Subaqueous Soils and their Importance for Species and Marine Ecosystems

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Subaqueous Soil Page: http://nesoil.com/sas

Outline

Brief history and introduction of subaqueous soils (SAS).

How subaqueous soils are mapped.

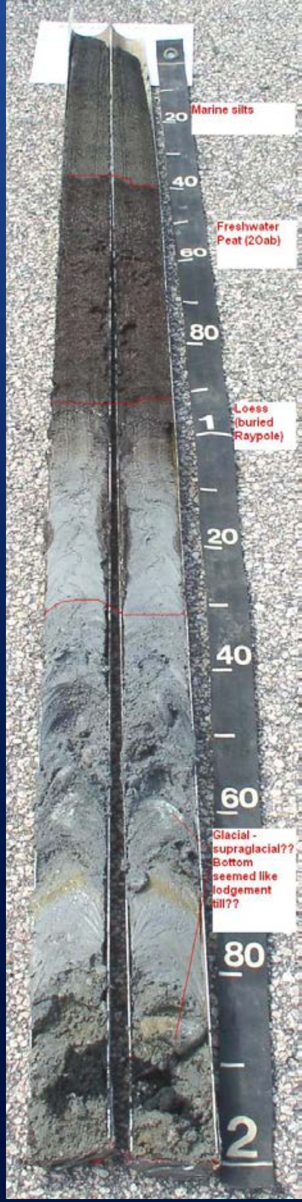
Q/A

Why subaqueous soils are mapped / needed.

Research, Interpretation, and Examples.

Questions.

Indian River – Fluventic Psammowassent



Billington - COARSE-SILTY, MIXED, ACTIVE, NONACID, MESIC THAPTO-HISTIC SULFIWASSENTS

Historical Background of SAS

von Post 1862

- 1st nomenclature for SAS
- Introduced terms “gyttja” and “dy” to describe limnic sediments.

Kubiena 1952

- Proposed a comprehensive soil classification system for Europe that included the neglected SAS.
- Included horizonation of SAS pedons.

Muckenhausen 1965

- West Germany classification – subhydric soils.

Pomamperuma 1972

- Used term “soil” for underwater sediments, undergo pedogenesis.

A. Sub-Aqueous or Underwater Soils (Ramann 1918)

Key for the Determination of the Types and certain particular Sub-types.

1. Soil without peat formation ... 2
1*. Soil with distinct peat formation ... 8
2. Soil without macroscopically distinguishable humus horizon ... 3
2*. Soil with macroscopically distinguishable humus horizons ... 6
3. Low in chalk, not effervescing with HCl ... 4
3*. Calcareous to highly calcareous, effervescing with HCl ... 5
4. Extremely rich in iron, intense rust yellow, rust brown, or rust red coloured.
   2. *Dystrophic lake iron protopedon.*
4*. Not extremely rich in iron and otherwise coloured.
   1. *Chalk deficient protopedon.*
5. Containing clay to rich in clay.
   3. *Lake marl protopedon.*
5*. Low in clay to free from clay, extremely calcareous.
   4. *Lake chalk protopedon.*
6. Very acid, consisting almost entirely of brown humus flocks, occurring only in acid brown waters.
   II. Dy.

http://nesoil.com/sas/Kubiena_sas.pdf

Yet Despite all this…

Soil Taxonomy (Soil Survey Staff) in 1975 stated:

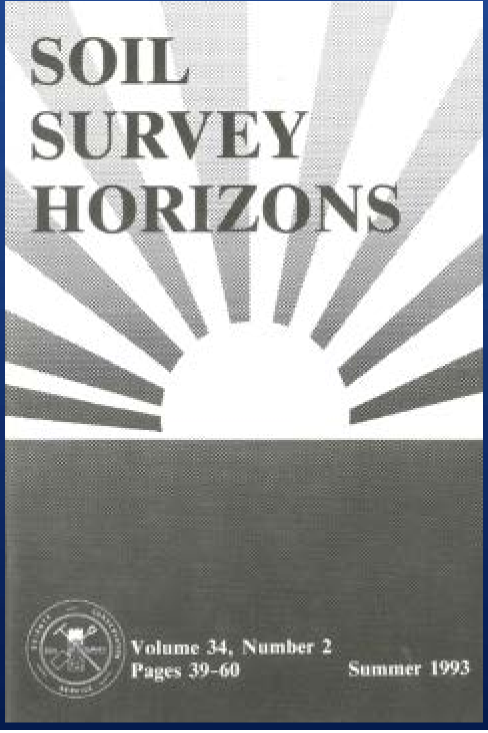
Soil, … is the collection of natural bodies on the earth's surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out-of-doors. **Its upper limit is air or shallow water. At its margins it grades to deep water** or to barren areas of rock or ice.

For the most part Subaqueous materials were excluded from the definition of soil by;

- their permanent saturation beneath deep water
- need to support rooted vegetation

Most, but not all, were deterred…

and map these soils. Let us take the step to boldly go where few soil scientists have gone before—and submerge ourselves in our own new frontier!



Submerged Soils: A New Frontier in Soil Survey

G.P. Demas[1]

Through my assignments to four soil survey projects on the Atlantic Coastal Plain in Maryland and Delaware, I have become increasingly aware of situations where information about soils could go a long way towards providing the supporting data needed to make intelligent environmental management decisions. A major area of environmental concern, especially on the Delmarva Peninsula, is the deteriorating quality of both subsurface and surface water. Among the myriad of negative effects caused by poor water quality is the decrease in health and populations of aquatic organisms. Regulatory and voluntary programs are presently in place on the Delmarva Peninsula that address such items as nonpoint source pollution, on-site sewage disposal, sediment and erosion control, wetland protection and restoration, and the restoration and enhancement of aquatic plant and animal populations. Soil survey information is playing a key role in many of these programs through the gathering, interpretation, and dissemination of previously unavailable soil data directly related to environmental issues.

History of Subaqueous Soils in the U.S.

- Traditional soil survey conducted on land. Not a lot of work in Coastal Zone and tidal marshes until the 70's.
- In 1993 – "Submerged Soils: A New Frontier in Soil Survey" by Dr. George Demas published in Soil Survey Horizons.
- Most early work in Chesapeake Bay Region – Maryland/Delaware.
- Dr. Demas pioneered the concept of Subaqueous Soils differentiating them from sediment.
- 1999 Definition of soil includes shallow water.

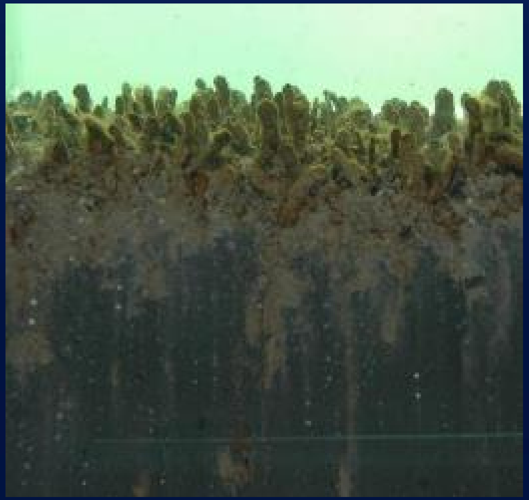
Dr. George Demas 1958-1995
http://en.wikipedia.org/wiki/George_Demas

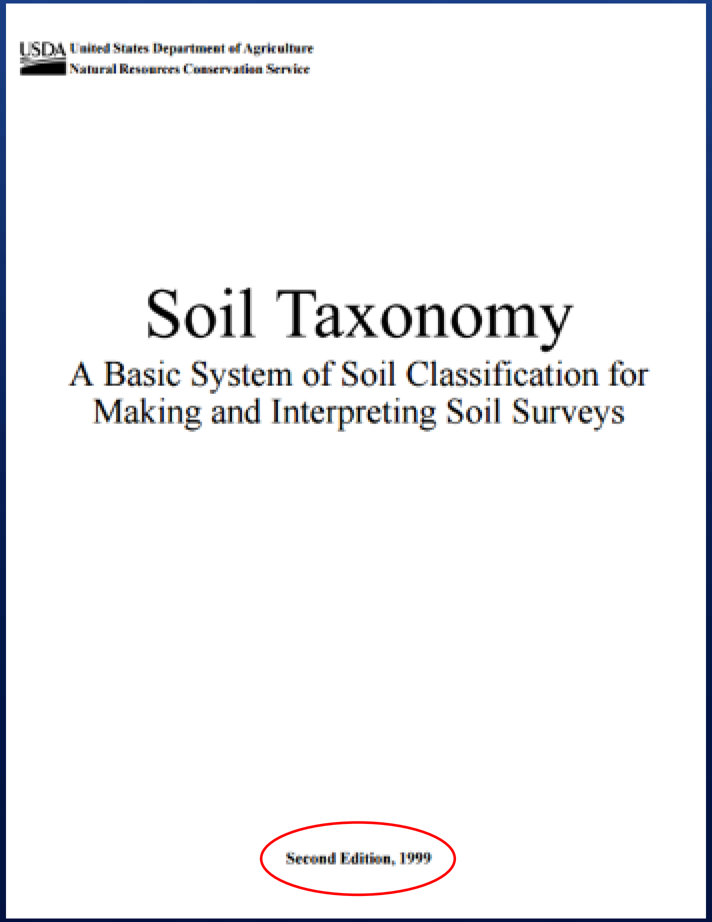
- NRCS Soil Survey Project Leader
- Pioneer of Subaqueous Soils
- USDA Secretary's honor for scientific research.
- SSSA Emil Truog award for outstanding contribution to soil science

Soil Definition Re-defined!

- The upper limit of soil is the boundary between soil and air [or] **shallow water**…[not] too deep (typically more than 2.5 m*) for the growth of rooted plants.

* Arbitrary limit following Cowardin, RI limit is set at 5 m NAVD-88




USDA United States Department of Agriculture
Natural Resources Conservation Service

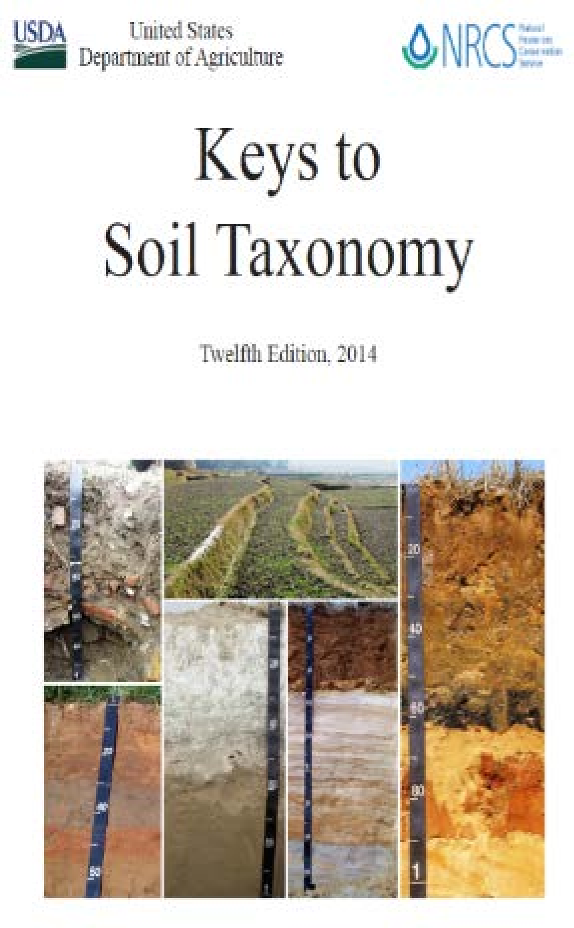
Soil Taxonomy

A Basic System of Soil Classification for Making and Interpreting Soil Surveys

Second Edition, 1999

Current Definition Subaqueous Soils in the U.S.

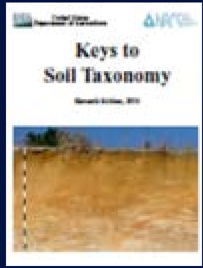
- Soils with a field observable water table 2 cm or more above ~~positive water potential at~~ the soil surface for more than 21 hours of each day in all years. The water column is shallow (< 2.5 m/8.2 feet). Wassists and Wassents.
- Soil must be capable of or presently supporting rooted plants in the natural environment and/or they must show evidence of horizonation due to soil forming processes.
- Four soil forming processes exist: additions, losses, transfers, and transformations are active in subaqueous environments.



History of Subaqueous Soils in the U.S.

- 1990's Demas/Rabenhorst/Balduff.
- 2001 – Bradley-Stolt thesis study in RI, others in ME, FL, MD, MA.
- 2003 – 1st National Workshop on SAS – Delaware (Rehoboth Bay – Coppack/Rabenhorst).
- 2004 – RI forms MapCoast, Dr. Mark Stolt (URI) sabbatical.
- 2005 Glossary of Landscape Terms, other areas begin mapping.
- 2006-2009 Proposal to amend Taxonomy & NASIS proposals, Interpretation studies.
- 2010 Eleventh Edition Soil Taxonomy released includes Wassents and Wassists.
- 2010 – 2nd National Workshop on SAS in Rhode Island.
- 2011 RI completes 1st official Coastal Zone Soil Survey (2012 first freshwater soil survey).
- 2013 – Present CT, NJ SSURGO Mapping, research, outreach, improvements…
- 2016 – 70,00 acre Barnegat Bay NJ will be published, 1,000 acres of Thimble Islands Ct.

1st National Workshop on Subaqueous Soils, Delaware 2003



It's Official!

Subaqueous Soils 101

The debate: Is it soil or sediment?

Soil qualifying criteria:

1. Supplies nutrients to rooted plants.
2. Soil horizons formed by pedogenic processes.

Organic and mineral (O, A and C) horizons.

Predominantly dealing with AC type soils (Entisols w/ few Histosols).

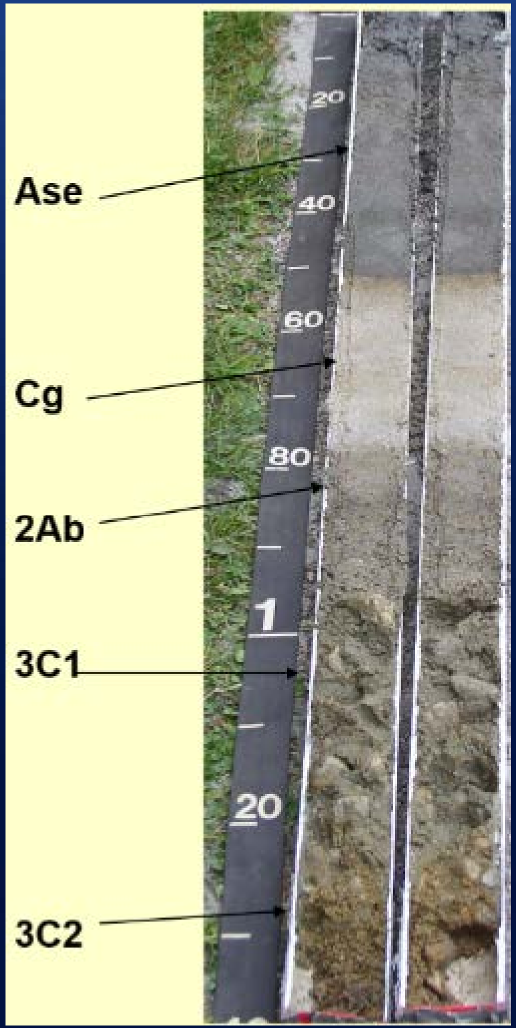
Numerous buried A and O horizons.

Some subaqueous and submerged soils have buried B horizons (spodic, argillic, etc.).

Chemistry – sulfides, pH, salts, reduction/oxidation.

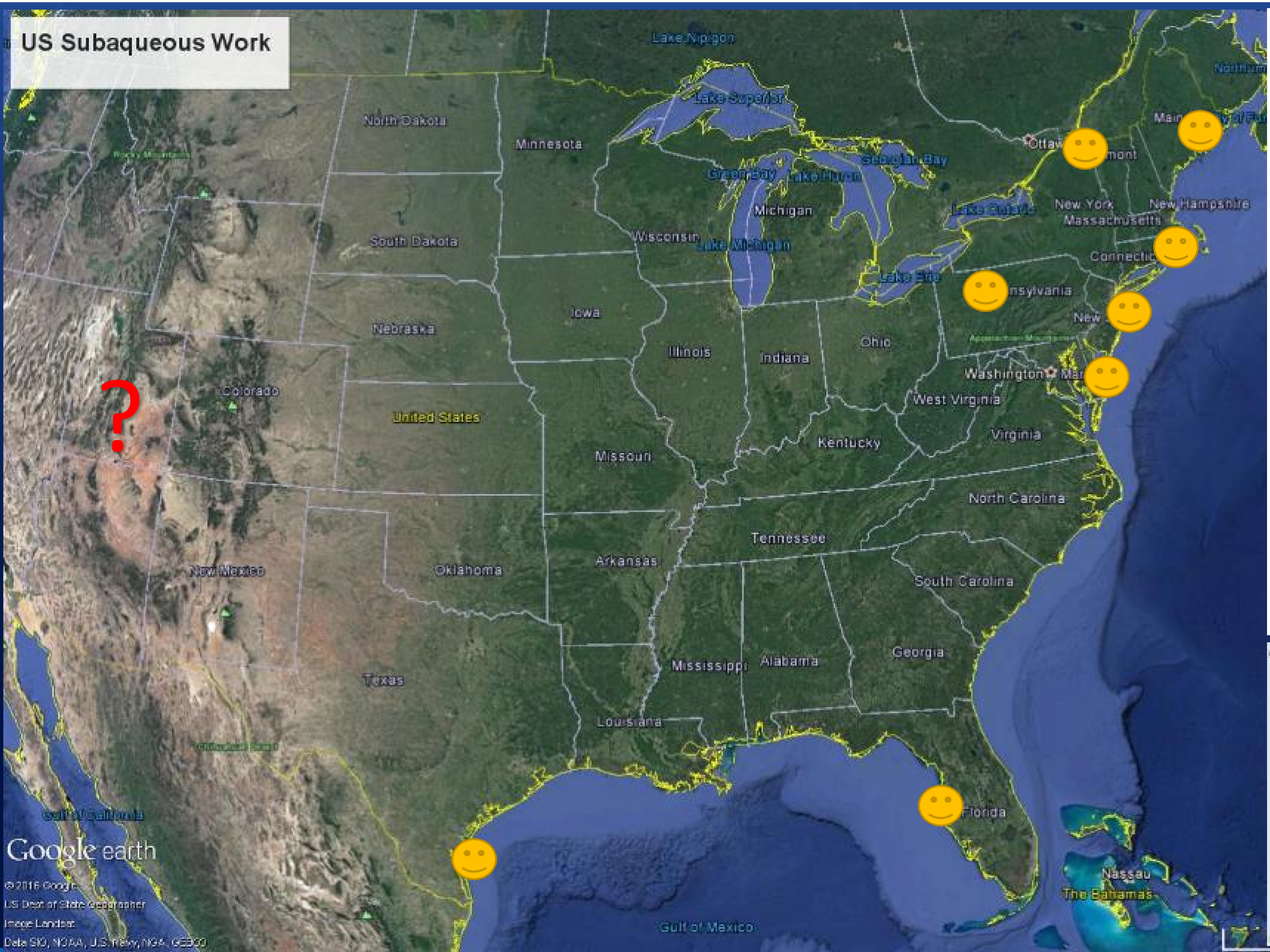
Ss = f(C,R,O,B,F,P,T,W,Ce)

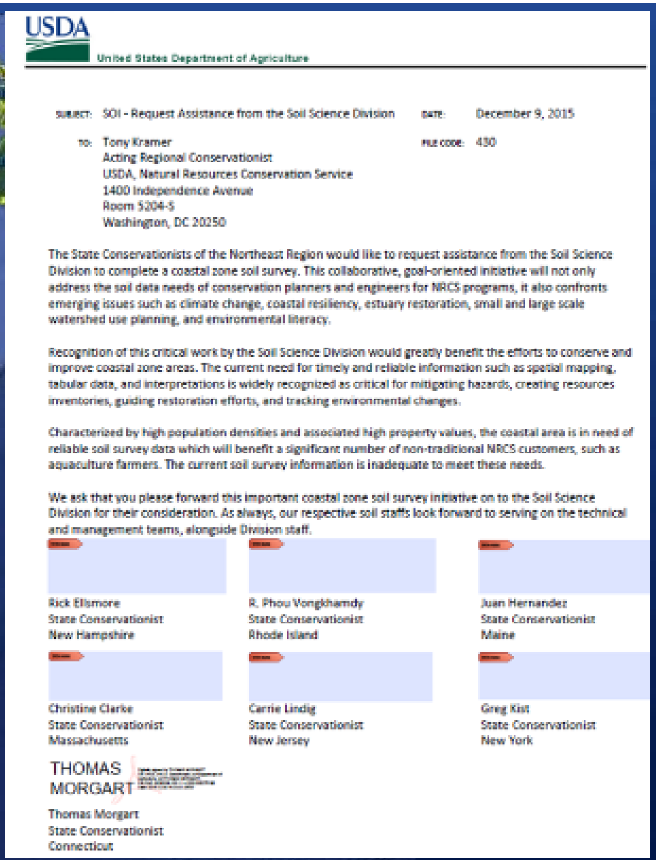
Bottom Line: Submerged lands can best be mapped and classified as soil!




Looks like a
Pishagqua Fluventic
Sulfiwassent Soil!

US Subaqueous Work





USDA
United States Department of Agriculture

SUBJECT: SOI - Request Assistance from the Soil Science Division DATE: December 9, 2015

TO: Tony Kramer FILE CODE: 430
Acting Regional Conservationist
USDA, Natural Resources Conservation Service
1400 Independence Avenue
Room 5204-S
Washington, DC 20250

The State Conservationists of the Northeast Region would like to request assistance from the Soil Science Division to complete a coastal zone soil survey. This collaborative, goal-oriented initiative will not only address the soil data needs of conservation planners and engineers for NRCS programs, it also confronts emerging issues such as climate change, coastal resiliency, estuary restoration, small and large scale watershed use planning, and environmental literacy.

Recognition of this critical work by the Soil Science Division would greatly benefit the efforts to conserve and improve coastal zone areas. The current need for timely and reliable information such as spatial mapping, tabular data, and interpretations is widely recognized as critical for mitigating hazards, creating resources inventories, guiding restoration efforts, and tracking environmental changes.

Characterized by high population densities and associated high property values, the coastal area is in need of reliable soil survey data which will benefit a significant number of non-traditional NRCS customers, such as aquaculture farmers. The current soil survey information is inadequate to meet these needs.

We ask that you please forward this important coastal zone soil survey initiative on to the Soil Science Division for their consideration. As always, our respective soil staffs look forward to serving on the technical and management teams, alongside Division staff.

Rick Ellsmore
State Conservationist
New Hampshire

R. Phou Vongkhamdy
State Conservationist
Rhode Island

Juan Hernandez
State Conservationist
Maine

Christine Clarke
State Conservationist
Massachusetts

Carrie Lindig
State Conservationist
New Jersey

Greg Kist
State Conservationist
New York

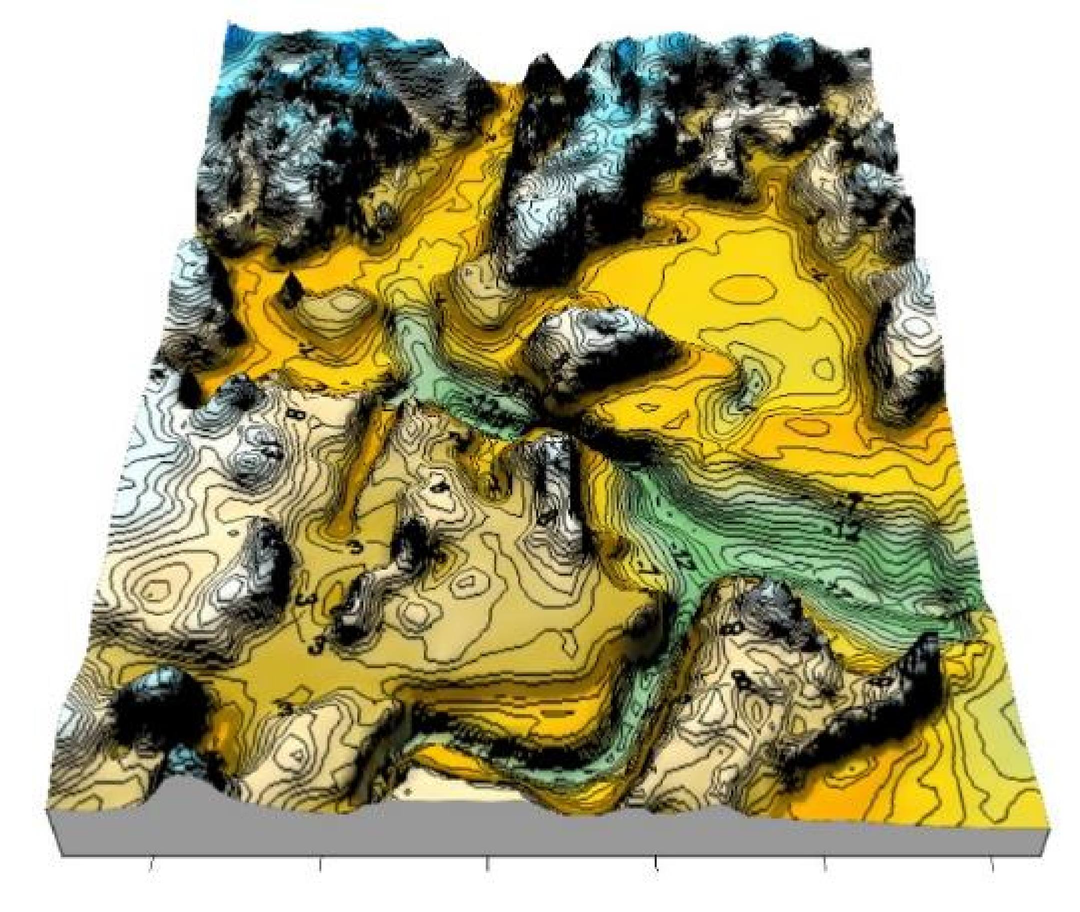
THOMAS MORGART

Thomas Morgart
State Conservationist
Connecticut

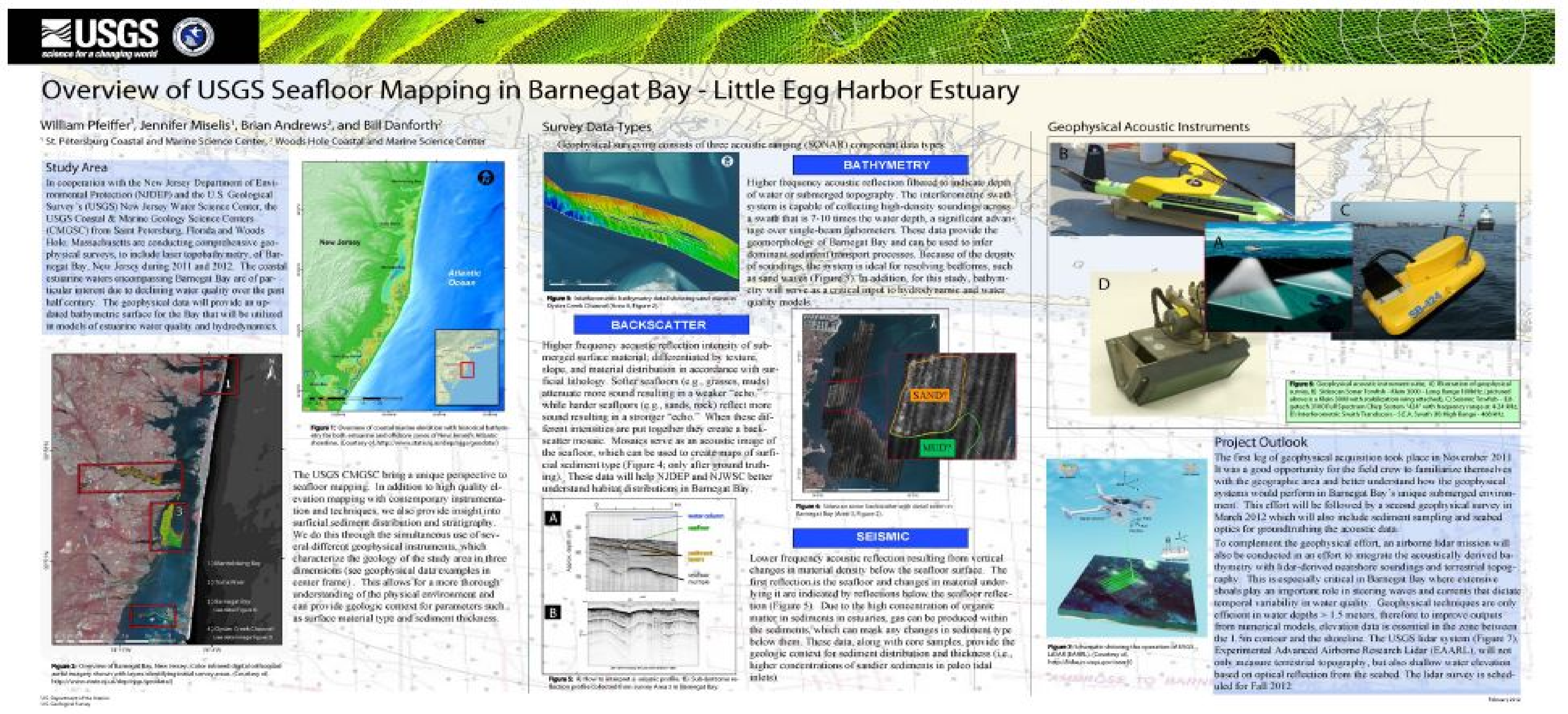
Coastal Zone Soil Survey Initiative

How are Subaqueous Soils Mapped?

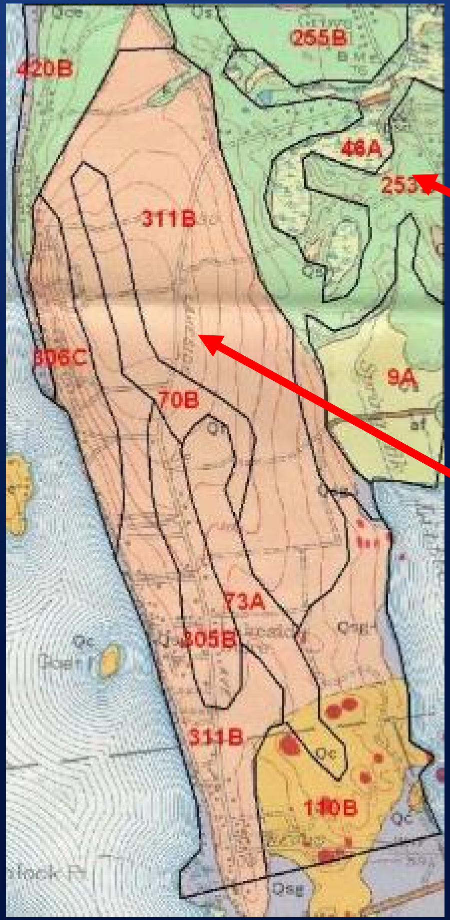
- Need to use or develop a bathymetric map which is used for subaqueous landform identification.
- Can use existing NOAA charts or create detailed bathymetry using fathometer and RTK GPS.
- Detailed bathymetry was the number 1 data need at our user conferences.
- Bathymetric data collection and interpolation method has been developed by MapCoast.
- Traditional imagery is also helpful.
- Develop soil-landscape model, delineate map units, field map using standard tools.
- Collect vibracore samples in representative areas, describe, sample, classify.
- Assemble map and NASIS entry.



How is subaqueous Bathymetry produced?



How are Subaqueous Soils Mapped?



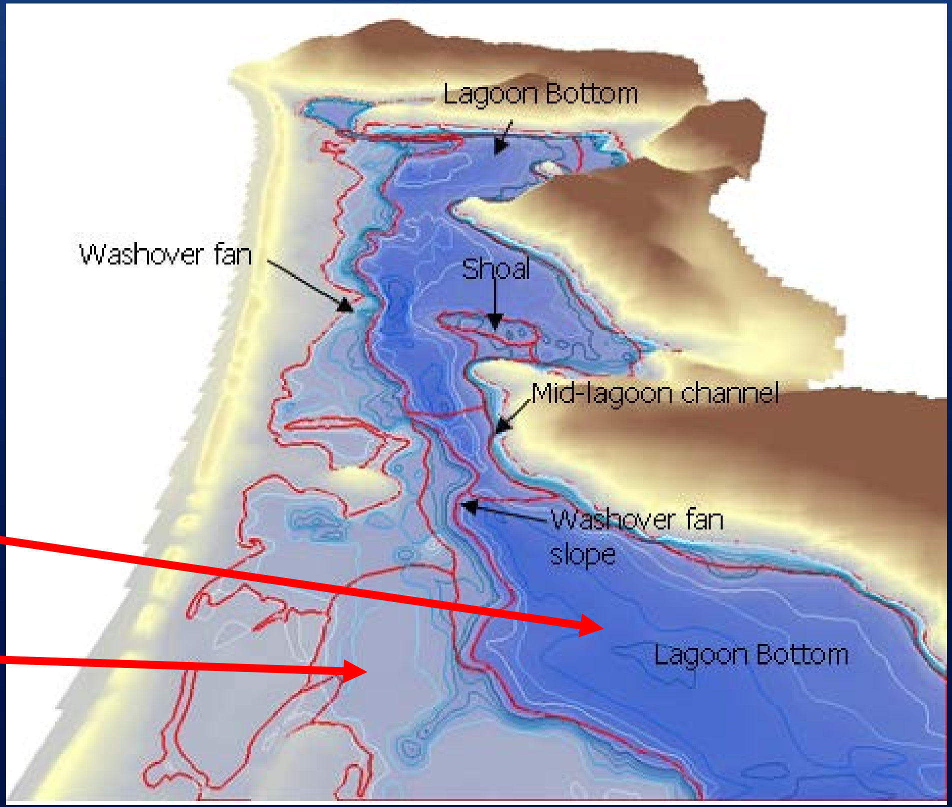
Part 629 – GLOSSARY OF LANDFORM AND GEOLOGIC TERMS

glaciofluvial deposit – Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, valley trains, deltas, kames, eskers, and kame terraces. Compare – drift and outwash. HP

drumlin – A low, smooth, elongated oval hill, mound, or ridge of compact till that has a core of bedrock or drift. It usually has a blunt nose facing the direction from which the ice approached and a gentler slope tapering in the other direction. The longest axis is parallel to the general direction of glacier flow. Drumlins are products of streamline (laminar) flow of glaciers, which molded the subglacial floor through a combination of erosion and deposition. Compare – drumlinoid ridge. SW, HP, & GG

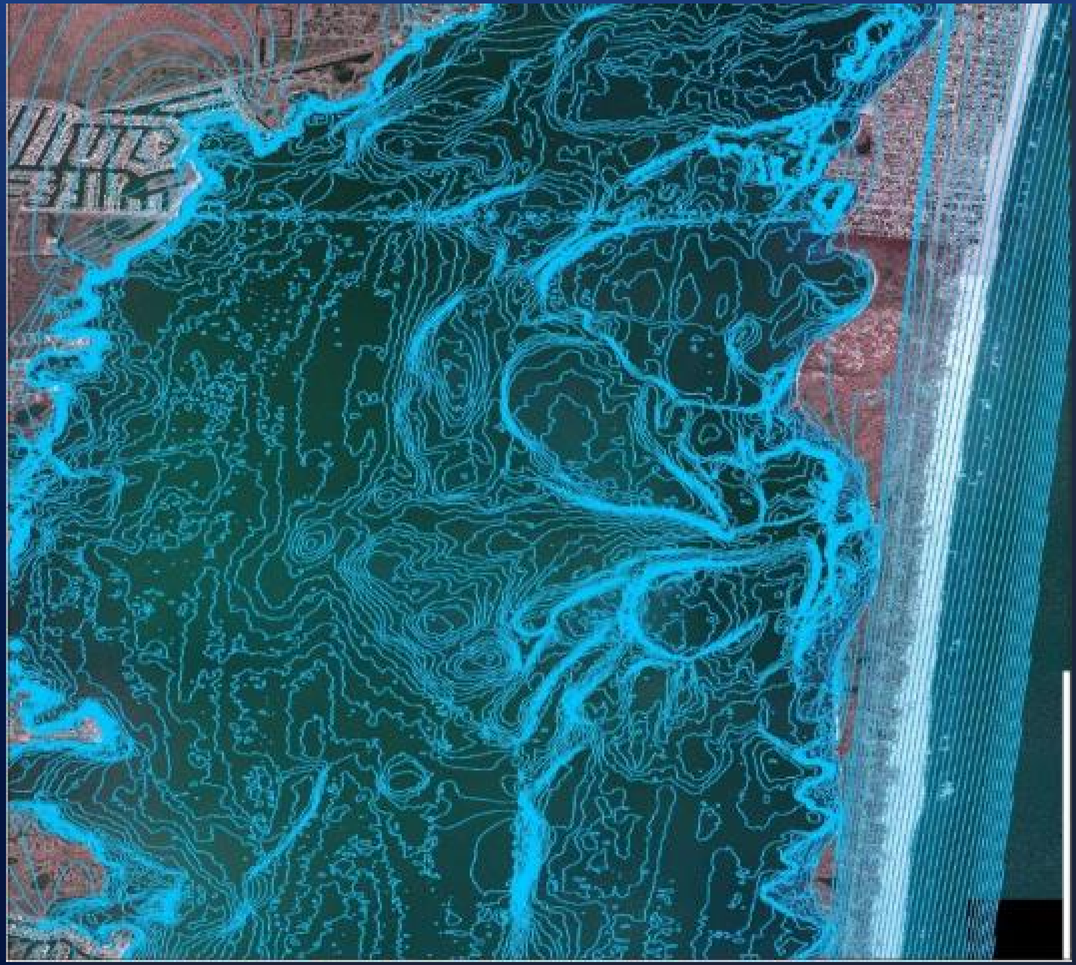
lagoon bottom – The nearly level or slightly undulating central portion of a submerged, low-energy, depositional estuarine basin (McGinn, 1982) characterized by relatively deep water (1.0 to >2.5 m). Compare – bay bottom. SSS

washover fan – A fan-like deposit of sand washed over a barrier island or spit during a storm and deposited on the landward side. Washover fans can be small to medium sized and completely subaerial, or they can be quite large and include subaqueous margins extending into adjacent lagoons or estuaries. Large fans can be



Barnegat Bay - NJ Subaqueous Bathymetry

National Ocean Service (NOS) 1934 – 1936 estuarine bathymetry

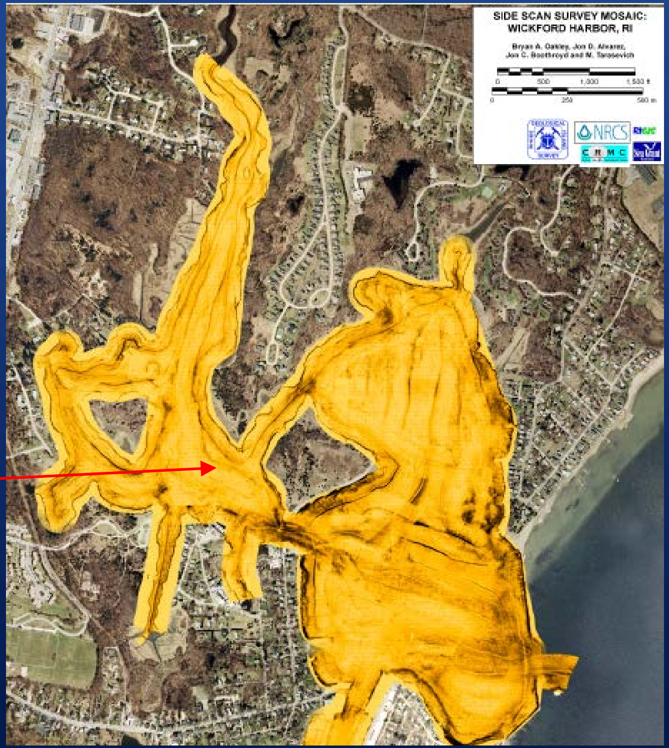


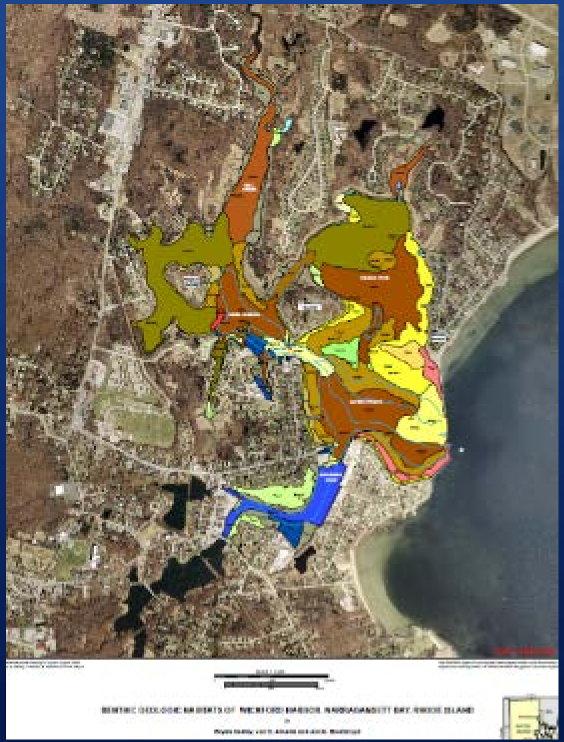
Pre-Sandy USGS EAARL-B LiDAR 2015 (ds885)

Remote Sensing

Wide array of remote sensing tool and techniques are available and can be employed to improve accuracy of the mapping:

- Side-scan sonar (acoustic map) – bottom type, benthic geologic habitat mapping.
- Sub-Bottom profiling (low frequency acoustic) – map deep structures.
- High-resolution imagery/pictometry (NOAA protocol).
- SPI Imagery, still and video images of the bottom.
- AUV's and other marine data.
- GPR and EMI for freshwater subaqueous soils.
- Resistivity.
- Divers.





Subaqueous Landforms

NRCS

GLOSSARY OF TERMS FOR SUBAQUEOUS SOILS, LANDSCAPES, LANDFORMS, AND PARENT MATERIALS OF ESTUARIES AND LAGOONS

Subaqueous Soils Subcommittee
of the
Standing Committee on NCSS Standards
National Cooperative Soil Survey Conference
Corpus Christi, Texas
2005

* **Lagoon Bottom:** The nearly level or slightly undulating central portion of a submerged, low-energy, depositional estuarine basin (McGinn, 1982) characterized by relatively deep water (1.0 to >2.5 m). Compare – Bay Bottom.

* **Lagoon Channel:** A subaqueous, sinuous area within a lagoon that likely represents a relict channel (paleochannel, Wells et al., 1994) that is maintained by strong currents during tidal cycles (Short, 1975).

Lagoonal Deposit: Sand, silt or clay-sized sediments transported and deposited by wind, currents, and storm washover in the relatively low-energy, brackish to saline, shallow waters of a lagoon. Compare – Estuarine Deposit, Fluviomarine Deposit, Marine Deposit.

Longshore Bar [relict]: A narrow, elongate, coarse-textured ridge that once rose near to, or barely above, a pluvial or glacial lake and extended generally parallel to the shore but was separated from it by an intervening trough or lagoon; both the bar and lagoon are now relict features. (Jackson, 1997)

* **Mainland Cove:** A subaqueous area adjacent to the mainland or a submerged mainland beach that forms a minor recess or embayment within the larger basin. Compare – Cove, Barrier Cove.

Subaqueous Landforms

16. SUBAQUEOUS FEATURES [Discrete underwater features (that commonly can support rooted plants), and adjacent features, ordinarily found below permanent open water. *[Historically, in Soil Survey Reports these underwater features have been included in the generic map unit "water"].* Subaqueous "Landscape" terms are obviously not terrestrial, but are **functionally equivalent** Earth surface features.

Landscapes:

bay [coast] (water body; also LF)	*BY*	sea (water body; also Landform)	*SEA*
estuary (also Landform)	*ES*	sound (water body; also Landform)	*SO*
gulf (water body; also Landform)	*GU*	strait (water body; also Landform)	*ST*
lagoon (water body; also Landform)	*LA*		
ocean (water body)	*OC*		

Landforms:

barrier cove	*BAC*	mainland cove	*MAC*
bay [coast] (water body; also Landscape)	*BAY*	marine lake	*ML*
bay bottom	*BOT*	nearshore zone	*NZ*
cove (water body)	*CO*	reef	*RF*
estuary (also Landscape)	*WD*	sea (water body; also Landscape)	*SEA*
flood-tidal delta	*FTD*	shoal	*WR*
flood-tidal delta flat	*FTF*	sound (water body; also Landscape)	*SO*
flood-tidal delta slope	*FTS*	strait (water body; also Landscape)	*STT*
fluviomarine bottom	*FMB*	submerged back-barrier beach	*SBB*
gulf (water body; also Landscape)	*GU*	submerged mainland beach	*SMB*
inlet	*IL*	submerged point bar [coastal]	*SPB*
lagoon (also Landscape)	*WI*	submerged wave-built terrace	*SWT*
lagoon bottom	*LBO*	submerged wave-cut platform	*SWP*
lagoon channel	*LCH*	tidal inlet	*TI*
lake	*WJ*	tidal inlet [relict]	*TIR*
lakebed	*LB*	washover-fan flat	*WFF*
longshore bar	*LON*	washover-fan slope	*WFS*

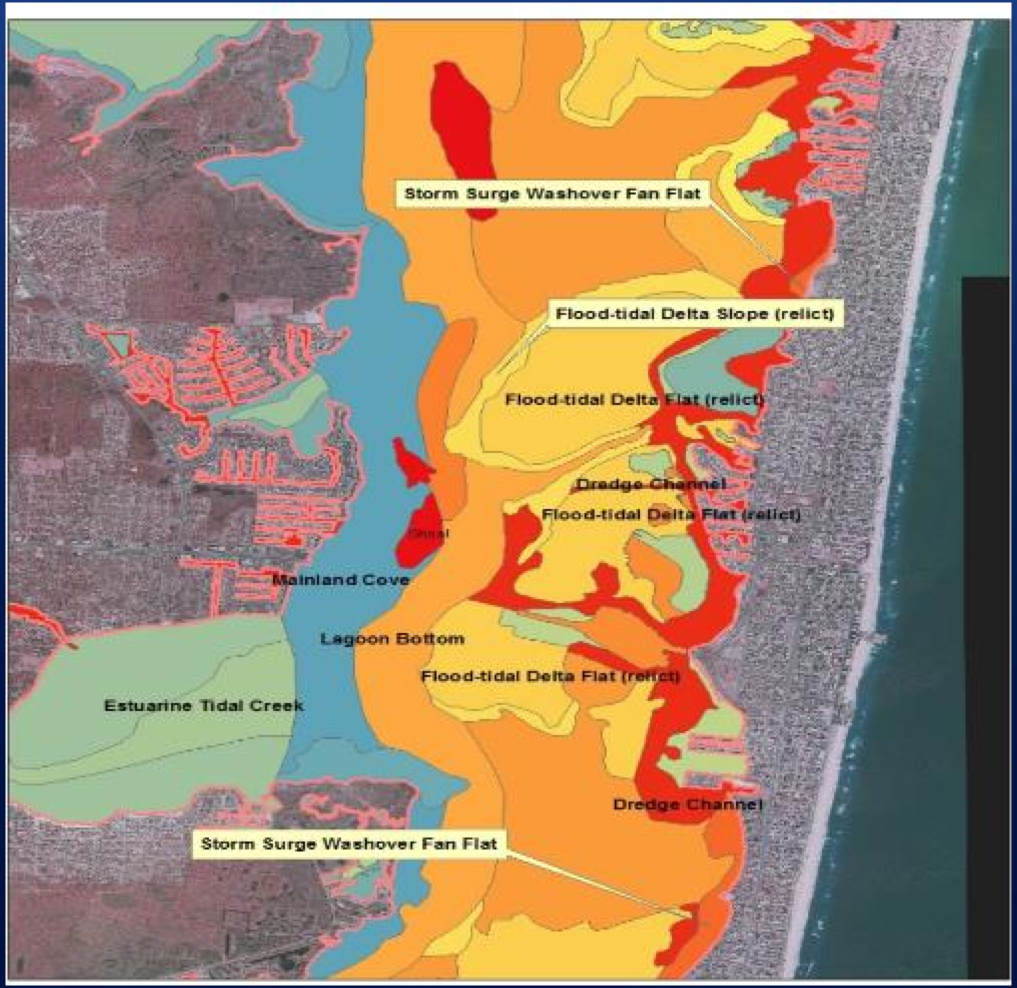
Microfeatures:

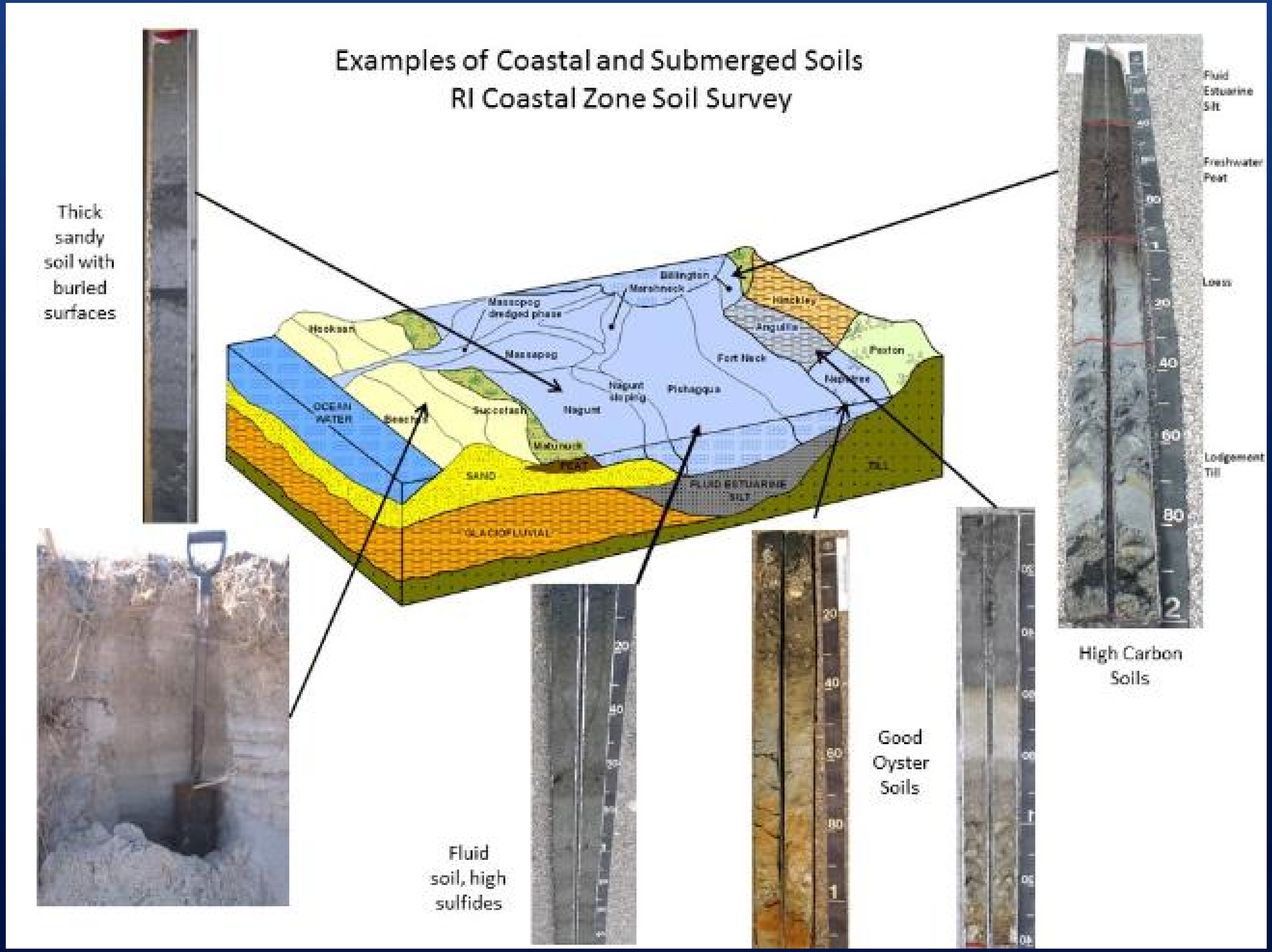
channel (permanent water)	*CH*	gut (channel; water body)	*WH*

Anthropogenic Features:

dredge-deposit shoal	*DDS*	dredged channel	*DC*

Subaqueous Landform Maps





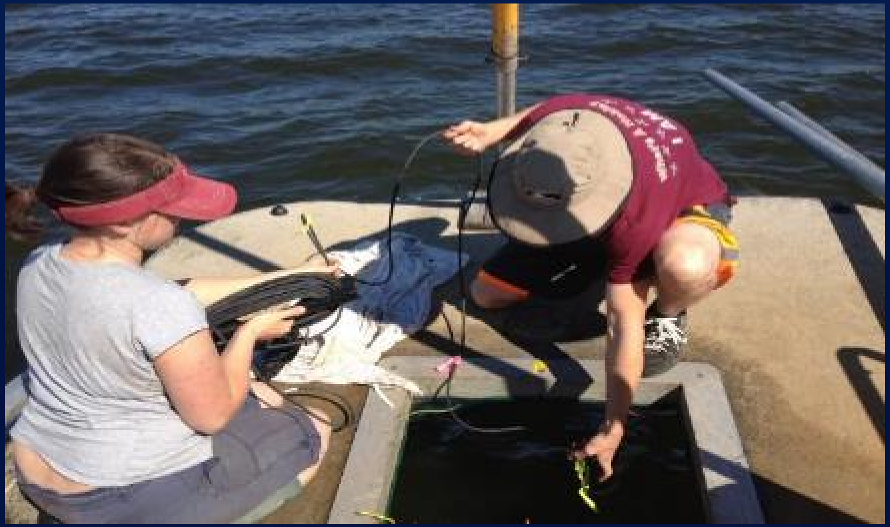
Barnegat Bay - NJ Subaqueous Landforms

(Each Landform below has it's own Soil Facies)
(Soil facies are distinctive soils that form under certain soil forming factors reflecting their process or environment.)

- ***Estuarine Tidal Creek***
- **Lagoon Bottom**
- **Lagoon Bottom Barrier Side**
- **Storm Surge Washover-Fan Flat**
- **Flood-tidal Delta Flat**
- **Flood-tidal Delta Slope**
- **Flood-tidal Delta Channel**
- ***Relict Flood-tidal Delta Flat***
- ***Relict Flood-tidal Delta Slope***
- **Submerged Wave-cut Platform**
- **Submerged Mainland Beach**
- **Mainland Cove**
- **Shoal**
- **Dredge Channel**
- **Dredge-Deposit Shoal**

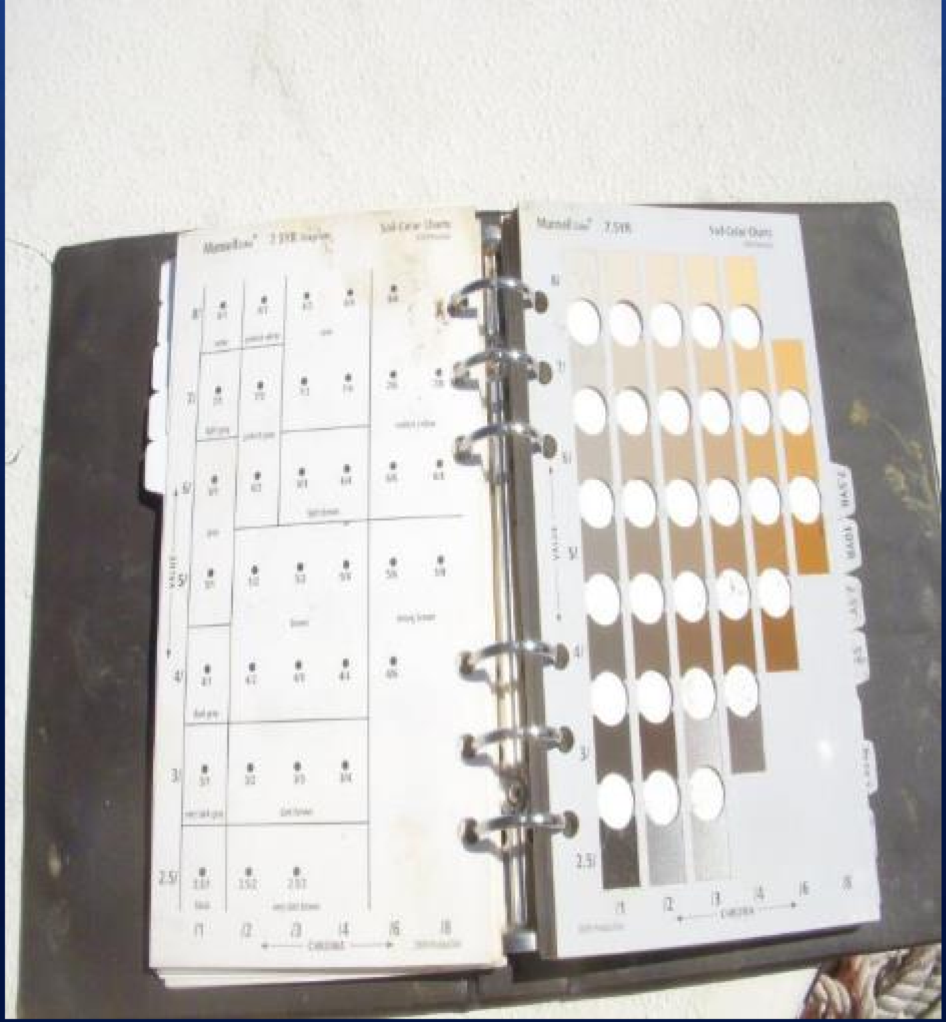
Subaqueous Soil Survey Field Data Collection Methods / Tools

Subaqueous Vibracoring



Subaqueous Soil Survey Vibracoring

Subaqueous Soil Survey Tools / Data Collection



Subaqueous Soil Survey Field Data Collection

Texture and Fluidity

MANNER OF FAILURE—The rate of change and the physical condition soil attains when subjected to compression. Samples are moist or wetter.

Failure Class	Code	Criteria: related field operation
BRITTLENESS		Use a 3-cm block (press between thumb and forefinger)
Brittle	BR	Ruptures abruptly ("pops" or shatters).
Semi-deformable	SD	Rupture occurs before compression to <1/2 original thickness.
Deformable	DF	Rupture occurs after compression to ≥1/2 original thickness.
FLUIDITY [1]		Use a palmful of soil (squeeze in hand)
Nonfluid	NF	After full compression, no soil flows through the fingers.
Slightly Fluid	SF	After full compression is exerted, some soil flows through fingers; most remains in the palm.
Mod. Fluid	MF	After full pressure is exerted, most soil flows through fingers; some remains in the palm.
Very Fluid	VF	Under very gentle pressure, most soil flows through the fingers as a slightly viscous fluid; very little or no residue remains in the palm of the hand.

Subaqueous Soil Survey Field Data Collection

Peroxide Reactions / Color change and Sulfide Odor (smell) / pH

Subaqueous Soil Survey Field Data Collection

se *Presence of sulfides*

This symbol indicates the presence of sulfides in mineral or organic horizons. Horizons with sulfides typically have dark colors (e.g., value ≤ 4, chroma ≤ 2). These horizons typically form in soils associated with coastal environments that are permanently saturated or submerged (i.e., tidal marshes or estuaries). Soil materials which have sulfidization actively occurring emanate hydrogen sulfide gas, which is detectable by its odor (Fanning and Fanning, 1989; Fanning et al., 2002). Sulfides may also occur in upland environments that have a source of sulfur. Soils in such environments are often of geologic origin and may not produce a hydrogen sulfide odor. Examples include soils formed in parent materials derived from coal deposits, such as lignite, or soils formed in coastal plain deposits, such as glauconite, that have not been oxidized because of thick layers of overburden.

WATER STATUS

DRAINAGE—An estimate of the natural drainage class (i.e., the prevailing wetness conditions) of a soil; e.g., *somewhat poorly drained* or *SP*.

Drainage Class	Conv. Code
Subaqueous Drainage	SA
Very Poorly Drained	VP
Poorly Drained	PD
Somewhat Poorly Drained	SP
Moderately Well Drained	MW
Well Drained	WD
Somewhat Excessively Drained	SE
Excessively Drained	ED

The following definitions are from the traditional, national criteria for natural soil drainage classes (Soil Survey Division Staff, 1993). Specific regional definitions and criteria exist. (Contact an NRCS State office for specific local criteria.)

Subaqeous Drainage—Free water is above the soil surface. The occurrence of internal free water is permanent, and there is a positive water potential at the soil surface for more than 21 hours each day. The soils have a peraquic soil moisture regime (proposed 2010; Soil Survey Staff revision online at soils.usda.gov/technical/manual/proposedchanges.html).

Very Poorly Drained—Water is at or near the soil surface during much of the growing season. Internal free water is *very shallow* and *persistent* or *permanent*. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Commonly, the soil occupies a depression or is level. If rainfall is persistent or high, the soil can be sloping.

Poorly Drained—The soil is wet at shallow depths periodically during the growing season or remains wet for long periods. Internal free water is *shallow* or *very shallow* and *common* or *persistent*. Unless the soil is artificially drained, most mesophytic crops cannot be grown. The soil, however, is not

Subaqueous Soil Survey Field Data Collection

Subaqueous Soil Survey Field Data Collection

Subaqueous Soil Survey Field Data Collection

	A	B–C	D–E	F–G	H	I	J	K	L
1	**Site Number:**	FN56	Mapping Unit:	WHe2	Description	Fine-silty, mixed, subactive, nonacid, mesic Fluvent			
2	Date:	10/4/2012	Location Description:	Inside a cove within Toms River.		Water Column measurements:			
3	Start Time:	11:18 AM	Water Depth (ft/m):	198 cm			Surface	Mid	Bottom
4	End Time:	12:10 PM	Temp (F/C)	73.0 F		pH			
5	Surveyors:	RS, SD, & RT	Bottom Type:	Bare mud		DO (mg/l)			
6	Waypoint:		SAV cover:	None		salinity (ppt)	6.2	14.3	15.5
7	GPS	ProXYZ	Observation Method:	McCauly		temp (F/C)	71.7 F	70.2 F	69.5 F
8	UTM Easting:	74 10 29.1839 W	Site Notes:	**Herring Creek taxadjunct**. Organics came in at 117 cm. Overcast weather w/ a rain shower. Flat landform to west and steep upland slope to the north.					
9	UTM Northing:	39 56 47.5661 N							
10									

	Horizon	Depth (cm)	Boundary Dist.	Field Texture Class	fluidity (n-value)	Munsell Color (Matrix)	Coarse frags (%)	Shell frags (%)	H_2S odor	Peroxide Color change	Notes	Origin
12	Aseg1	0-5 cm	clear	MUCKY SIL	moderately fluid (1)	5Y 2.5/1	0%	0%	Moderate			Marine silt
13	Aseg2	5-24 cm	clear	MUCKY SIL	moderately fluid (1)	5Y 3/1	0%	0%	Moderate		A couple coarse sand grains.	Marine silt
14	Cseg1	24-72 cm	clear	SIL	moderately fluid (1)	5Y 3/1	0%	0%	Moderate		Very fine root fibers throughout	Marine silt
15	Cseg2	72-117 cm	abrupt	SIL	moderately fluid (1)	5Y3/1	0%	0%	Slight		Increase again in clay content from the	Marine silt
16	2Oeseb	117-171 cm	clear	MUCKY PEAT		2.5Y 3/1	0%	0%	Moderate		55% unrubbed & 20% rubbed fiber content.	Organic, tidal
17	3Oaseb	171-200 cm		MUCK		10YR 2/1	0%	0%	Slight		45% unrubbed & 15% rubbed fiber content.	Organic, fresh

Subaqueous Soil Survey Field Data Collection

Vib 3.000 — **Vibracore Log Form**

Site

Site ID (YYYYSTFIPS###)	SPCMSC-20
Year	2014
State	NJ
County	029
Nmbr	
Pedon ID (YYYYSTFIPS###)	SPCMSC-20
Date Sampled	8/14/2014
Time Sampled	9:45
Soil Name as Sampled	Tingles
Map Unit Symbol	WTf2
OSD Site?	n
Latitude	40.0046546
Sampled (y/n)	n
Longitude	-74.0985156
Horizontal Datum	WGS84
Waypoint #	
GPS Model	ProXYZ (PDOP = 3.5)
Elevation (NAVD88)	
Water Depth	226
Tidal Period	I — incoming

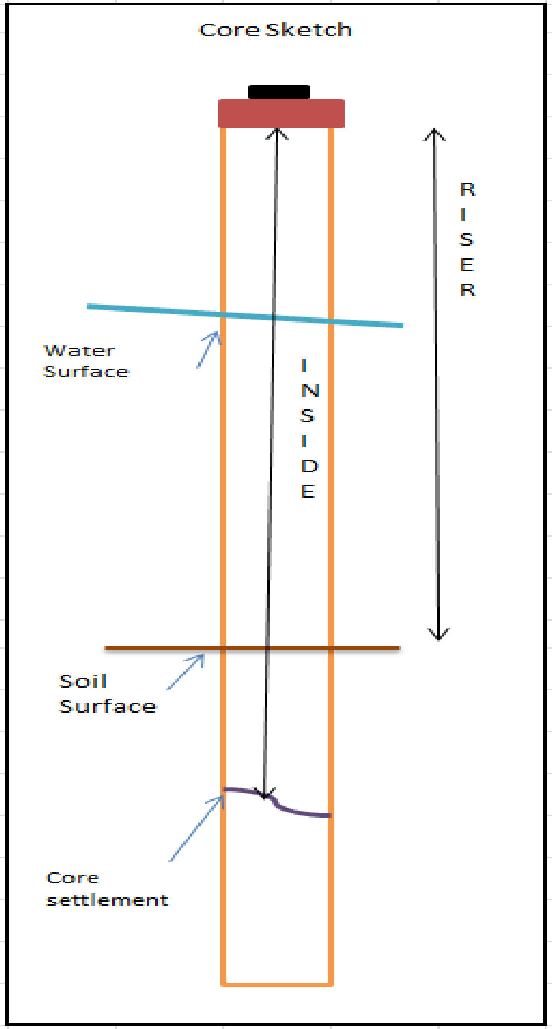
1) Draw a line through the mistake
2) Touch or check the eraser
3) Write new value over the mistake

CORE LOG

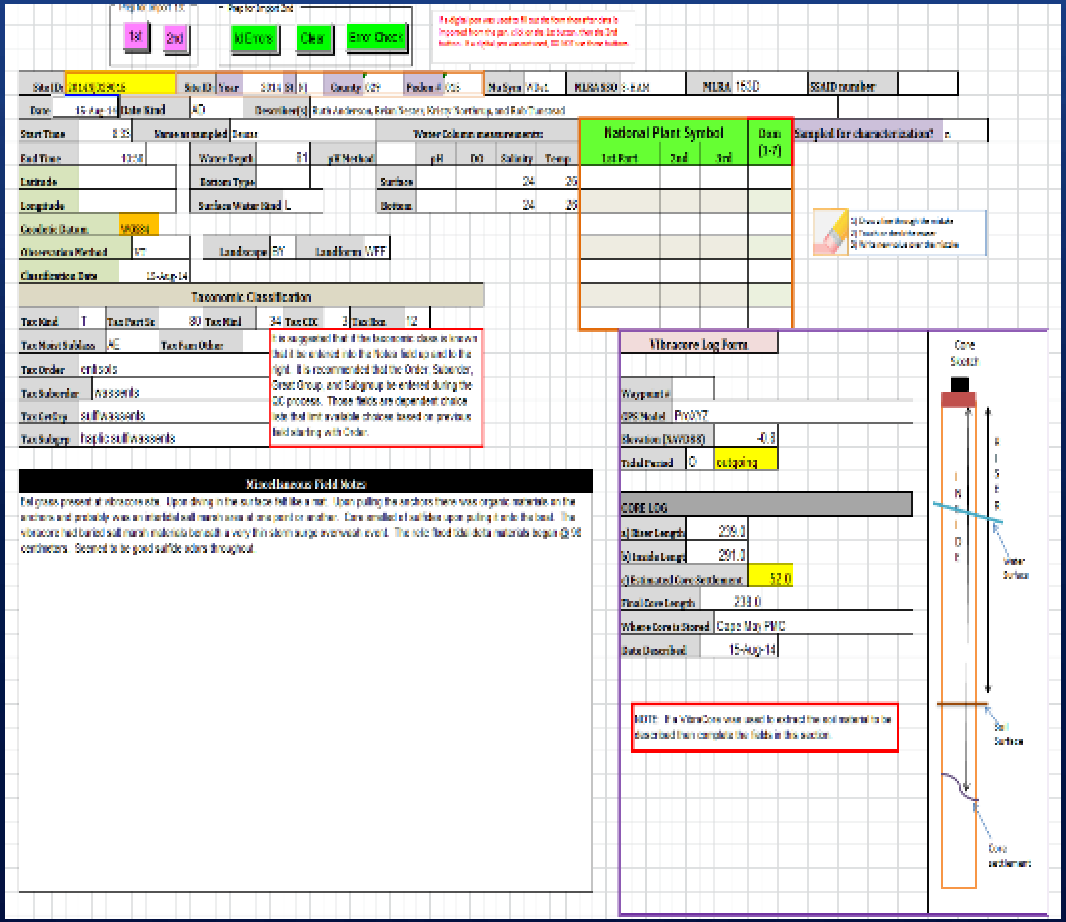
a) Riser Length	364
b) Inside Length	386
c) Estimated Core Settlement	22
Final Core Length	236
Where Core is Stored	Cape May PMC
Date Described	dd-mmm-yy

Prep for Import 1st: 1st | 2nd

Prep for Import 2nd: Id Errors | Clear | Error Check



Subaqueous Soil Survey Field Data Collection



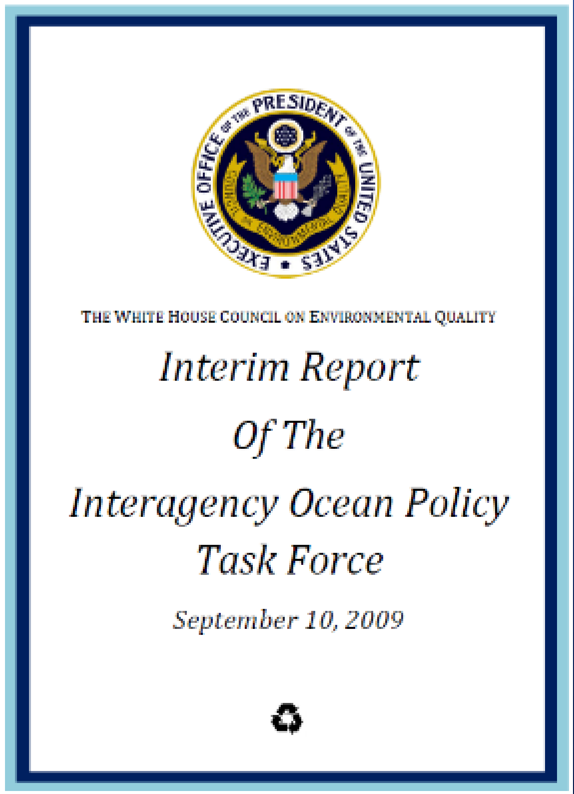
Pedon ID: 2014NJ029015

#	Depth Top	Depth Bot	Hz Desg	Bndy Dist	Bndy Topo	Matrix Color (moist) Pct	Hue	Val	Chr	Texture	Fluidity	Plasticity	Stickiness	Reaction pH	Reaction Method	H_2O_2 Chng	H_2O_2 Chng 30% conc.	Odor Knd	Odor Int	PM Origi	Fragments Knd	Fragments Pct	Fragments Rnd	Fragments Shp	Fragments Sz	Roots Qty	Roots Size	Roots Loc	% Fibers Unrubbed	% Fibers Rubbed
1	0	4	C/Ase	A	S	60	2.5Y	4	1	S	NF	PO	SO	8.2	IND	y	SL	N								C	F	T		
	Do not write in this space					40	2.5Y	2.5	1	Do not write in this space																C	VF	T	Do not write in this space	
2	4	10	2Ase	C	W		10YR	3	3	L	SF	SP	SS	7.6	IND	n	SL	S	SL							M	VF	T		
	Do not write in this space									Do not write in this space																M	F	T	Do not write in this space	
3	10	19	2Cse1	C	S		2.5Y	3	1	L	SF	MP	MS	7.2	IND	n	M	S	MD							C	VF	T		
	Do not write in this space									Do not write in this space																C	F	T	Do not write in this space	
4	19	24	2Cse2	C	W		5Y	3	1	L	NF	SP	SO	7.4	IND	n	V	S	ST							C	VF	T		
	Do not write in this space									Do not write in this space																C	F	T	Do not write in this space	
5	24	34	3Aseb1	C	S		10YR	3	2	SIL	SF	SP	SO	7.4	IND	n	ST	S	ST							C	VF	T		
	Do not write in this space									Do not write in this space																VF	F	T	Do not write in this space	
6	34	41	3Aseb2	C	S		2.5Y	3	1	SL	NF	SP	SO	7.8	IND	y	V	S	ST							C	VF	T		
	Do not write in this space									Do not write in this space																			Do not write in this space	
7	41	53	3ACseb	C	W		5Y	2.5	2	LS	NF	PO	SO	8.2	IND	n	ST	S	MD							F	VF	T		
	Do not write in this space									Do not write in this space																			Do not write in this space	
8	53	63	3Cseb1	C	S		5Y	3	1	SL	SF	SP	SS	8.2	IND	y	M	S	ST							C	VF	T		
	Do not write in this space									Do not write in this space																			Do not write in this space	
9	63	78	3Cseb2	C	S		5Y	4	1	LS	NF	PO	SO	8.4	IND	y	SL	S	ST							VF	VF	T		
	Do not write in this space									Do not write in this space																			Do not write in this space	
10	78	98	4Cseb3	C	S		2.5Y	3	1	SIL	NF	SP	SO	8.0	IND	n	M	S	ST							C	VF	T		
	Do not write in this space									Do not write in this space																			Do not write in this space	

Why Map Subaqueous Soils (Who Cares?)

“Talking Points”

- The 2004 U.S. Commission on Ocean Policy identified the need for “accurate and seamless living and nonliving marine resource data with bathymetry, and other natural features across the shoreline, coastal zone, near shore areas, and open ocean waters” (Recommendation 25-7)
- In 2010 39% (124 million) of U.S. population live in counties directly on shoreline.
- None to little mapping currently available for shallow water landscapes, coastal soil survey was not mapped to level of terrestrial areas.
- Mantra “Coastal Soil and Sediment Mapping Helps us Better Manage, Protect, and Restore our Underwater Marine Landscapes” (Ecological Site Description).


THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY

Interim Report

Of The

Interagency Ocean Policy

Task Force

September 10, 2009

The Task Force's recommendations and frameworks should be cost effective and improve coordination across Federal agencies.

This memorandum covers matters involving the oceans, the Great Lakes, the coasts of the United States, and related seabed, **subsoil**, and living and non-living resources.

Marine Spatial Planning!

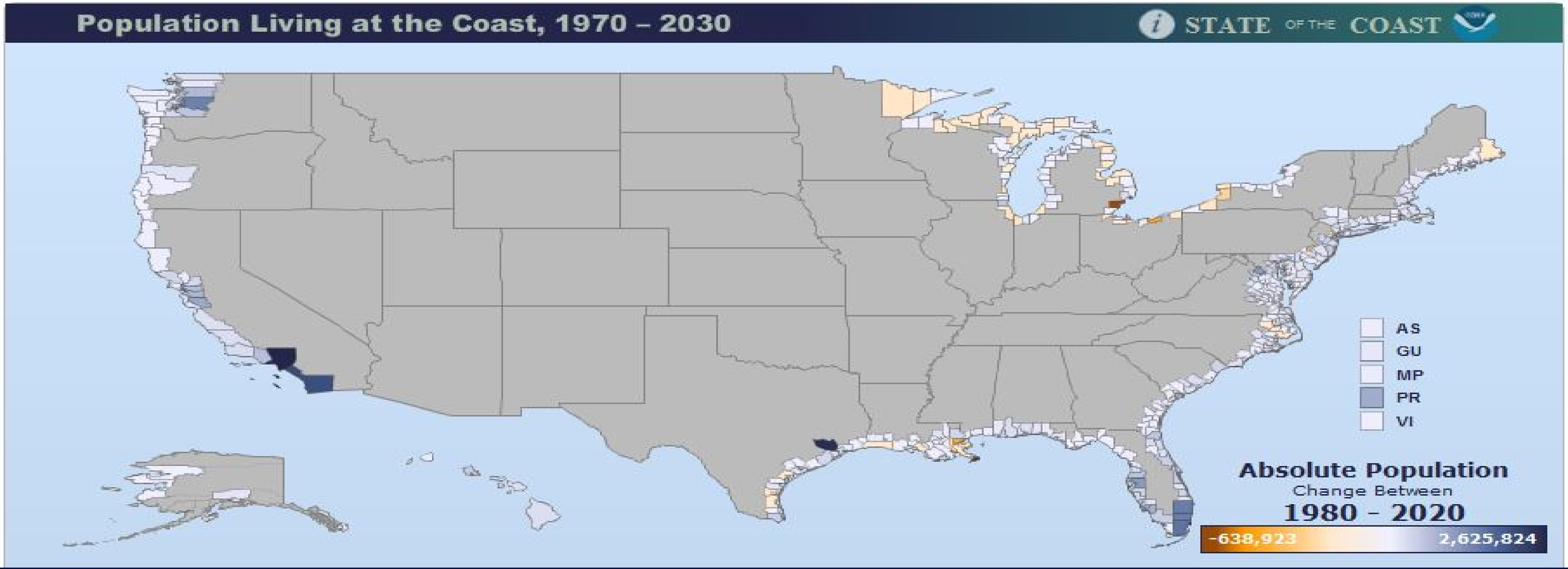
Subaqueous Soil Survey Uses (the Why?)

39%
Percent of the nation's total population that lived in Coastal Shoreline Counties in 2010 (less than 10% of the total land area excluding Alaska).
Source: U.S. Census Bureau, 2011

34.8 million
Increase in U.S. Coastal Shoreline County population from 1970 to 2010 (or a 39% increase).
Source: U.S. Census Bureau, 2011

446 persons/mi²
Average population density of the Coastal Shoreline Counties (excluding Alaska). Density in U.S. as a whole averages 105 persons/mi².
Source: U.S. Census Bureau, 2011

37 persons/mi²
Expected increase in U.S. Coastal Shoreline County population density from 2010–2020. Expected increase for entire U.S. is 11 persons/mi².
Source: Woods & Poole, 2011; NOAA, 2012



Rhode Island is small, but not that small

By Jacqueline Tempera on Sunday, April 10th, 2016 at 12:00 a.m.

Asher Schofield, designer and co-owner of Frog and Toad holds up a shirt with a RI logo design by artist/designer Hilary Treadwell.

After Rhode Island's proposed "Cooler & Warmer" slogan tanked, many small-state natives threw their own catchphrases into the mix.

Enter artist Hilary Treadwell, who sells a quirky T-shirt on her website, Lilhop.com. "Rhode Island: 3% bigger at low tide."

Beaches = 2,917 ac
Total = 3,719 acres
Total land = 775,676
Percent of RI that is beach = 0.4% half of the beach is exposed at high tide equates to 0.2% bigger at low tide.

Technical Soil Services!

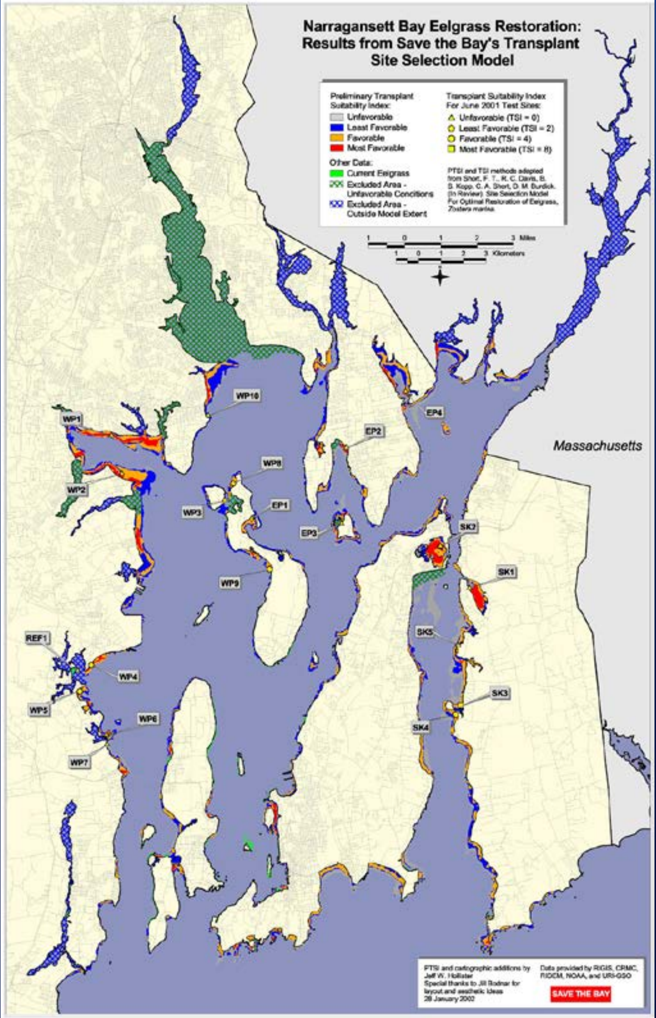
Subaqueous Soil Survey Uses (the Why?)

- Identity and protect potential SAV habitat (shellfish, finfish, and shorebird nurseries)
- Identify areas for creation of estuarine habitat i.e. coastal bird flyways, restocking of shellfish (aquaculture)
- Assess site potential for managing eelgrass (SAV) remediation/restoration
- Evaluate soils and groundwater sources as potential contributors to eutrophication
- Determine cause of habitat loss (physical, chemical and biological)
- Provide consistent and comprehensive baseline soils data that was previously unavailable for lagoon's / bays
- Create a SA Vegetation prevalence map
- Evaluate and identify soil (blue) carbon storage (sequestration) capabilities
- Evaluate potential for eliminating noxious/invasive species (stinging nettle and clinging jelly).
- Characterize sediments/soil (nutrients, pH, pollutants, metal contamination)
- Evaluate barrier beach dynamics (Relict Inlets)
- Assess site potential for pier/piling, dock and mooring placement
- Manage dredge activities & acid sulfate weathering potentials (evaluate areas needing removal / replenishment and identify source materials)

Subaqueous Soil Survey Uses (the Why?)

- Identify Tidal Marsh protection and restoration areas
- Identify potential rare species habitat
- Manage the shoreline resource by identifying high erosion and depositional areas
- Benthic Site ID and preservation (* when we dig a site we can often determine if shellfish were present or not)
- ID stable and dynamic estuarine environments

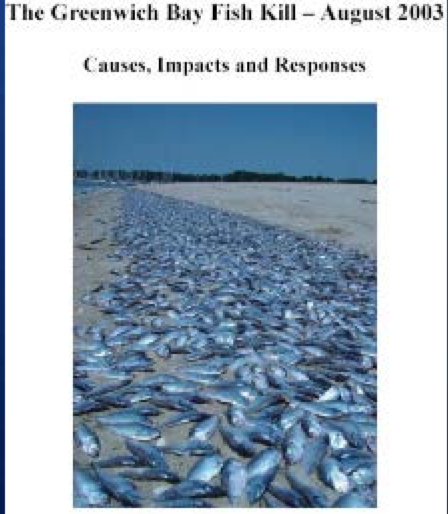
Why Map Subaqueous Soils (Who Cares?)



Restoration – Seagrass, Tidal Marsh, Beaches, Shellfish

- Eelgrass site selection model:
  - Wave Exposure (currents)
  - Soil Characteristics (texture, sulfides, organic matter).
  - Temperature.
  - Bathymetry (critical depth).

Missing!



Eelgrass Restoration (SAV maps / interps.)

Site Selection Model:

- Wave exposure / tidal velocity
- Soil Characteristics (sulfide, texture, organic matter)
- Bioturbator abundance
- Temperature
- Bathymetry depth (not too deep or shallow)

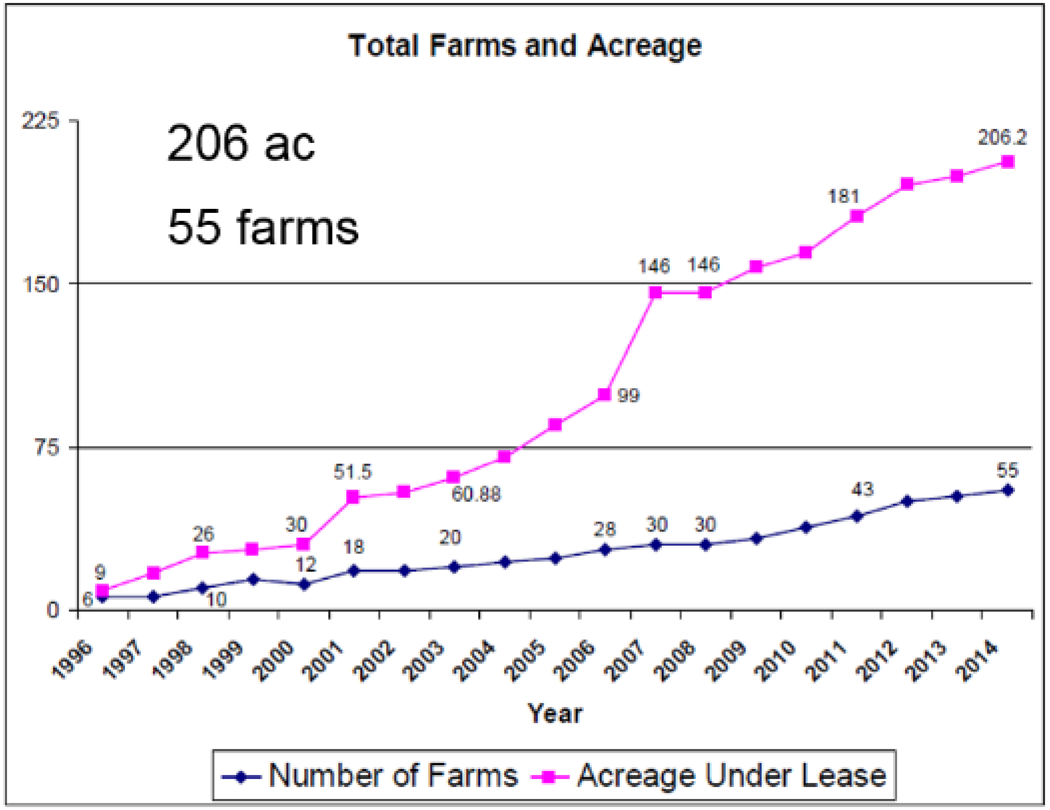
NRCS Needs

Oyster Restoration Initiative in Rhode Island

The USDA Natural Resources Conservation Service – Rhode Island's Oyster Restoration Initiative under the Environmental Quality Incentives Program (EQIP)

The application deadline for FY 2016 funding for the Oyster Initiative is February 12, 2016.

Bivalve Aquaculture in Rhode Island

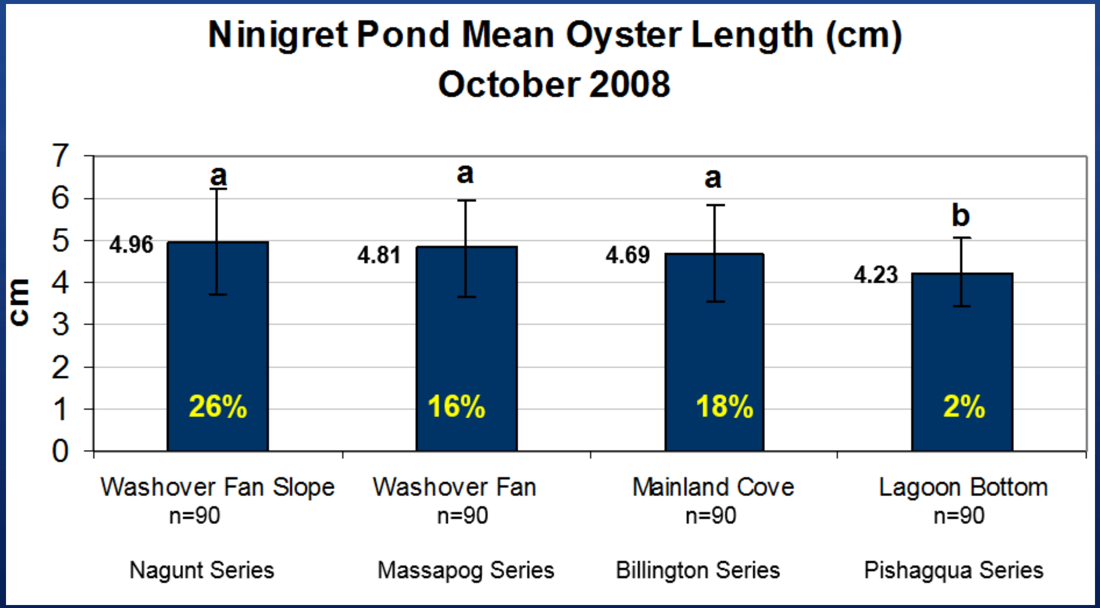


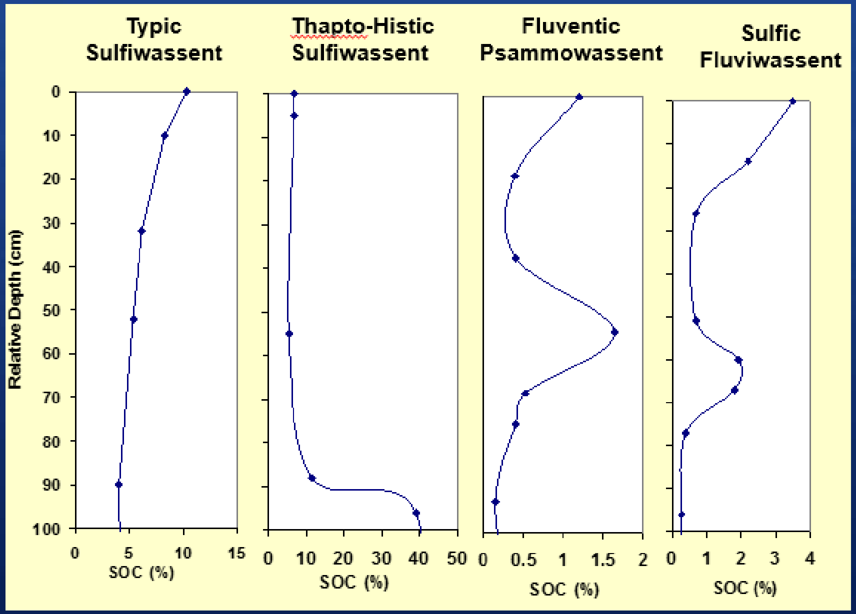
*In the **coastal salt ponds** the area occupied by aquaculture shall **not exceed five percent (5%)** of the total open water surface area of the coastal pond below MLW. (CRMC Red Book 300.11(E)(6)*

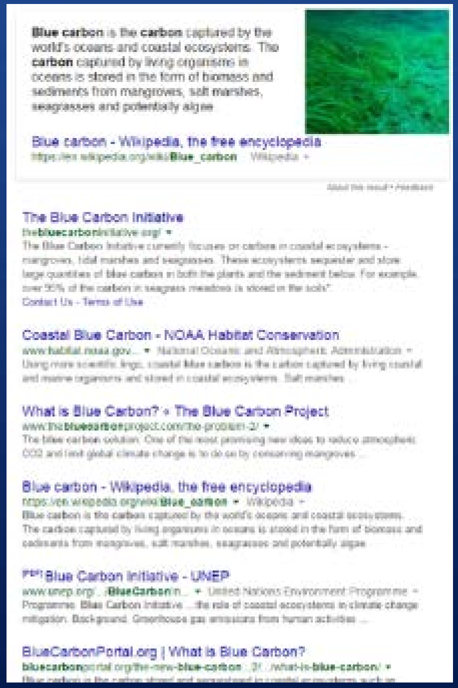
Research, Interpretations, Examples

- Since 1990's numerous (~20) thesis/doctorate studies on shallow water mapping (UMD, URI, Penn State, NRCS sponsored).
- Long list of interpretations needed and being developed (user conferences).
- Baseline data is needed for chem/physical properties and classification of soils.
- Numerous areas for research.
- Applications to Technical Soil Services (equipment, coring, bathy).
- Continued improvements to mapping and data collection.
- Work with partners to work collaboratively so data is collected and made in usable platforms (not redundant).

- SAV Restoration
- Crab Habitat
- Clam Stocking
- Management for Sustainable Production - Shellfish
- Nutrient Reduction
- Benthic Preservation Site Identification
- Wildlife Management
- Critical Habitats for Wading Shore Birds
- Nurseries and Spawning areas
- Habitat Protection for Horseshoe Crabs
- Dredging Island Creation
- Tidal Marsh Protection and Creation
- Bathymetric Map
- Navigational Channel Creation/ Maintenance
- Effects of Dredging on Benthic Ecology
- Off Site Disposal of Dredge Spoil
- Acid-Sulfate Weathering Hazards
- Dune Maintenance/Replenishment
- Halinity in marshes.
- Thin layer Deposition
- Living Shoreline restoration projects
- Blue carbon sequestration volumes / landforms







Blue carbon is the **carbon** captured by the world's oceans and coastal ecosystems. The **carbon** captured by living organisms in oceans is stored in the form of biomass and sediments from mangroves, salt marshes, seagrasses and potentially algae.

Blue carbon - Wikipedia, the free encyclopedia

The Blue Carbon Initiative

Coastal Blue Carbon - NOAA Habitat Conservation

What is Blue Carbon? » The Blue Carbon Project

Blue carbon - Wikipedia, the free encyclopedia

Blue Carbon Initiative - UNEP

BlueCarbonPortal.org | What is Blue Carbon?

Major dredging planned for Harbor of Refuge

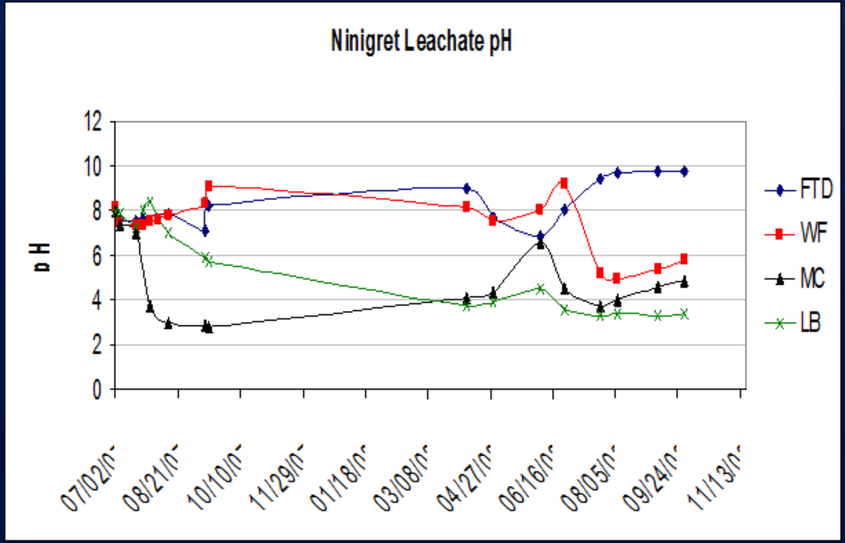
Sand would replenish nearby East Matunuck State Beach

By GALEN McGOVERN

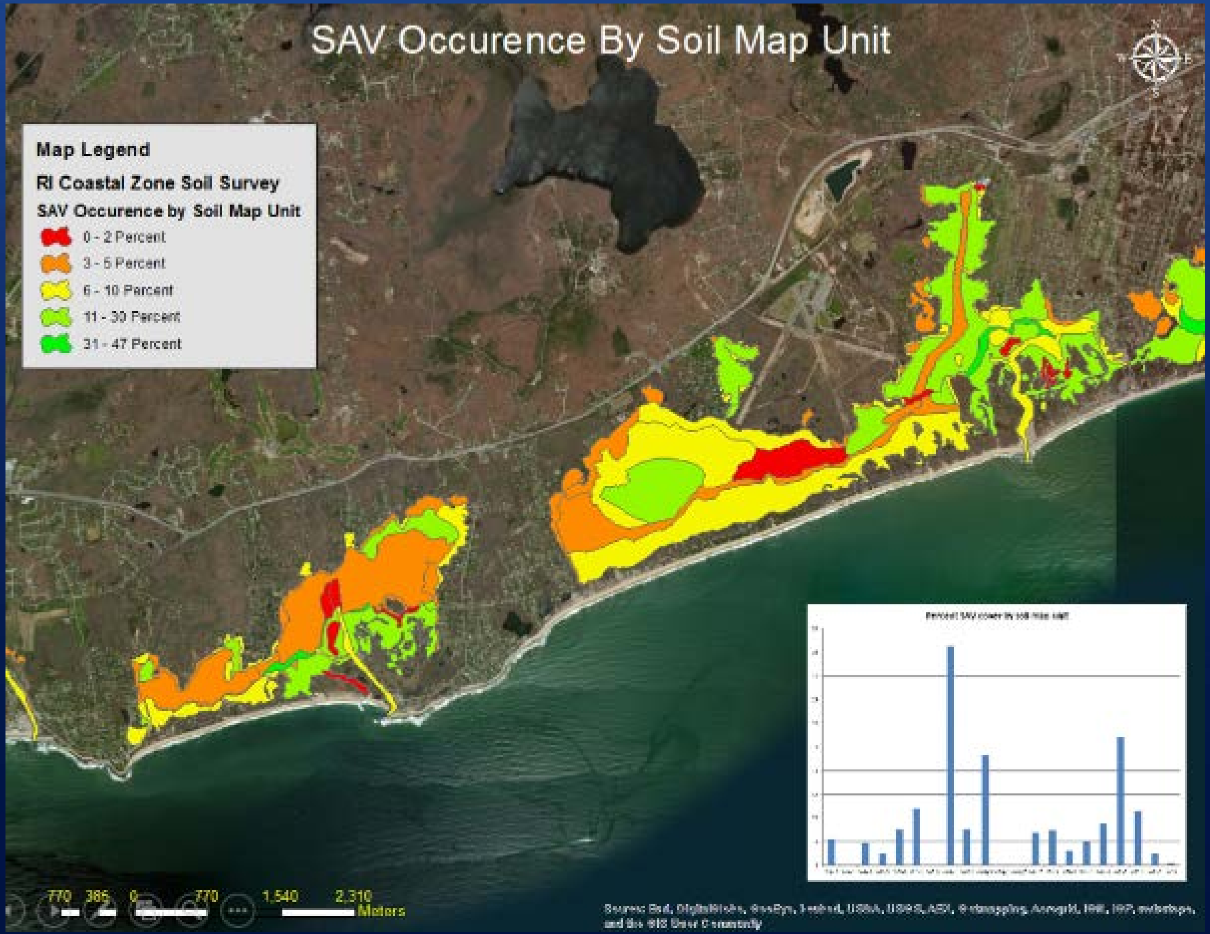
SOUTH COUNTY – A proposal by the U.S. Army Corps of Engineers to dredge the Harbor of Refuge and east and west channels into Point

be picked up by a local sponsor," according to Walsh.

Bruce Kaiser, director of Administrative Services for South Kingstown, hopes if the current is right that the South Kingstown Town Beach



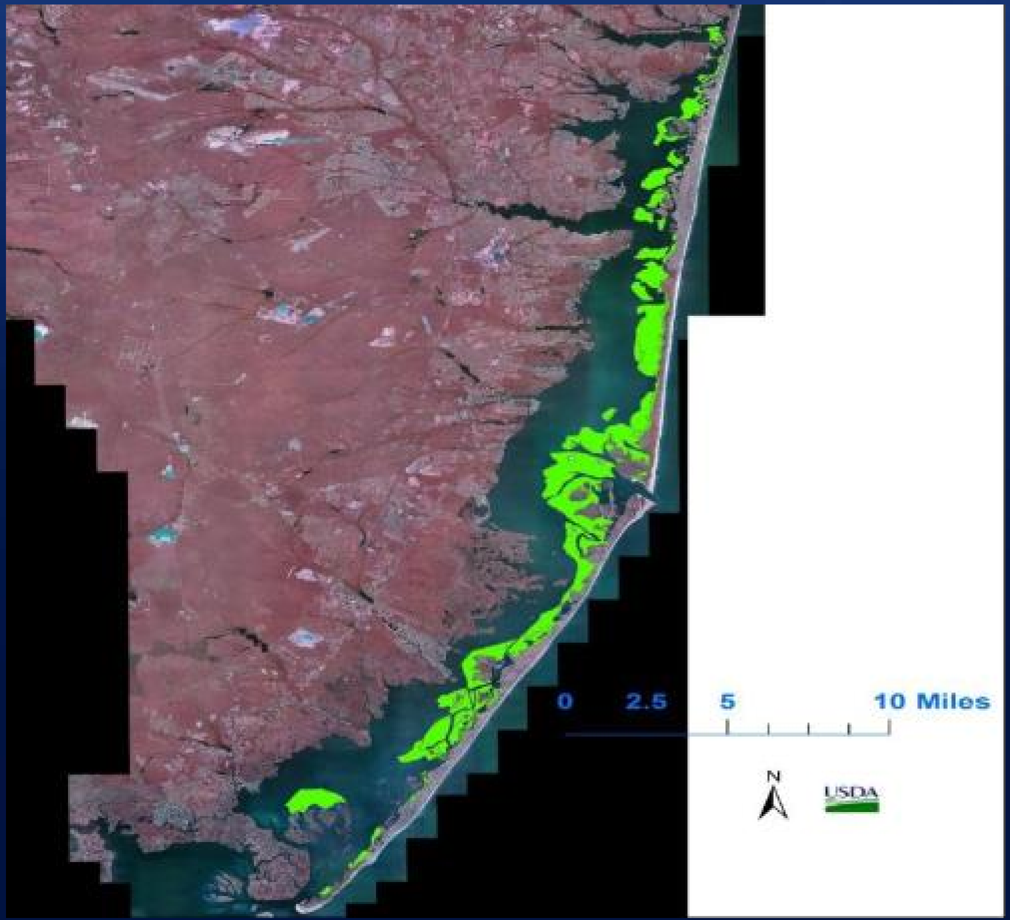

Suitability for Oyster Reef Restoration
Soil Suitability for Oyster Restoration Sites
Map Legend
Subaqueous Soil Survey
Oyster_Restoration_Potential
Good
Fair
Poor
4,000 2,000 0 4,000 Feet


SAV Occurence By Soil Map Unit
Map Legend
RI Coastal Zone Soil Survey
SAV Occurence by Soil Map Unit
0 - 2 Percent
3 - 5 Percent
6 - 10 Percent
11 - 30 Percent
31 - 47 Percent
770 385 0 770 1,540 2,310 Meters

Barnegat Bay, NJ Subaqueous Soil Survey

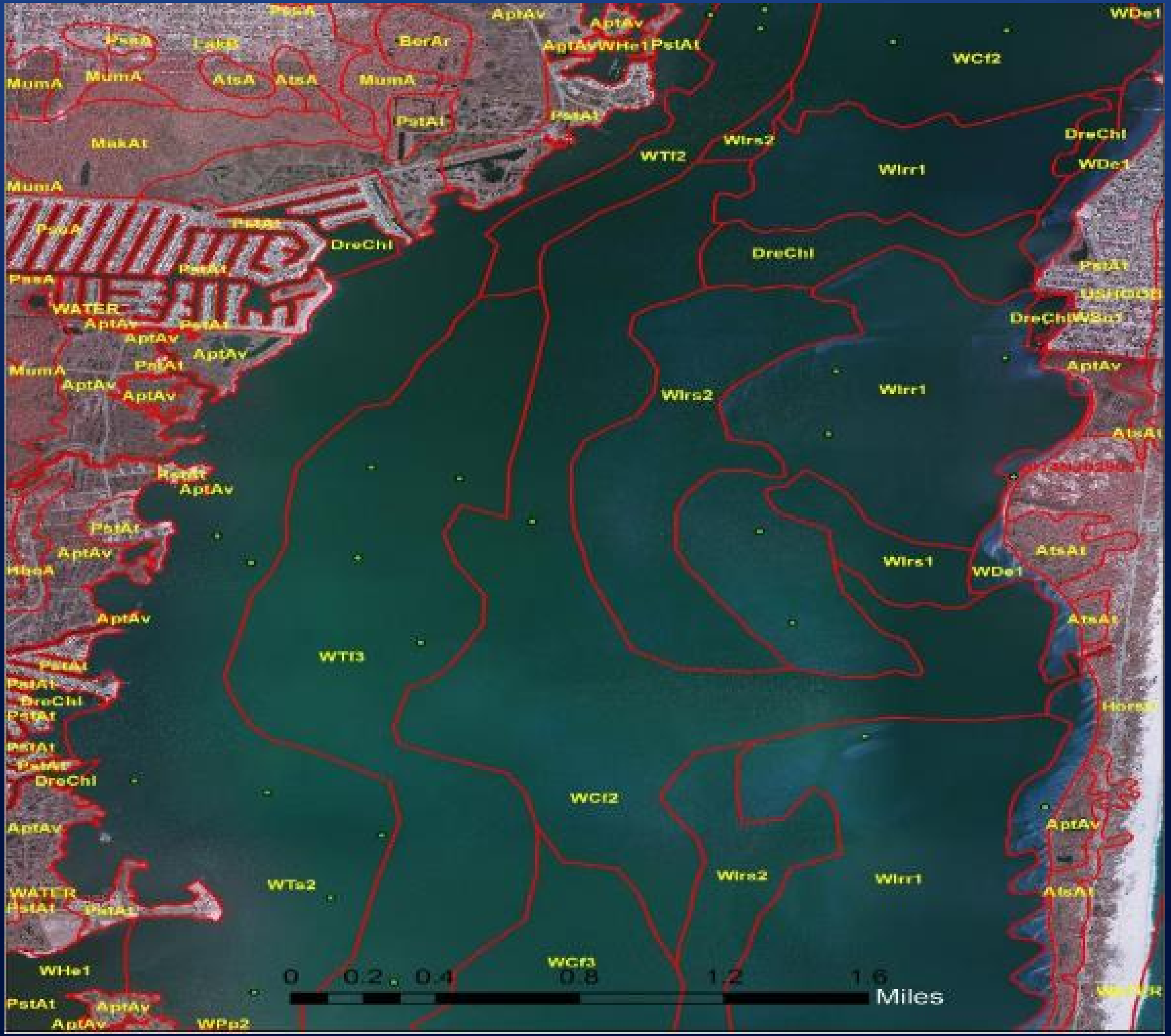
"Blue" Carbon Sequestration Areas of Barnegat Bay

Potential Eelgrass Restoration (SAV)

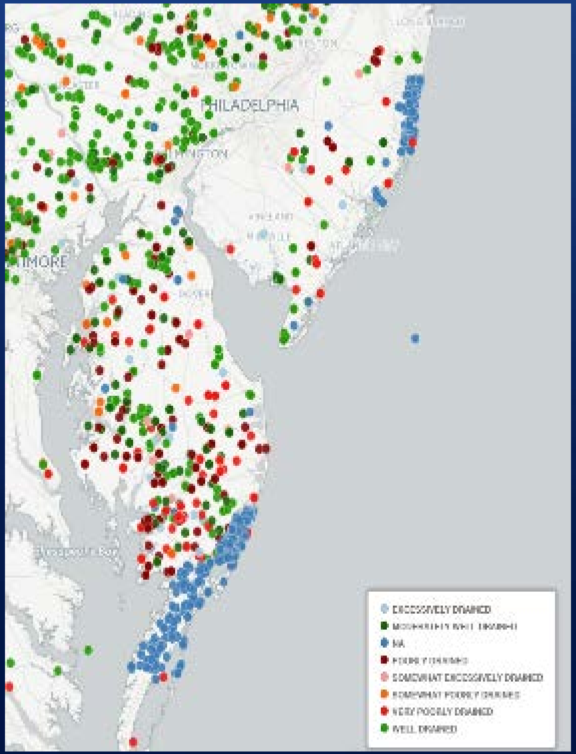


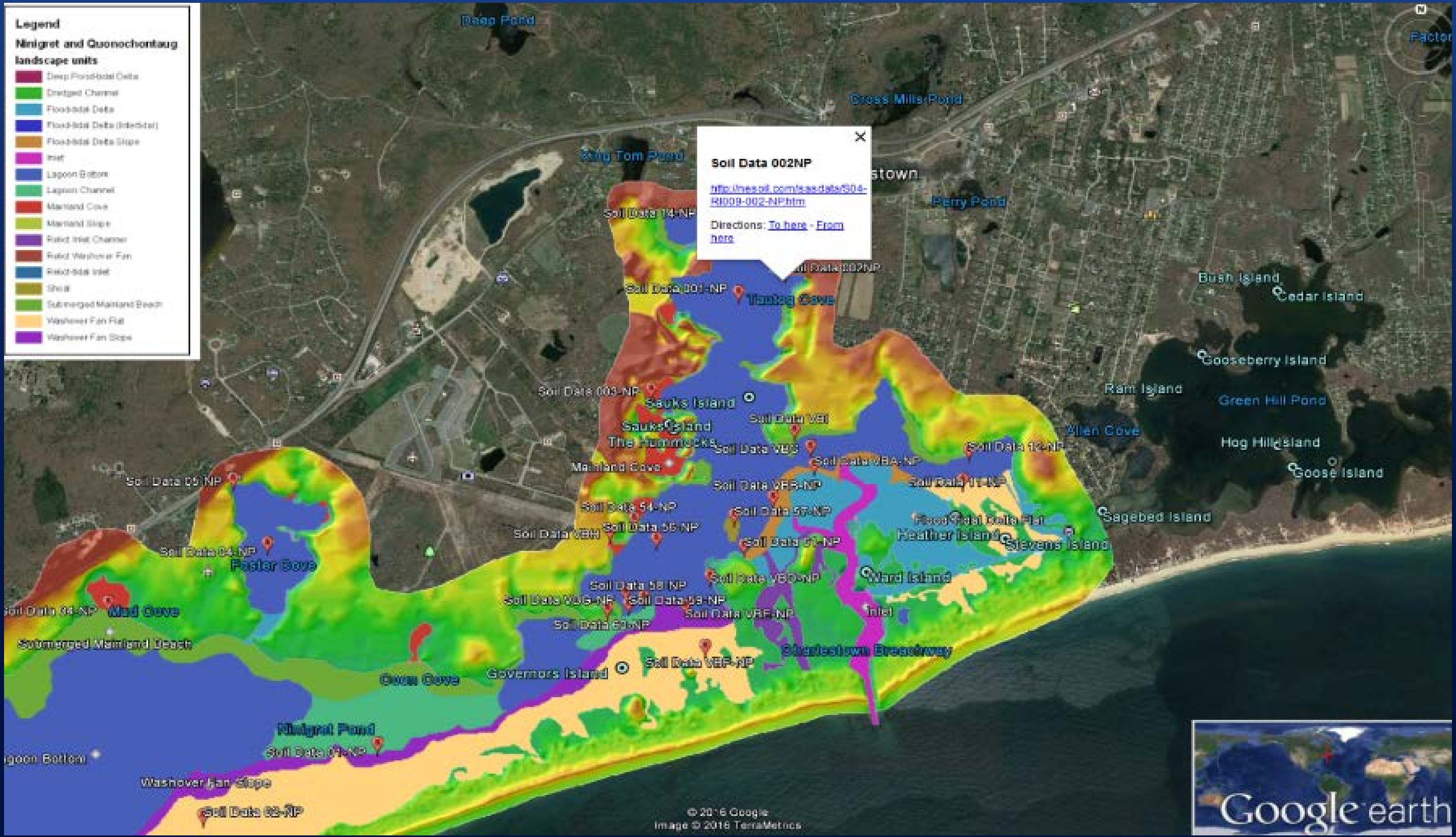
Comparison of 1996 and 2011 RI SSURGO

Comparison of 2015 and 2016 Barnegat Bay - NJ



Point Data Availability





CZSS (Coastal Zone Soil Survey) Initiative Focus

New NRCS Initiative working on CZSS issues / problems / deficiencies to be improved?

1 – Spatial deficiencies / shoreline loss

2 – Outdated mapunit design

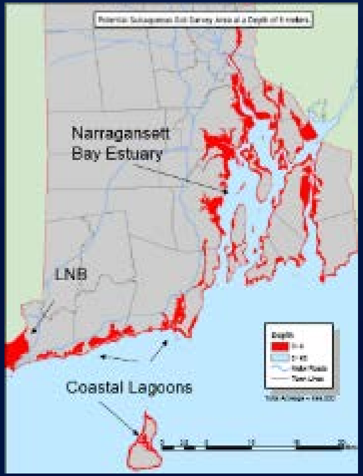
3 – Field documentation data deficiency

4 – Soil interpretation issues

5 – New soil series concepts for subaqueous areas and outdated subaerial series concepts

Rhode Island’s Coastal Zone Soil Survey

- 2003 RI NRCS adopts a “Working Waters” strategic plan – Farm Bill $$ directed to coastal zone ($1 million earmark for Eelgrass restoration).
- Gap in soil survey data identified – No subaqueous soils data for site selection model.
- 2004 RI State Conservationist direct SSS to develop a plan to have RI be Center of Excellence in coastal soils.
- Internal = MLRA office plan (approved by BOD).
- External = worked with URI to establish MapCoast and begin the mapping protocol and map the coastal zone.
- MapCoast protocol developed and south coastal lagoons mapped, user conferences held, outreach, work with CEMCS, NASIS proposals, Glossary of landforms…
- 2011 1st SSURGO CZSS is published, 2012 first freshwater soil survey published on WSS.



Special Thanks

NCSS folks working on SAS (from 2nd National Workshop)

Dr. Marty Rabenhorst (UMD) and Dr. Mark Stolt (URI)

Questions? I think I'm stuck!