Living Shorelines Professionals' Training

February 22nd 2010

Medium-Energy Systems and Sills

Gene Slear

Environmental Concern Inc.

Environmental Concern Inc.

Mission – improve water quality and enhance habitat by promoting

- Restoration of wetlands and the construction of new wetlands,
- Stewardship of wetlands through education and outreach
- Native species horticulture

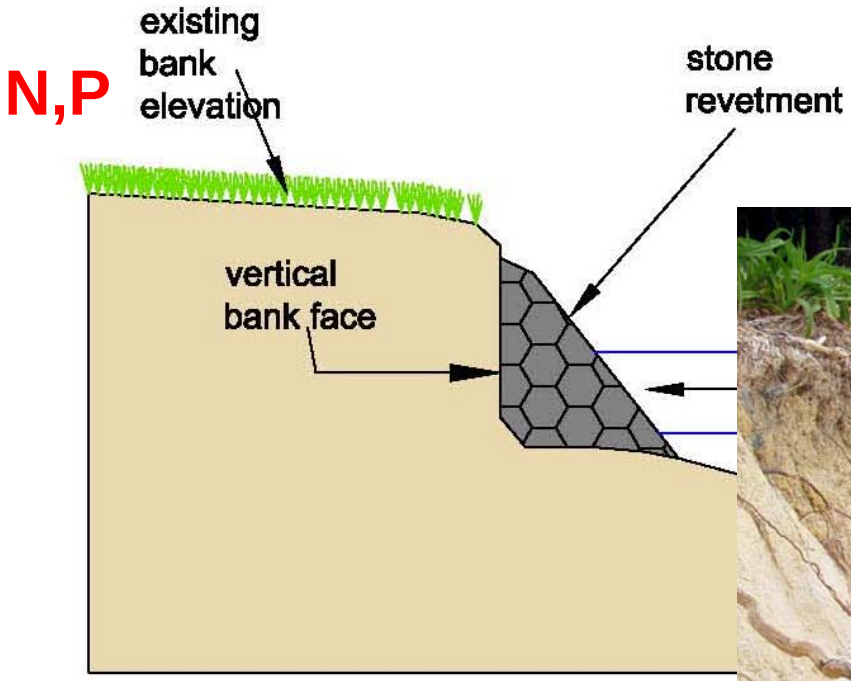
Living Shoreline

The Living Shoreline is a wetland (tidal marsh), restored/constructed at the terrestrial/aquatic interface in order to recreate the natural functions of a shoreline ecosystem and to stabilize the bank.

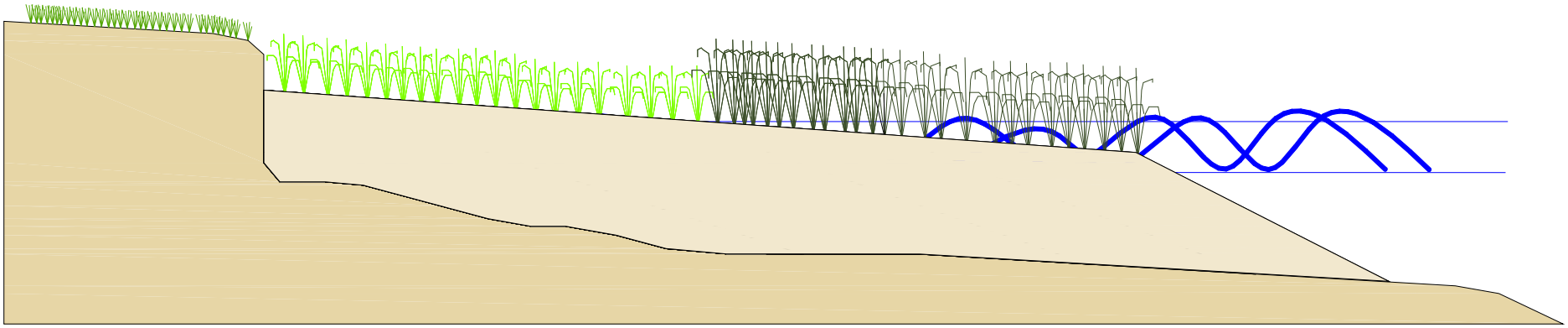
The Living Shoreline design is a specific approach to shoreline stabilization intended to maximize primary productivity - thereby improving water quality and living resource habitat.

Environmental Concern

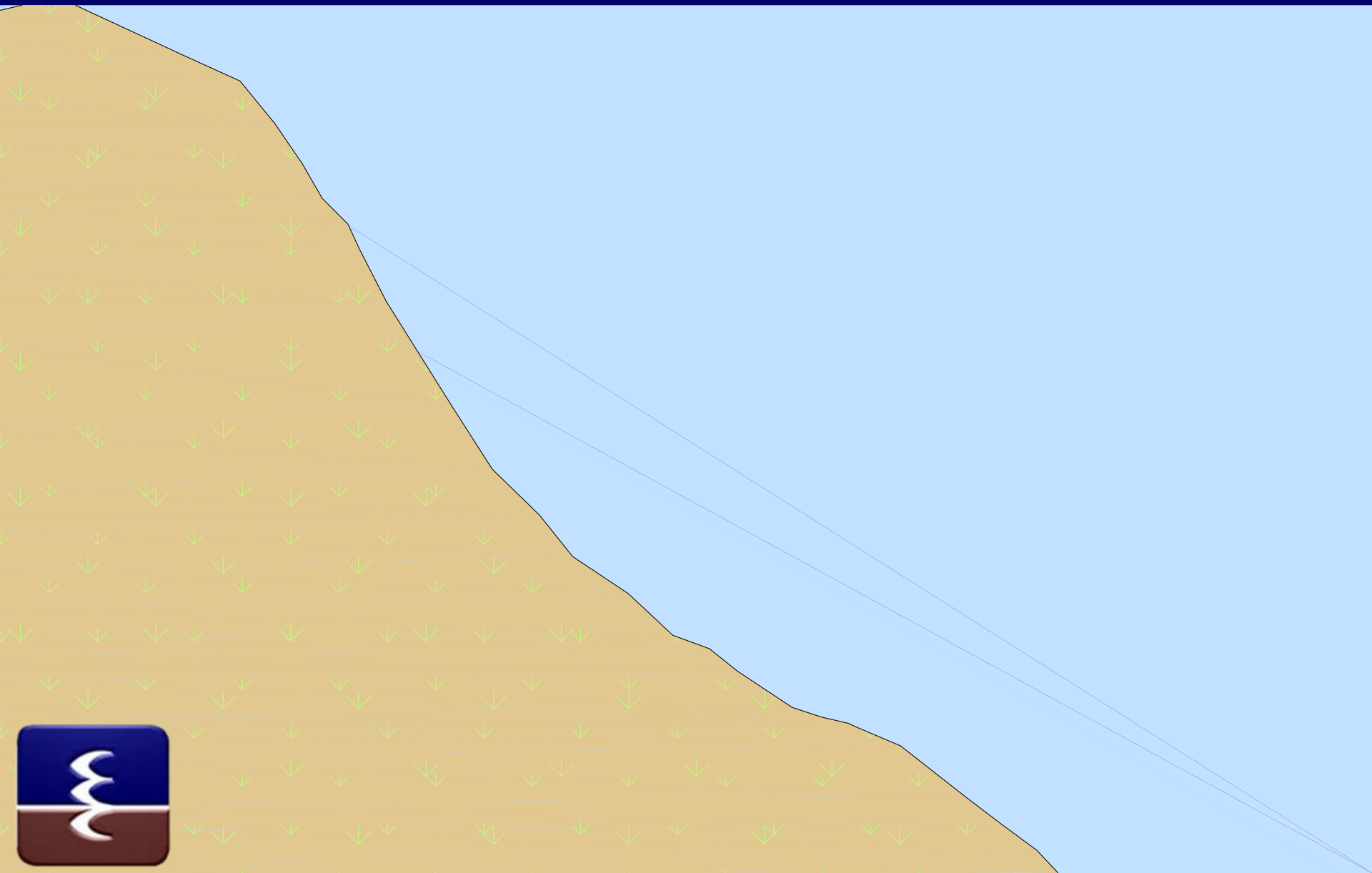
Rip-Rap-Typical Section



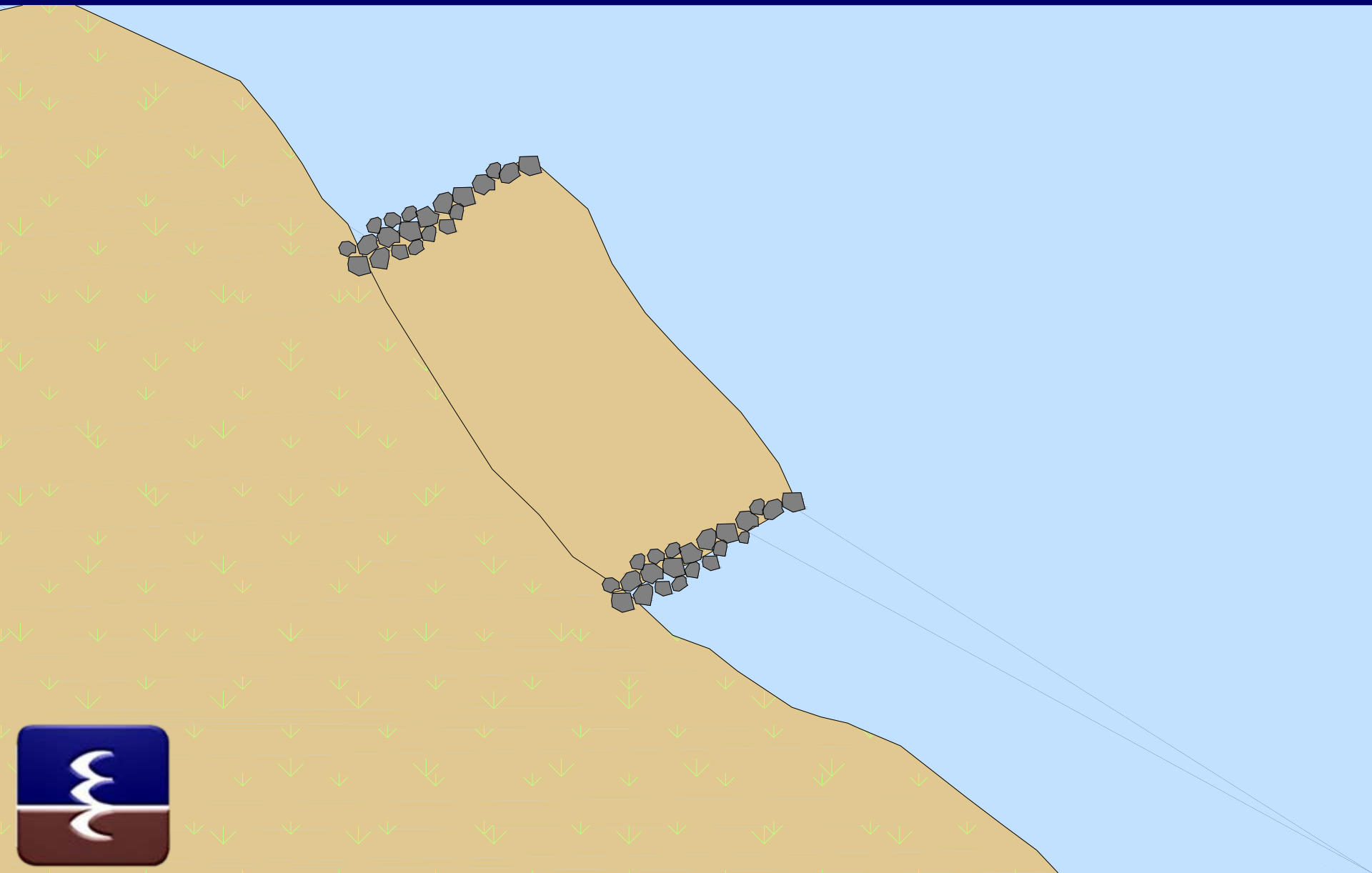
Sand Fill



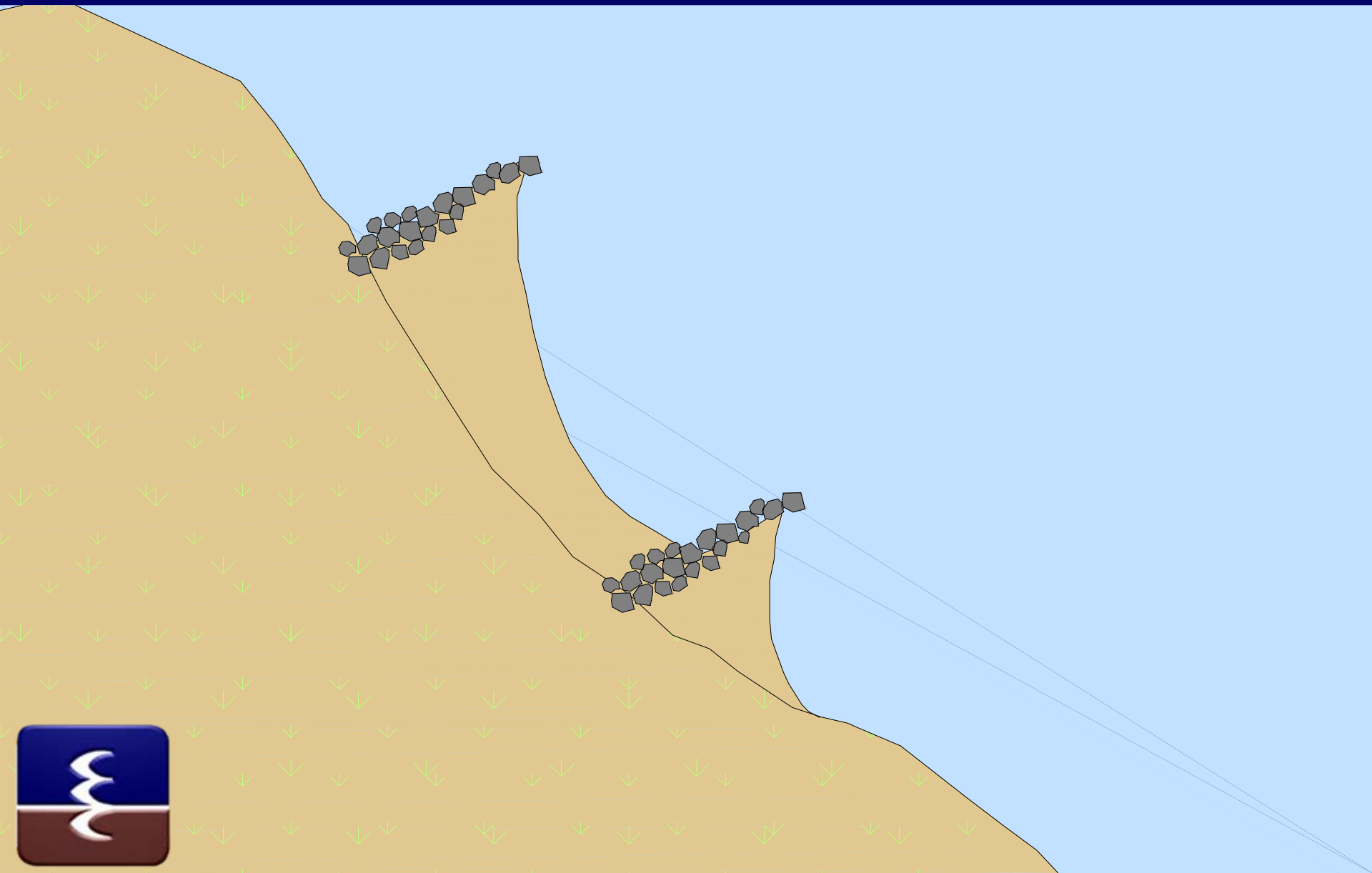
Stone Groin



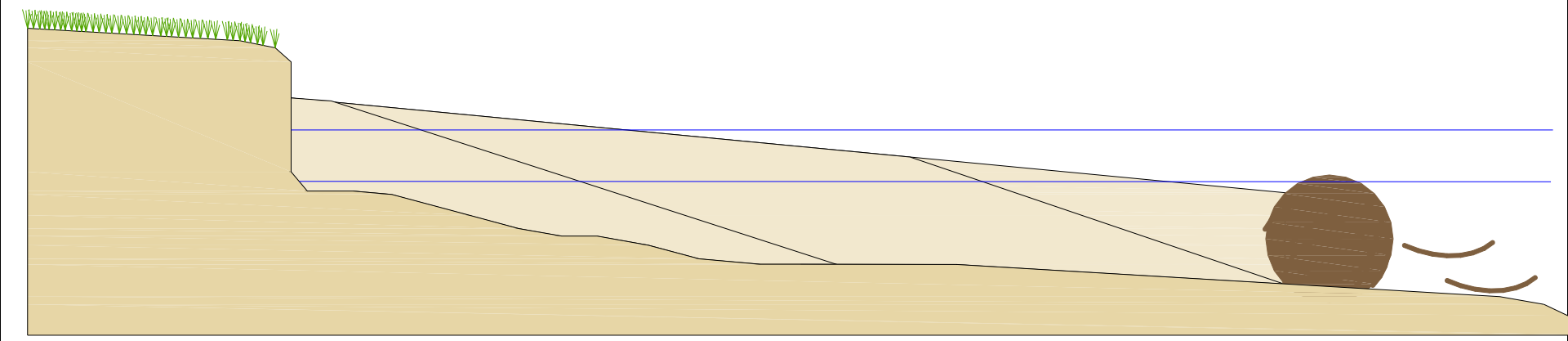
Stone Groin



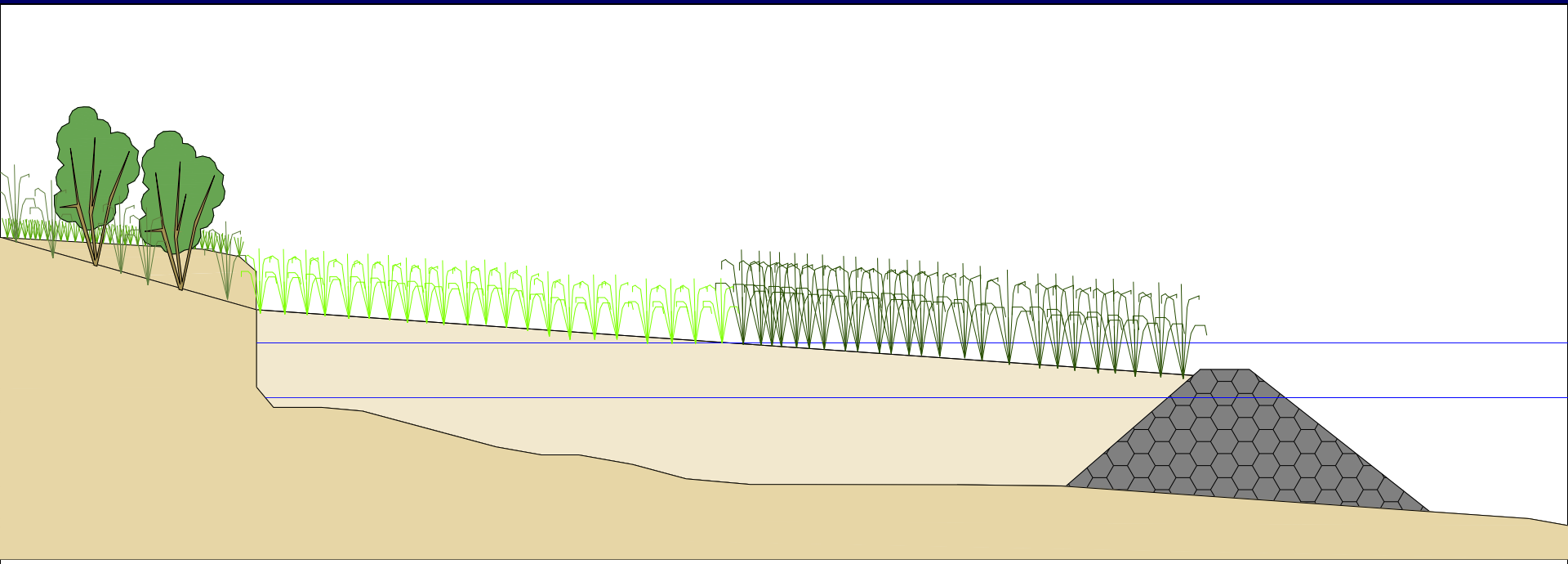
Stone Groin



Biolog



Low Profile Stone Containment Structure



Sill

Functions and Values of the Living Shoreline

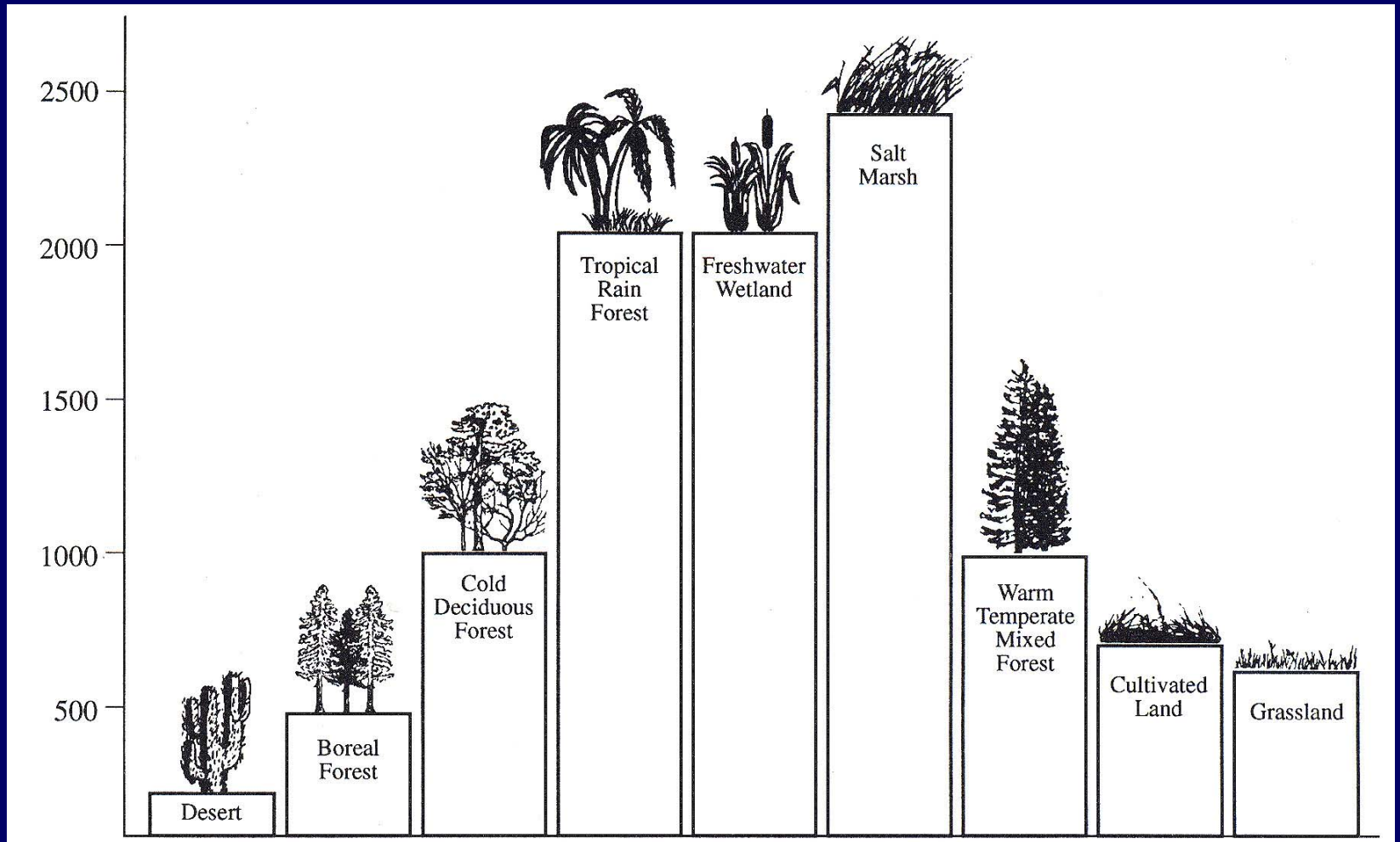
Shoreline Stabilization

Water Quality

Productivity

Habitat Enhancement

Primary Productivity



Net Primary Productivity of Selected Ecosystems ($g/m^2/year$)

adapted from Lieth (1975) and Teal (1969)

Habitat Enhancement

Diverse Ecosystem

- More than half of the commercially useful fish depend on the coastal marshes as spawning beds, hatcheries, nurseries or feeding grounds

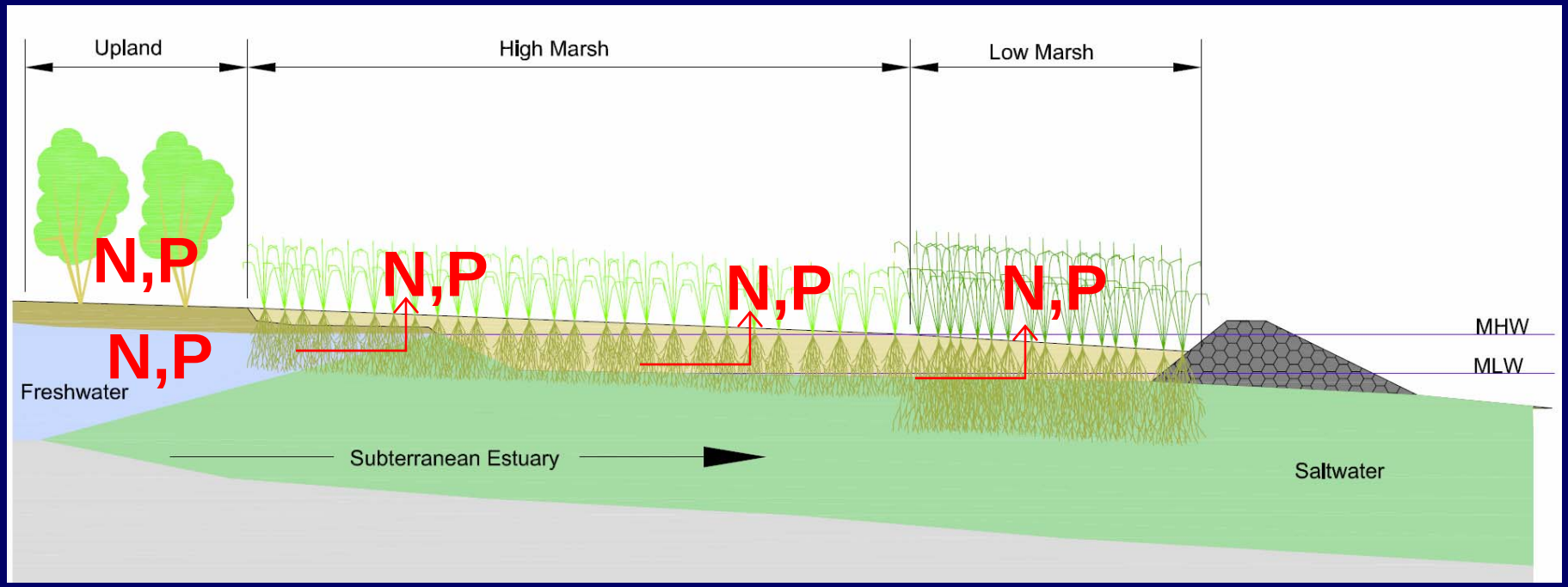
(Tiner and Burke 1995; Kesselheim and Slattery 1995, Adams et. al. 1987)

Salt Marsh traps silt and pollutants contained in stormwater runoff AND in the receiving waters (Knutson et al. 1982; Tiner and Burke 1995).

Water Quality

- Uptake Nutrients
- Filter Pollutants
- Trap Sediments

Nutrient Removal



- Filtration
- Denitrification
- Uptake & Sequestration

Shoreline Stabilization

- **Energy**
  - Fetch (Velocity)
  - Mass (Depth)
- Sunlight
- Elevation


ORDINARY POINT
10 miles
Fetch
The distance wind travels – undisturbed – over open water

Functions & Values

Shoreline Stabilization:

Results showed that *Spartina alterniflora* marshes significantly reduced wave height and erosional energy.

Wave height was reduced by:

- 50% within the first 5m of marsh
- 95% after crossing 30m of marsh

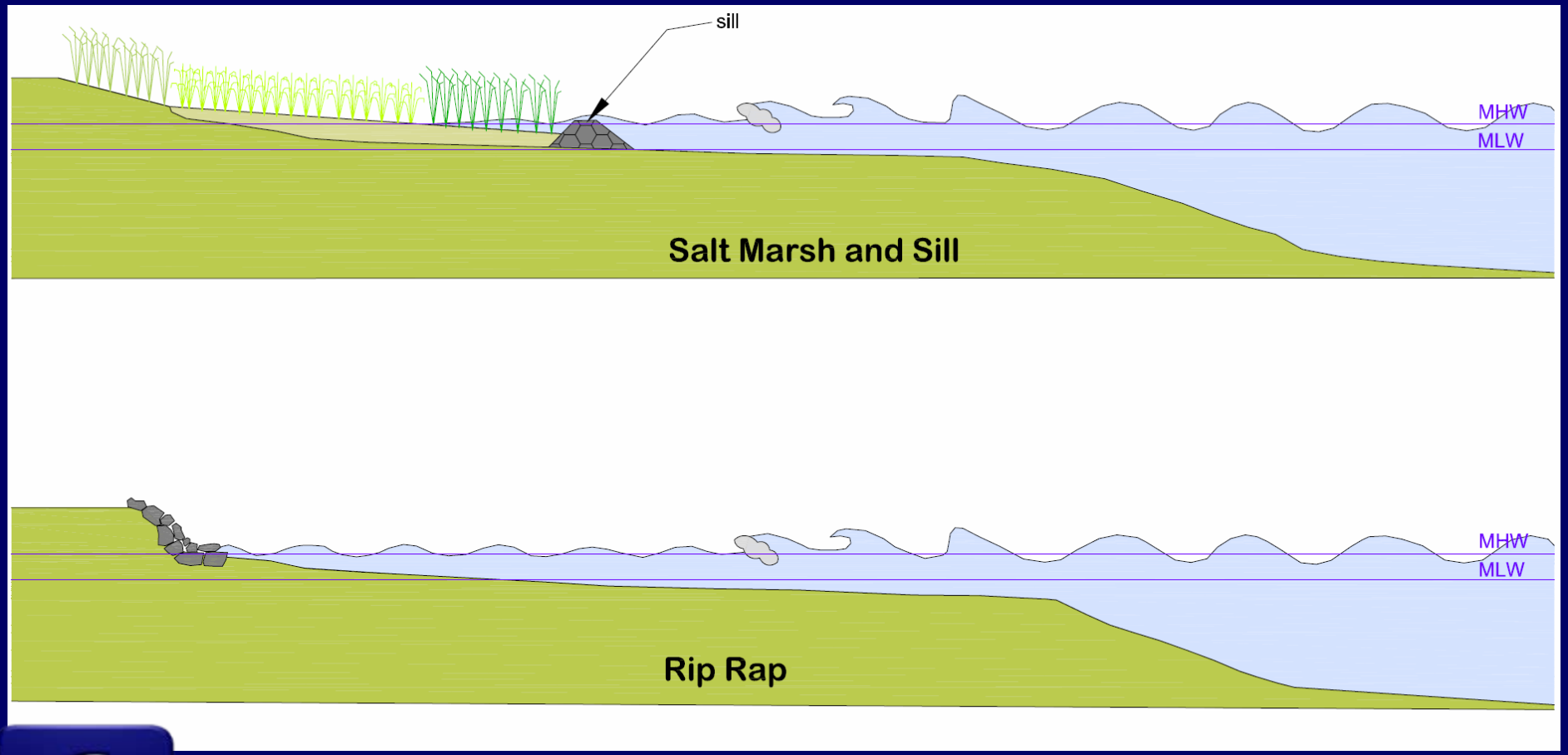
(Knutson et al. 1982)

Wave Attenuation

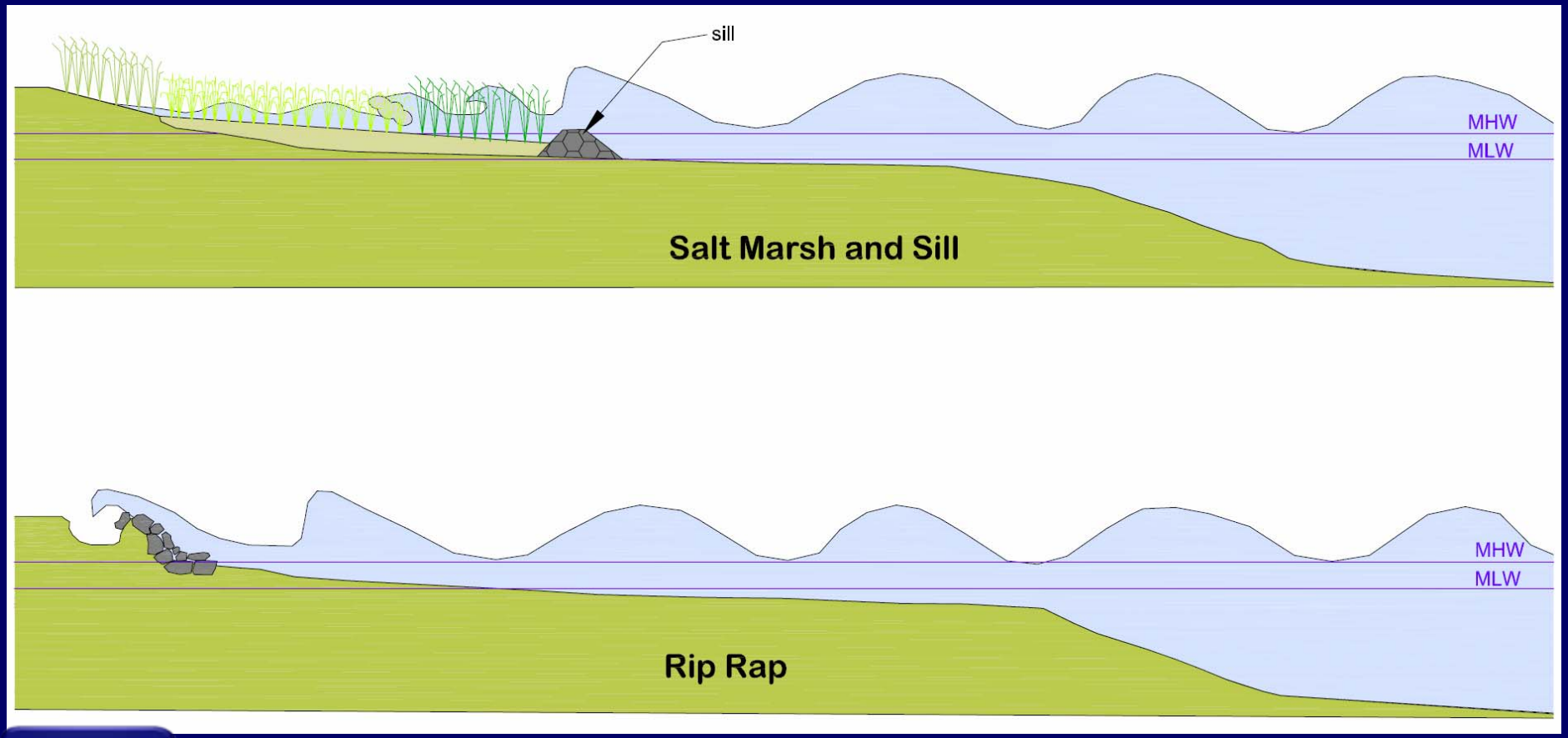
The reduction in wave height (wave attenuation) and thus the severity of the impact at the upland bank is a function of :

- Interaction with the bottom
- Interaction with the sill structure
- Interaction with marsh vegetation

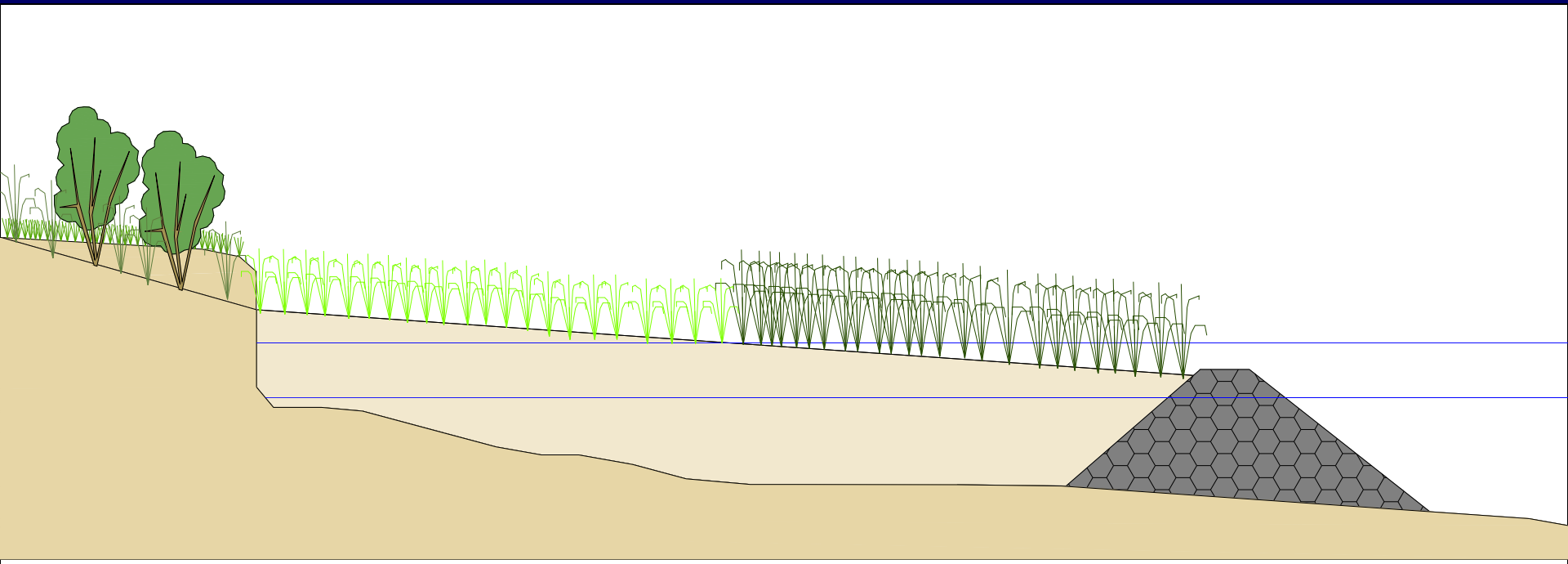
Typical wave height



Storm tide



Low Profile Stone Containment Structure



Sill

Wave Attenuation

The reduction in wave height (wave attenuation) and thus the severity of the impact at the upland bank is a function of :

- Interaction with the bottom
- Interaction with the sill structure
- Interaction with marsh vegetation

Sill Height is a function of Fetch & Bathymetry

Short Fetch – Shallow Bottom
Lower Sill Elevation

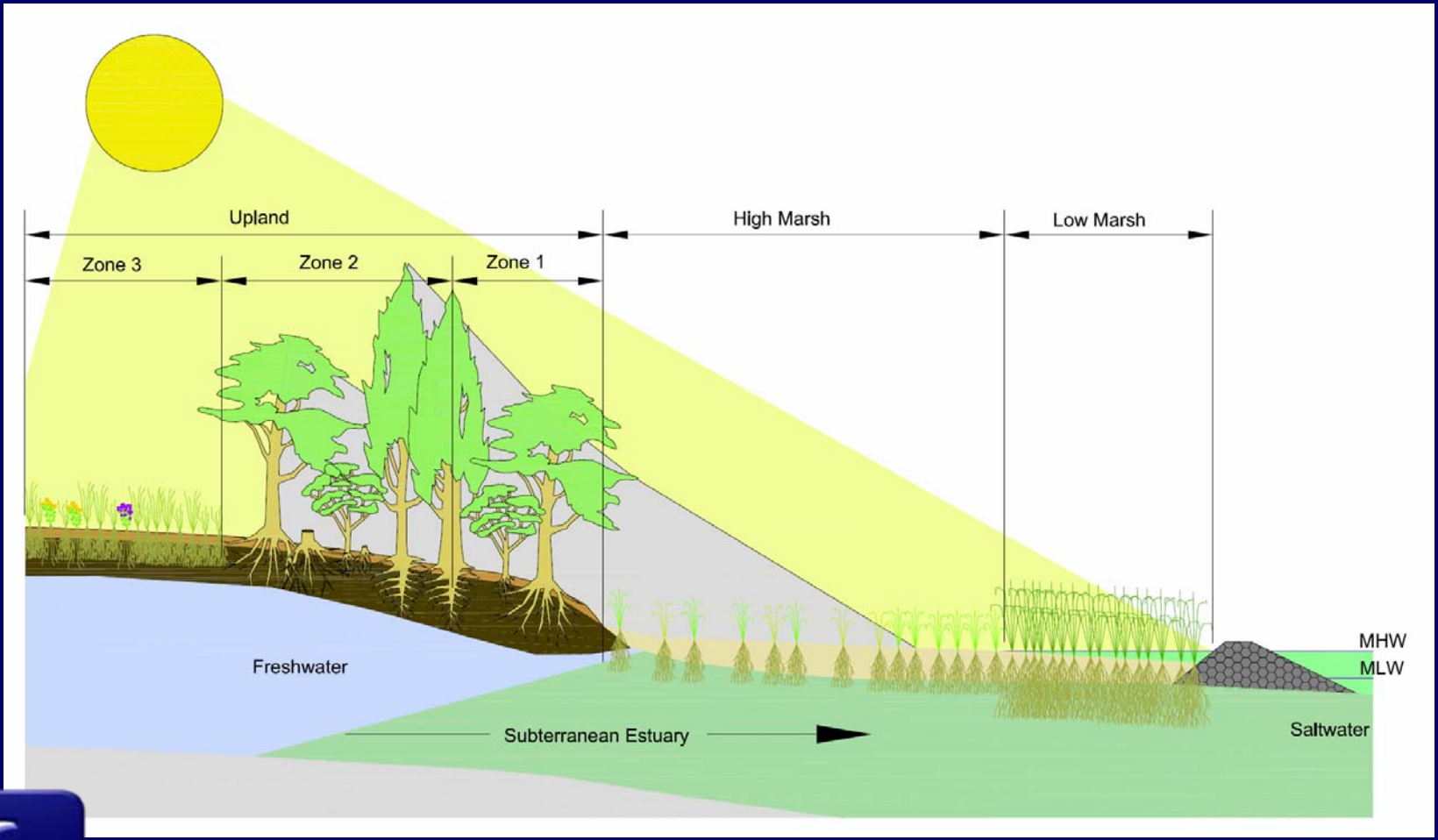
Low Tide

High Tide

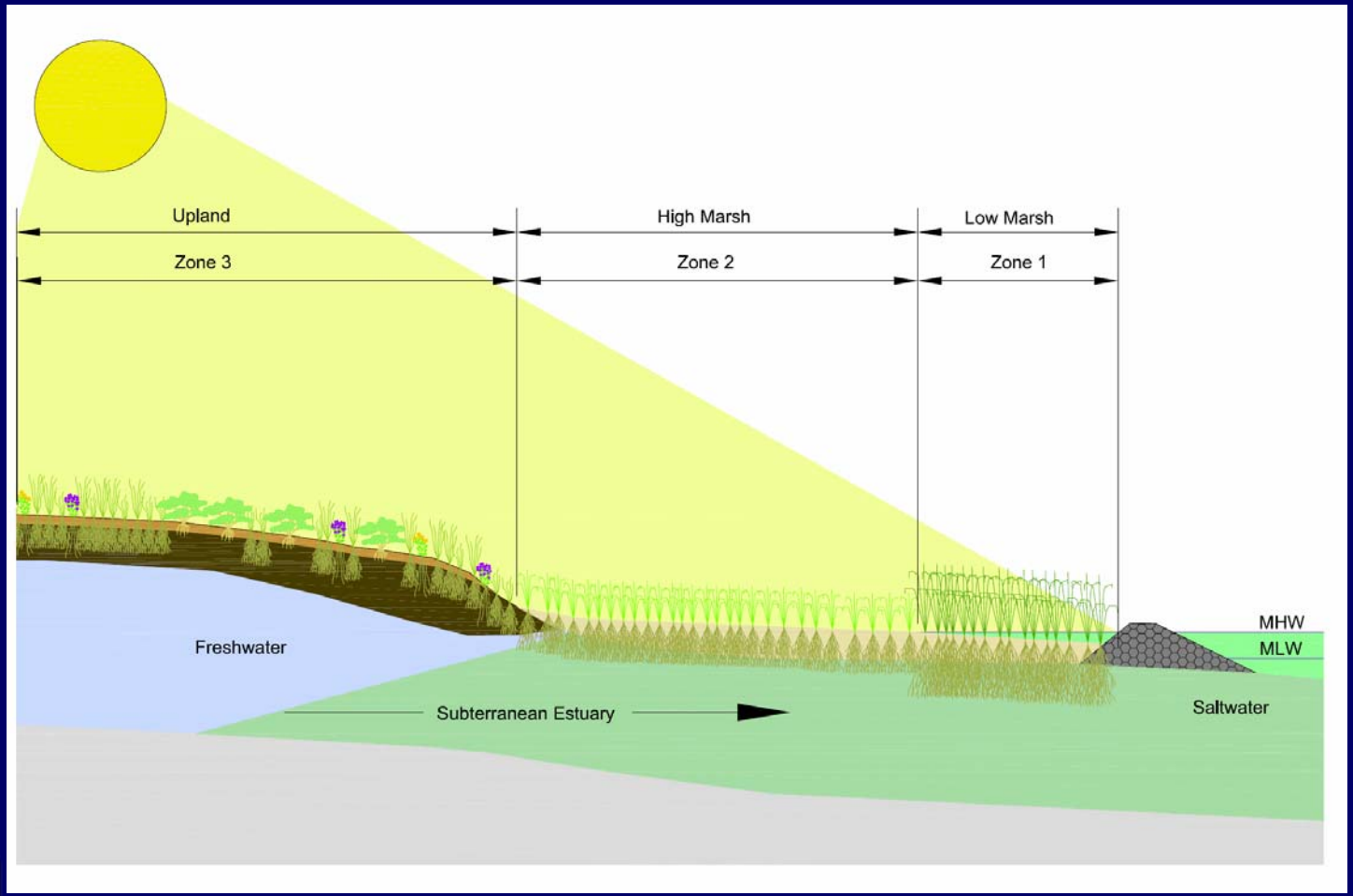
Shoreline Stabilization

- Energy
  - Fetch (Velocity)
  - Mass (Depth)
- **Sunlight**
- Elevation

Shade reduces health and function of marsh plantings



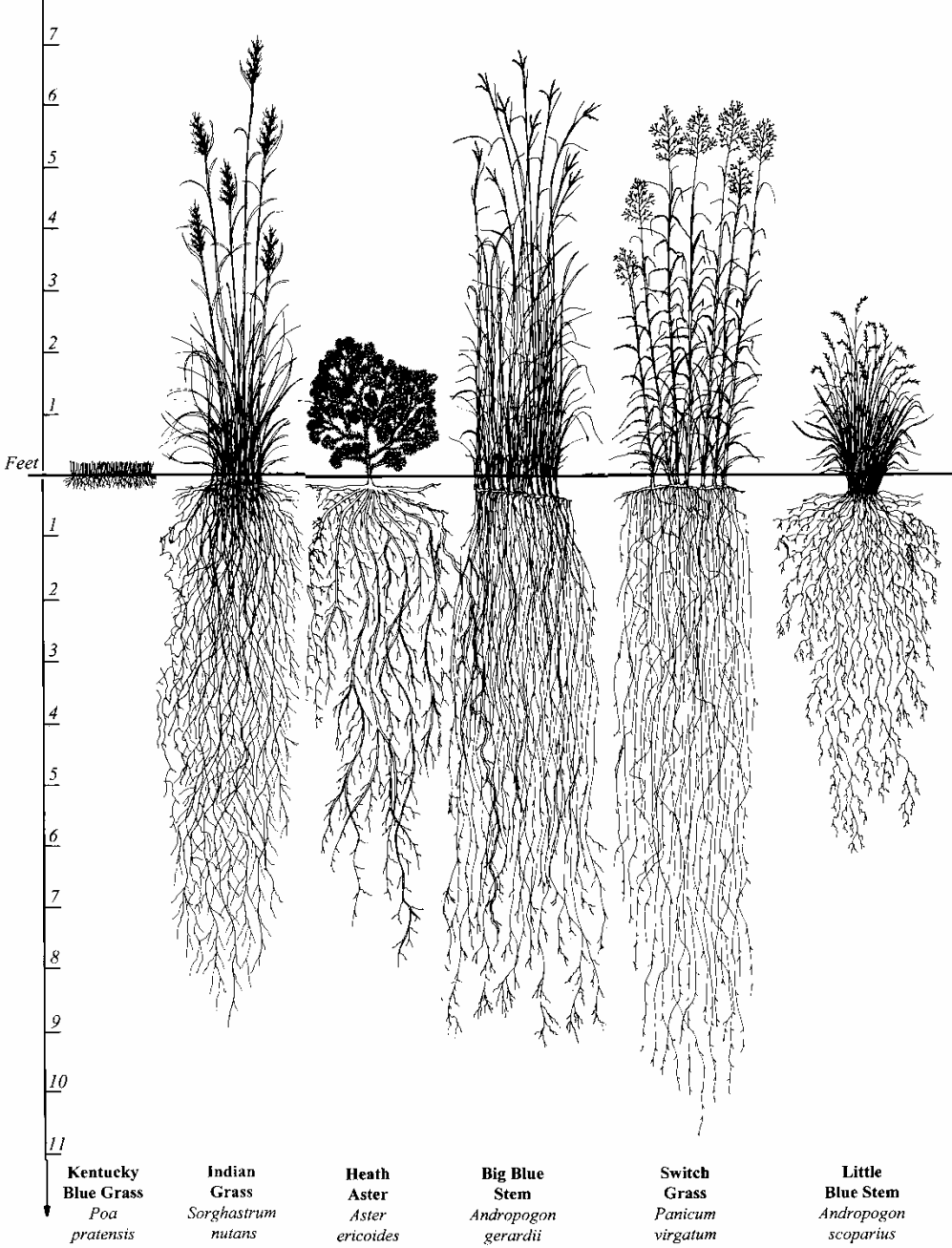
Bayscape shrubs and warm season grasses do not shade marsh



Native Warm Season Grasses

Benefits:

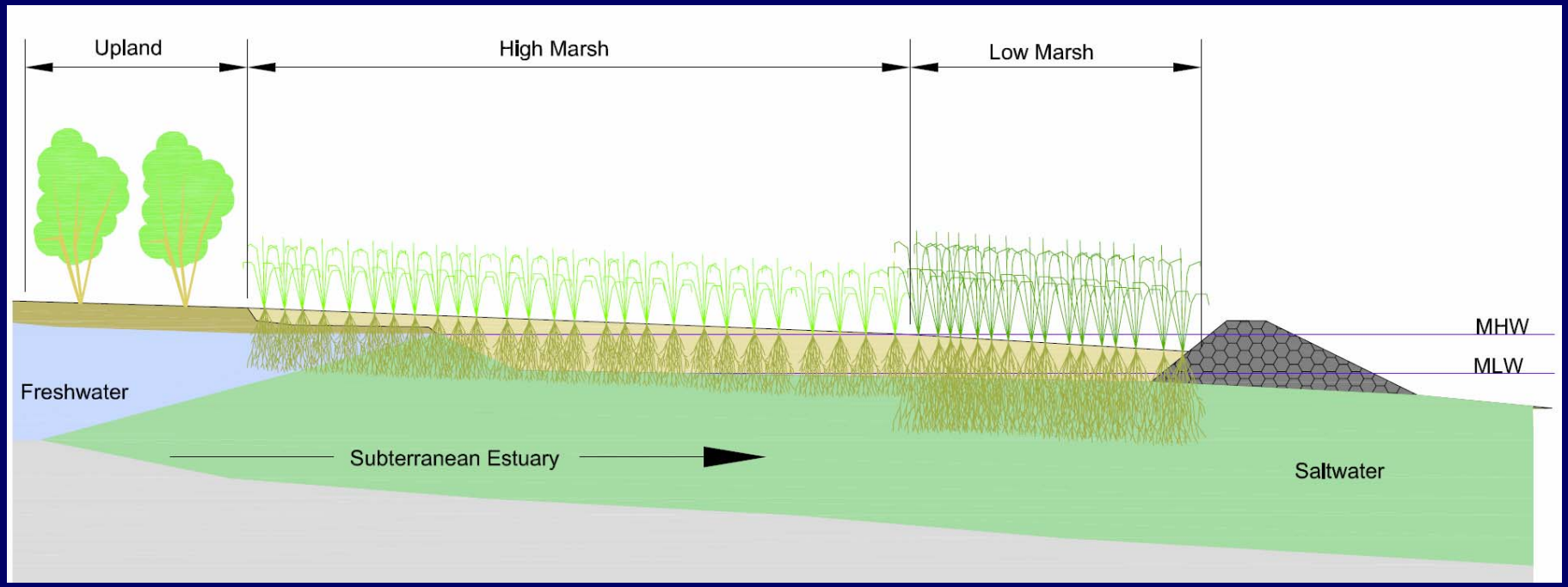
- Stabilizes the soil and controls erosion.
- Reduces sediments, nutrients and other harmful pollutants from runoff entering receiving waters.
- Maintains an area of transitional habitat between aquatic and upland communities
- Provides wildlife habitat.
- Minimizes adverse effects of human activity on tidal waters and aquatic resources.



Shoreline Stabilization

- Energy
  - Fetch (Velocity)
  - Mass (Depth)
- Sunlight
- **Elevation**

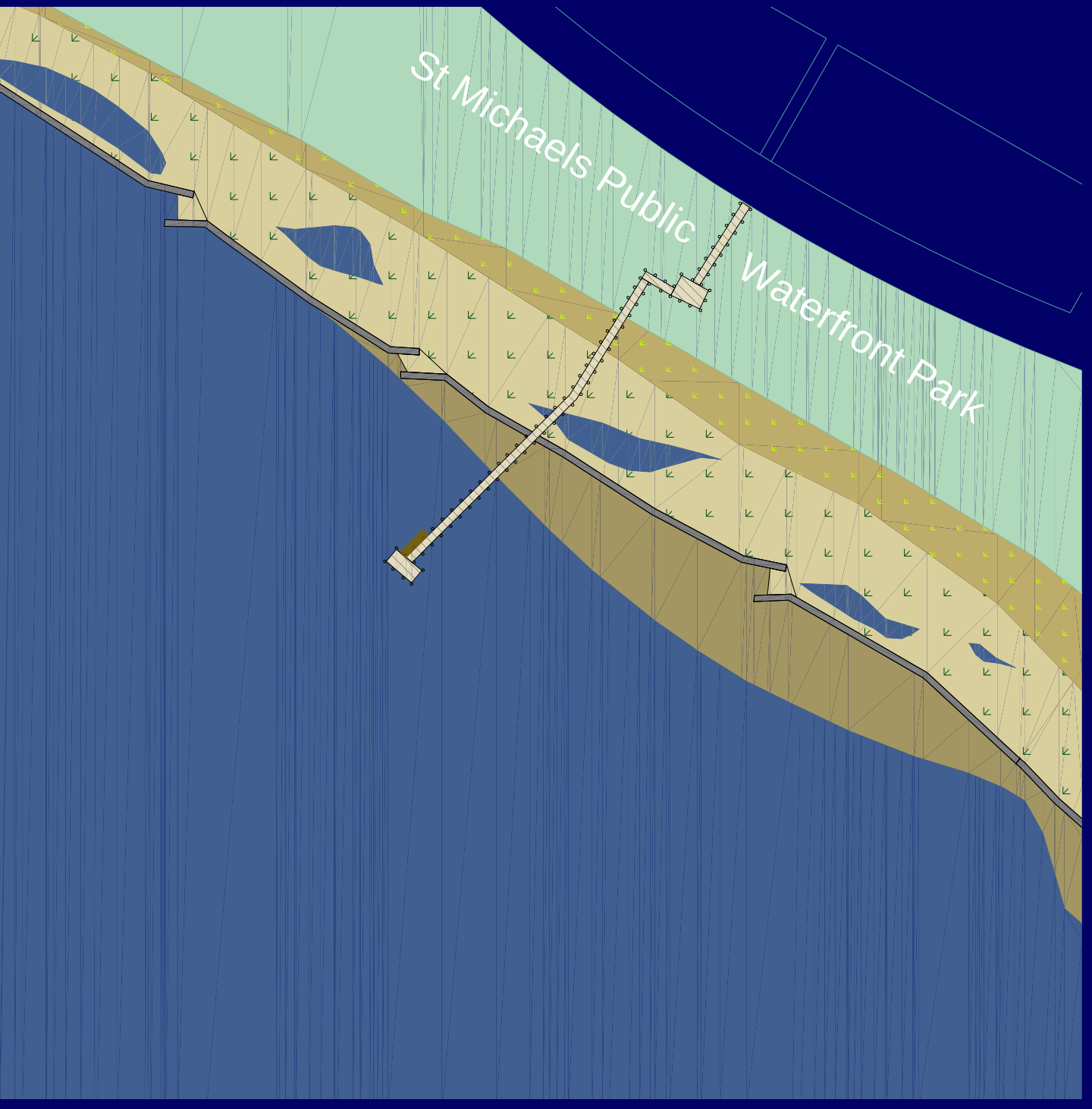
Proper Elevation

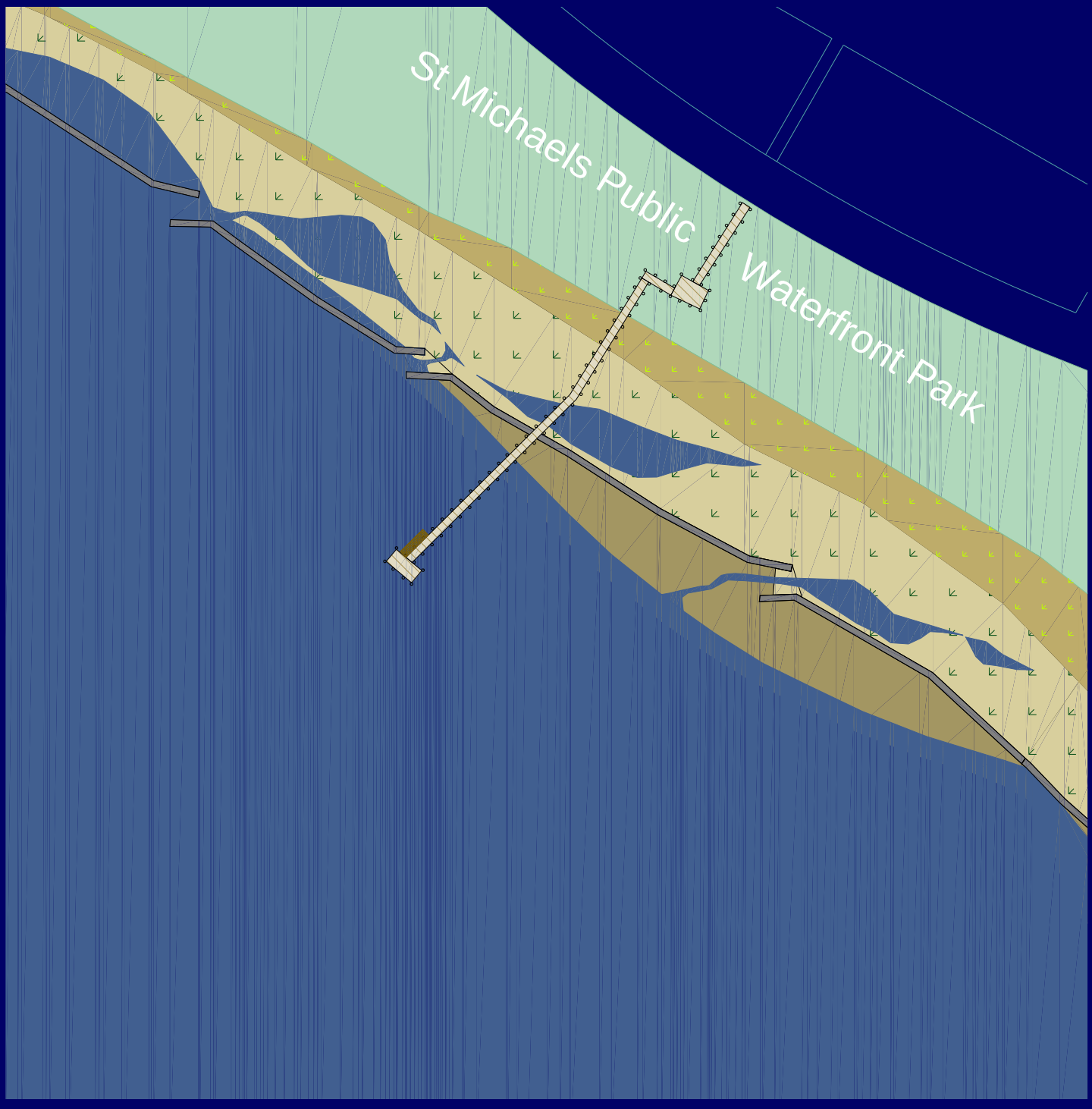


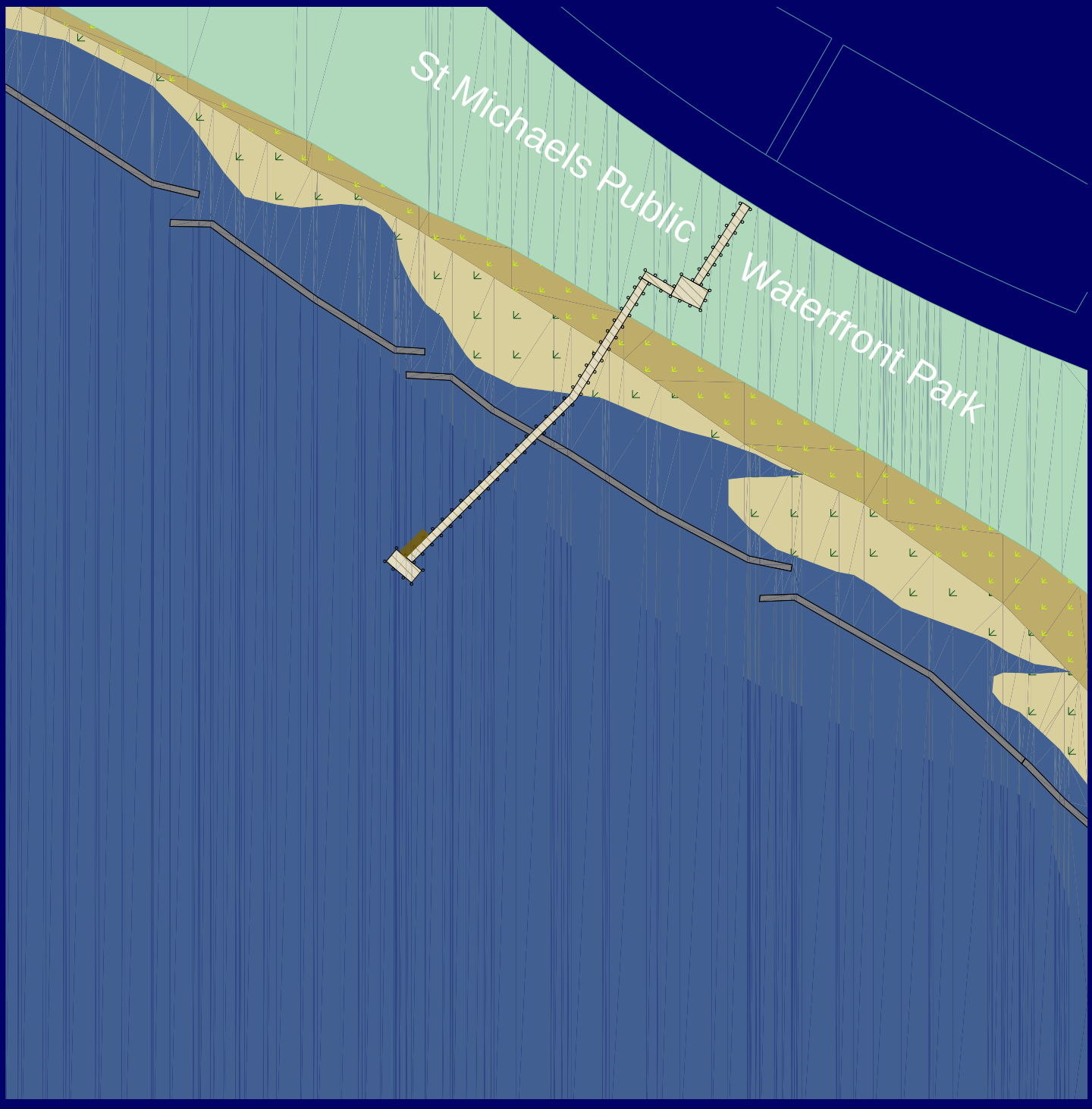
- Low Marsh - *Spartina alterniflora*
- High Marsh – *Spartina patens*
- Upland (Bayscape) – *Panicum virgatum, Morella cerifera*

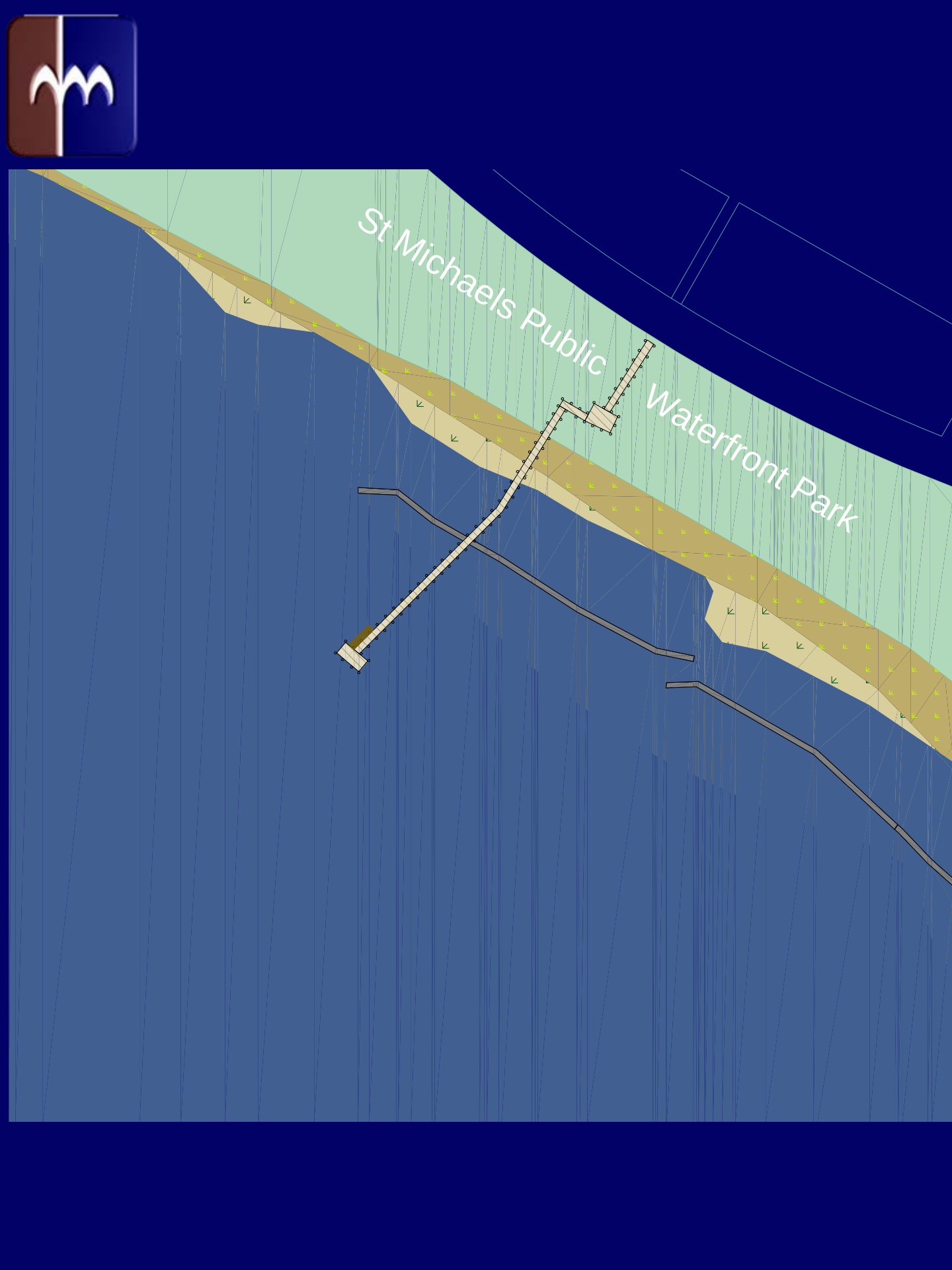
Tidal Flushing

EC 2006


St Michaels Public Waterfront Park


St Michaels Public Waterfront Park


St Michaels Public Waterfront Park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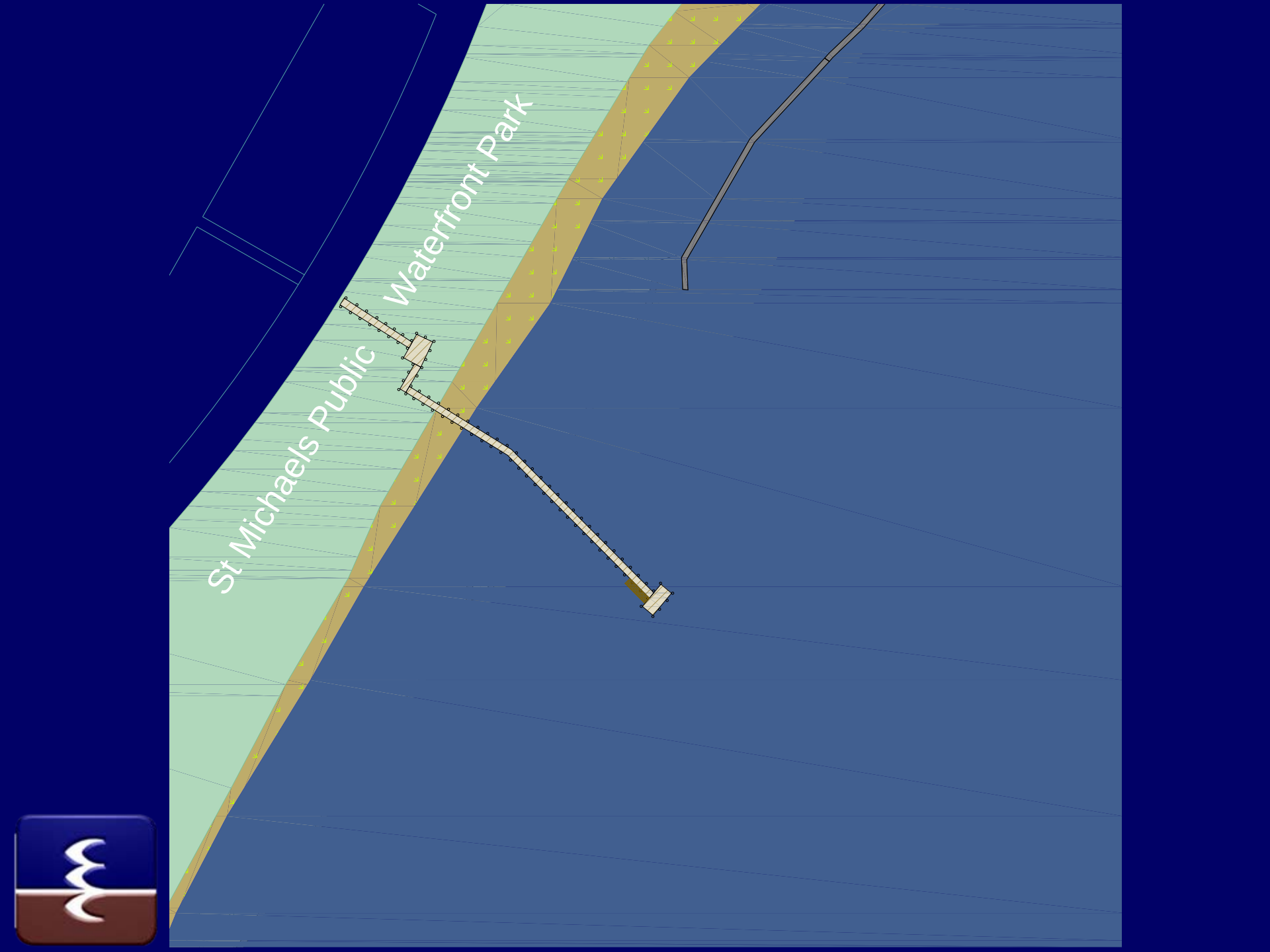
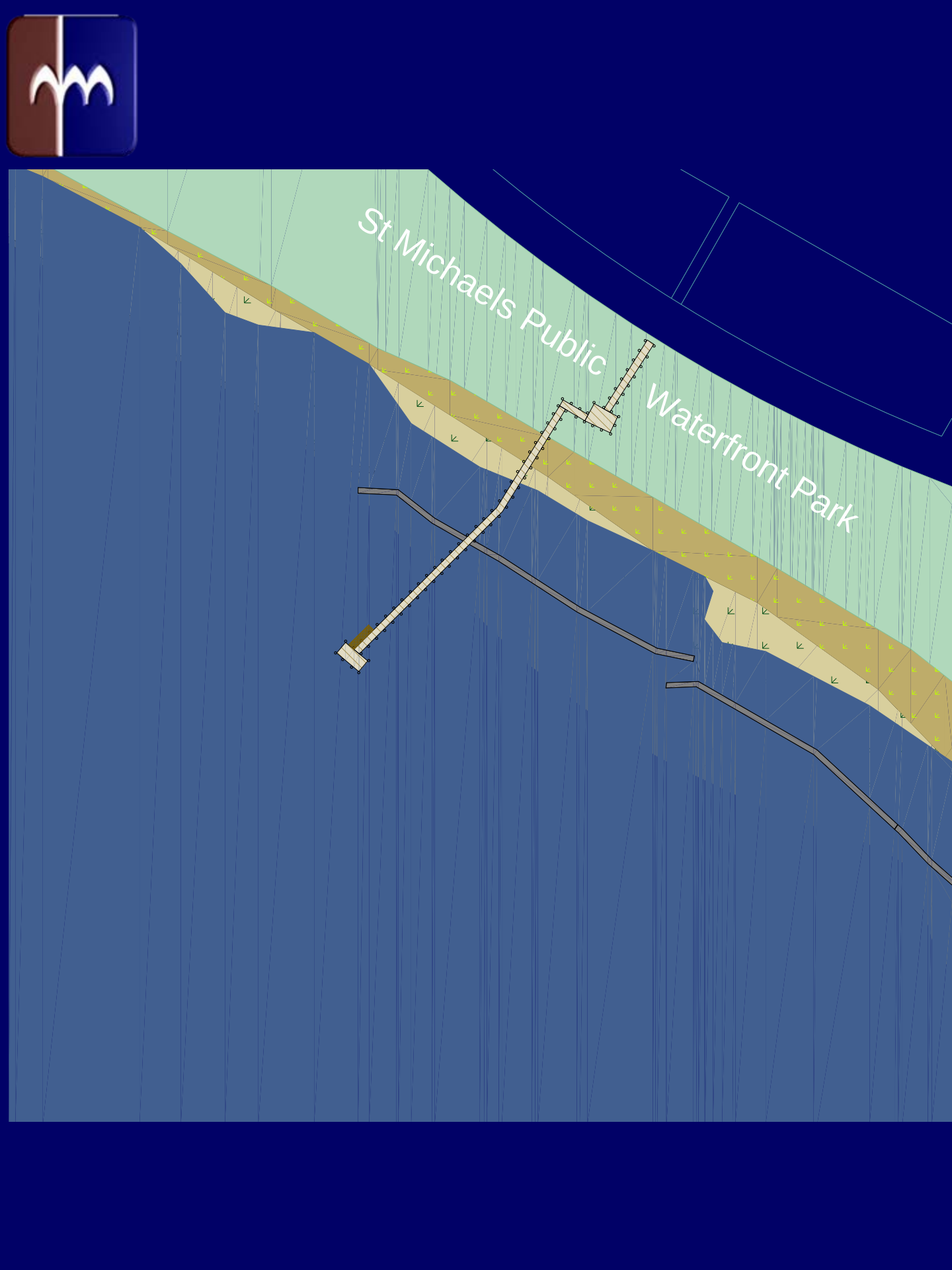

St Michaels Public
Waterfront Park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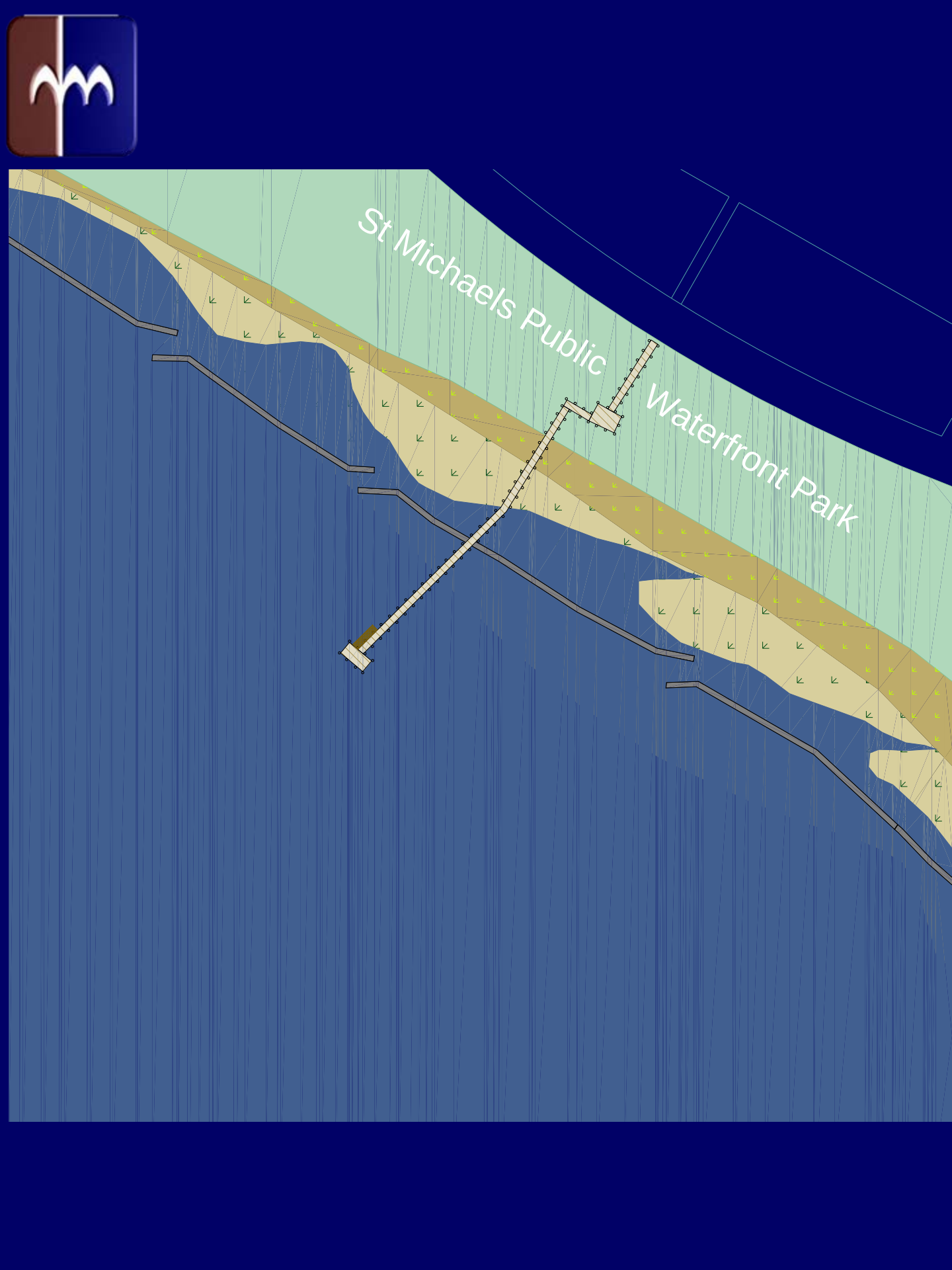
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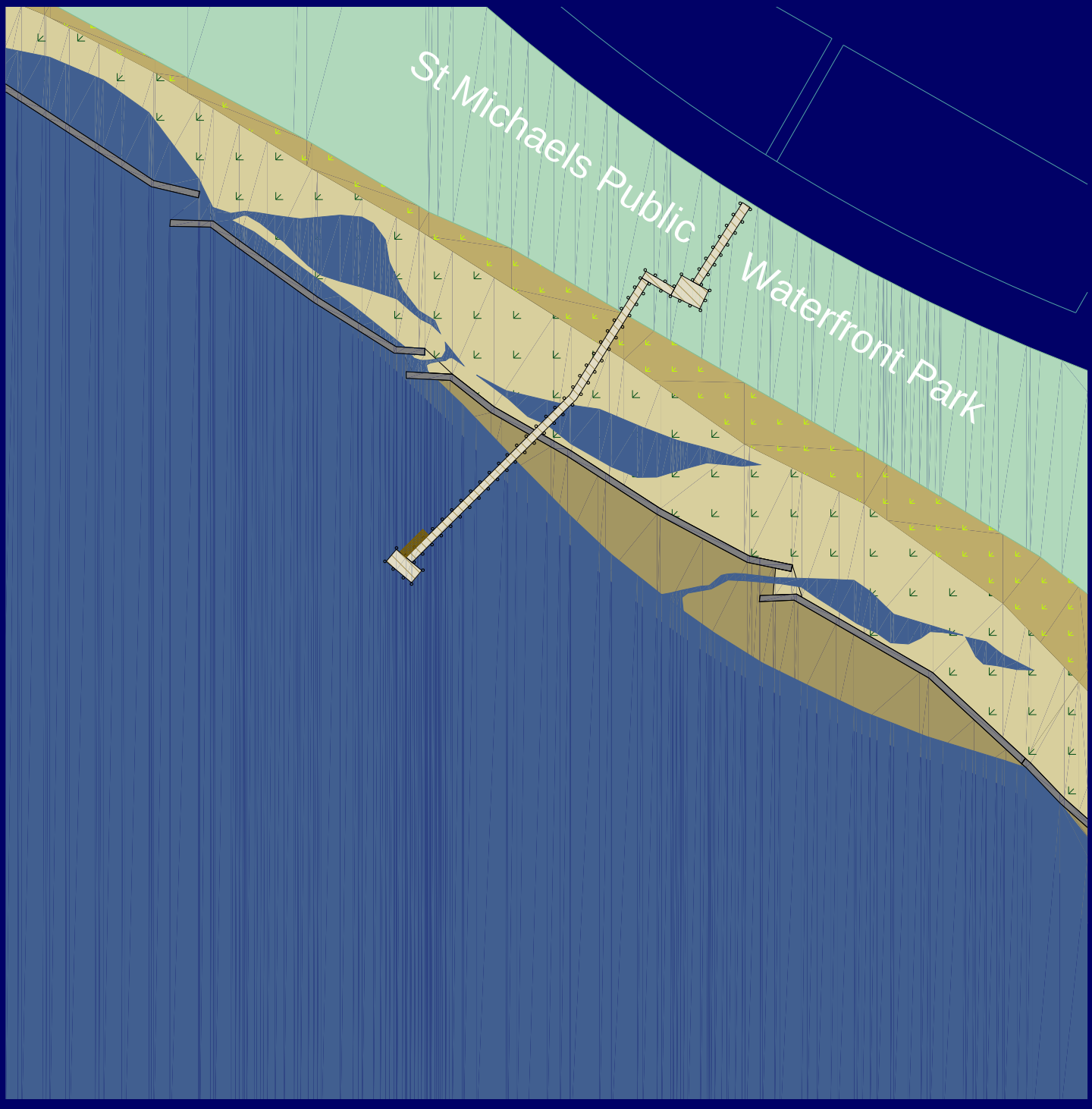
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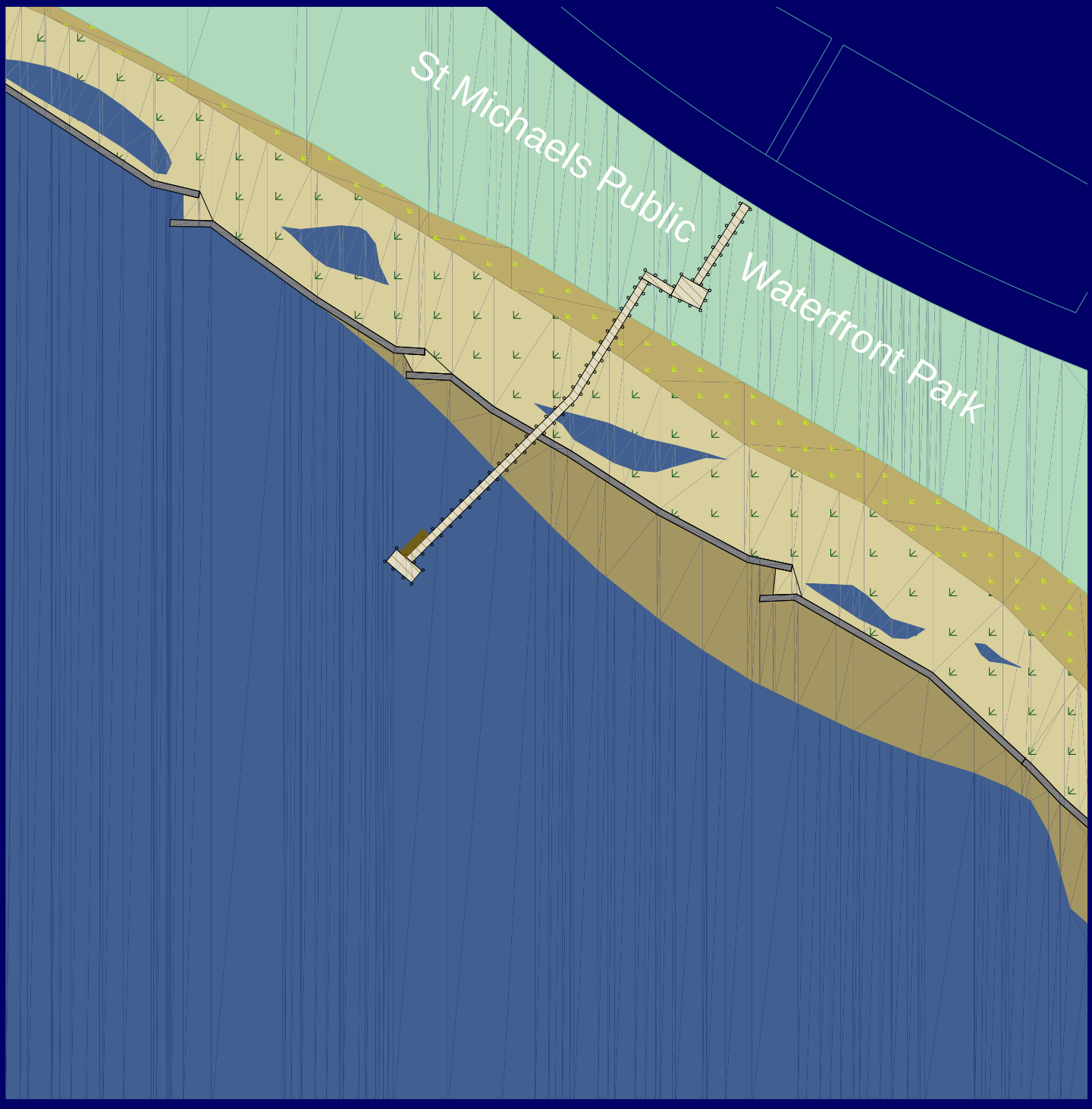
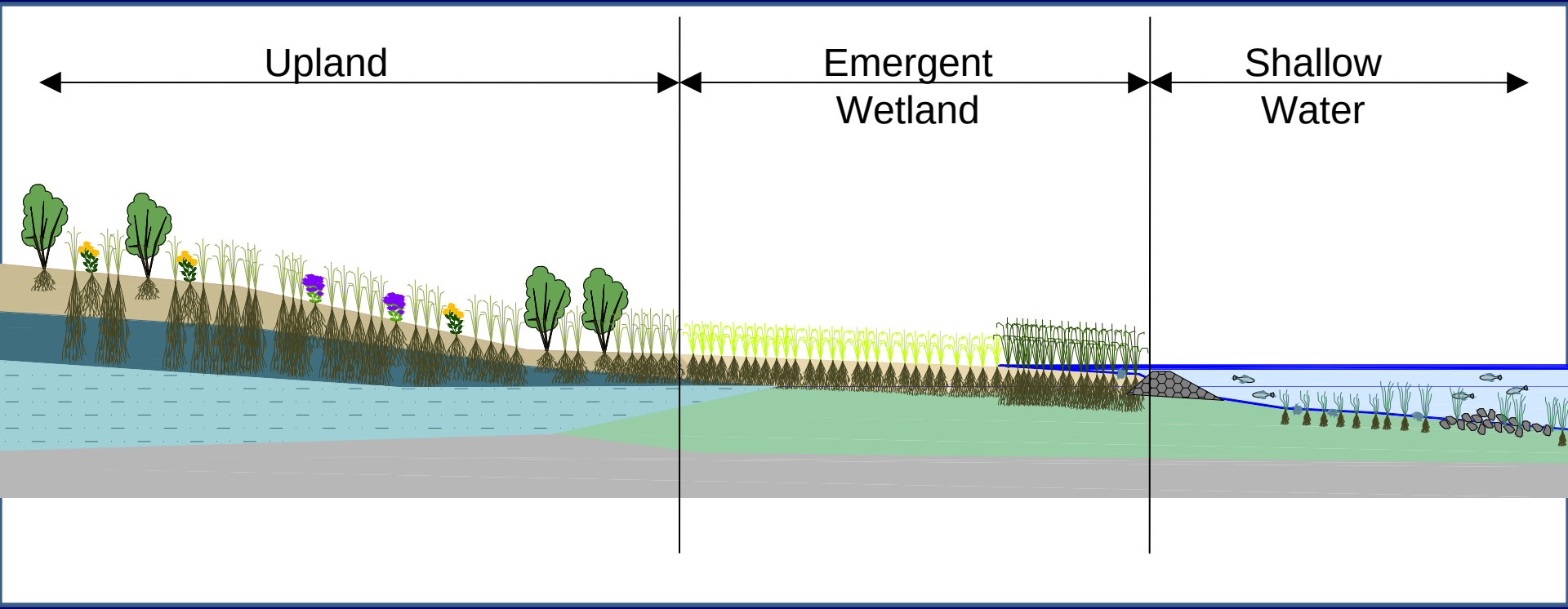
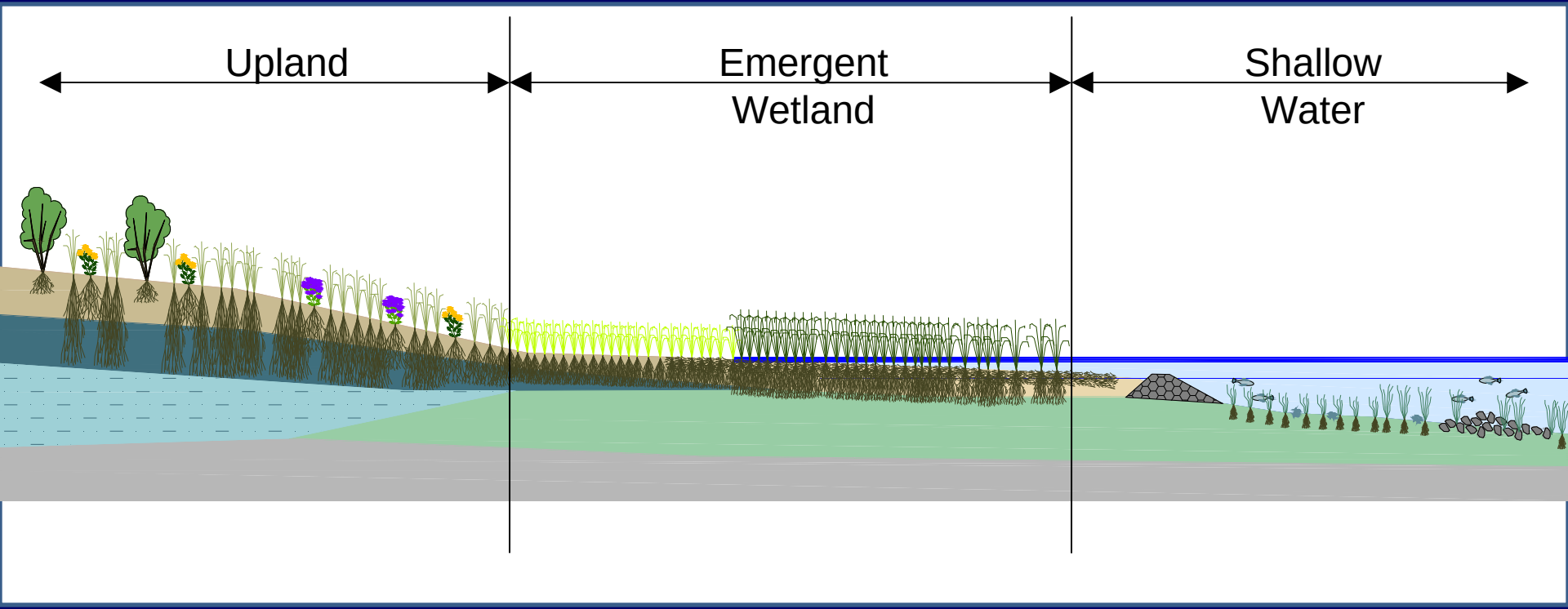

St Michaels Public Waterfront Park

Effect of Sea Level Rise on Living Shorelines



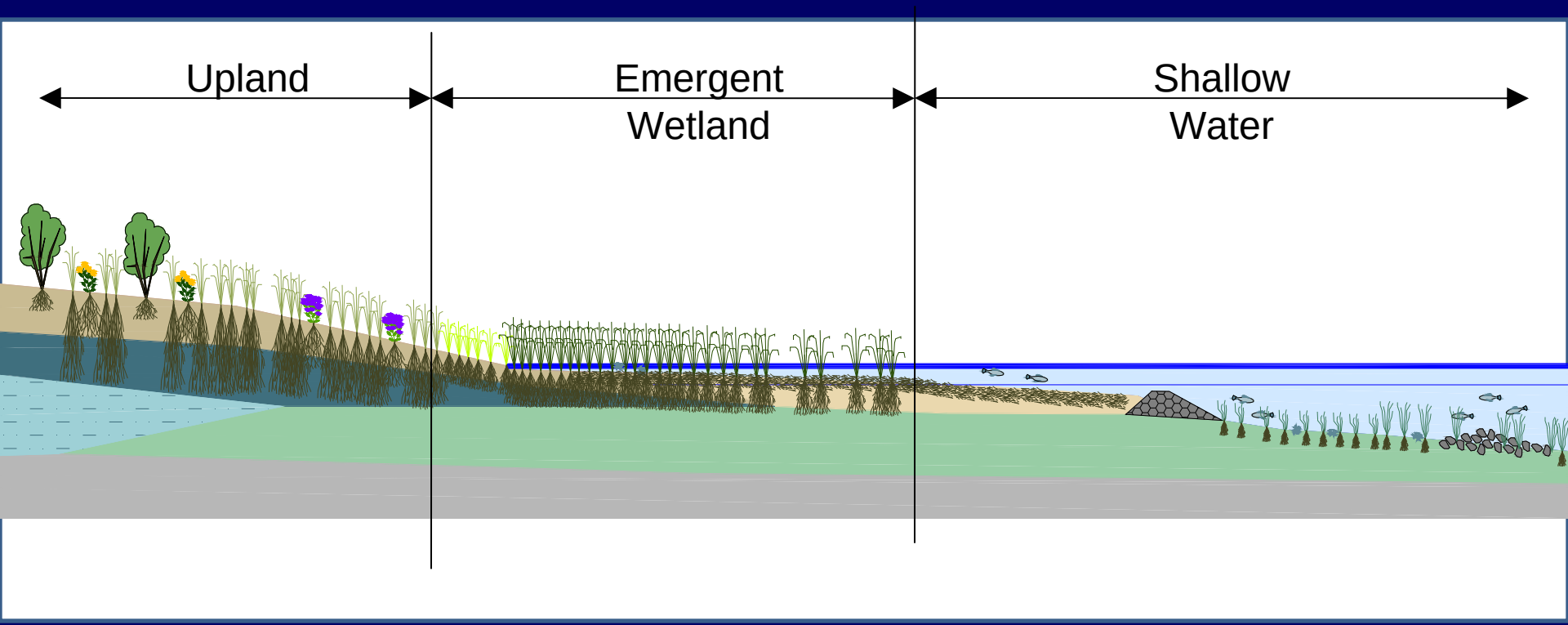
Current

Effect of Sea Level Rise on Living Shorelines



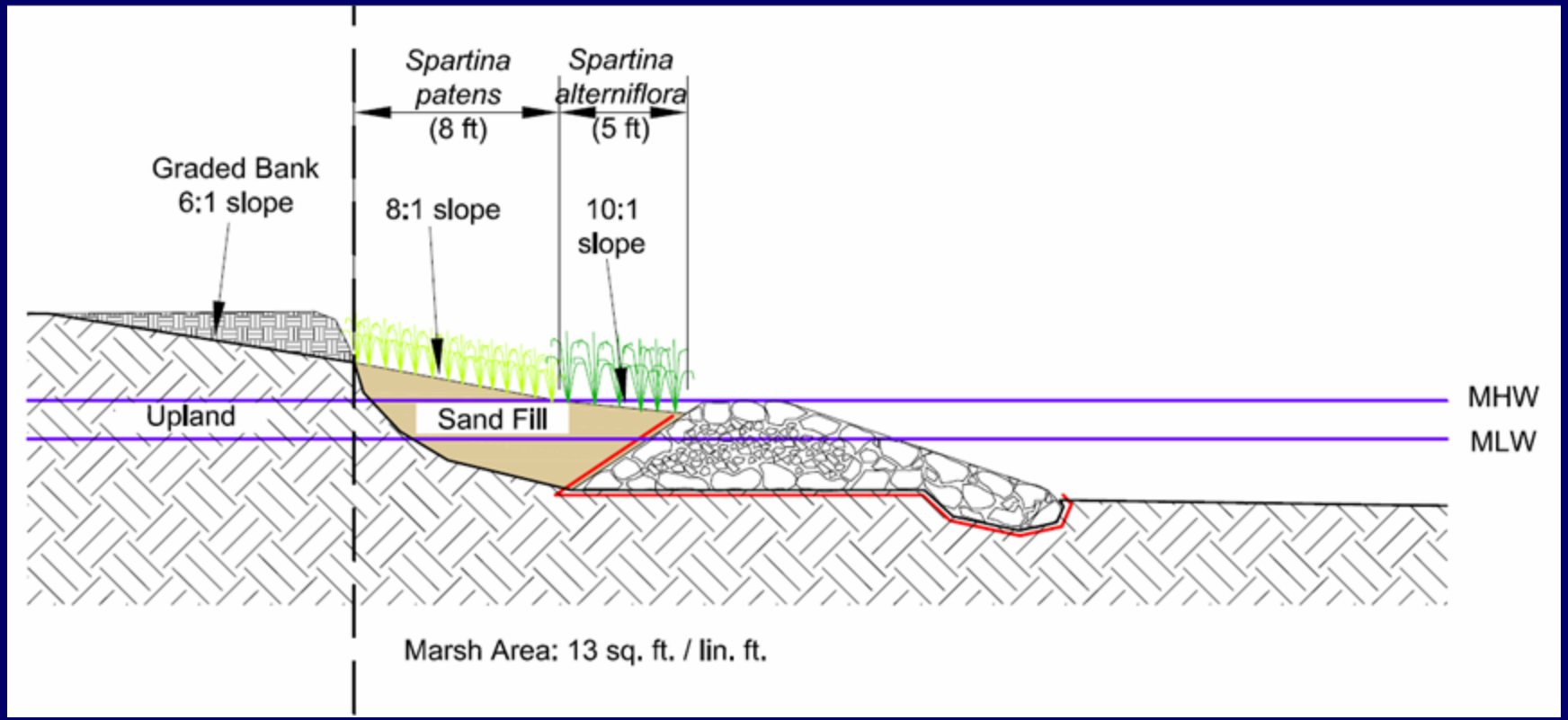
+1 foot

Effect of Sea Level Rise on Living Shorelines

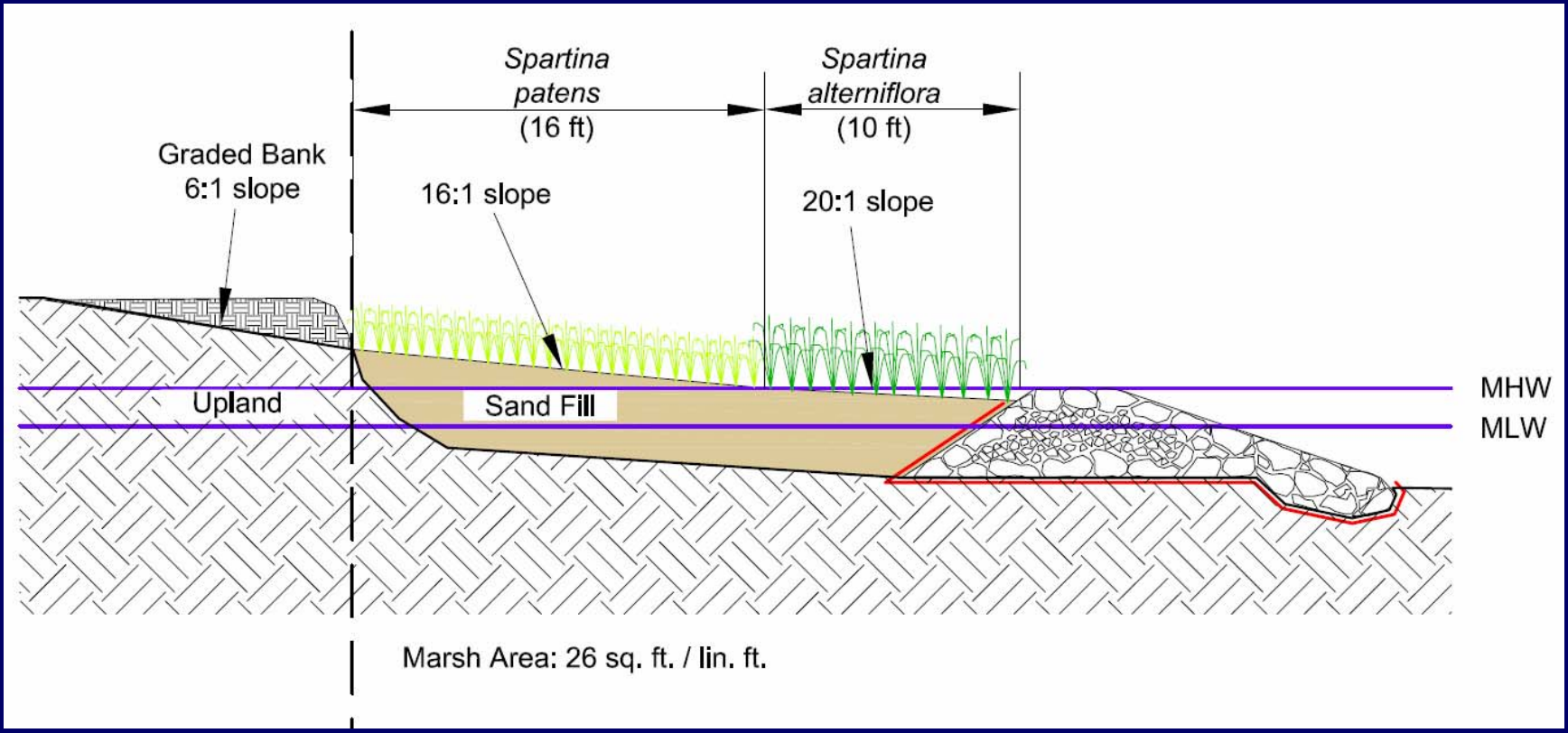


+2 feet

DESIGN CONSIDERATIONS



DESIGN CONSIDERATIONS



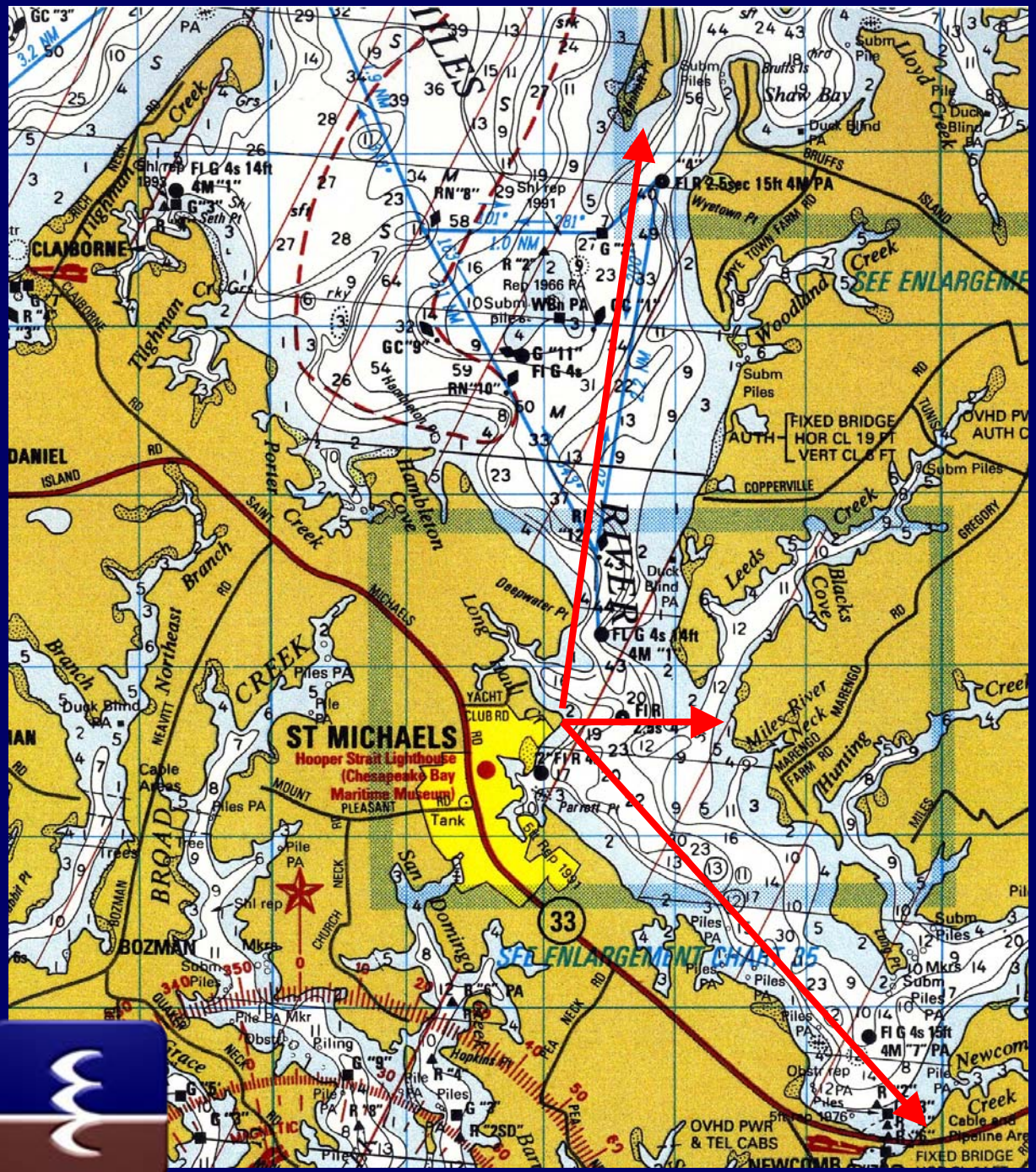
Design Considerations

The reduction in wave height (wave attenuation) and thus the severity of the impact at the upland bank is a function of :

- Interaction with the bottom
- Interaction with the sill structure
- Interaction with marsh vegetation

Miles Point Eroding Bank

01-06



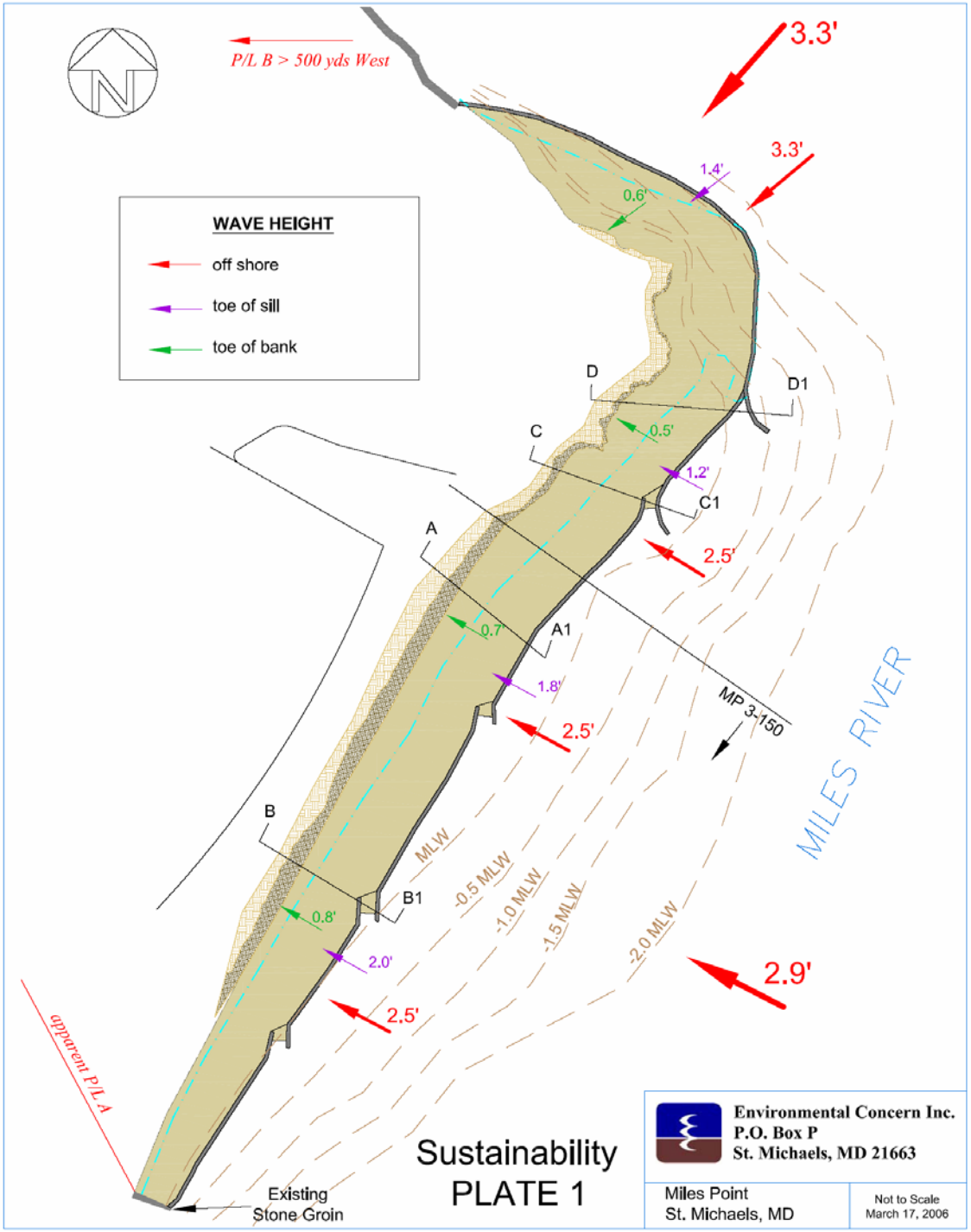
Miles Point

Fetch:

4.3 miles NNE

1.0 mile E

3.4 miles SE


P/L B > 500 yds West
3.3'
3.3'
1.4'
0.6'
WAVE HEIGHT
off shore
toe of sill
toe of bank
D
D1
C
0.5'
1.2'
C1
A
2.5'
0.7'
A1
1.8'
2.5'
MP 3-150
MILES RIVER
B
MLW
-0.5 MLW
-1.0 MLW
-1.5 MLW
-2.0 MLW
B1
0.8'
2.0'
2.5'
2.9'
apparent P/L A
Existing
Stone Groin
Sustainability
PLATE 1
Environmental Concern Inc.
P.O. Box P
St. Michaels, MD 21663
Miles Point
St. Michaels, MD
Not to Scale
March 17, 2006

Design Width & Bank Height

Southerly Section:

- Existing conditions: Erosion is minimal. Bank height +3.0’ MLW. Fetch 3.4 is miles.
- Design: Sill elevation +1.7’ MLW, protective marsh constructed to 55 ft channelward from the existing bank.

Design Width & Bank Height

Middle Section:

- Existing conditions: Erosion is significant. Bank height increases to +7.0’ MLW . Fetch 1 mile.
- Design: Sill elevation +2.5’ to +3.0’ MLW, protective marsh constructed to 90 – 100 ft channelward from the existing bank.

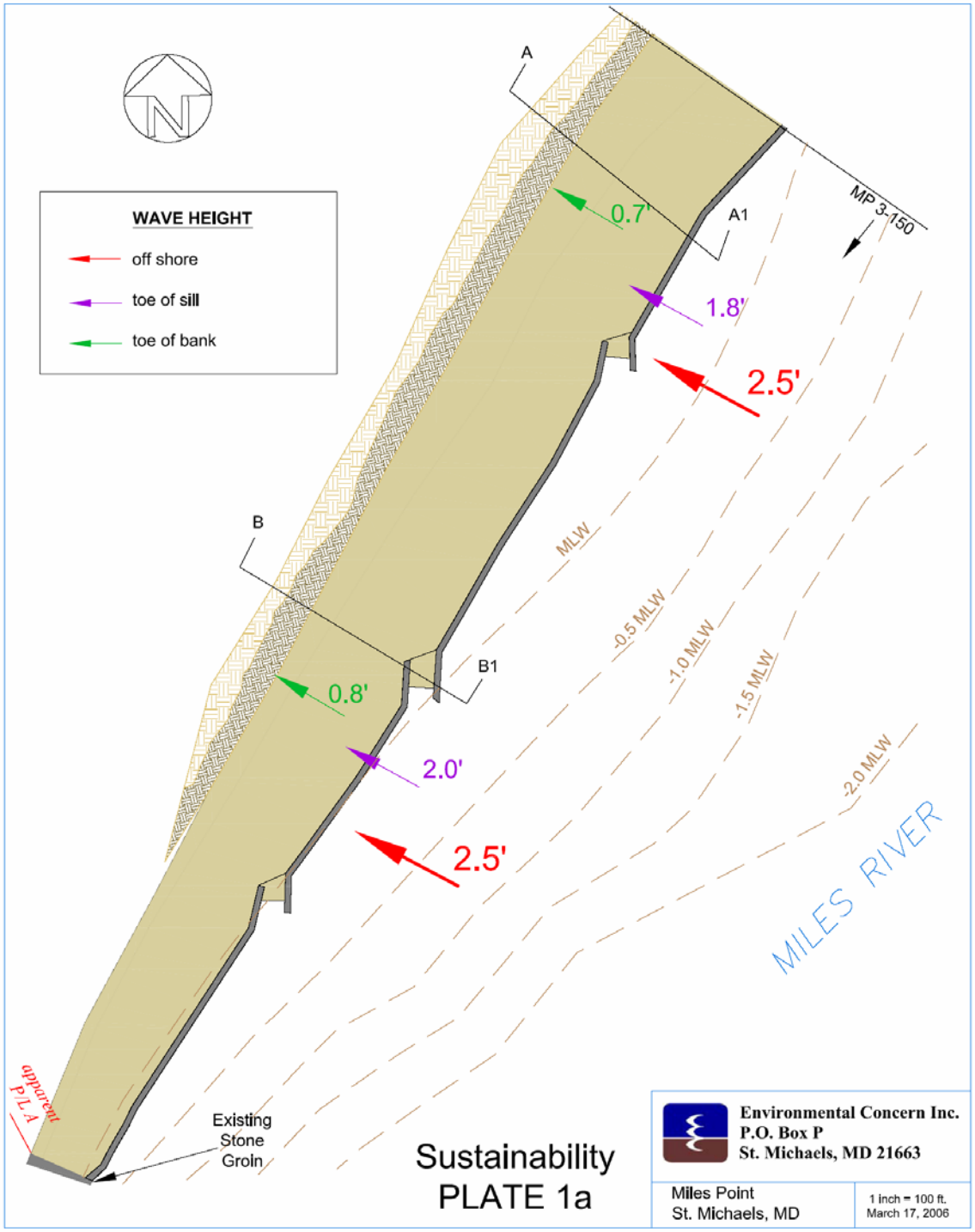
Miles Point E2USN (DNR) at mid tide

01-06

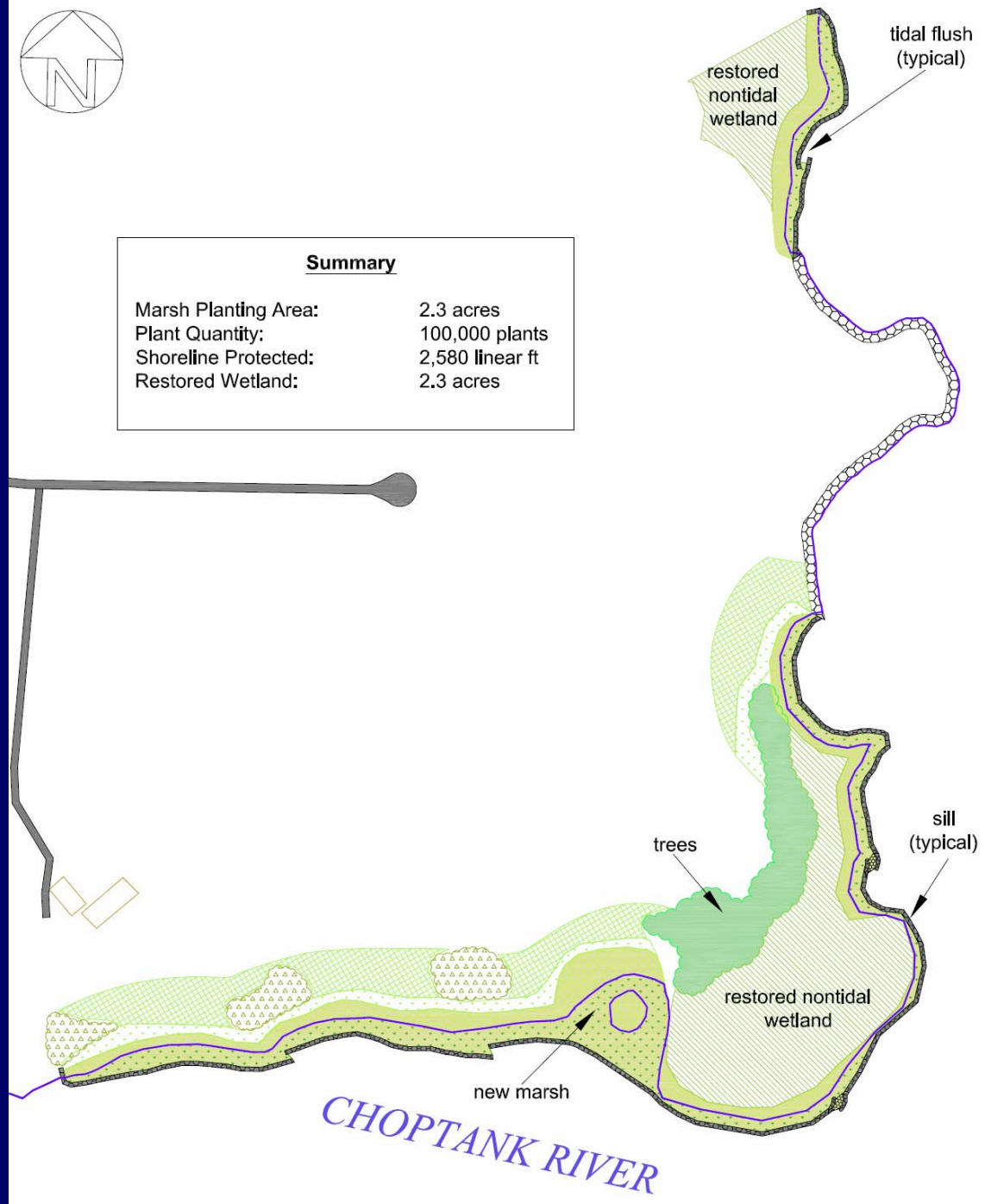
Design Width & Bank Height

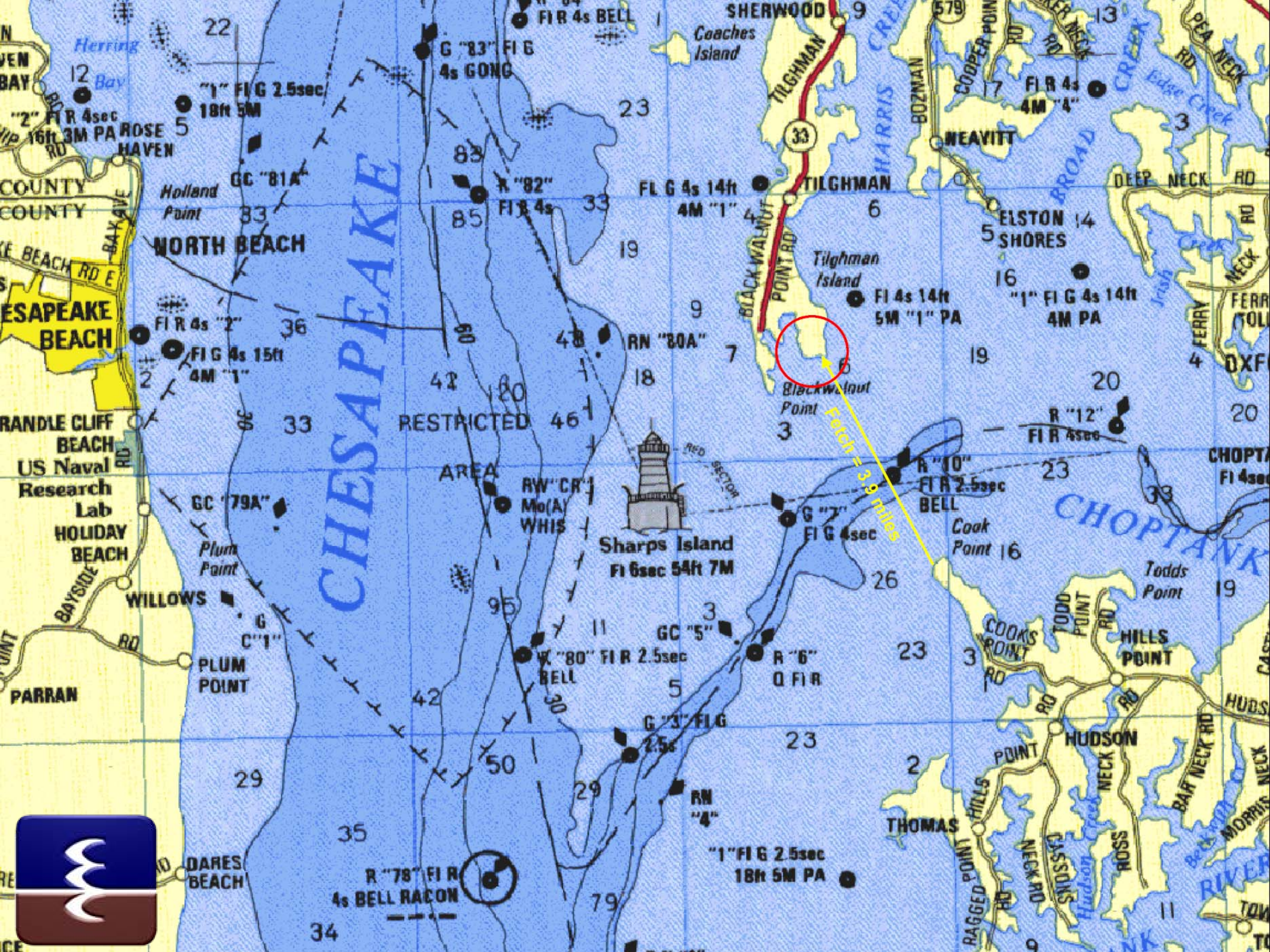
Northerly Section:

- Existing conditions: Severe erosion, Bank height +8.0’ MLW on average. Fetch is 4.3 miles.
- Design: Sill elevation +3.0’ to +3.8’ MLW, protective marsh constructed to 100 – 110 ft channelward from the existing bank.


WAVE HEIGHT
off shore
toe of sill
toe of bank
A
A1
B
B1
MP 3-150
0.7'
1.8'
2.5'
0.8'
2.0'
2.5'
MLW
-0.5 MLW
-1.0 MLW
-1.5 MLW
-2.0 MLW
MILES RIVER
apparent P/L A
Existing Stone Groin
Sustainability
PLATE 1a
Environmental Concern Inc.
P.O. Box P
St. Michaels, MD 21663
Miles Point
St. Michaels, MD
1 inch = 100 ft.
March 17, 2006


Tilghman Island Farm
Living Shoreline –
Tidal Marsh Creation: 2.3 acres
Biomass: 100,000 plugs – Spartina alterniflora/patens
Living Shoreline: 2,580 lin.ft.


tidal flush
(typical)
restored
nontidal
wetland
Summary
Marsh Planting Area: 2.3 acres
Plant Quantity: 100,000 plants
Shoreline Protected: 2,580 linear ft
Restored Wetland: 2.3 acres
sill
(typical)
trees
restored nontidal
wetland
new marsh
CHOPTANK RIVER

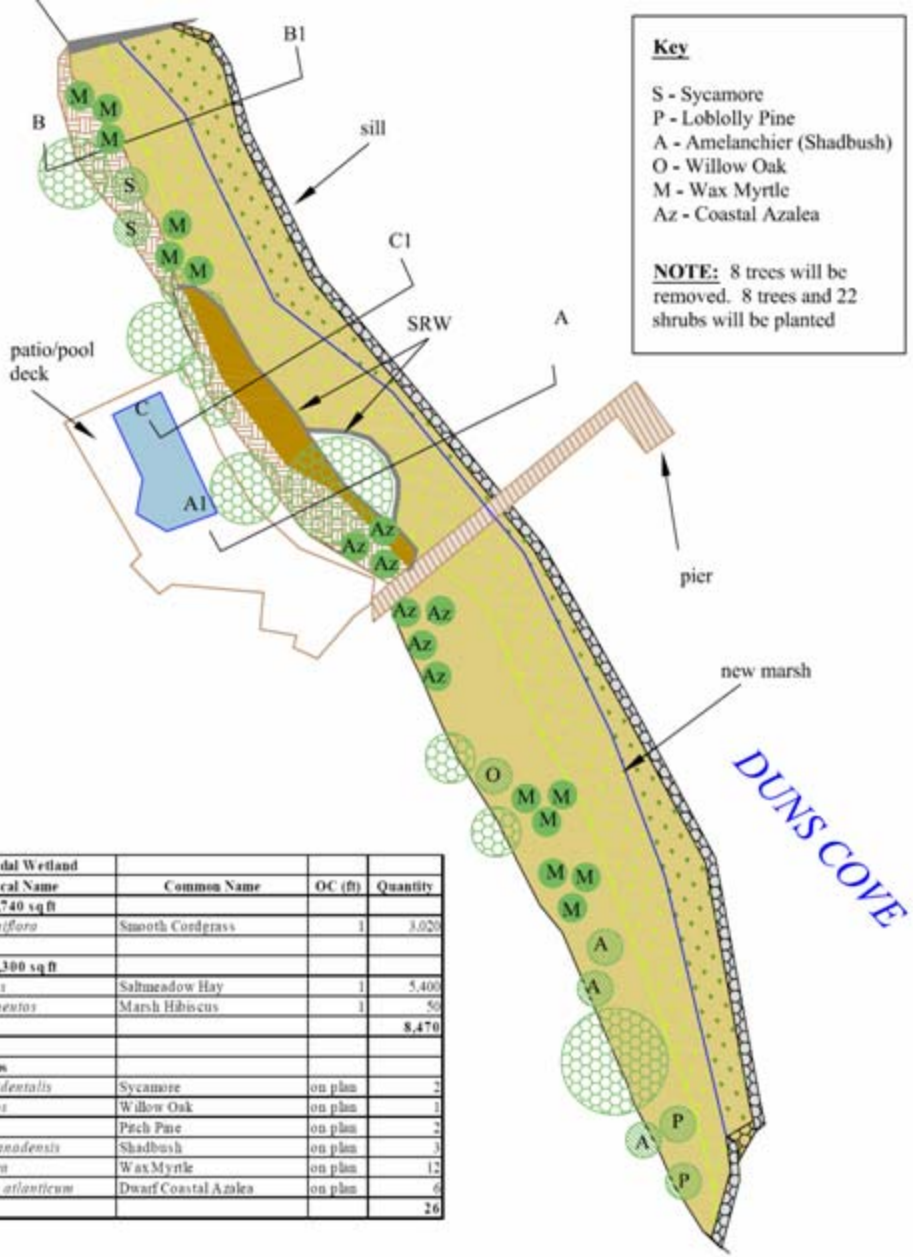


CHESAPEAKE
CHOPTANK
RESTRICTED AREA
Sharps Island
Fl 6sec 54ft 7M
Fetch = 3.9 miles
Tilghman Island
Blackwalnut Point
Cook Point
Todds Point
Coaches Island
Herring Bay
Holland Point
NORTH BEACH
CHESAPEAKE BEACH
US Naval Research Lab
HOLIDAY BEACH
Plum Point
WILLOWS
PLUM POINT
PARRAN
DARES BEACH
SHERWOOD
TILGHMAN
NEAVITT
ELSTON SHORES
HUDSON
HILLS POINT
COOKS POINT
THOMAS
ROSE HAVEN
G "83" Fl G 4s GONG
"1" Fl G 2.5sec 16ft 5M
GC "81A"
R "82" Fl R 4s
Fl G 4s 14ft 4M "1"
Fl 4s 14ft 5M "1" PA
"1" Fl G 4s 14ft 4M PA
Fl R 4s 4M "4"
RN "80A"
RW "CR" Mo(A) WHIS
GC "79A"
G "7" Fl G 4sec
R "10" Fl R 2.5sec BELL
R "12" Fl R 4sec
GC "5"
R "6" Q Fl R
R "80" Fl R 2.5sec BELL
G "3" Fl G 2.5s
RN "4"
"1" Fl G 2.5sec 18ft 5M PA
R "78" Fl R 4s BELL RACON
Fl R 4s "2"
Fl G 4s 15ft 4M "1"


POSI-TRACK


KOMATSU
PC 200 LC
KOMATSU


KOMATSU
PC 200 LC
HDR 40



Constructed Tidal Wetland			
Botanical Name	**Common Name**	**OC (ft)**	**Quantity**
Low Marsh: 2,740 sq ft			
Spartina alterniflora	Smooth Cordgrass	1	3,020
High Marsh: 5,300 sq ft			
Spartina patens	Saltmeadow Hay	1	5,400
Hibiscus moscheutos	Marsh Hibiscus	1	50
			8,470
Trees & Shrubs			
Plantanus occidentalis	Sycamore	on plan	2
Quercus phellos	Willow Oak	on plan	1
Pinus rigida	Pitch Pine	on plan	2
Amelanchier canadensis	Shadbush	on plan	3
Morella cerifera	Wax Myrtle	on plan	12
Rhododendron atlanticum	Dwarf Coastal Azalea	on plan	6
			26

PLATE 2a - Revision
Shoreline Stabilization & Buffer Management


ENVIRONMENTAL
CONCERN
KX161-3


Goldsborough Creek
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AERIAL PHOTOGRAPHY


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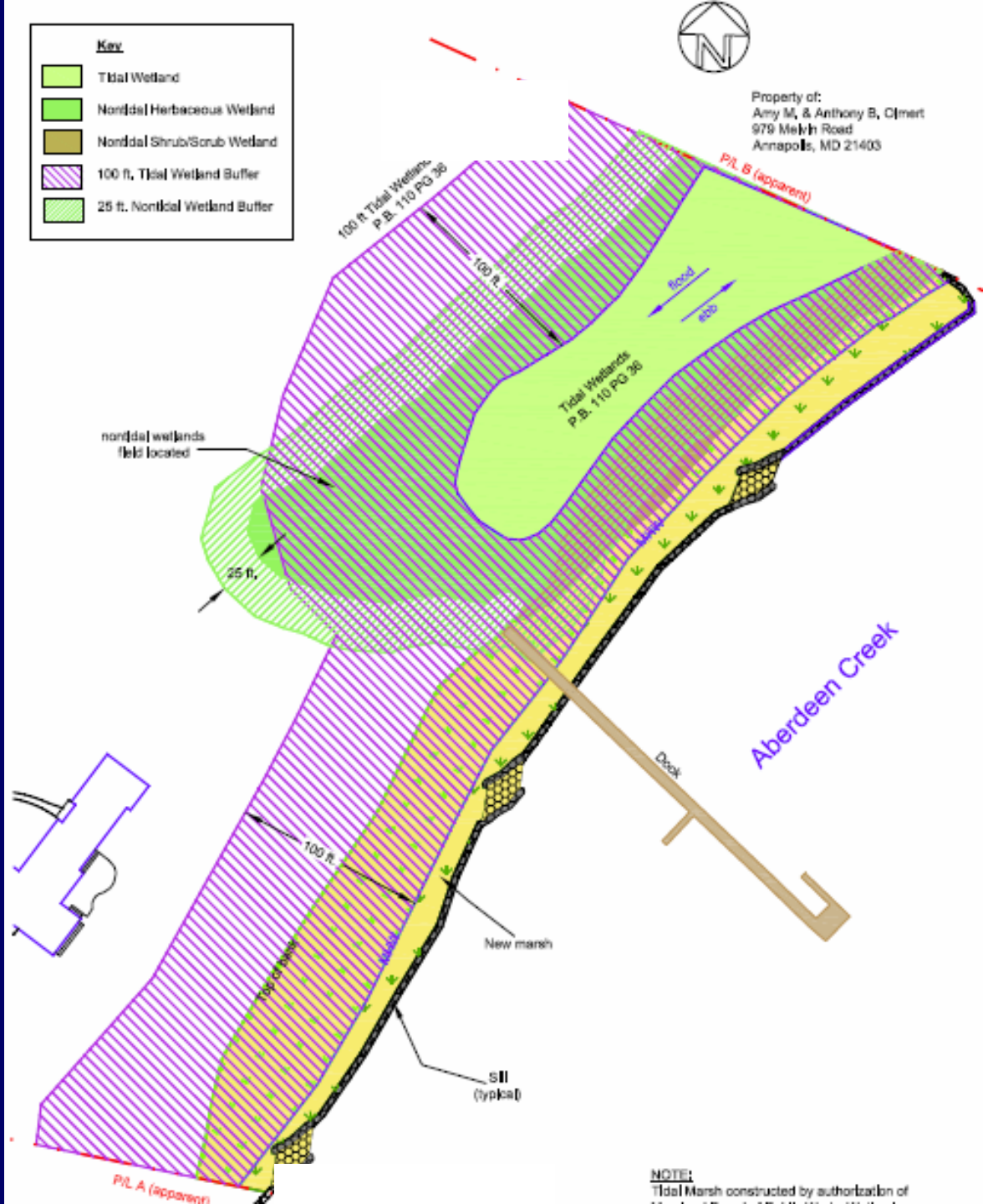
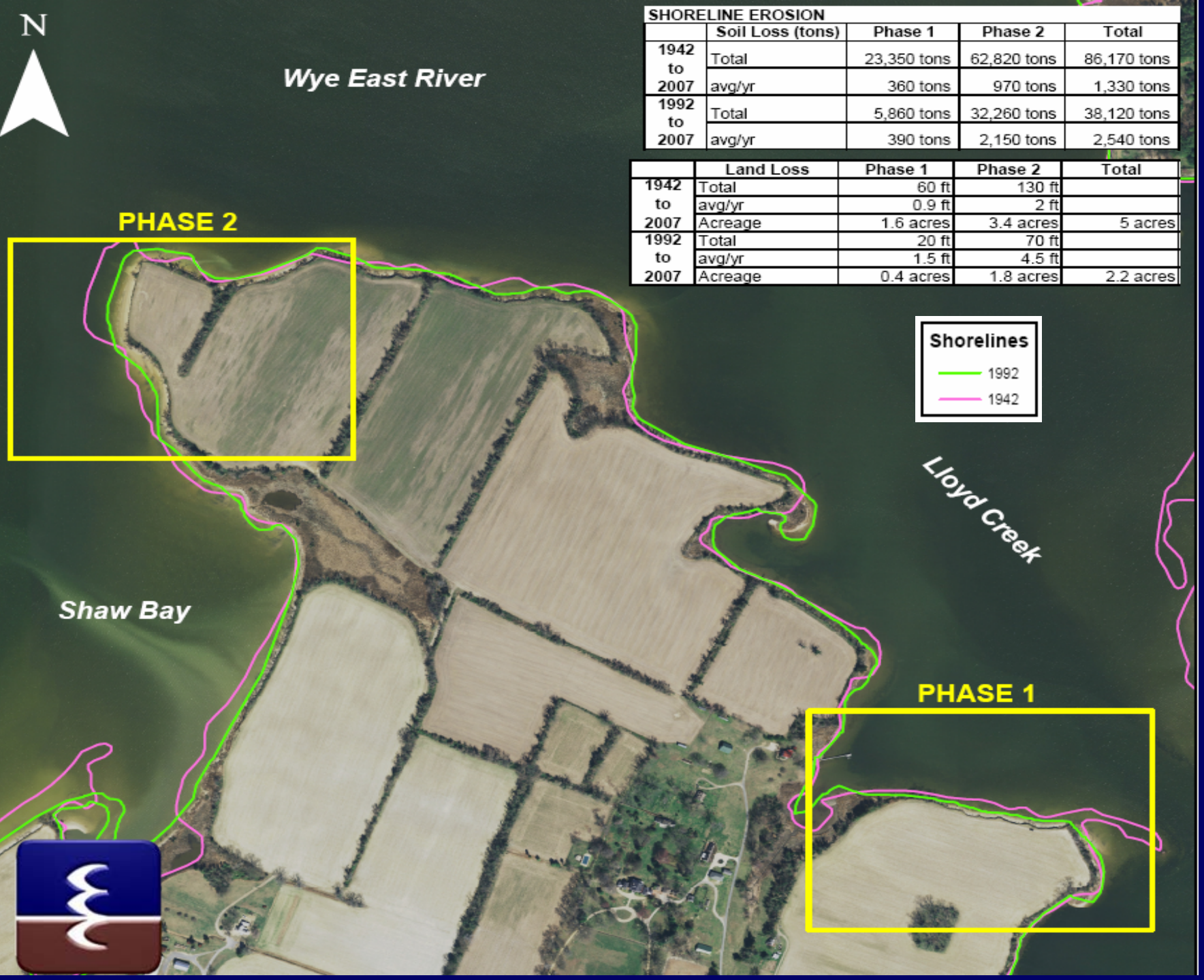
Aberdeen Creek





SHORELINE EROSION

	Soil Loss (tons)	Phase 1	Phase 2	Total
1942 to 2007	Total	23,350 tons	62,820 tons	86,170 tons
	avg/yr	360 tons	970 tons	1,330 tons
1992 to 2007	Total	5,860 tons	32,260 tons	38,120 tons
	avg/yr	390 tons	2,150 tons	2,540 tons

	Land Loss	Phase 1	Phase 2	Total
1942 to 2007	Total	60 ft	130 ft	
	avg/yr	0.9 ft	2 ft	
	Acreage	1.6 acres	3.4 acres	5 acres
1992 to 2007	Total	20 ft	70 ft	
	avg/yr	1.5 ft	4.5 ft	
	Acreage	0.4 acres	1.8 acres	2.2 acres