 250 500 750
Kilometers

Albers Equal Area Map Projection
North American Datum of 1983

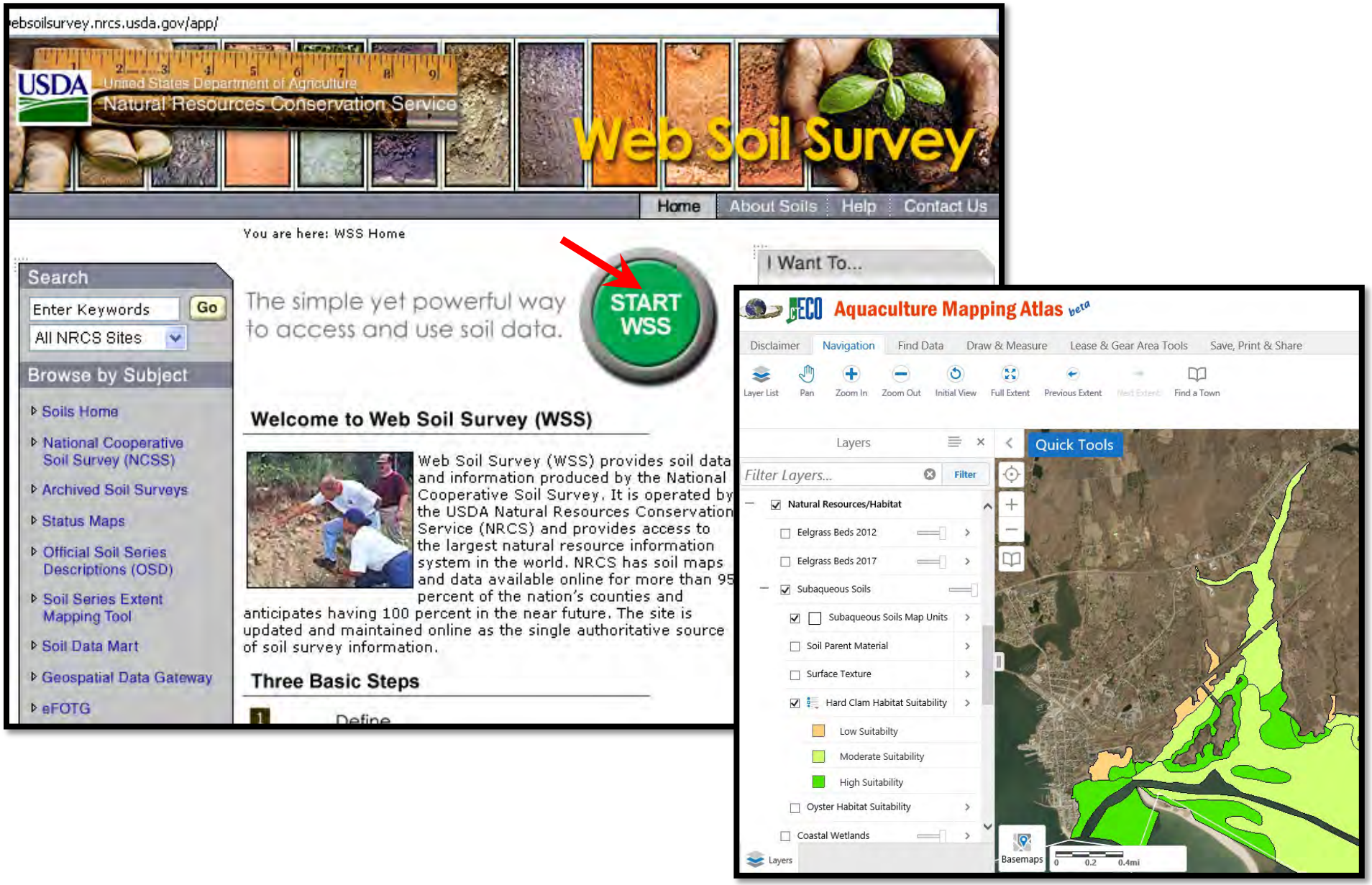
Source: Prepared using LUGR means attached to the 2013 gSSURGO grid and oridary kriging of RaCA pedon stocks.

Prepared by: Skye Wills, 2016

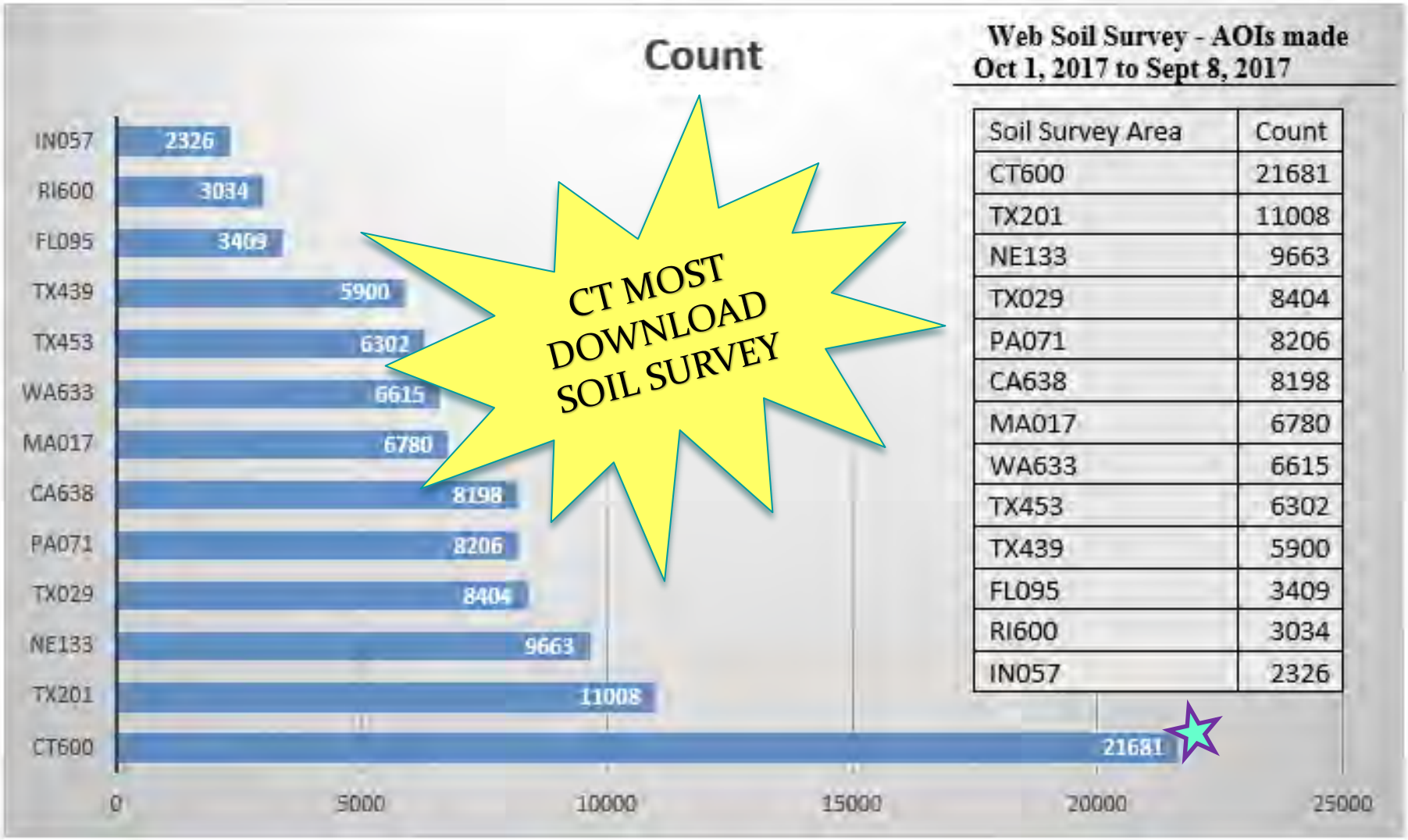
RaCA Sites (Mg/ha)

- < 10.0
- 10.1 - 25.0
- 25.1 - 50.0
- 50.1 - 75.0
- 75.1 - 100.0
- 100.1 - 125.0
- 125.1 - 175.0
- 175.1 - 225.0
- 225.1 - 300.0
- 300.1 - 500.0
- 500.1 - 1,000.0
- 1,000.1 - 1,200.0
- 1,200.1 - 1,500.0
- 1,500.1 - 2,000.0
- 2,000.1

Click on the green “START WSS” button



Web Soil Survey Metrics

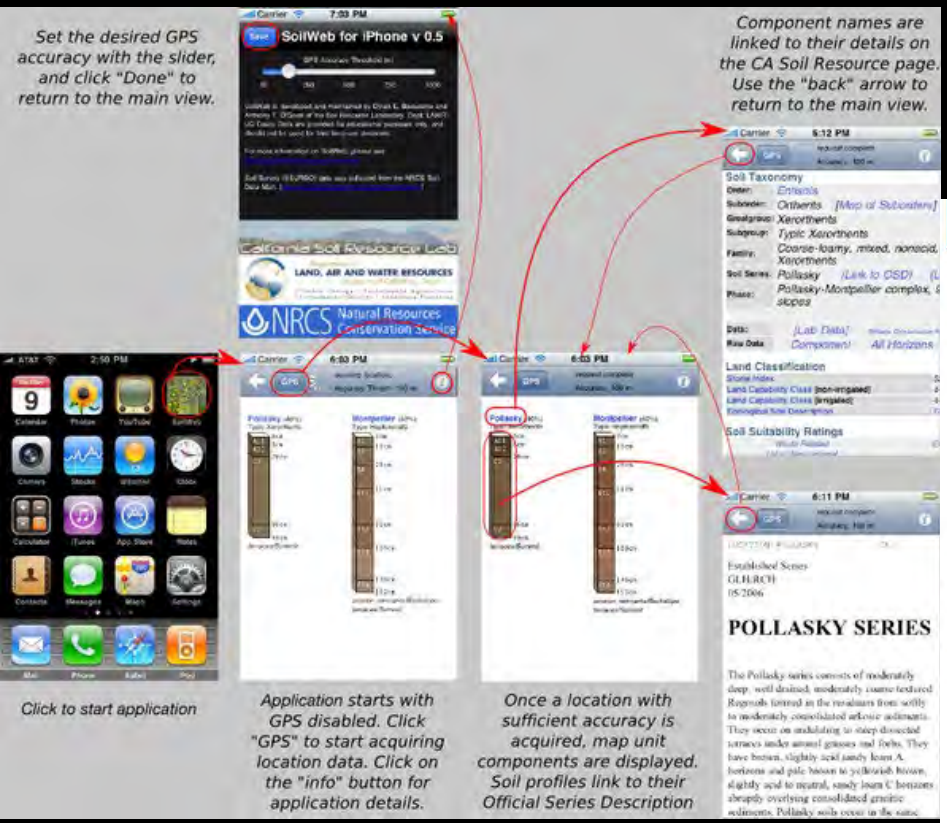


Web Soil Survey - AOIs made Oct 1, 2017 to Sept 8, 2017

Soil Survey Area	Count
CT600	21681
TX201	11008
NE133	9663
TX029	8404
PA071	8206
CA638	8198
MA017	6780
WA633	6615
TX453	6302
TX439	5900
FL095	3409
RI600	3034
IN057	2326

There is an App for that!

United States Department of Agriculture



SoilWeb

SoilWeb : An Online Soil Survey Browser

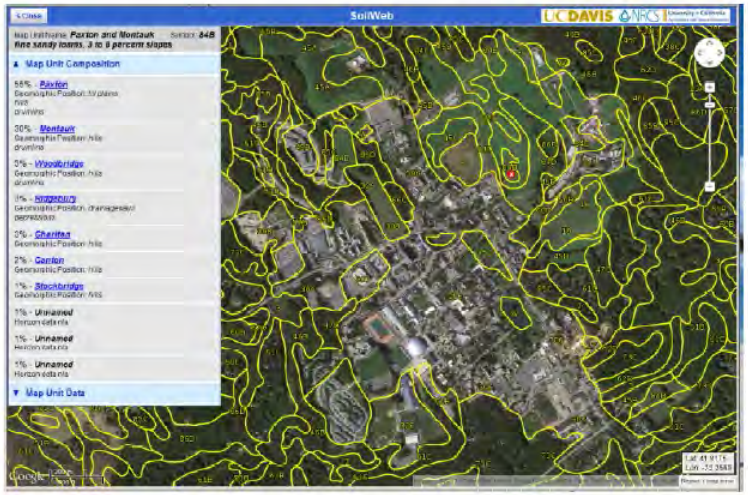
Explore USDA National Cooperative Soil Survey data at locations throughout most of the U.S with this interactive map. It is compatible with your desktop computer, tablet, or smartphone.

Getting Started

1. Go to http://casoilresource.lawr.ucdavis.edu/soilweb/ and click on SoilWeb.
2. Go to *Menu > Zoom To Location* to enter your area of interest or let your browser determine your current location.
3. Click on the map to identify "map units", which are delineated by the yellow lines. Then click on the expandable category headings to view the data of interest to you.

For more help with the use of this app, or for help with soil survey terms and definitions, see the topics under *Menu->Help*.

Screenshots




Is it Soil or
Sediment?