

# SALEM LIVING SHORELINE PROJECT

**CZM Green Infrastructure for Coastal Resilience Grant**  
**COLLINS COVE LIVING SHORELINE DESIGN**

SALEM, MA  
PUBLIC MEETING  
February 16, 2017



Photo Credit- Salem Sound Coastwatch and LightHawk

# 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**

1. December 2014 – June 2016 for shoreline assessment
2. December 2016 – June 2017 design & permitting 1 site

*Kathryn Glenn – CZM North Shore Regional Coordinator*

*Julia Knisel – CZM Coastal Shoreline & Floodplain Manager*

# Living Shoreline Installations

## = Natural “Green” Infrastructure

- Alternatives or enhancements to bulkheads, seawalls, or revetments
- Introduction of a naturalized edge using plants, sand/soil, and the limited use of hard structures

### ***BENEFITS:***

- Stabilizing the shoreline – more resistant to erosion
- Protecting surrounding riparian and intertidal environment
- Improving water quality via filtration of upland run-off
- Creating habitat for aquatic and terrestrial species





# LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.



**One square mile** of salt marsh stores the carbon equivalent of **76,000 gal of gas** annually.



Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.



Living shorelines improve **water quality**, provide fisheries **habitat**, increase **biodiversity**, and promote **recreation**.



Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.



Living shorelines are **more resilient** against storms than bulkheads.



**33%** of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.



Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.

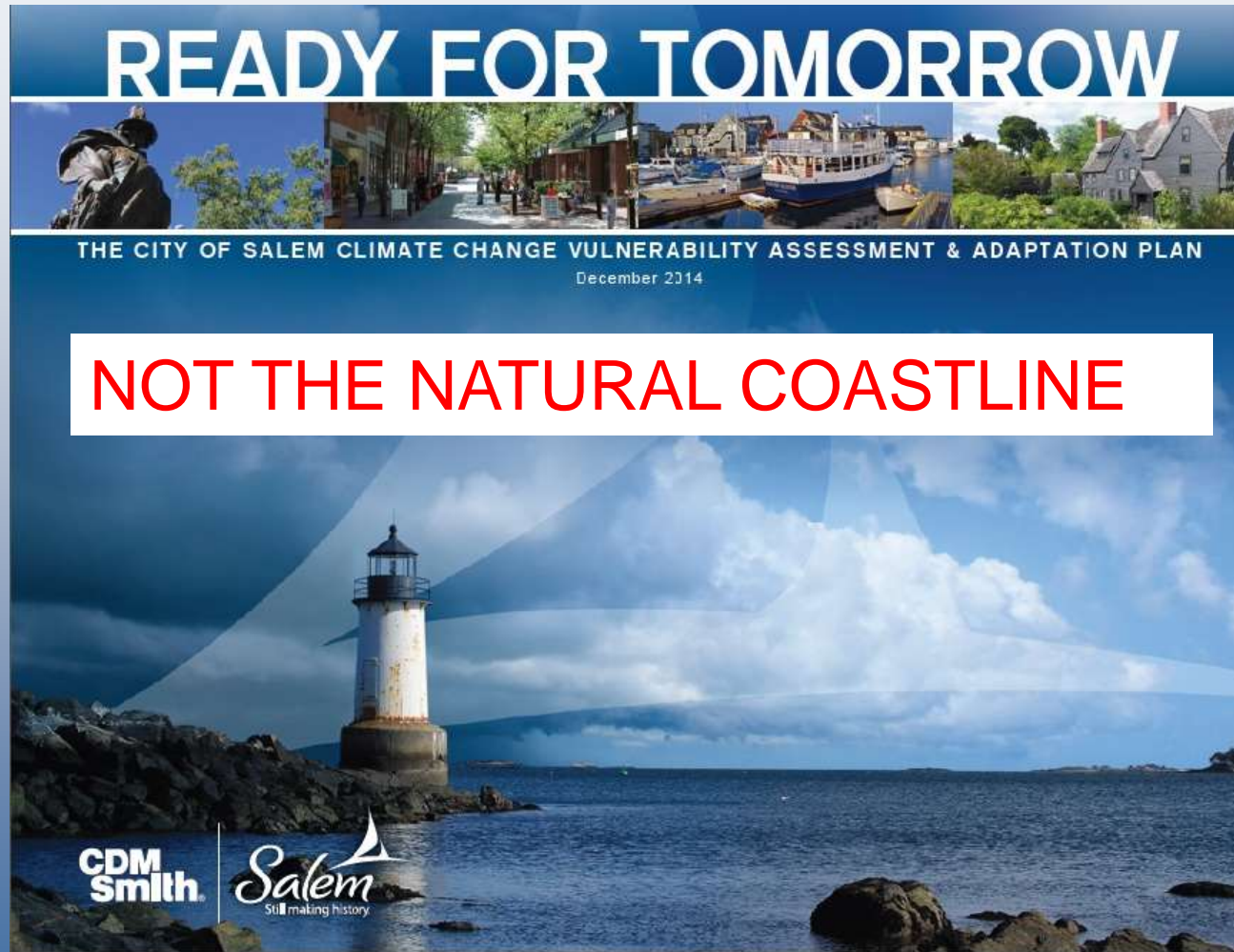


The National Centers for Coastal Ocean Science | [coastalscience.noaa.gov](https://coastalscience.noaa.gov)

Some graphics courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science ([ian.umces.edu/symbols/](http://ian.umces.edu/symbols/))

# Climate Change Vulnerability Assessment & Adaptation Plan

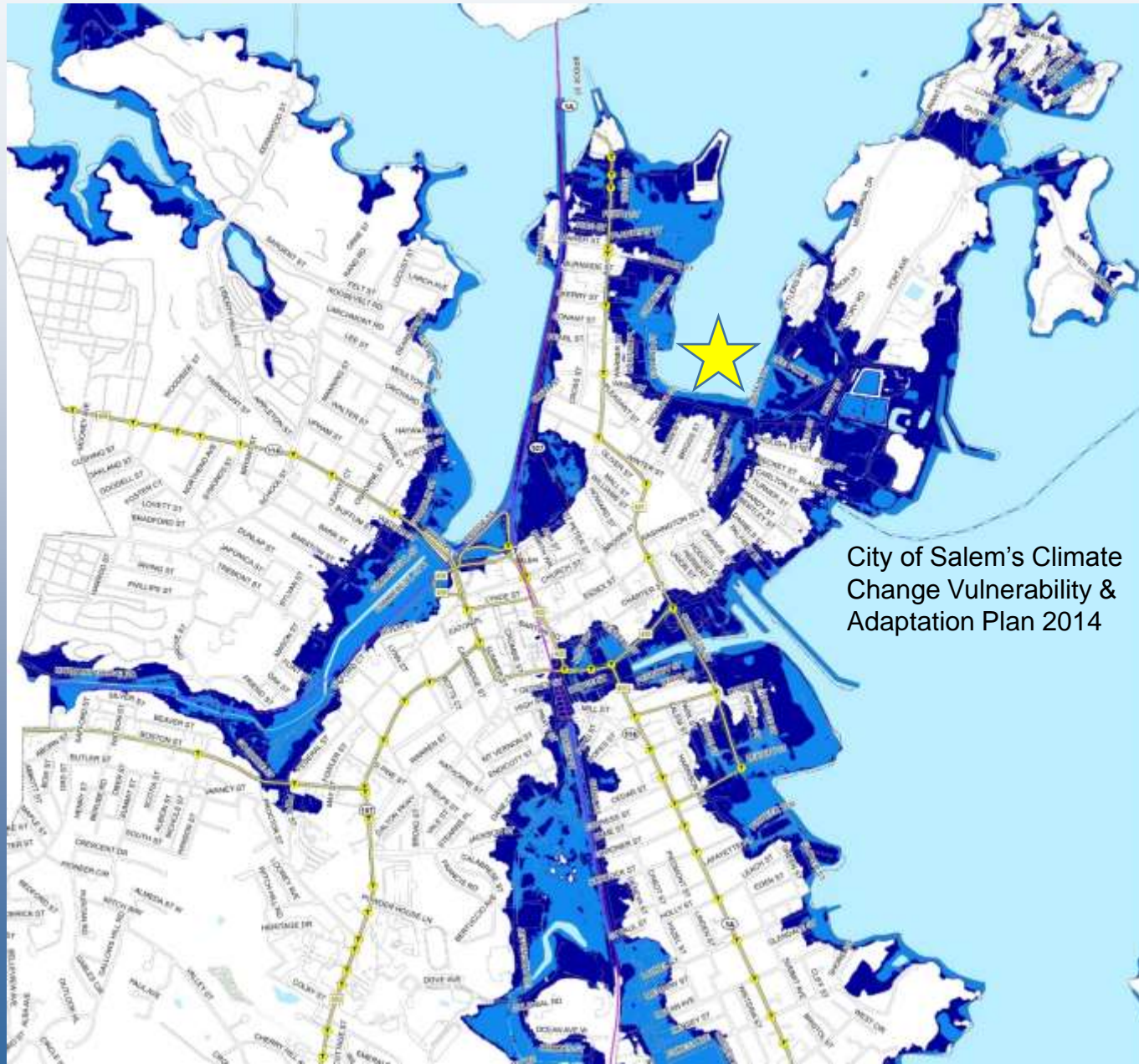
## Focused on 5 Sectors



- Critical building infrastructure
- Drinking water
- Energy
- Stormwater
- Transportation
- Vulnerable populations

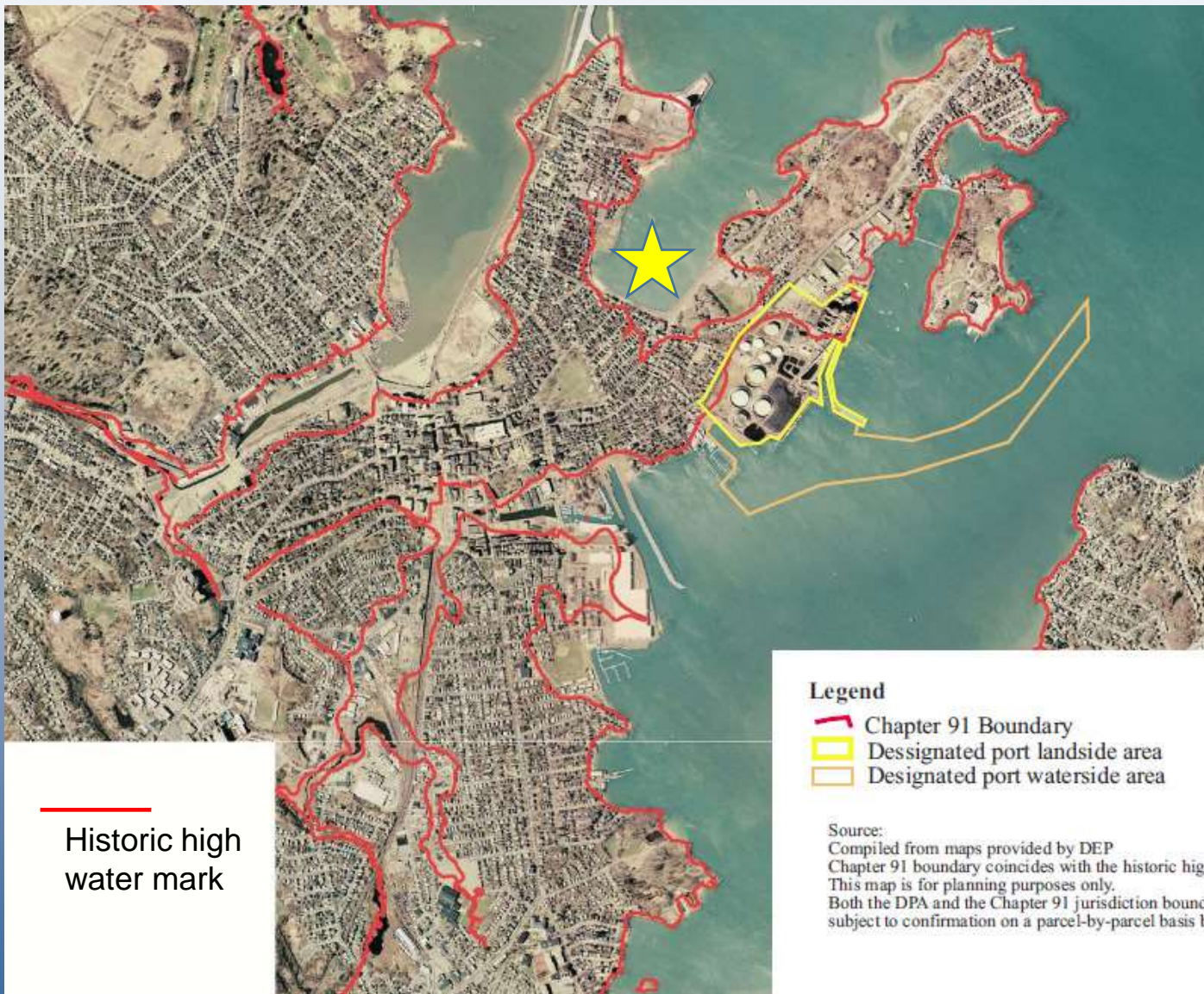


# Storm Surge Transportation Map





# Filled Tide Lands – Chapter 91



# The PROCESS

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





# Created a Matrix to Determine Site Priority

	Kernwood Marina	McCabe Park	Furlong Park	Collins Cove - East	Collins Cove Park	Collins Cove Beach
Site Name						
Site ID	5	6	14	19	20	21
Criteria -- Scoring System: High (3); Medium (2); Low (1) Use number in cells.						
<b>Physical</b>						
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 / resilience (landward migration or sediment accretion)	2	2	3	3	2	3
<b>Biological</b>						
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
<b>Social</b>						
Public property	3	3	3	1	3	3
Residential 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
<b>Economic</b>						
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
<b>TOTAL SCORE</b>	40	35	51	44	49	50

# 28 Salem Municipal Site Profiles

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

**LS ID #:** 22a

**Site Name:** Collins Cove Beach- Bike Path

**Owner:** Salem

**Site Address:** Collins/Webb Streets

**Habitats Present:** Mudflat, salt marsh, sand

**Constructed Environments:** Buildings, sidewalk, street, sewage pipe, outfall

**Dominant Material:** Gravel, cobble, boulder, sand

**Vulnerability:** Flooding from storm surge and sea-level rise, potential overflow onto Essex and Webb Streets

**Who/What at Risk:** Homes, important transportation route, bike path, habitat loss

**Map:** <https://www.google.com/maps/@42.5206891,-70.8856964,859a,20y,41.32t/data=!3m1!1e3>

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## *CZM Coastal Infrastructure Inventory and Assessment, 2007*

### **Description/Summary of Site:**

Sand/mud/gravel beach at the head of Collins Cove, paralleling Webb Street. Much of the land surrounding Collins Cove is filled tidelands. Beach is directly in front of highly used bike and walking path, domestic neighborhoods and H & A Propeller shop. Beach area is characterized by a boulder barrier which shows signs of wash-out from wave and tidal action, and sparse saltmarsh (pictures 1, 3). A sewer main is buried in the area between the path and the boulders.

Area has high potential for extreme flooding due to high storm surge and continued sea-level rise. Boulder and cobble barrier stretching along most of sandy/gravel beach showing signs of erosion from wash-out. Vulnerable to wave and tidal action.

### **Summary:** See 22-b

*\*CZM assessment combined with Collins Cove 22b site*

**Feasibility:** High. Conceptual design completed by Chester Engineers with input from Salem Sound Coastwatch and Jeff Elie of the City of Salem.

### *CZM Coastal Infrastructure Inventory and Assessment, 2007*

**CZM ID:** 064-042-000-003-100

**CZM Grade:** D

**Date of Survey:** 7/12/2007

**CZM Priority:** I

**CZM Rating:** Poor

**FIRM Elevation:** 13

**FIRM Map Zone:** V3

*Estimated reconstruction/repair \$2,897,739.00*



# Conceptual Designs for 3 Living Shoreline Projects

chose 2 of the 4 general Focus Areas

1. Bio-engineering with biodegradable materials and plantings
2. Fringing salt marsh
  - 15 feet of marsh can absorb 50% of incoming wave energy

NOT

1. Natural oyster or mussel reef
2. Beach, berm & dune

# Collins Cove Selected as 1 of the 3 Priority Sites



Awarded 2<sup>nd</sup> Massachusetts Coastal Zone Management Coastal Resilience Grant for design and permitting of Collins Cove



[illegible]

A creek runs from the Salem Common along present-day Forrester Street to the Cove.

# 1790 Salem Map of Collins Cove

# Shallop Cove 1700 - 1800

1805 (*September 12*):

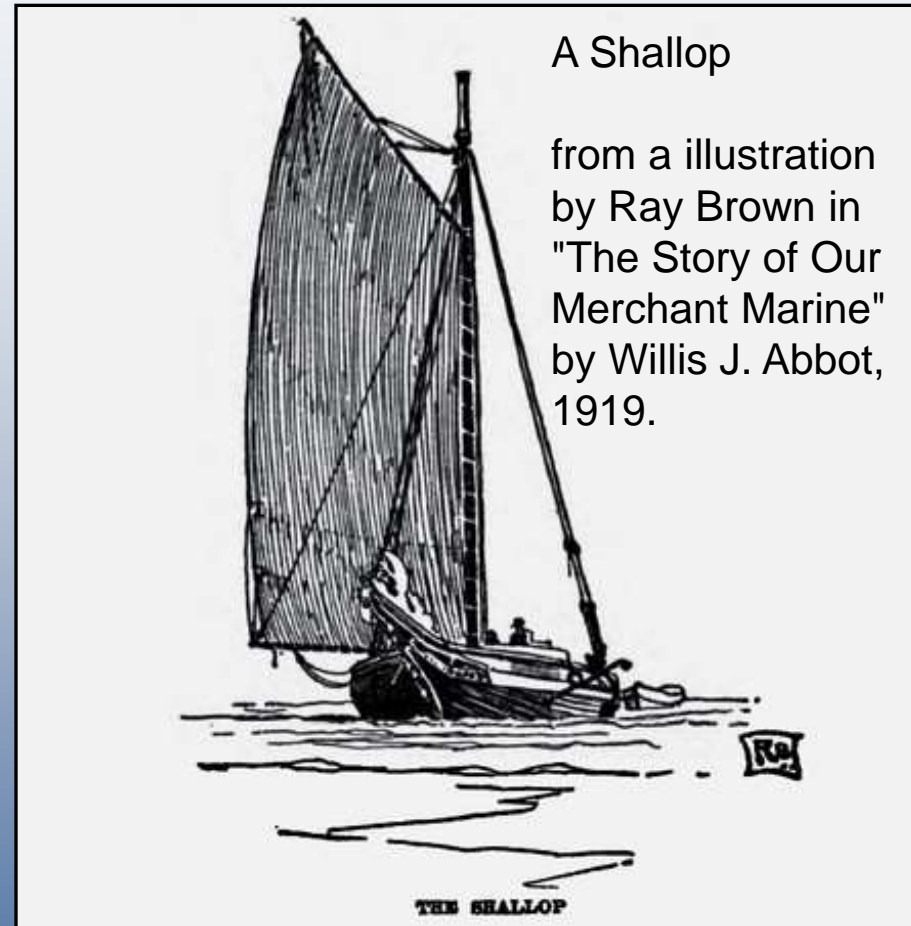
The *Salem Register* reports that a 460-pound “tunny” (tuna) was stranded on the flats at “Shallop Cove.”

1815 (June 17):

The *Essex Register* notes that “the Shallop Cove, which lays eastward of the bridge, Pleasant and East [present-day Forrester] streets, & the Neck, is continually filling up.

Great changes have taken place in the memory of the present generation, and very great from the first settlement of the town.

It was at first their principal place for their Shallops; it is now without water at every fall of the tide.





# Filling of Collins Cove

1815 (June 17):

The *Essex Register* continues:

Towards East Street, it is daily filling, from the sluices which conduct the water from the streets into it. The continuation of Webb Street into East Street... was formerly the only pass which the town had to the Neck, till it was washed into the cove, by the action of the tide upon its banks..."



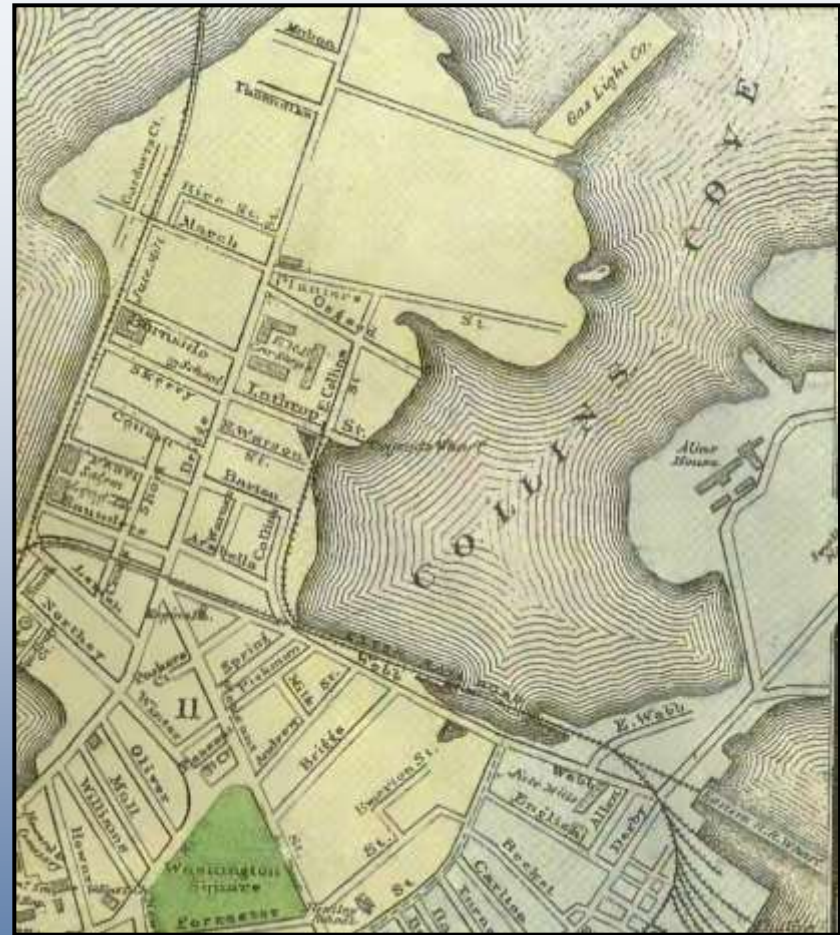
1820 Salem Map of Collins Cove

# Railroad Tracks – Filling of Collins Cove

1848-49: The **Essex Railroad** builds a track **across the bottom of the Cove, using gravel brought in from Danvers.** On May 12, 1849 the *Salem Observer* notes that the rail is conveyed across the Cove “by an embankment and bridge.” This line connects Phillips’s Wharf (now roughly where Salem Ferry is located) to the North River.

1861: “...permanent improvements have been made in the construction of a **new sea wall and road by Collins’ Cove, called Collins street.**” Salem City Documents page 52.

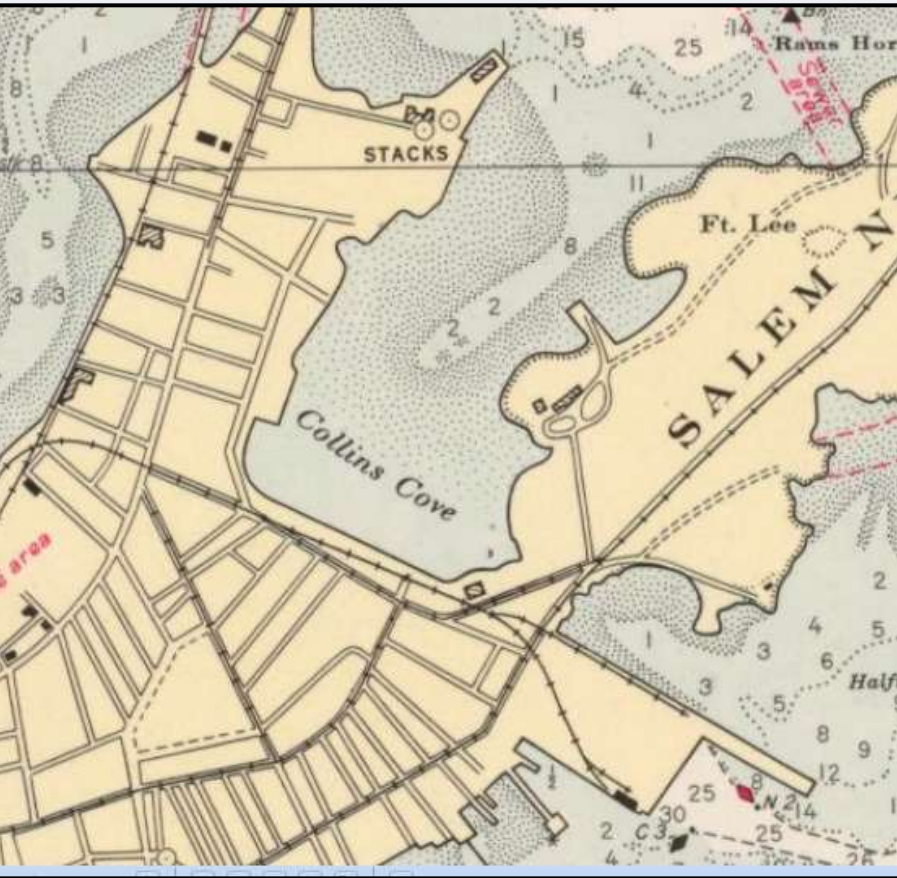
1869-73: **Sewers** are built along Forrester, Essex, Pickman, Andrew, Brown, and St. Peters Streets. **All empty into Collins Cove.** (Salem City Documents, Street Commissioner’s Reports)



1874 – Map of the City of Salem Map - H. F. Walling - cropped



# Sewerage is a Public Nuisance



1944 Salem and Lynn Harbors,  
US Coast Survey - cropped

c. 1960-1973: The rail line is removed.

1889-1890: Salem Board of Health in its annual report declares the **“Webb Street Basin”** (the water body between the shoreline and the rail line) a **sanitary nuisance**. In 1889, the Board reports that

“About 8000 cubic yards of gravel have been placed here by the [Boston and Maine] railroad, and some 600 loads of gravel, loam and other suitable filling exclusive of city ashes have been dumped here.”

Fill work is completed the following year. This adds the land on the present-day “odd” side of Webb Street.

1904-09: A main sewer line is constructed beneath Webb Street, part of a larger project that takes Salem sewage out to Great Haste Island.

1935-36: The Collins Cove Playground, a WPA project, is planned and completed.

c. 1935-1940: City property along Almshouse Road and Fort Avenue is used for a city dump. In 1940 the city completes acquisition of privately held “flats” next to the dump. The WPA thickens the “neck” by filling in a roughly triangular area bounded by Almshouse Road and Fort Avenue. They begin a sea wall on its edge, but MA WPA programs are terminated before the wall is completed.

# Collins Cove Today





# Collins Cove – walking and bike path along the water





# Collins Cove – walking and bike path along the water



# Collins Cove – average tide





# Collins Cove – After 11.8ft. King Tide on 11/16/2016





# Collins Cove – During hurricane Sandy 10/29/2012



Nothing like Scituate.....



# Collins Cove – *Spartina alterniflora* and other salt marsh plants growing there now





**SITE**



**COLLINS COVE**

**WEBB STREET**





BIKE ROUTE  
WATER







## EXISTING VEGETATION

***Spartina patens***  
and other salt marsh plants growing there now













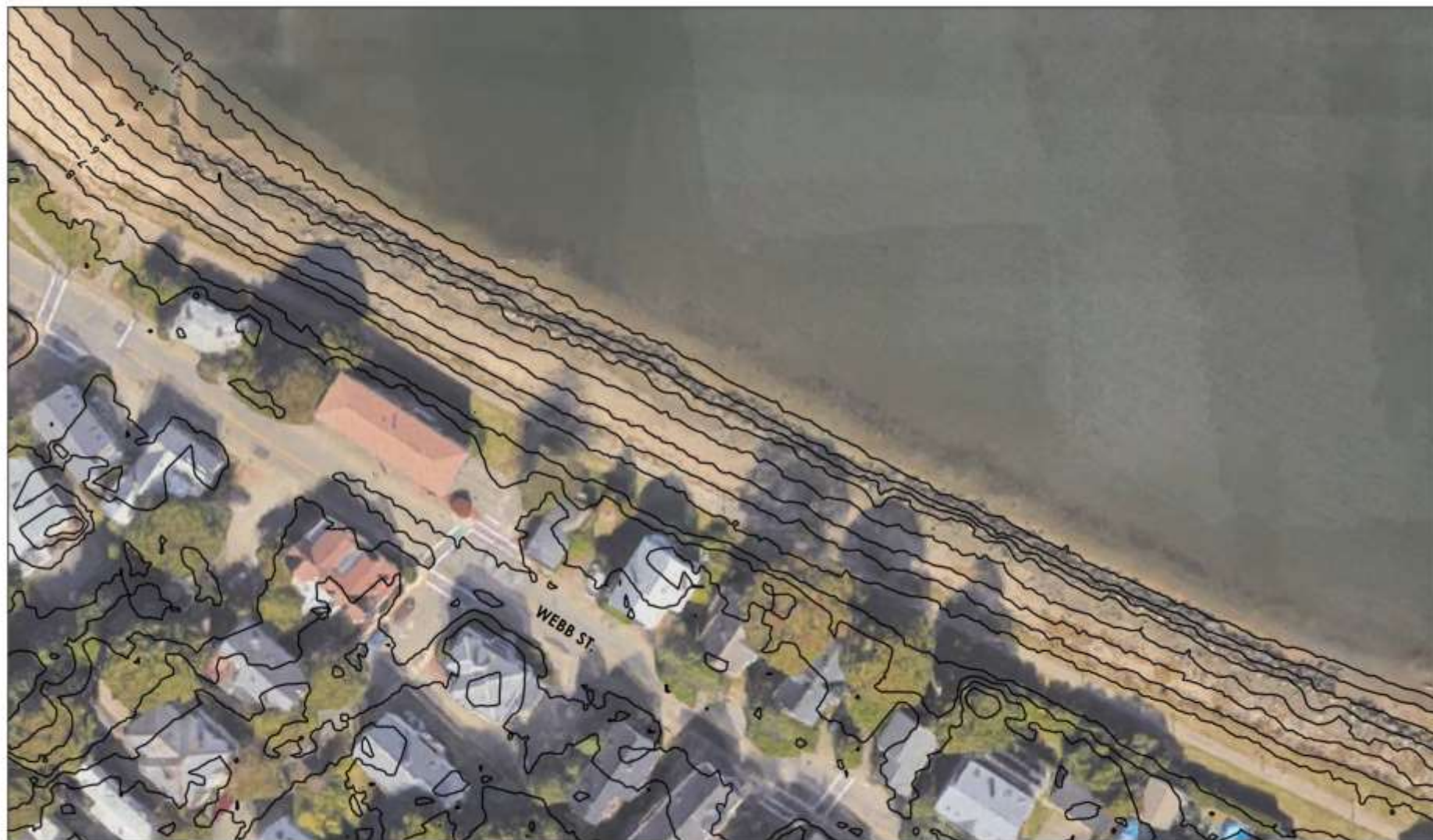
TIDE DATUMS BOSTON		Station 8443970
Datum	Description	NAVD88 (feet)
MHHW	Mean Higher-High Water	4.77
MHW	Mean High Water	4.33
MTL	Mean Tide Level	-0.42
MSL	Mean Sea Level	-0.30
DTL	Mean Diurnal Tide Level	-0.37
MLW	Mean Low Water	-5.16
MLLW	Mean Lower-Low Water	-5.51
NAVD88	North American Vertical Datum of 1988	0
STND	Station Datum	-9.03
MN	Mean Range of Tide	9.49



# SURVEY DATA

		Setup #1	Measured	Elevation (NAVD 88)
		B.M. (SMH)		5.77
		Instrument	6.15	11.92
Station 0+00		Length (FT)		
	Sidewalk	0	4.74	7.18
	High Tide Line	17	5.40	6.52
	Base of Wall	38	7.97	3.95
	Top of Wall	41	4.85	7.07
	Behind wall	58	9.80	2.12
Station 1+00				
	Sidewalk	0	4.87	7.05
	High Tide Line	12.5	5.46	6.46
	Base of Wall	43	8.79	3.13
	Top of Wall	47.5	6.77	5.15
	Behind wall	60.5	11.18	0.74
Station 2+00				
	Sidewalk	0	5.04	6.88
	High Tide Line	6	5.42	6.50
	Base of Wall	40	8.99	2.93
	Top of Wall	45	6.56	5.36
	Behind wall	59.5	11.31	0.61
Station 3+00				
	Sidewalk	0	5.30	6.62
	High Tide Line	5.5	5.66	6.26
	Base of Wall	46	9.36	2.56
	Top of Wall	49	7.73	4.19
	Behind wall	63	11.54	0.38
Station 4+00				
	Sidewalk	0	5.44	6.48
	High Tide Line	6	5.60	6.32
	Base of Wall	39	8.60	3.32
	Top of Wall	47	8.46	3.46
	Behind wall	60	11.50	0.42

		Setup #1	Measured	Elevation (NAVD 88)
		B.M. (SMH)		5.77
		Instrument	6.15	11.92
Station 5+00		Length (FT)		
	Sidewalk	0	5.08	6.84
	High Tide Line	13	5.36	6.56
	Base of Wall	42	8.55	3.37
	Top of Wall	49	7.43	4.49
	Behind wall	64	12.2	-0.28
Station 6+00				
	Sidewalk	0	5.12	6.8
	High Tide Line	16	5.26	6.66
	Base of Wall	47.5	8.73	3.19
	Top of Wall	50	7.45	4.47
	Behind wall	65	12	-0.08
Station 7+00				
	Sidewalk	0	5.17	6.75
	High Tide Line	16	5.47	6.45
	Base of Wall	46	9.32	2.6
	Top of Wall	50	6.7	5.22
	Behind wall	68	11.68	0.24
Station 8+00				
	Sidewalk	0	5	6.92
	High Tide Line	19	5.33	6.59
	Base of Wall	41.5	7.99	3.93
	Top of Wall	46	6.94	4.98
	Behind wall	56	9.76	2.16



0 50 100 150 200  
Feet



**Collins Cove LIDAR**  
Google Earth 2016 Ortho Imagery  
2013-2014 Sandy DEM Data  
Contours referenced to NAVD88 (feet)





Google Earth 2016 Ortho Imagery  
MAPTITE Planting Zones based on 2013-2014 Sandy DEM Data  
Contours referenced to NAVD88 (feet)

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

Ribbed mussels (and oysters) successfully recruited onto natural substrates deployed in the intertidal zone along eroding salt marshes

DelawareEstuary.org





## DELSI Tactic

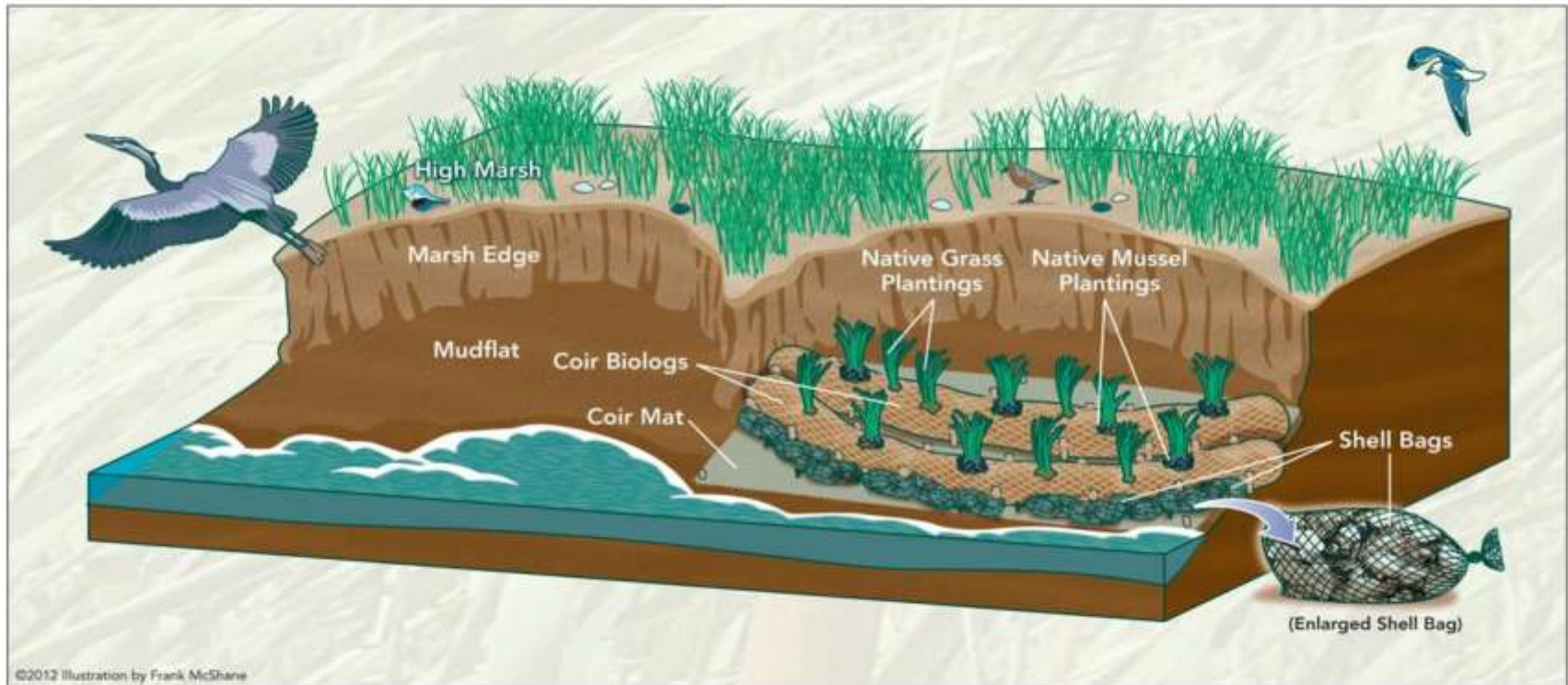
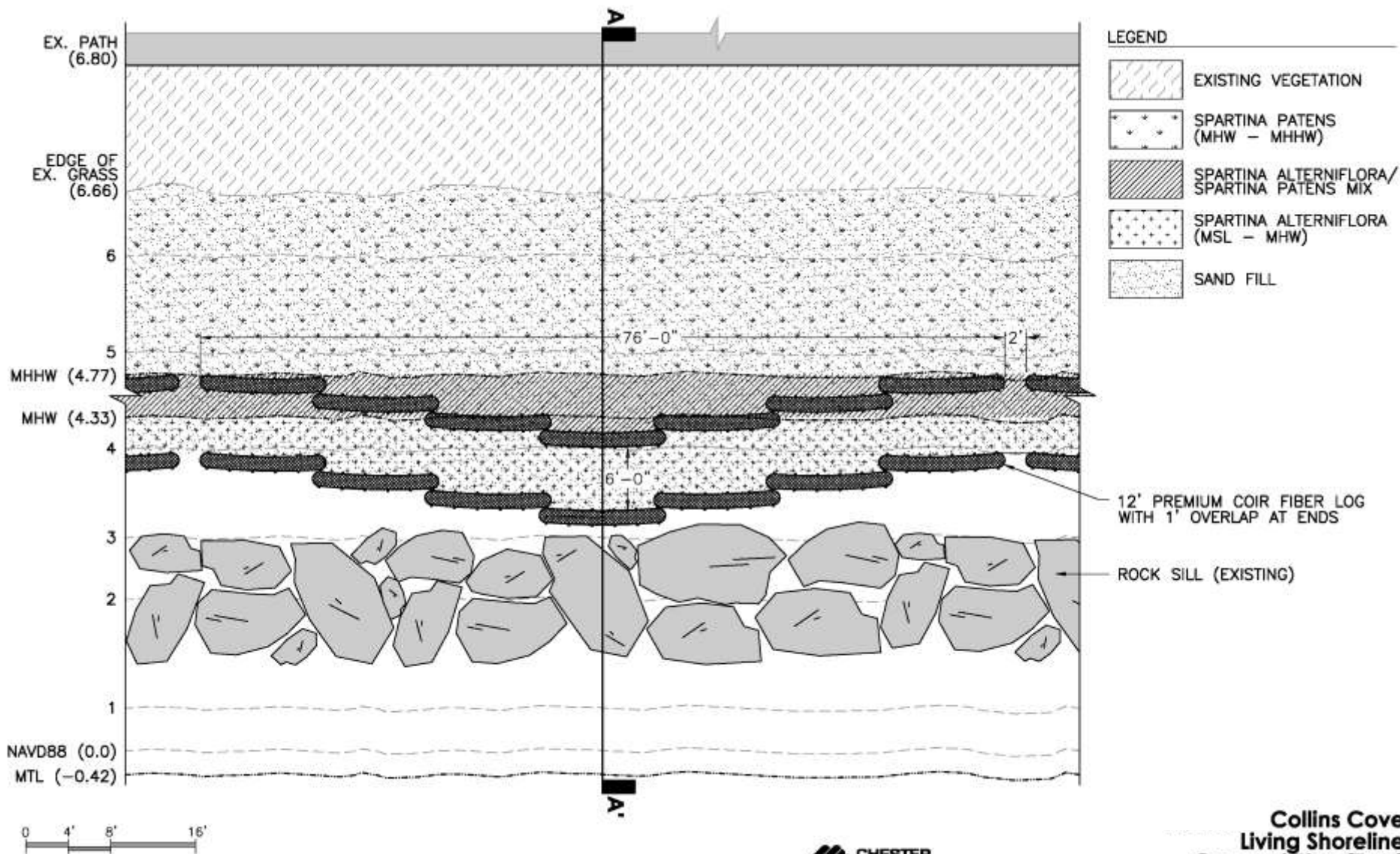


Illustration of DELSI Tactic which uses a combination of native wetland plants, natural structures, and intertidal shellfish to trap sediment and absorb waves.



**Collins Cove  
Living Shoreline  
Concept Plan (Typ.)**  
SALEM, MA





## Collins Cove Living Shoreline Layout Plan

Google Earth 2016 Ortho Imagery  
2013-2014 Sandy DEM Data  
Contours referenced to NAVD88 (feet)

# Legend

- Station\_Lines
- 1 Ft Contour



Collins Cove Survey  
Salem, MA  
Friday, January 06, 2017

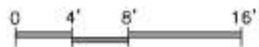
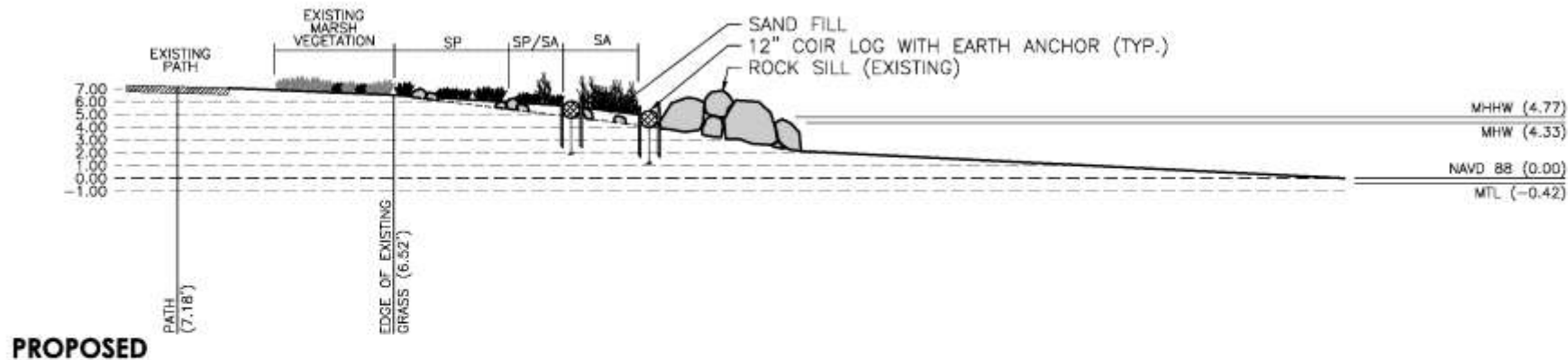
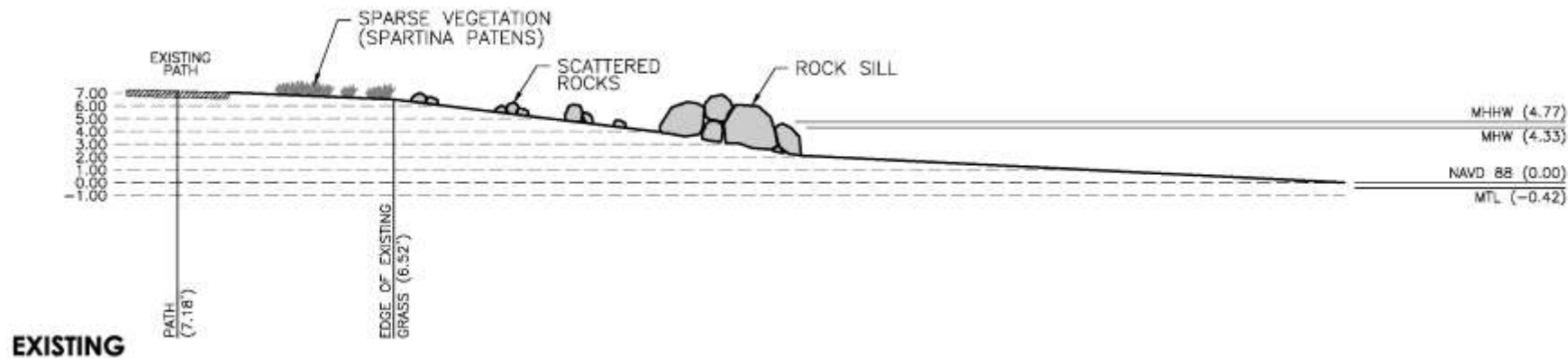


0 50 100  
Feet  
1 inch = 100 feet







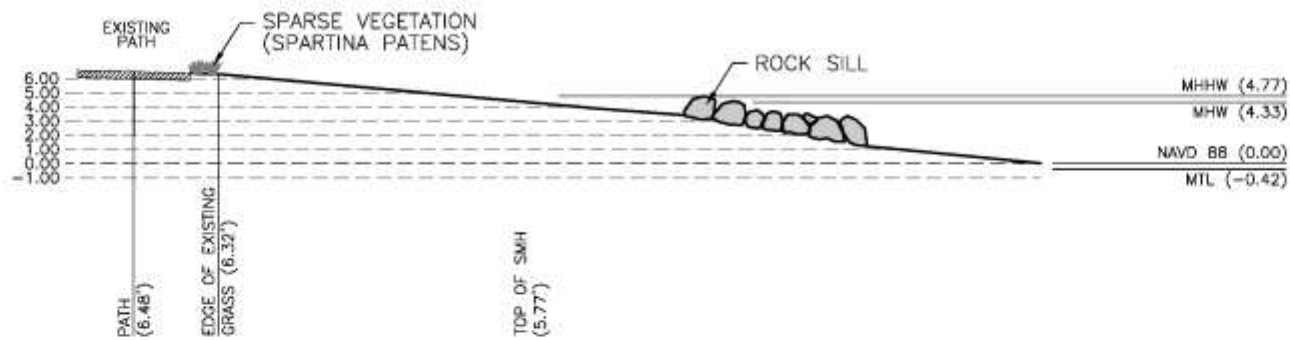


**Collins Cove  
Design Section  
STA 0+00  
SALEM, MA**

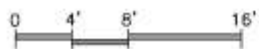
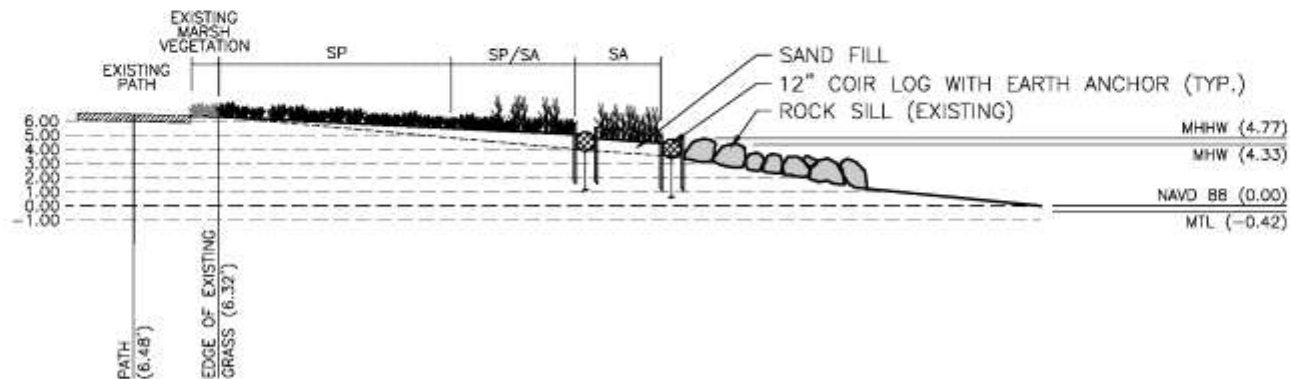




EXISTING



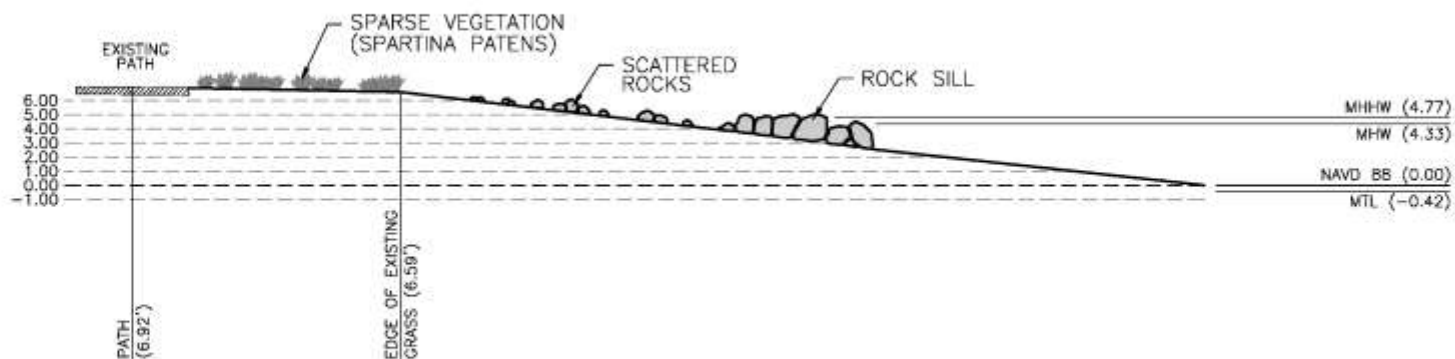
PROPOSED



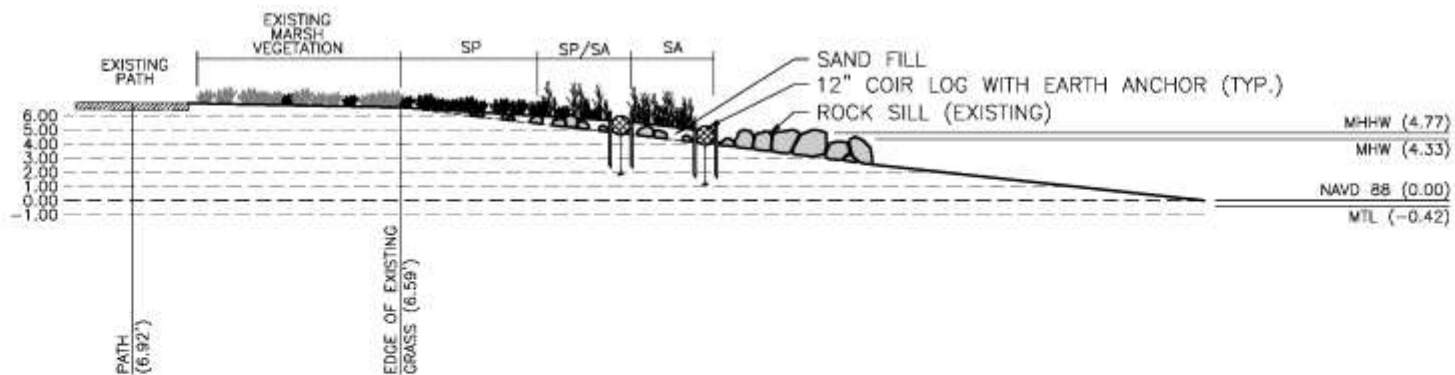
**FIGURE 10: Collins Cove  
Design Section  
STA 4+00  
SALEM, MA**



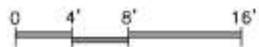




EXISTING



PROPOSED



Collins Cove  
Design Section  
STA 8+00  
SALEM, MA











# Questions and Comments

## Contacts:

*Tom Devine* – [tdevine@salem.com](mailto:tdevine@salem.com) / 978-619-5682

City of Salem Department of Planning & Community Development Senior Planner

*Eric Nelson* – [enelson@chesterengineers.com](mailto:enelson@chesterengineers.com) / 978-224-3139

Chester Engineers Senior Project Manager

*Barbara Warren* – [barbara.warren@salemsound.org](mailto:barbara.warren@salemsound.org) / 978-741-7900

Salem Sound Coastwatch Executive Director & MassBays Lower North Regional Service Provider



# Other 2 Priority Sites

Furlong Park  
along the North River



Juniper Cove  
along Columbus Avenue

