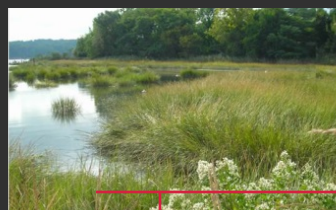


consulting engineers and scientists



What are Living Shorelines & Where do they Work?

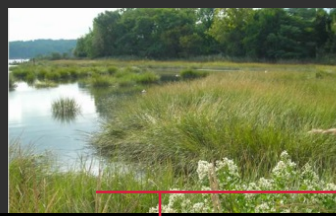
Kimberly Bradley
Laura Schwanof, RLA
January 9, 2015



FOCUS ON THE SHORELINE

- Historic private, industrial, and commercial development along waterfronts.
- Driving Regulatory and Public Concerns
 - Coastal/shoreline Resiliency
 - Increased concern over flood and natural hazard protection and mitigation
 - Protection of property from erosion/sea level rise
 - Environmental Permitting
 - Regulatory requirements

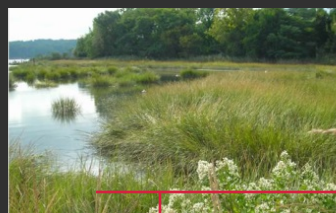




WHAT IS A LIVING SHORELINE?

“A shoreline management practice that provides **erosion control** benefits; protects, restores or enhances **natural shoreline habitat**; and **maintains coastal processes** through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g., biologs, oyster reefs, etc.).”

- NOAA Shoreline Glossary



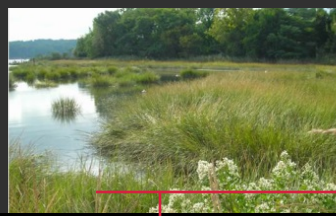
“PROTECTS, RESTORES & ENHANCES NATURAL HABITATS & COASTAL PROCESSES...”



BEFORE:
Mid 1900's method of
stabilizing shorelines using
various forms of construction
debris...

AFTER:
Replacing rubble with clean
backfill, controlling toe
erosion and restoring
ecological function & value

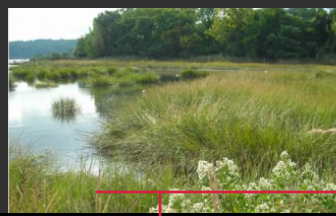




LIVING SHORELINES IN CONNECTICUT

CTDEEP Working Definition of Living Shorelines:

- “Living shorelines: A shoreline **erosion control** management practice which also restores, enhances, **maintains or creates natural coastal or riparian habitat, functions and processes**. Coastal and riparian habitats include but are not limited to intertidal flats, tidal marsh, beach/dune systems, and bluffs. Living shorelines may include structural features that are combined with natural components to attenuate wave energy and currents”.



LIVING SHORELINES IN CONNECTICUT

CTDEEP Definition of Living Shorelines is not yet included in Connecticut General Statute.

Public Act 12-101 of the CT General Assembly

– Coastal Management Act

- Refined definition of “feasible, less environmentally damaging alternative”
- Exemption of living shoreline projects for the definition of “shoreline flood and erosion control structure”.

CTDEEP OLISP Guidance on P.A. 12-101:

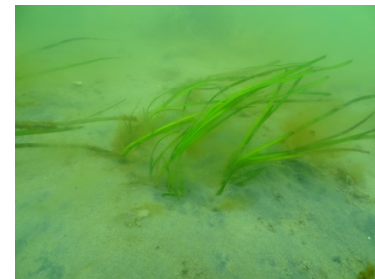
<http://www.ct.gov/deep/cwp/view.asp?A=2705&Q=512226>

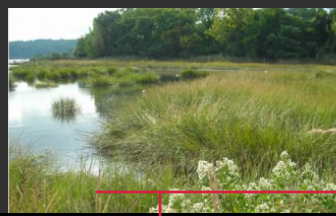
LIVING SHORELINES IN CONNECTICUT



Feasible, less environmentally damaging alternative”

- *Includes, but not limited to relocation of an inhabited structure to a landward location, elevation of an inhabited structure, restoration or creation of a dune or vegetated slope, or living shorelines techniques utilizing a variety of structural and organic materials, such as tidal wetland plants, submerged aquatic vegetation, coir fiber logs, sand fill and stone to provide shoreline protection and maintain or restore coastal resources and habitat.*

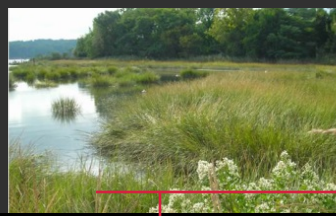




LIVING SHORELINES IN CONNECTICUT

“CGS 22a-109(d) states, in part: “...For the purposes of this section, “shoreline flood and erosion control structure” ... shall not include ... (2) any activity, including, but not limited to living shorelines projects, for which the primary purpose or effect is the restoration or enhancement of tidal wetlands, beaches, dunes, or intertidal flats.”



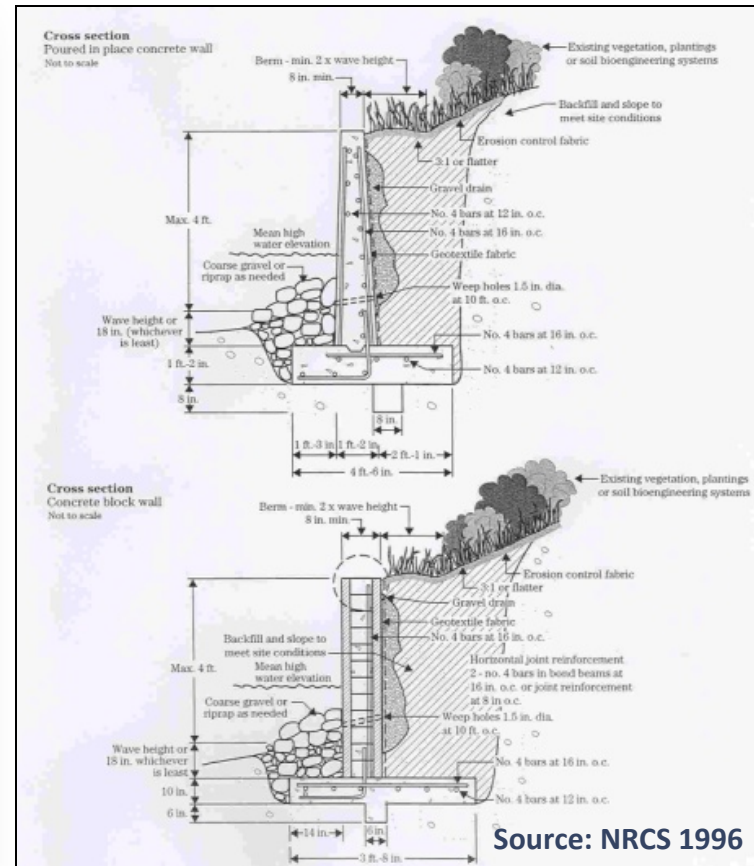


WHERE CAN LIVING SHORELINES WORK?

- Initial site assessment process
- 4 Guiding Principals for design
- Tools for implementation – examine conventional, green and hybrid techniques
- Requisite follow-up to ensure project success

CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

Erosion control; but no habitat or coastal processes benefits

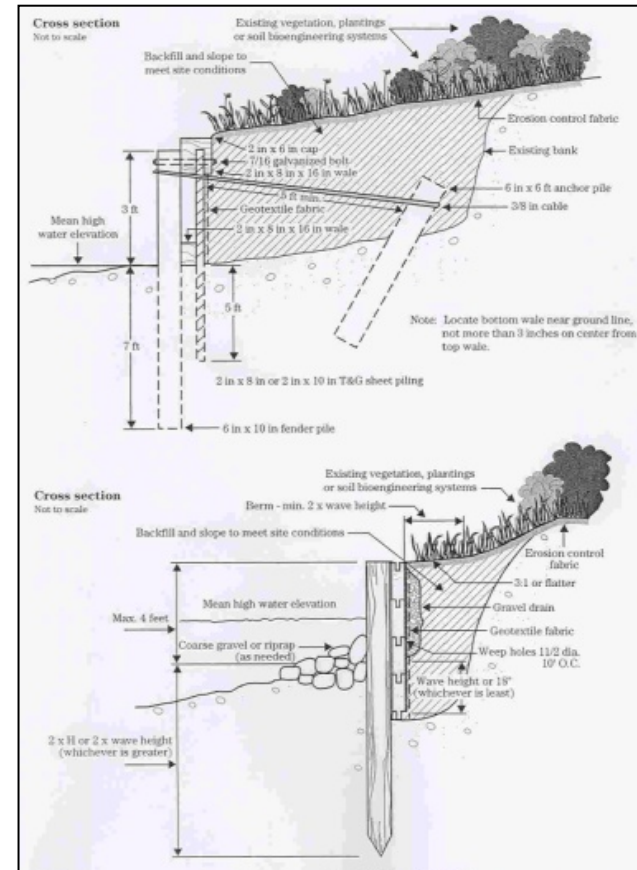


CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

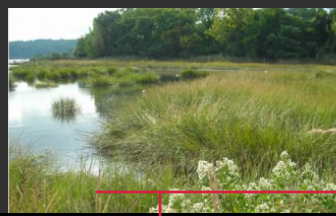
Erosion control; but minimal habitat or coastal processes benefits



Timber or Sheet Pile Bulkheads

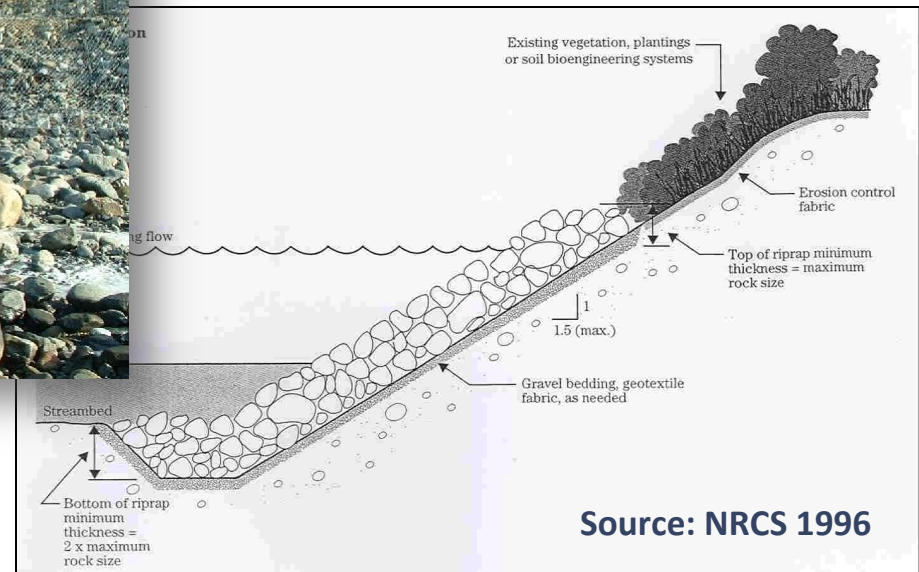


Source: NRCS 1996



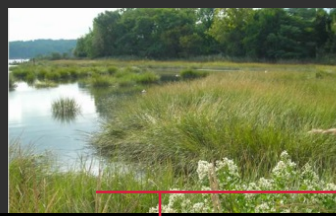
CONVENTIONAL SHORELINE STABILIZATION TECHNIQUES

Erosion control & some habitat and coastal processes benefits



Rock Gabions

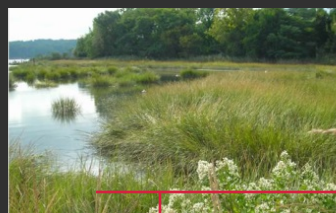
Source: NRCS 1996



WHY? ...CONSIDER COST BENEFITS:

Treatment	Relative Complexity	Relative Cost
Conventional vegetation	Simple to Moderate	Low
Live Stake	Simple	Low
Joint Planting	Simple	Low
Live Fascines	Moderate	Moderate
Brushmattress	Moderate to complex	Moderate
Live Cribwall	Complex	High
Branchpacking	Moderate to complex	Moderate
Conventional bank armoring	Moderate to complex	Moderate to High

Table based on “Streambank Erosion Protection Treatment Relative Costs and Complexity”
(Fischenich and Allen 1999)



WHAT WORKS...WHAT DOESN'T?

Vegetative Treatment Potential Rating Sheet

TABLE I VEGETATIVE TREATMENT POTENTIAL FOR ERODING TITLE SHORELINES IN THE MID-ATLANTIC STATES

DIRECTION FOR USE

- Evaluate each of the first four shoreline variables and match the site characteristics of the variable to the appropriate descriptive category.
- Place the Vegetative Treatment Potential (VTP) assigned for each of the four variables in the right hand column.
- Obtain the Cumulative Vegetative Treatment Potential for variables 1, 2, 3 & 4 by adding the VTP for each.
- If it is 23 or more, the potential for the site to be stabilized with vegetation is very good and the rest of the table need not be used. If it is below 23, go to step 5.
- Determine the VTP for shoreline variables 5 through 9 and obtain the cumulative VTP for variables 1-9.
- Compare the cumulative VTP score with the Vegetative Treatment Potential Scale at the bottom of this page.

SHORELINE VARIABLES	DIRECTION FOR USE The Vegetative Treatment Potential (VTP) is Located in Upper Left Hand of Each Category Box					VTP
	8	7	4	2	0	
1. Fetch: Average distance in miles of open water measured perpendicular to the shore and 45° either side of perpendicular to shore.	Less than 0.5 miles	0.5 thru 1.4 miles	1.5 thru 3.4 miles	3.5 thru 4.9 miles	over 5 miles see footnote 1/	
2. General shape of shoreline for distance of 200 yards on each side of planting site.	Coves		Irregular shoreline	Headland or straight shoreline		
3. Shoreline orientation: General geographic direction the shoreline faces.	Any orientation less than one-half mile fetch	West to North	South to West	South to East	North to East	
4. Boat traffic: Proximity of site to recreational & commercial boat traffic	None	1-10 per week within 1/2 mi. of shore	More than 10 per week within 1/2 mi. of shore	1-10 per 100 yds. of shore	More than 10 per week within 100 yds. of shore	
Cumulative Vegetative Treatment Potential for Variables 1, 2, 3 & 4						
If this score is 23 or above, the potential for the site is very good and the rest of the table need not be used. If it is below 23, go to step 5 below.						
5. Width of Beach Above Mean High Tide in Feet	Greater than 10'	10' thru 7'	6' thru 3'	Less than 3'		
6. Potential width of ^{2/} Planting Area in Feet	More than 20'	20' thru 15'	14' thru 10'	Less than 10' Do Not Plant		
7. On Shore Gradient: % slope from MHT to toe of bank	Below 8%	8 thru 14%	15 thru 20%	over 20%		
8. Beach Vegetation	Vegetation below toe of slope		No vegetation below toe of slope			
9. Depth of sand at ^{3/} Mean High Tide in inches	More than 10"	10" thru 3"		Less than 3"		
Cumulative Vegetative Treatment Potential for Variables 1-9						

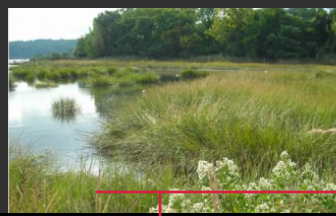
1/ Do not plant or see page 9 and figure 9 for possible exception.

2/ If tidal fluctuation is 2.5 feet or less, measure from MHT to toe of bank. If tidal fluctuation is over 2.5 feet, measure from MHT to toe of bank. See page 7 for more information.

3/ Refers to depth of sand deposited by littoral drift over the substrate.

VEGETATIVE TREATMENT POTENTIAL SCALE

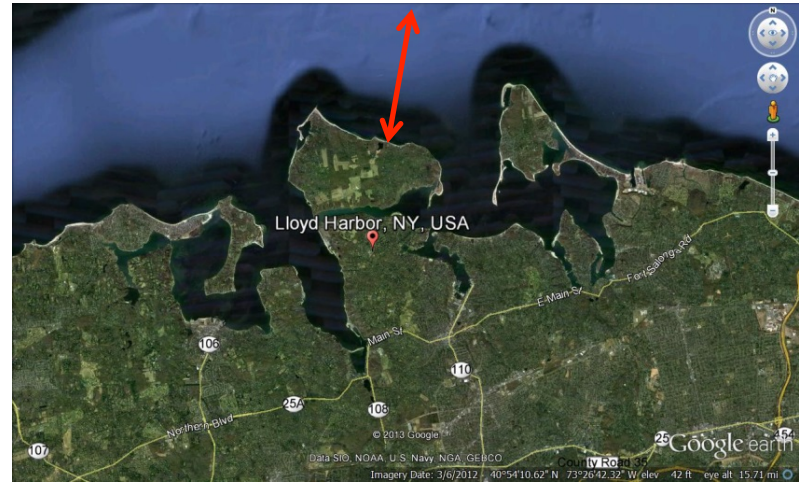
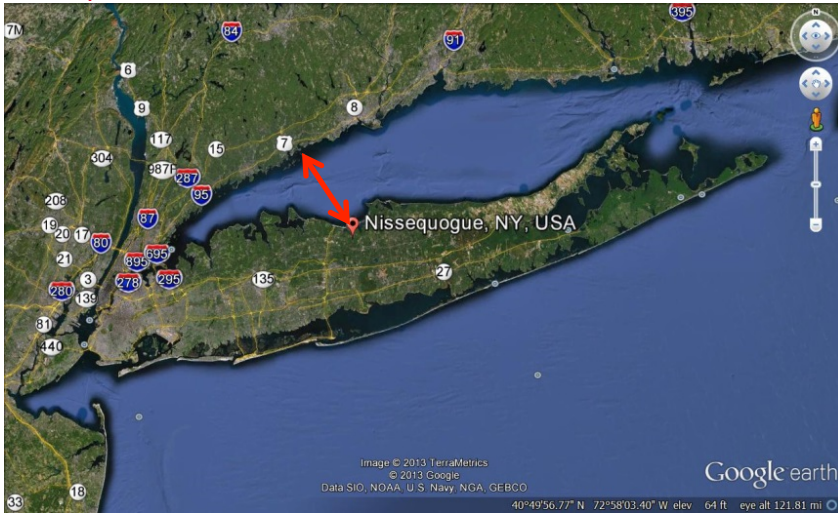
If the VTP is, Between	And	Potential of Site to be Stabilized with Vegetation
40	33	Good
32	24	Fair
23	16	Poor
below 16		Do Not Plant



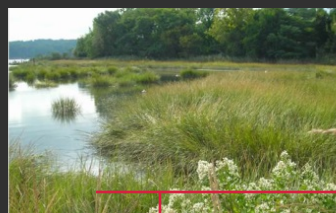
4 GUIDING PRINCIPLES

1. Consider the Length of Open Water or Fetch
2. Control Drainage
3. Determine the Natural Angle of Repose
4. Protect the Base of the Slope or Toe

#1 – CONSIDER LENGTH OF FETCH



When vegetation alone just won't do...



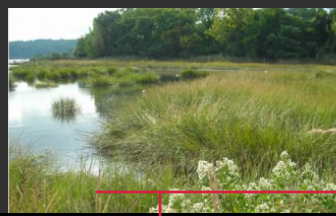
#2 – CONTROL DRAINAGE



Both Overland Flow...



...and Subsurface Seeps



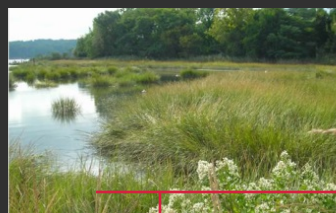
#3 – NATURAL ANGLE OF REPOSE

Defined as the maximum slope at which loose solid material will remain in place without sliding and the slope remains stable...

...and the critical slope where vegetation used alone will provide long-term stabilization.



Modifying that angle will require some form of structural support.

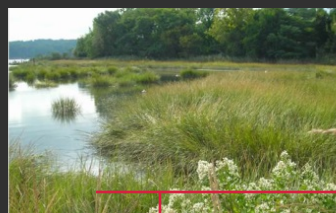


#4 – TOE PROTECTION IS CRITICAL

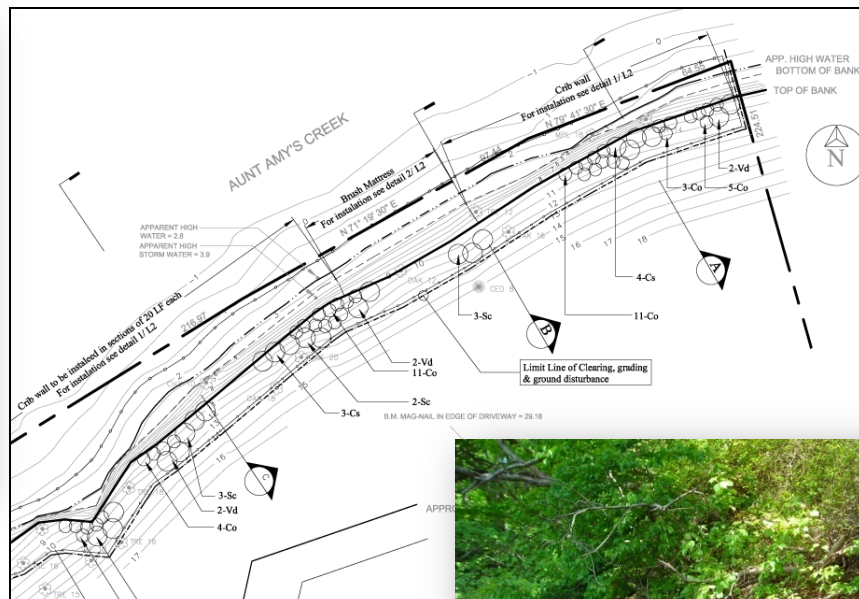


However, careful planning, selection and installation is equally important...





CHOICE OF TREATMENT



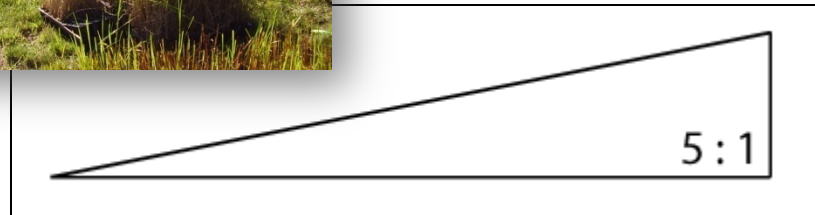
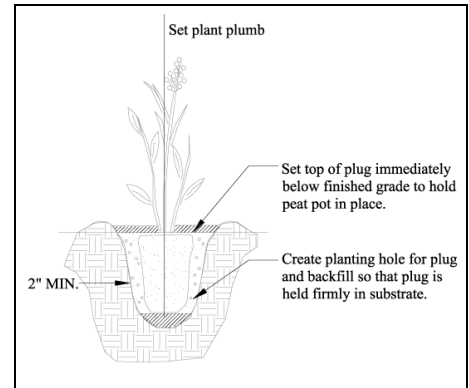
1. Plants as Primary Support (5:1 and flatter)
2. Plants with Erosion Control (5:1 to 3:1)
3. Plants as Structural Support (3:1 to 2:1)
4. Plants with Additional Structural Support (2:1 and steeper)

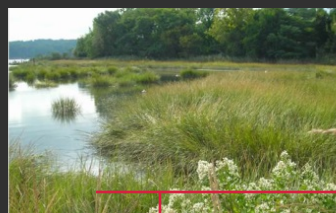


1. PLANTS AS PRIMARY SUPPORT



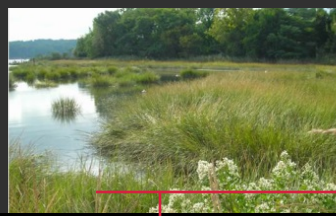
- **5:1 (horizontal: vertical) or flat ground**
- **Not seeded**
- **Low energy environment**
- **No concentrated surface flows (sheet flow only)**





PLANTING PLUGS





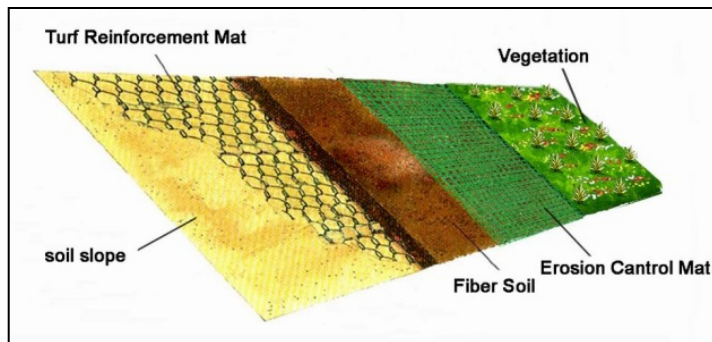
2. PLANTS WITH EROSION CONTROL

- 5:1 to 3:1 (horizontal: vertical)
- Seeded
- Low energy environment
- Sheet flow only

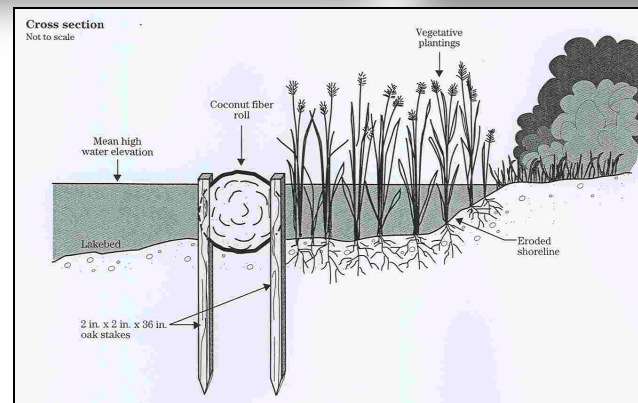
Erosion Control Blankets & Mats



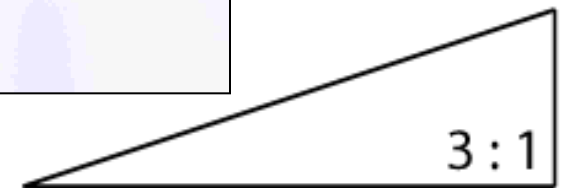
Coir Pallets

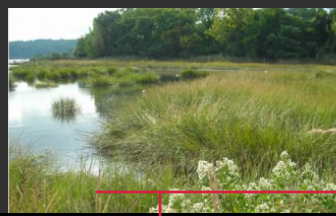


Hydro Mulching



Coir Logs

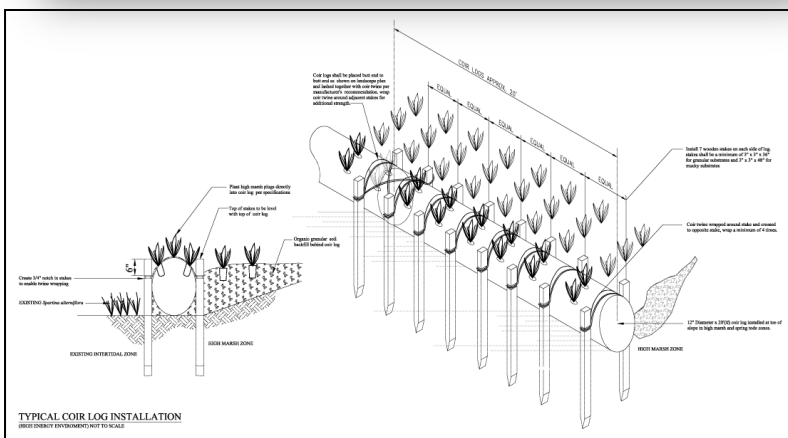




COIR LOGS

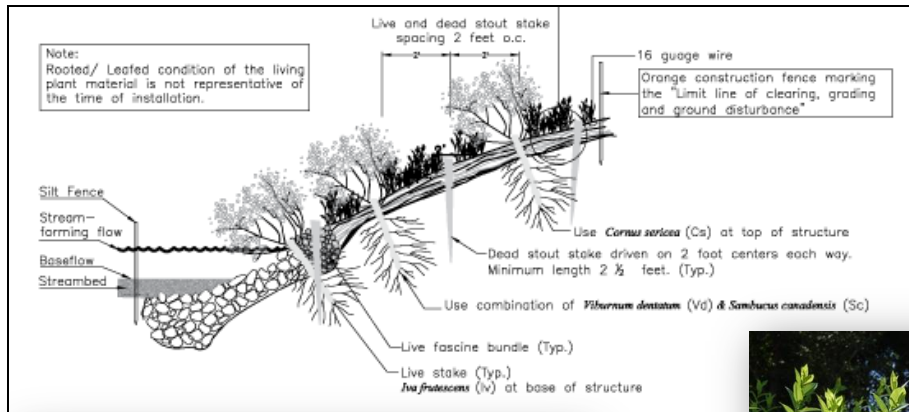


Tidal and Streambank Application for Toe Protection and Benched Plantings



3. PLANTS AS STRUCTURAL SUPPORT

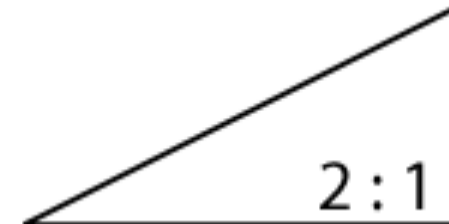
- 3:1 to 2:1 horizontal/ vertical
- Low to moderate energy environment
- Seeding may be included

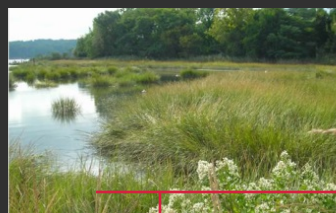


Live Stakes

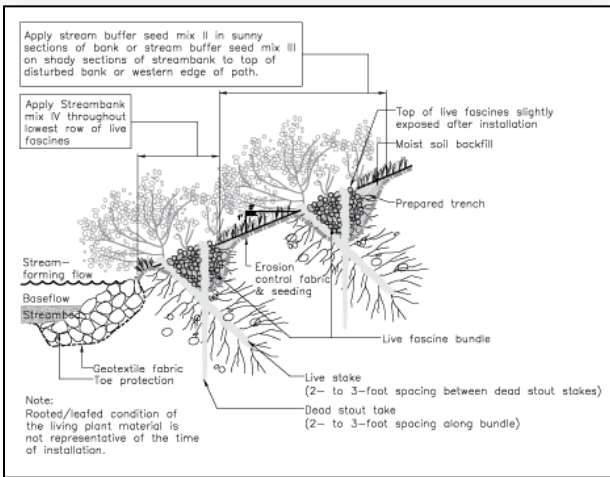


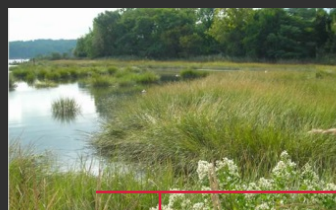
Brushmattress Installation





LIVE STAKES & FASCINES





BRUSHMATTRESS

- Live Stakes
- Dead Stakes
- Fascine Bundles
- Galvanized Wire Webbing
- Seeds



4. PLANTS WITH ADDITIONAL STRUCTURAL SUPPORT



Live Crib Walls

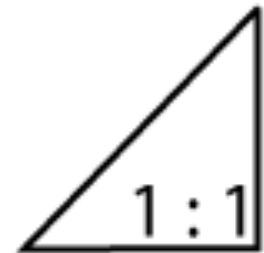
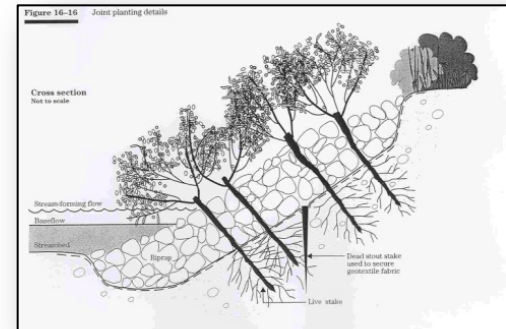
- $2:1 <$ Approaching Natural Angle of Repose
- Low to Moderate Energy Environments

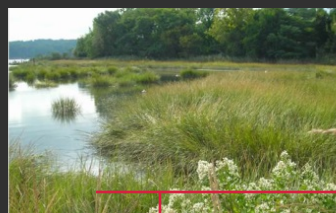
(On steeper slopes & high energy environments structural stabilization **MUST** predominate)



Vegetated Rip Rap

Source: Terra Erosion Control Ltd.

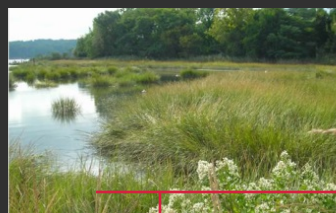




LIVE CRIB WALL



Installation of Structure



LIVE CRIB WALL

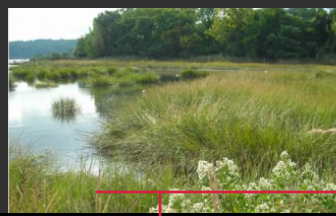


Post Construction



Monitoring Growth





QUALITY CONTROL & QUALITY ASSURANCE

Build Into Contract:

- Professional Design Team
- Construction Observation
- Long Term Monitoring

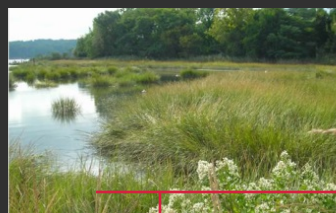
Design Phase:

- Consider Long Term Performance Standards (85%-90% - If You Can't Meet It – Don't Propose It...)

Remember:

- Post Construction Monitoring Spans 2 to 5 Years (1 Year Guarantees May Not Be Adequate)



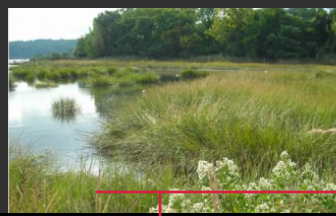


MULTIFUNCTIONAL LIVING SHORELINE:



- ✓ Flood control;
- ✓ Stormwater treatment;
- ✓ Wetland enhancement
- ✓ Shoreline retreat;
- ✓ Invasive plant removals





CONCLUSIONS / STEPS FORWARD

1. Understanding the Working Definition of Living Shorelines
2. Key Design Considerations
3. 4 Guiding Principals
4. Approach Site Feasibility Analysis from Less to More
5. Integrate Plant Materials as Structural Elements & Permanent Cover
6. Monitoring is Essential to Success
7. Living Shorelines Applications in Connecticut

.....ANY QUESTIONS??

lschwanof@geiconsultants.com

O: 631-759-2969

C: 631-513-1604

kbradley@geiconsultants.com

O: 860-368-5414

C: 860-917-0670