Creating Living Shorelines – Using Natural Solutions to Build Resilience

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MassBays Lower North Shore Regional Coordinator

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Climate Change Vulnerability Assessment & Adaptation Plan

Focused on 5 Sectors

- Critical building infrastructure

- Drinking water

- Energy

- Stormwater

- Transportation

- Vulnerable populations

Climate Change Vulnerability Assessment & Adaptation Plan

Focused on 5 Sectors

READY FOR TOMORROW

THE CITY OF SALEM CLIMATE CHANGE VULNERABILITY ASSESSMENT & ADAPTATION PLAN
December 2014

NOT THE NATURAL COASTLINE

- Critical building infrastructure

- Drinking water

- Energy

- Stormwater

- Transportation

- Vulnerable populations

Storm Surge Transportation Map

City of Salem's Climate Change Vulnerability & Adaptation Plan 2014

City of Salem Awarded

Massachusetts Coastal Zone Management
Green Infrastructure for Coastal Resilience

Financial & Technical Resources
to advance understanding & implementation
of natural approaches to
**mitigate coastal erosion
& flooding problems**

December 2014 – June 2016

Julia Knisel - Coastal Shoreline and Floodplain Manager

Jeff Ellie – Overseeing grant for the City
Energy and Sustainability Manager, Department of Planning and Community Development

Hardened Shorelines – Sea Walls, Revetments

- Erosion continues

- Cuts off sediment source

- Causes scouring

- Can be overtopped

Revetment - a facing of sloping stone
or other material

Sea Wall – a shore-parallel vertical structure
(often concrete or stone)

Collins Cove – Szetela Lane

Sea Walls – Hardened Shorelines

- Require monitoring
- Costly to maintain – 2013 reconstruction estimate ~ $4.3 million!
  upgrade estimate ~ $8.5 million!

Collins Cove – Szetela Lane

Alternative!

Living Shoreline Installations

= **Natural "Green" Infrastructure**

- Alternatives or enhancements to bulkheads, seawalls, or revetments

- Goal to create a more stable shoreline –

  resistant to erosion and flooding

- Introduction of a naturalized edge using plants, sand/soil, and the limited use of hard structures

  - **Preserve, create, or enhance coastal habitats**

  - **Improve water quality**

  - **Reduce sedimentation**

Living Shoreline Projects
4 general areas of Focus

1. Beach, berm & dune

2. Bio-engineering with biodegradable materials and plantings
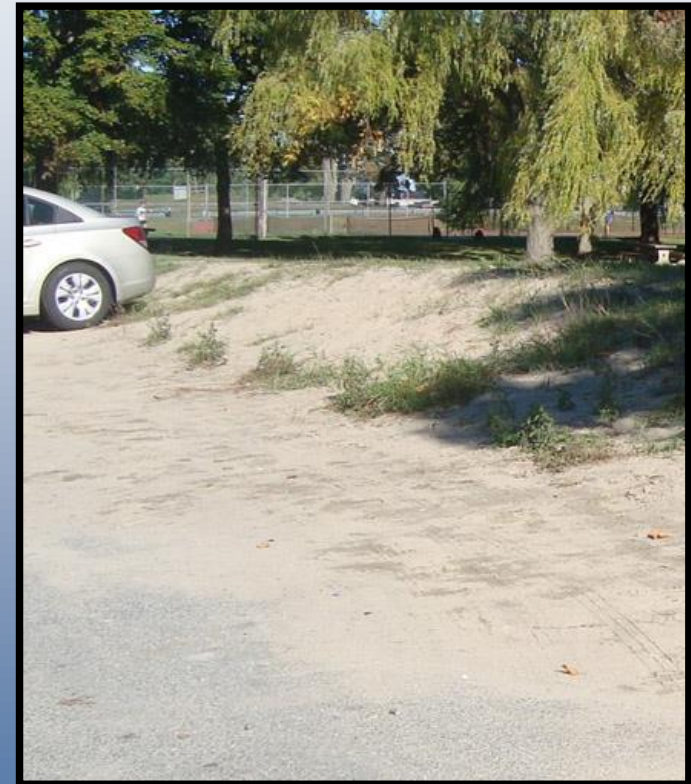
3. Fringing salt marsh

4. Natural oyster or mussel reef

1. Beach, Berm & Dune

- ## Build, Enhance, Restore

with compatible sediment & native vegetation

Collins Cove – end of Planters Street

Not viable option in Salem

Salem Willows – Memorial Drive

2. Fringing Salt Marsh Creation or Restoration

- Spray sediment slurry over the marsh
- Experimental plots in the marsh from dredging projects

- Not viable option

in Salem

www.smithjam.com/the-opposite-of-resilient/

3. Bio-engineering with Organic, Biodegradable Materials with Plantings
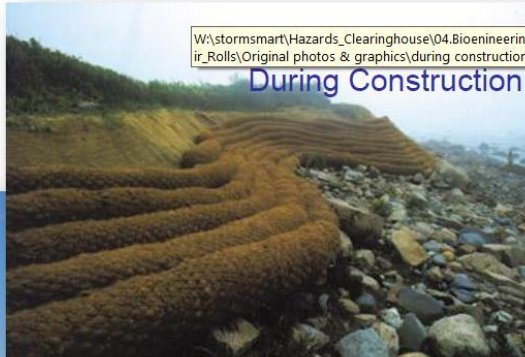
Coir rolls and natural fiber blankets

Before

Bioengineering: Coir Rolls & Vegetation

W:\stormsmart\Hazards_Clearinghouse\04.Bioenineering-
ir_Rolls\Original photos & graphics\during construction.p

During Construction

10 Years later

- Reflects less wave energy than rocks or sandbags
- Limits erosion of sediment sources
- Can be used to re-establish vegetation

Public Shoreline Management Alternatives
By Rebecca Haney, CZM Coastal Geologist

www.nantucket-ma.gov/DocumentCenter/View/920

Remediation at Lead Mills – Salem & Marblehead

Bank needs to be stabilized after lead contaminated soils were removed.

Remediation at Lead Mills – Salem & Marblehead

Blankets and Coir Rolls used to stabilize soils while vegetation got established.

3. Fringing Salt Marshes

4. Natural Oyster or Mussel Reefs

Creation, Enhancement or Restoration

4. Natural Oyster or Mussel Reefs
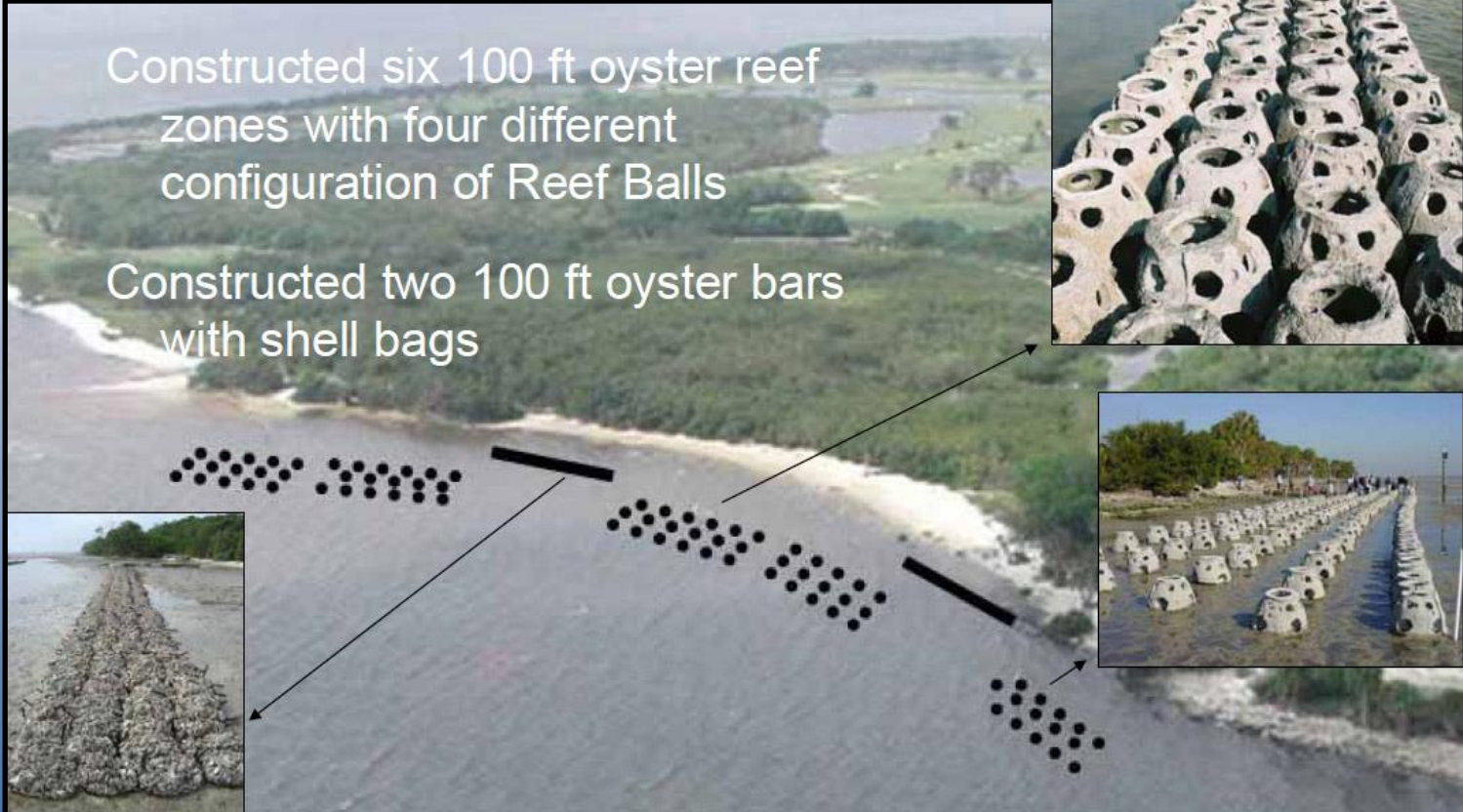

The Demonstration Site – Phase I

January 2004

Constructed six 100 ft oyster reef zones with four different configuration of Reef Balls

Constructed two 100 ft oyster bars with shell bags

Oyster Shell Bar (Bar) Reef

January 2005

~5'

100'

Cannot Create New Permanent,
Edible Shellfish Populations
in Contaminated Waters
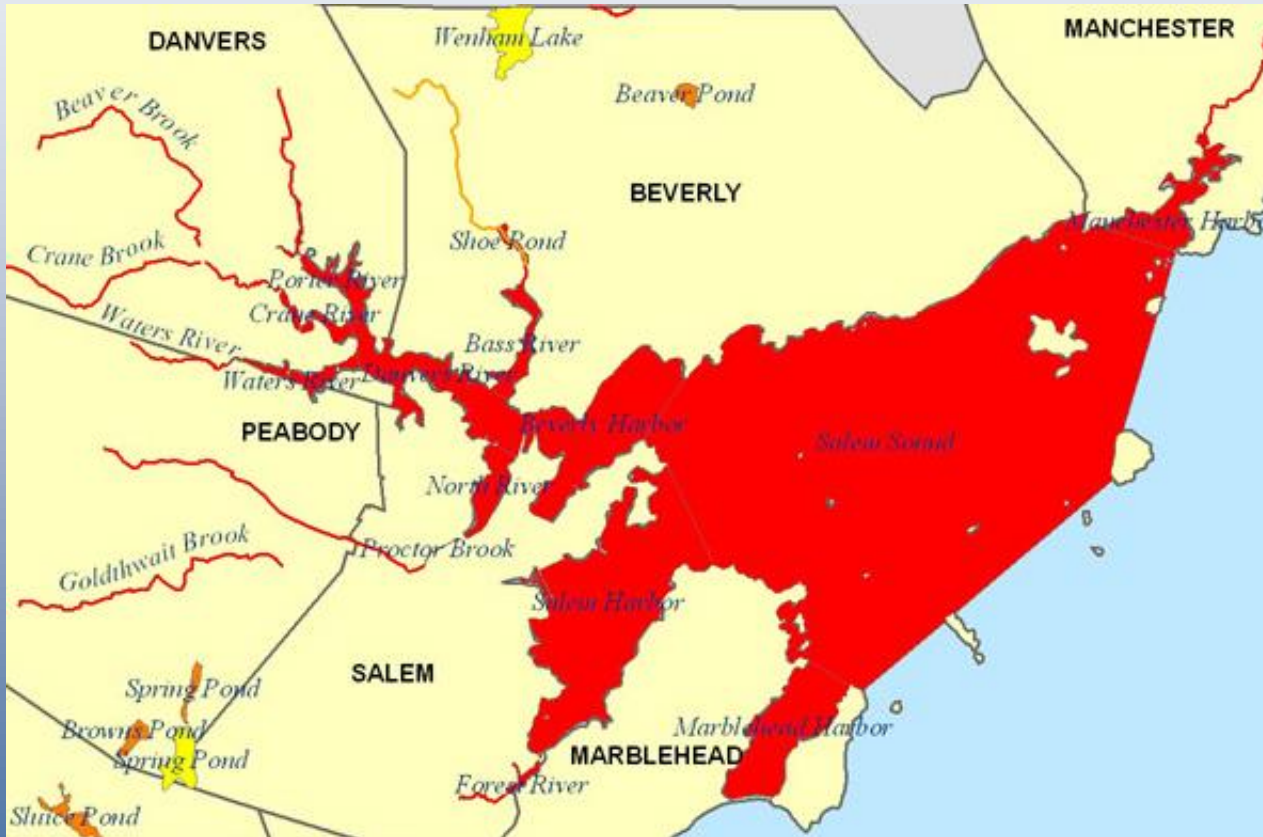
Not a viable option in Salem or the Sound.

Ribbed Mussels & Marsh Grasses
Mutualism

Delaware Estuary
Spartina **Marsh**

Ribbed Mussels *(Geukensia demissa)*
generally ot consumed by humans.

.DelawareEstuary.org

Ecosystem Engineers

Coir Biologs and Mats:
Reduce erosion and encourage mussel recruitment

Coconut fibers (coir) are spun or woven to create mats or bound into logs.

Designed to stabilize sediments to allow colonization by plants.

Fibrous structure also enables mussel colonization.

Mussels can recruit naturally or be seeded directly from wild populations, hatcheries or shellfish gardeners.

.DelawareEstuary.org

Shellfish-based living shorelines trapped sediment and
appeared to decrease erosion at low-moderate energy sites.

Ribbed mussels successfully recruited onto natural substrates
deployed in the intertidal zone along eroding salt marshes.

.DelawareEstuary.org

The PROCESS

Phase 1

Salem Sound COASTWATCH

1. Municipal Shoreline Survey
2. Identify 10 possible sites
3. Chose 3 sites
4. Develop 3 Conceptual Designs

Private Shoreline Survey
Spring 2016

– City of Salem

– MA Coastal Zone Management

– Salem Sound Coastwatch

– Chester Engineers (formerly Bioengineering Group)

Survey of Salem's Municipally Owned Coast

Shoreline Survey –
looking for future site of Living Shoreline?

City of Salem – MA CZM – Salem Sound Coastwatch – Chester Engineers (formerly Bioengineering Group)

Salem Shoreline – fringing salt marshes
that is eroding badly

Collins Cove – Planters Street

Salem Willows - fringing salt marsh
that is healthy and appears to be receiving new sediment.
Note that is protected by rock outcropping at the water's edge.

Near Salem Willows Yacht Club

McCabe Park – future site of Living Shoreline?

Coastal Resilience - Living Shoreline, Salem, Massachusetts, 2015.

LS ID #: 6

Site Name: McCabe Park

Owner: City of Salem

Site Address: Kernwood Ave

Habitats Present: Mudflat, salt marsh

Constructed Environments: Sidewalk

Dominant Material: Gravel, sand, mud

Vulnerability: Sidewalk heavily eroded – public safety hazard, habitat loss (salt marsh loss), flooding from sea level rise or storm surge into park

Who/What at Risk: Safety of walkers, salt marsh

1. Salem Sound Coastwatch surveyed

29 Municipally Owned
Coastal Properties

2. Then created a Profile Page
for Each

Example of McCabe park page 1 of two page profile.

GOAL: Coastal Resilience

**Reduce Risk
More Than Habitat Restoration**

advance understanding &
implementation
of natural approaches to
**mitigate coastal erosion
& flooding problems**
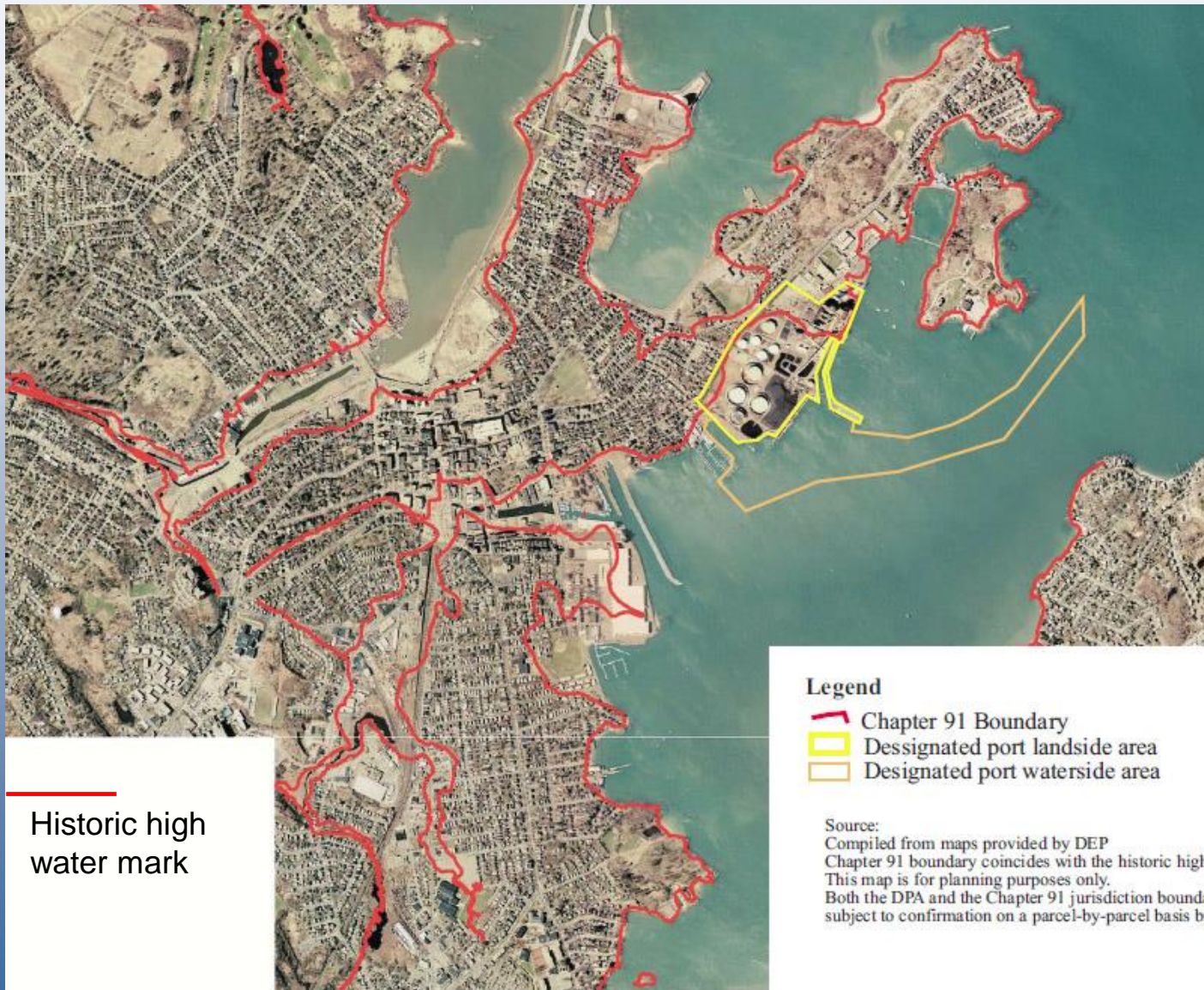
Developed a Matrix to Determine Site Priority

Site Name	Kernwood Marina	McCabe Park	Furlong Park	Collins Cove - East	Collins Cove Park	Collins Cove Beach
Site ID	5	6	14	19	20	21
Criteria -- Scoring System: High (3); Medium (2); Low (1) Use number in cells.						
Physical						
Natural shoreline	2	3	2	3	1	1
Flooding potential (FEMA & Storm surge maps)	1	1	3	3	3	2
Erosion impacts (extent, rate, cause and shoreline change)	2	1	1	3	2	2
Filled tidelands (shoreline change map & chapter 91 maps)	1	1	2	3	3	2
Low topography	1	3	3	3	1	2
Exposure to storm waves	1	2	2	1	1	2
Vulnerability to sea level rise	2	2	2	2	2	2
Potential for natural shoreline adaptation / resilence (landward migration or sediment accretion)	2	2	3	3	2	3
Biological						
Presence of marine & coastal resources (eelgrass, shellfish, salt marsh, etc.)	3	3	3	3	2	3
Restoration potential for coastal habitat	2	1	2	2	2	2
Social						
Public property	3	3	3	1	3	3
Residental impacts	1	1	3	2	3	3
Vulnerable population (elderly, schools, low income, hospitals)	1	1	2	2	3	3
Evacuation route / connector road	2	1	1	2	3	3
Recreational benefits	3	2	3	2	3	2
Historical & cultural significance	2	1	3	1	2	2
Economic						
Cost of gray infrastructure repair or installation (functional condition assessment)	2	2	2	2	3	3
Economic value (lost revenues for City, businesses, residents)	2	1	3	1	1	1
Cost of recovery to repair flooding impacts	2	2	2	2	3	3
Funding opportunities	2	1	3	1	3	3
Transferability to other coastal communities	3	1	3	2	3	3
TOTAL SCORE	40	35	51	44	49	50

1. Used Matrix to identify 10 possible sites

2. Took 3 sites to Conceptual Design

Filled Tide Lands – Chapter 91
Red line denotes original shoreline before filling.

Historic high water mark

Legend

Chapter 91 Boundary
Designated port landside area
Designated port waterside area

Source:
Compiled from maps provided by DEP
Chapter 91 boundary coincides with the historic high water mark
This map is for planning purposes only.
Both the DPA and the Chapter 91 jurisdiction boundaries are approximate and
subject to confirmation on a parcel-by-parcel basis by MCZM and DEP.

N

Filled Tide Lands – Chapter 91
Juniper Cove (not filled tide land) went to conceptual design (black circle).

Legend

— Chapter 91 Boundary

▢ Designated port landside area

▢ Designated port waterside area

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N

Historic high
water mark

Juniper Cove– future site of Living Shoreline?

Columbus Avenue, sidewalk and low retaining wall next to marsh.

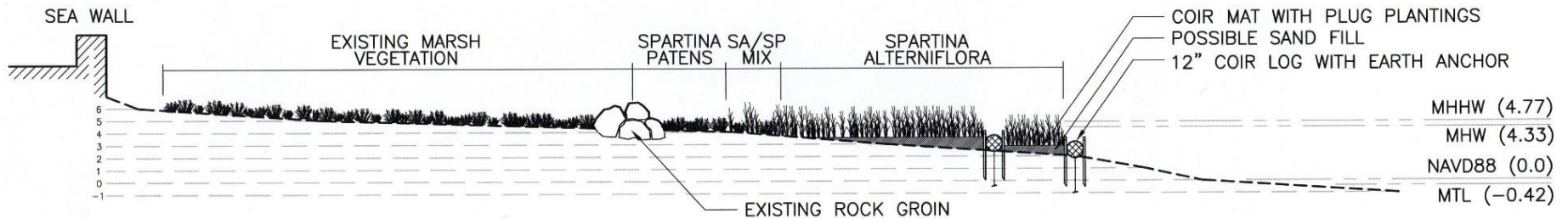# Juniper Cove– future site of Living Shoreline?

During storms or extreme high tides, water comes on to Columbus Avenue.

Juniper Cove– future site of Living Shoreline?

The marsh is becoming water logged from rising sea level, but sand is building in the corner.
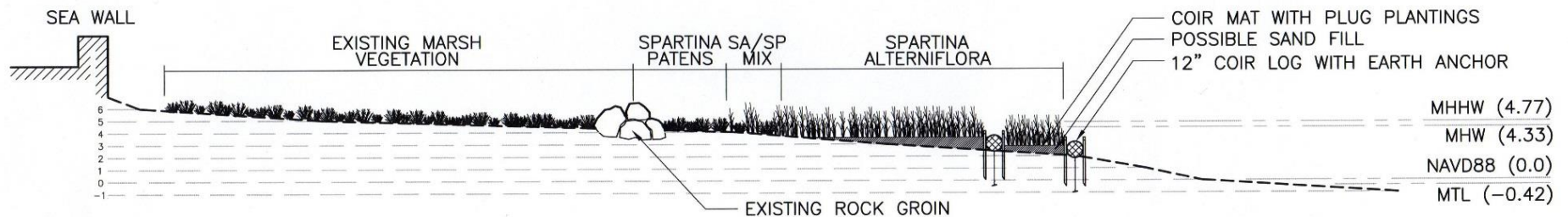

SEA WALL

EXISTING MARSH VEGETATION

SPARTINA SA/SP PATENS MIX

SPARTINA ALTERNIFLORA

COIR MAT WITH PLUG PLANTINGS
POSSIBLE SAND FILL
12" COIR LOG WITH EARTH ANCHOR

MHHW (4.77)
MHW (4.33)
NAVD88 (0.0)
MTL (−0.42)

EXISTING ROCK GROIN

Conceptual Design
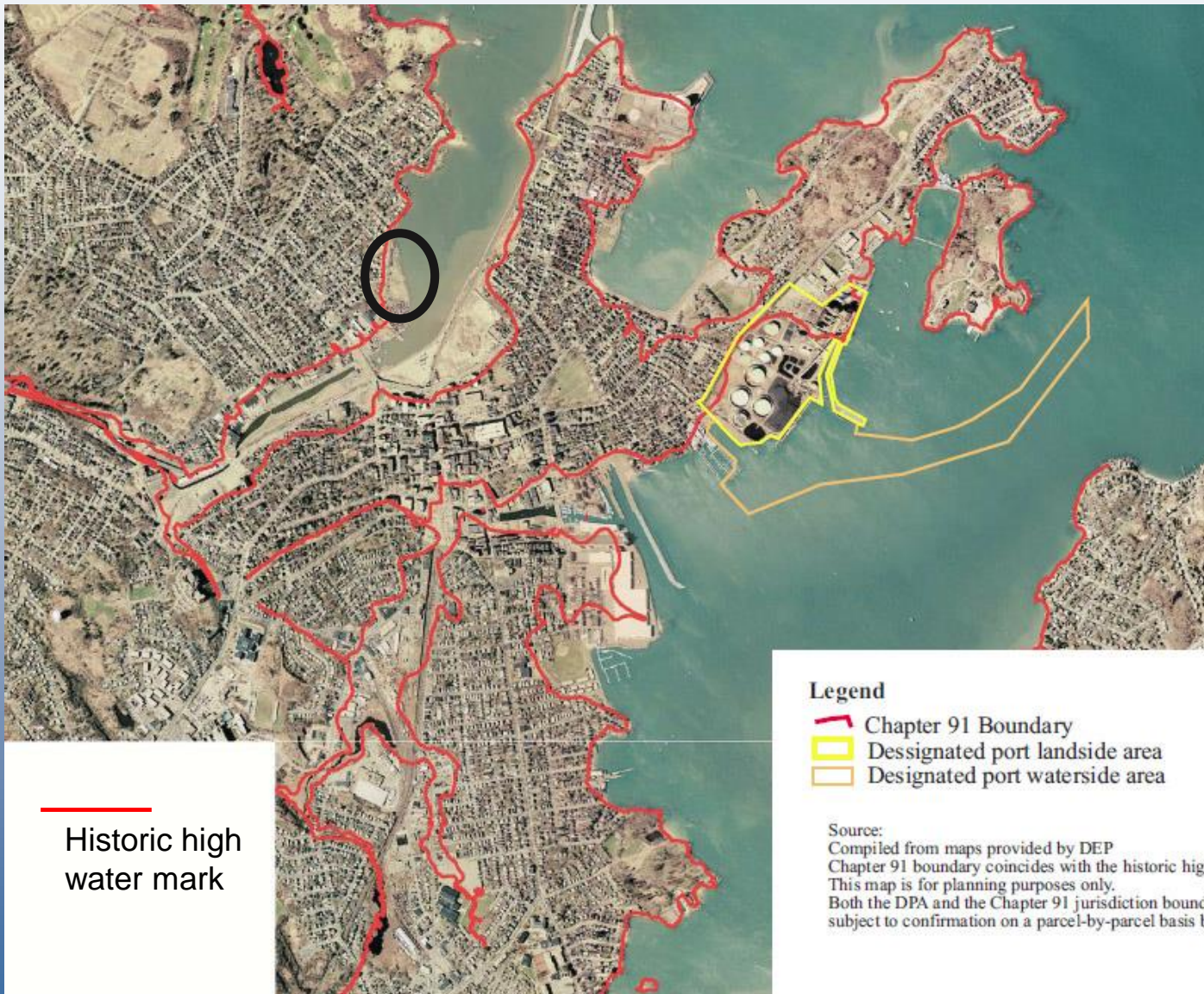
Juniper Cove– future site of Living Shoreline?

Conceptual Design
Using coir rolls.

Filled Tide Lands – Chapter 91
## Furlong Park (filled tide lands) was selected for conceptual design.

Legend

 Chapter 91 Boundary
 Dessignated port landside area
 Designated port waterside area

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N

Historic high
water mark

Furlong Park, North River –
future site of Living Shoreline?

SECTION B - B'

ADDED FILL
(MAINTAIN SLOPE TO WATER)

HIGH—MARSH VEGETATION

SPARTINA SA/SP
PATENS   MIX

SPARTINA ALTERNIFLORA

COIR MAT WITH PLUG PLANTINGS

POSSIBLE SAND FILL

12" COIR LOG WITH EARTH ANCHOR

MHHW (4.77)

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EXISTING ROCK SILLS
ADDITIONAL ROCKS TO RAISE SILL ELEVATION APPROX. 1'–0"

FURLONG PARK LIVING SHORELINE CONCEPT SECTIONS
SALEM, MA

CHESTER
ENGINEERS

SCALE: $\frac{3}{16}$" = 1' - 0"

Furlong Park, North River –
future site of Living Shoreline?
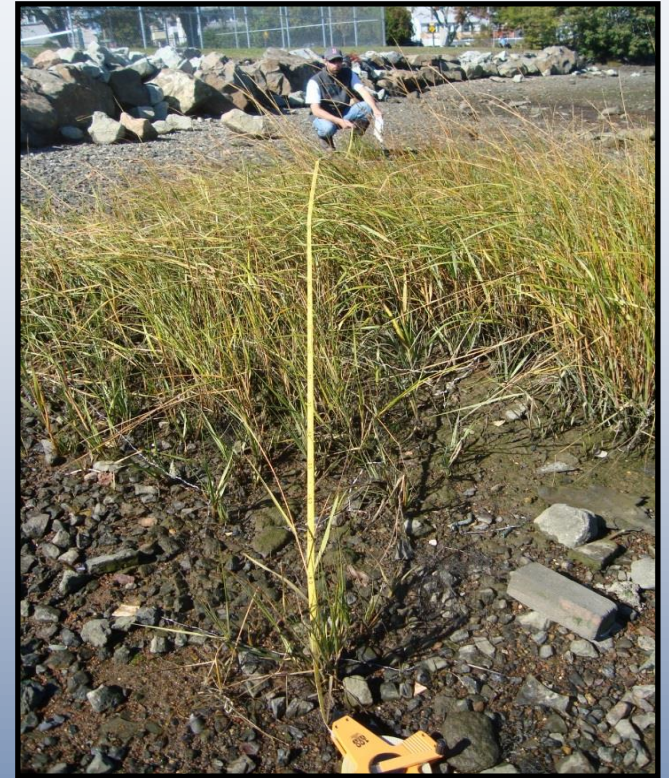
Conceptual Design calls for raising the elevation
at the seaward edge near the baseball diamond and
adding coir rolls to help the fledging salt marsh
that is trying to grow along the park's intertidal edge.

Furlong Park, North River –
future site of Living Shoreline?
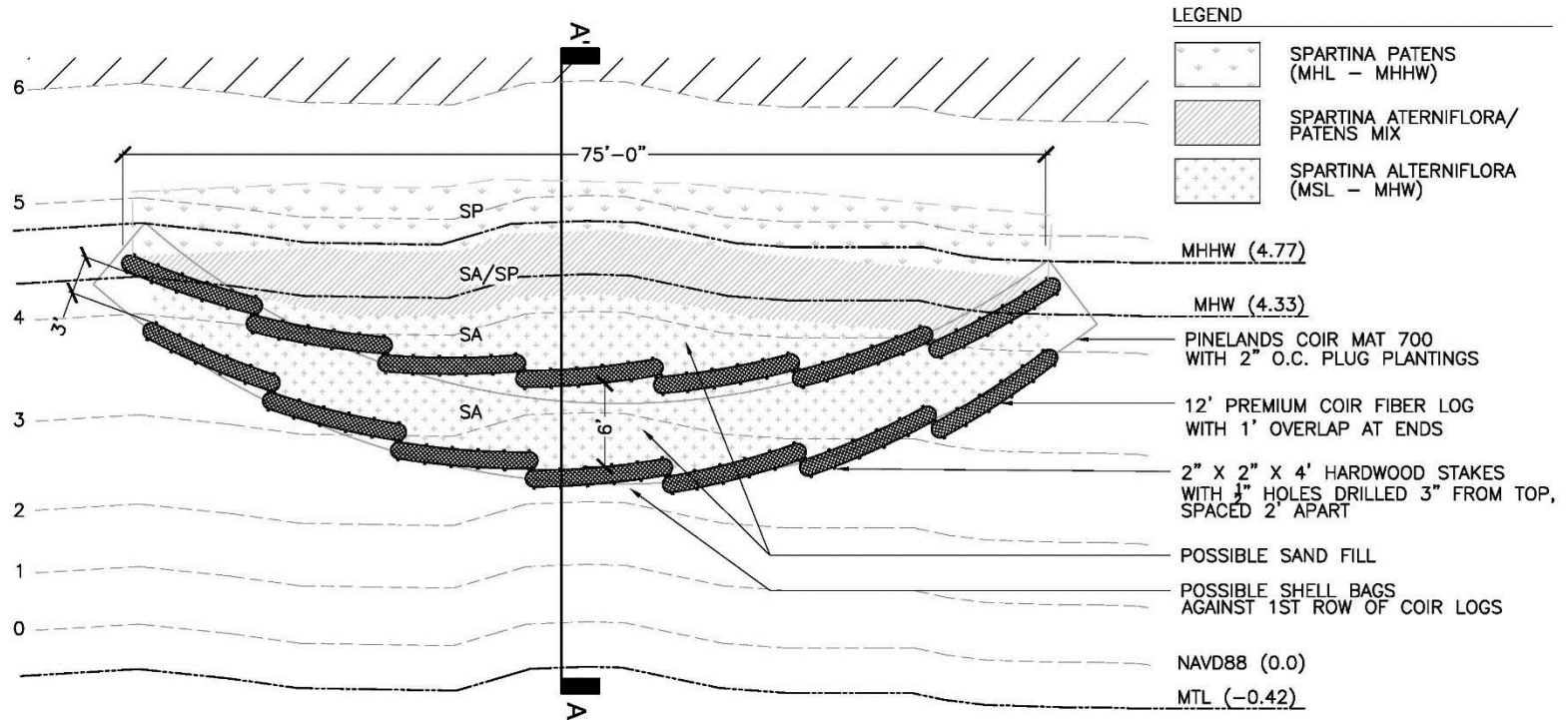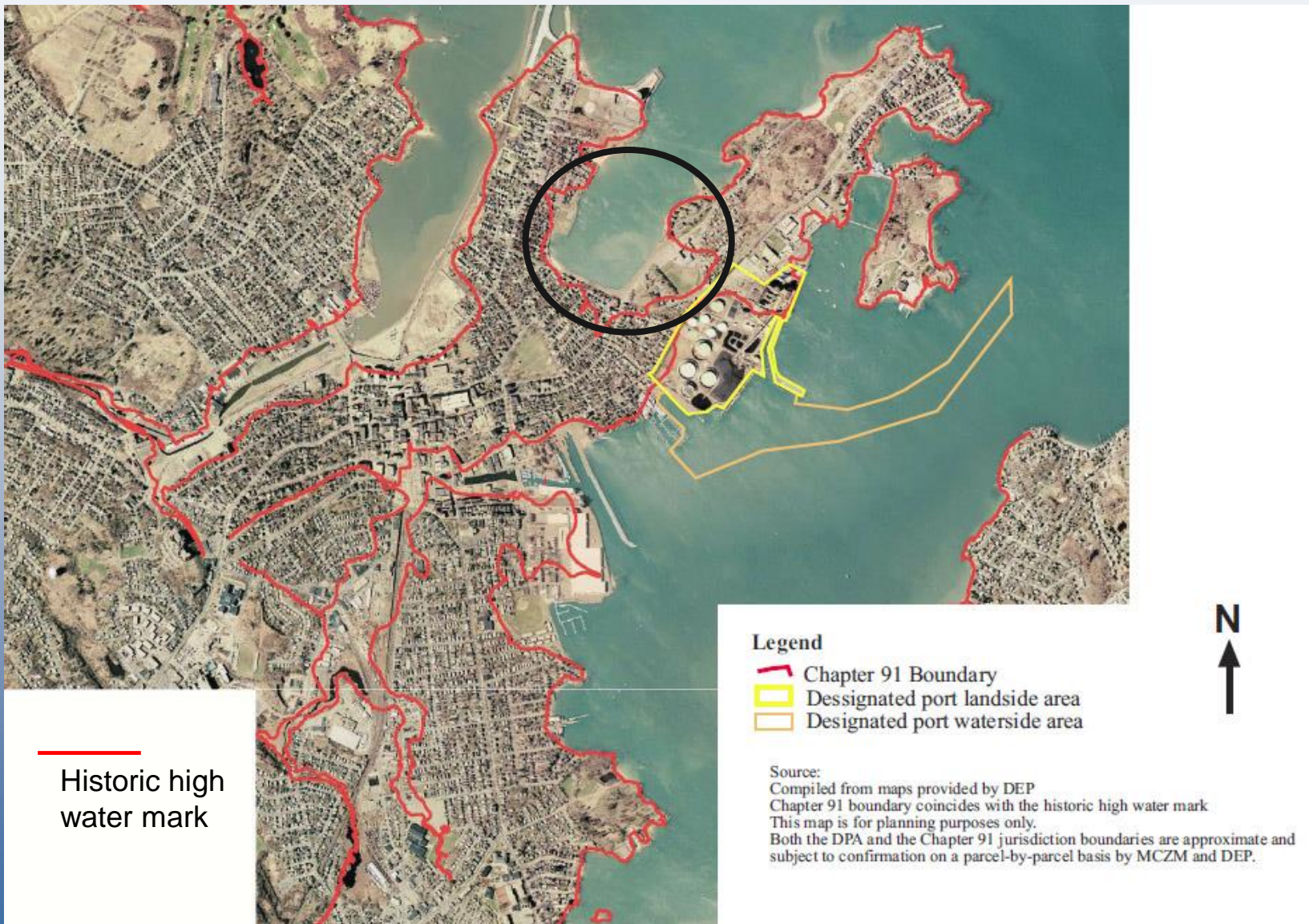

TYPICAL LIVING SHORELINE CONCEPT PLAN: FURLONG PARK
SALEM, MA

Filled Tide Lands – Chapter 91
Collins Cove (filled tide land) went to conceptual design.

Legend

⌐ Chapter 91 Boundary
▢ Dessignated port landside area
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Historic high
water mark

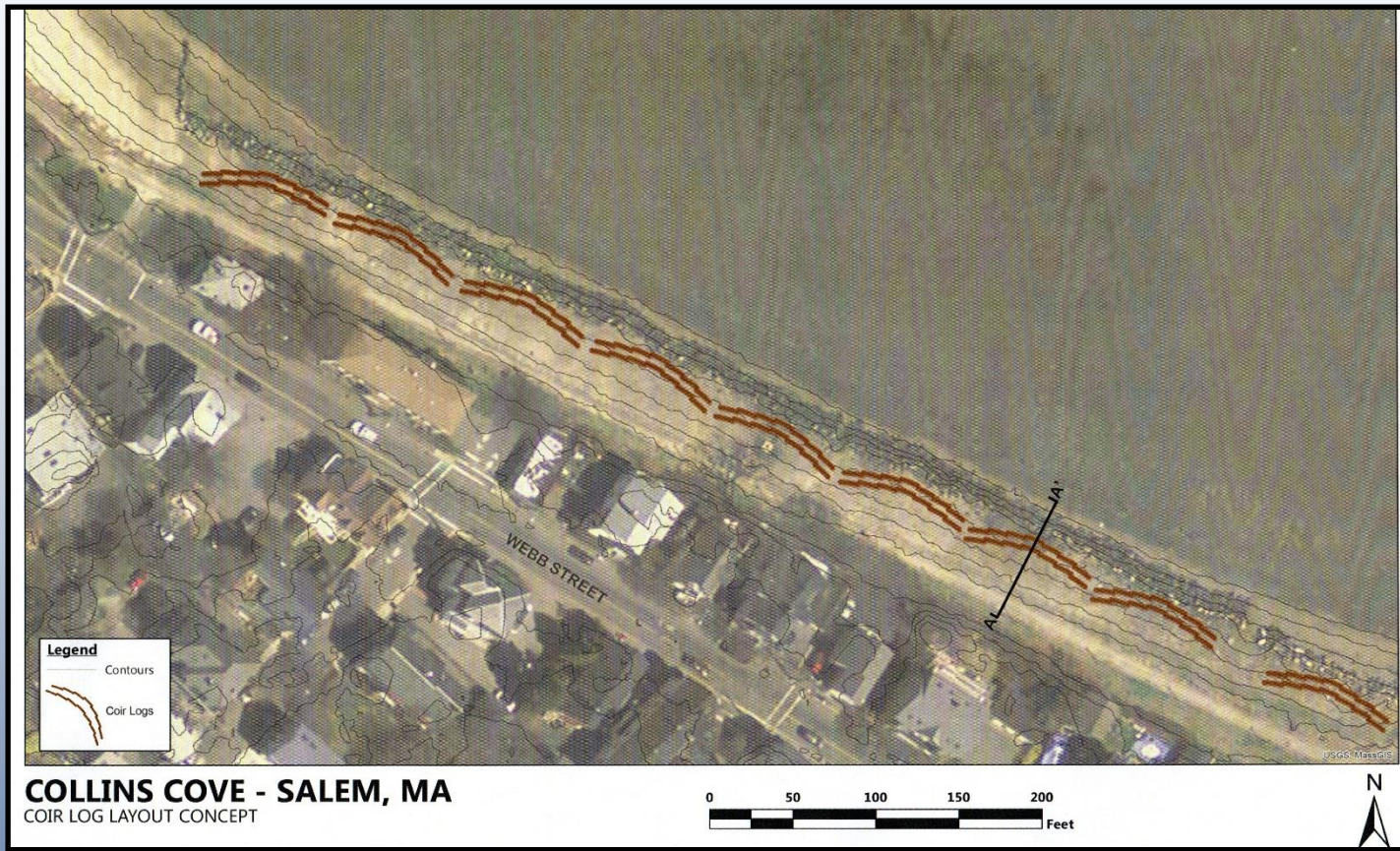# Collins Cove – future site of Living Shoreline?
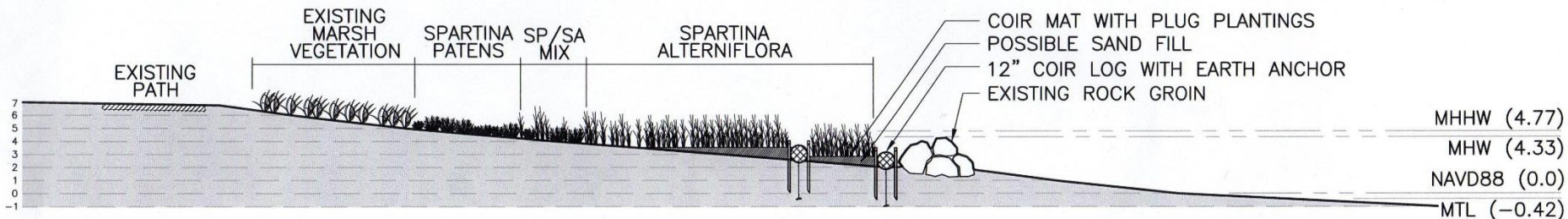
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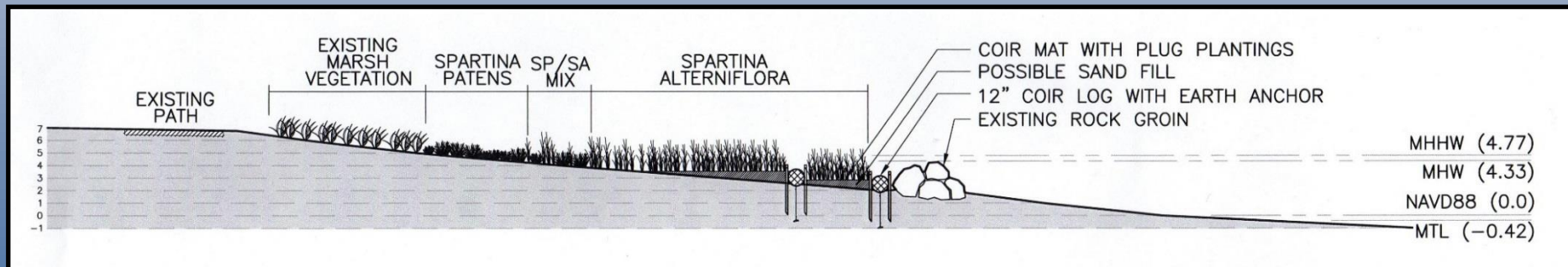
Conceptual Design for area along the bike & walking path.

Collins Cove – future site of Living Shoreline?

Conceptual
Design
Using coir rolls

COLLINS COVE - SALEM, MA
COIR LOG LAYOUT CONCEPT

Legend
Contours
Coir Logs

WEBB STREET

0   50   100   150   200
Feet

N

EXISTING
MARSH
VEGETATION

SPARTINA
PATENS

SP/SA
MIX

SPARTINA
ALTERNIFLORA

EXISTING
PATH

COIR MAT WITH PLUG PLANTINGS
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The PROCESS

Phase 1

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Private Shoreline Survey

Spring 2016

City of Salem – MA CZM – Salem Sound Coastwatch – Chester Engineers (formerly Bioengineering Group)

Phase 2 – next steps

Engineered design + permitting

$$,$$$

Phase 3 in the future

Implementation of Living Shoreline

$$$,$$$

Salem Sound
COASTWATCH