

6TH ANNUAL CAPE COASTAL CONFERENCE DECEMBER 4-5, 2018



Protect, Accommodate, or Retreat? Integrating Adaptation Strategies and Ecosystem Services into the Cape Cod Coastal Planner

Jennifer Clinton Cape Cod Commission



April Wobst Association to Preserve Cape Cod



Project Overview

Jennifer Clinton, Special Projects Coordinator, Cape Cod Commission

NOAA Coastal Resiliency Grant Program

Competitive grants for 3-year projects that advance coastal resilience through:

- Land/ocean use planning
- Disaster preparedness projects
- Environmental restoration
- Hazard mitigation planning
- Other regional/state/ community planning efforts



Project Overview

- Three-year, \$780,000 grant awarded to the Cape Cod **Commission and partners**
- Investigate environmental and socio-economic effects of local and regional coastal resiliency strategies
- Town of Barnstable pilot program



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Committee Roles









A D V I S O R Y B O A R D

- Provide advice on the overall approach and key decisions
- Review draft work product

SCIENCE COMMITTEE

- Provide access to data on natural hazards
- Interpret climate,
 weather and coastal
 geology data

ADAPTATION STRATEGIES COMMITTEE

- Review and comment on strategies database
- Advise team on how to apply strategies across the Cape

REGULATORY+LEGAL COMMITTEE

• Ensure the implementation of appropriate strategies across the region

Project Phases

ΟΝΕ

Data Collection and Adaptation Strategies Database

TWO

Public Engagement and Socio-Economic Analysis

THREE

Communication and Decision-Support Tool

Resiliency Decision Support Tool Framework

Adaptation Strategies Database Feeds the options for strategy selection

Users select a strategy to address coastal hazards. The database also informs tool outputs, with factors such as benefits provided, disadvantages, etc. Serve as planning layers to model current and future conditions

GIS Map Layers

Socio-Economic Analysis Informs the impacts of the selected strategies



Stakeholder Engagement



TOOL BETA TESTER GROUP

- Provided feedback as decision support tool was developed
- Helped shape functionality, fine tune outputs, and create wish list for future versions



SUBREGIONAL STAKEHOLDERS

- Engaged participants across the region based on their connection to the waters that surround the Cape.
- Presented information and solicited feedback that informed the tool's development

Stakeholder Engagement



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Understanding Vulnerability and Coastal Systems





BLACK BOX HOME | capecodcommission.org

Cape Cod Sea Level Rise

🖤 Tweet Q search for an address..

Cape-wide impacts at 6ft of Sea Level Rise:

- 21,760 acres (9%) of land is submerged.
- 116 Critical Facilities are impacted.
 11,724 Acres of Priority Habitat is
- lost. • Sales of \$1.07 billion and 8,222 jobs are lost in 795 businesses.
- 174.1 Miles of roadway are submerged and 708.6 miles are disconnected from the network.



More Information

Saved Map Views: You have no saved map views.



Cape Cod Commission | Earthstar Geographics, CNES/Airbus DS

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AREA OF MINIMAL FLOOD HAZARD

Adaptation Strategies Matrix

April Wobst, Restoration Ecologist, Association to Preserve Cape Cod

WHAT STRATEGIES INCREASE COASTAL RESILIENCY ON CAPE COD?



Adaptation Strategy:

an action that can be taken to protect an area from coastal hazards

Collecting Coastal Resiliency Data

Spectrum of Adaptation Strategies





DO BEACH NOTHING? NOURISHMENT? OFFSHORE REEFS? COASTAL ARMORING?

Collecting Coastal Resiliency Data

DATA ON RESILIENCE STRATEGIES



CREATE DATABASE

LINK TO GIS, DECISION SUPPORT TOOL

Data collection on site requirements, costs, life span, advantages and disadvantages Information will live at the Commission; shareable & exportable for use by policy makers, stakeholders

Geo-referenced data and tool allow users to test resiliency scenarios risk-free

Adaptation Strategies Database Development

- Researched and gathered data on adaptation strategies for region-wide database
- Strategy types include:
 - Policy Strategies
 - Hard (or Engineered) Strategies
 - Soft (or Green) Strategies
- Based on literature review with input from local and regional partners and experts



Adaptation Strategies Committee

MISSION

To review and comment on the structure and content of the adaptation strategies database, suggest strategies to include, and provide advice on considerations for applying strategies across the region

MEMBERS

- Paul Kirshen, UMass Boston
- Lisa Auermuller, Jacques Cousteau NERR
- Greg Berman, WHOI Seagrant/Cape Cod Cooperative Extension
- John Ramsey, Applied Coastal
- Julia Knisel, MA Coastal Zone Management
- Seth Wilkinson, Wilkinson Ecological
- Jim O'Connell, Coastal Advisory Services

Adaptation Strategies Database

Database (24 data fields):

- Description
- Type of Strategy
- Benefits and limitations
- Scale
- Costs and Maintenance
- Siting and Constraints
- Case Studies

Adaptation	Adaptation		Adaptation Type	Adaptation Type Clincate Change Hazard		
Strategy	Measures	Description	CES or Non-CES	Erosion	Storm Surge	Sea level rise
Open Space Protection Policy	Managed Realignment	Intentionally exposing a coastal area by removing or altering existing manmade shoreline structures such as buildneads, reventments, seawalls, and/or coir logs in order to create or expand intertidal habitats that can provide more natural flood protection.	non-CES	Y	¥	Y
Open Space Protection Policy	Managed Relocation	Moving development and infrastructure away from the coastline and out of harms way.	non-CES	Y	Y	Y

Adaptation Strategies Database

Categorized by type of strategy:

- **Protect** an area from coastal hazards,
- Accommodate the coastal hazard within the area through some modification of infrastructure or the natural system, or
- **Retreat** from an area by removing buildings or structures.

Adaptation Adaptation			Adaptation Type	Climate Chaoge Hazard			
Strategy	Measures Description		CES or Non-CES	Erosion	Storm Surge	Sea level rise	
Open Space Protection Policy	Managed Realignment	Intentionally exposing a coastal area by removing or altering existing manmade shoreline structures such as buildneads, reventments, seawalls, and/or coir logs in order to create or expand intertidal habitats that can provide more natural flood protection.	non-CES	Y	¥	Y	
Open Space Protection Policy	Managed Relocation	Moving development and infrastructure away from the coastline and out of harms way.	non-CES	Y	Y	Y	

ADAPTATION STRATEGIES DATABASE



Adaptation Strategies Database





15 | Nature Based Solutions (Non-CES)
19 | Structural Solutions (CES)
11 | Policy approaches

ADAPTATION STRATEGIES	RETREAT ADAPTATION CATEGORY
strategy:	SCALE:
Managed Relocation	Site Neighborhood Community Regional



Example of managed relocation at Brewster Breakwater Landing Beach after moving the parking lot back from the coastline. Gray outline shows location of parking lot prior to relocation.

DESCRIPTION: Gradually moving development and infrastructure away from the coastline and areas of projected loss due to flooding and sea level rise.

ADDRESSES THE FOLLOWING CLIMATE CHANGE HAZARDS Weight of the second state permits may be required.

BENEFITS PROVIDED

Storage

Aesthetics

Recreation

/Tourism

lood

ADAPTATION STRATEGIES

Managed Relocation



Example of managed relocation at Brewster Breakwater Landing Beach after moving the parking lot back from the coastline. Gray outline shows location of parking lot prior to relocation.

ADVANTAGES:

- Spares existing development from the effects of erosion and flooding.
- Protects future development from flooding.
- Allows for the maintenance or restoration of intertidal habitat.

DISADVANTAGES:

- Cost of moving development.
- Acquisition of land for new development.
- Loss of coastal property values.

ADAPTATION CATEGORY



RETREAT

ADAPTATION STRATEGIES

STRATEGY: Bank Stabilization -Fiber/Coir Roll



Example of a bank stabilization project using a coir roll.

DESCRIPTION: Cylindrical rolls, 12-20 inches in diameter & 10-20 feet long, made of coir (coconut) fiber held together by a fiber mesh, covered with sand, and are planted with salt-tolerant vegetation with extensive root systems. These reinforced banks act as physical barriers to waves, tides, and currents. They typically disintegrate over 5-7 years to allow plants time to grow their root systems to keep sand and soil in place.

ADDRESSES THE FOLLOWING CLIMATE CHANGE HAZARDS





PROTECT ACCOMMODATE R

ADAPTATION CATEGORY



ADAPTATION STRATEGIES

STRATEGY: Living Shoreline: Combined Vegetation and Structural Measures

ADAPTATION CATEGORY SCALE:



Ten-foot long coir logs are basis of living shoreline project at Felix Neck Wildlife Sanctuary on Martha's Vineyard.

DESCRIPTION: A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some other type of harder shoreline structure (e.g. oyster reefs or rock sills) for added stability. A combined approach integrates living components, such as plantings, with strategically placed structural elements, such as sills, revetments, and breakwaters.

ADDRESSES THE FOLLOWING CLIMATE CHANGE HAZARDS



CURRENTLY PERMITTABLE IN MA

Various local, state, and federal permits required depending on scope and location of project.

BENEFITS PROVIDED

Habitat	Water Quality	Carbon Storage	Aesthetics	Flood Mgt.	Recreation /Tourism
Habitat	Quality	Storage	Aesthetics	Mgt.	/Tour

Socio-Economic Analysis

Jennifer Clinton, Special Projects Coordinator, Cape Cod Commission

Goals for Socio-Economic Analysis

- 1. Understanding how Cape Cod values coastal ecosystems
- Understanding how these values might be impacted by climate change, erosion, sea level rise, and adaptation to these forces
- 3. Integrating this research into a GISbased decision support tool



Ecosystem Services:

direct and indirect contributions from ecosystems to human well-being

The Economics of Ecosystems and Biodiversity (TEEB)

Cape Cod Ecosystem Services

ECOSYSTEMS

- Coastal beaches
- Coastal dunes
- Land under the ocean
- Barrier beaches
- Coastal banks
- Rocky intertidal shores
- Salt marshes

SERVICES

- Storm damage protection
- Flood control
- Protection of wildlife habitat
- Protection of marine fisheries
- Sediment supply
- Groundwater pollution prevention

Understanding Tradeoffs

How do we value our environment?

Dollar values don't matter as much as **relative** values Goal of GIS tool: Make tradeoffs explicit between adaptation strategies and changes in ecosystem values

Understanding Tradeoffs

Why do we value our environment?

Policy choices often come down to **cost** Without understanding the 'cost' or **value of the environment**, it can't be properly factored into decisions

Short-term benefits outweigh long-term ones

Decision Support Tool

Intended Users

Designed as an educational tool to help **town staff**, **county staff** and **consultants** facilitate conversations and support community decision making around coastal resiliency issues.

Conversation starter and communication tool.

Select Shoreline Location



Welcome

The Cape Cod Coastal Planner is a tool developed to create awareness of and plan for hazards that occur on Cape Cod. Disclaimer: This is intended for general planning only and is not lorem ipsum tudor.

SELECT A SHORELINE LOCATION TO BEGIN PLANNING

Select Shoreline Location

START PLANNING

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ZONE OF IMPACT



Each selection on the vulnerability ribbon consists of five 100 ft. segments for a total of 500 ft. per selection.

You may make up to **eight contiguous selections** for a maximum planning area of 4000 ft.

A contiguous selection may be made by selecting any one of the five segments to the immediate left or right of the existing selection.

Selections: 2 of 8 Shoreline Extent: 1000 ft.

CANCEL

ADD STRATEGY

Behind the Scenes:



Behind the Scenes:



PLANNING LAYERS

0

GENERAL PLANNING LAYERS

Structures Sewer Infrastructure Public Roads Private Roads Rare Habitat Areas of Critical Environmental Concern Districts of Critical Planning Concern Historic Properties

SEA LEVEL RISE 1FT – 2FT - 3FT – 4FT – 5FT – 6FT Disconnected Roads Critical Facilities

COASTAL EROSION Sediment Transport Historic Shoreline Positions

STORM SURGE FEMA FIRM Flood Zones SLOSH Hurricane Categories 1-4

ADD YOUR LAYERS



Barnstable

Erosion No Action

Undevelopment

Open Space Protection

Salt Marsh Restoration

Revetment	(n/a for selection)
Dune Creation	(n/a for selection)
Bank Stabilization	(n/a for selection)
Living Shoreline	(n/a for selection)
Beach Nourishment	(n/a for selection)

APPLY STRATEGY

ADAPTATION STRATEGIES SHEET

Strategy: No Action



	ADDI	RESSES T	HE FOLL	OWING	
	CLIM	IATE CHA	ANGE HA	ZARDS	
6		(.		-	
Er	osion	Storr	m Surge	Sea Lev	vel Rise
	E	BENEFITS	PROVID	ED	

Barnstable Harbor

Description: Take no action to address changes in the coast. Effects of erosion, SLR, and flooding will continue or intensify. Depending on conditions, coastal resources may not migrate naturally where steep topography or preexisting coastal erosion control structures are present. Structures or facilities may be threatened or undermined.

Advantages:

Disadvantages:

- Allows natural erosion and sediment processes to occur.
- · Does not address coastal threats.



Retreat

C

Storm Surge

No Action

Undevelopment

Open Space Protection

Salt Marsh Restoration

Dune Creation	(n/a for selection)
Bank Stabilization	(n/a for selection)
Living Shoreline	(n/a for selection)
Beach Nourishment	(n/a for selection)

APPLY STRATEGY

ADAPTATION STRATEGIES SHEET

Strategy: No Action



	ADDF	RESSES THE FOL	LOWING
	CLIM	ATE CHANGE H	AZARDS
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Er	rosion	Storm Surge	Sea Level Rise

Barnstable Harbor

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Retreat

Description: Take no action to address changes in the coast. Effects of erosion, SLR, and flooding will continue or intensify. Depending on conditions, coastal resources may not migrate naturally where steep topography or preexisting coastal erosion control structures are present. Structures or facilities may be threatened or undermined.

Advantages:

Disadvantages:

- Allows natural erosion and sediment processes to occur.
- · Does not address coastal threats.



Coastal Hazard Impact Planner

Barnstable Harbor

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	Storm S	Surge 🚺	ADAPTATION STRATEGIES SH
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	Open Space Protectio	n	Open Space Pro
	Salt Marsh Restoration	n	
	Dune Creation	(n/a for selection)	
	Bank Stabilization	(n/a for selection)	ALL BULL STORE
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En Banks Million	Habitat	Water Quality	Carbon Storage	Aesthetics	Flood Mgt.	Recreation / Tourism

Description: Town, land trust or private entity purchasing or donating land to limit or prevent development at that site to maintain open space and preserve the natural defense system.

Advantages:

- Land donation can provide a tax benefit to the private property owner.
- Infrastructure won't need to be relocated/removed

Disadvantages:

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- Fee simple acquisition of coastal properties is expensive.
- The property will lose value as the "highest and best

APPLY STRATEGY

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Critical Facilities

BACK

Rare Species Habitat

CLEAR

Output Panel

- Cost, Lifespan, Scale directly from Adaptation Strategies Matrix
- Click instantly between no action and any other selected strategy

ST	TRATEGY OUTPU	T			
NO ACTION	SALT MARSH	RESTORATION			
selected No Action [®]					
Low (<\$200) COST [@]	Short LIFESPAN	Site Neighborhood Community Region SCALE			
SCENARIO ADDRESSES Erosion	LOCATION: Barnstab DURATION: 40 years SCENARIO SIZE: 1500	le Harbor area () linear ft. ()			
SCENARIO OUTPUTS All outputs are relative to the	e user taking no action withi	n the planning area.			
	\$25.4M	\$18.2M			
Public Building	Private Shoreline	Private Building			
Value	Land Value	Value			
Salt Marsh Ch ACRES LOS 2.77	ange Beach T • A	Area Change CRES LOST @ 0.81			
Critical Facilities	Rare	Species LOSS			
BACK		CLEAR			

Output Panel

- Relative to No Action ("No change")
- Protected vs. Lost
- KEY CONTEXT

Scenario addressed, location, duration, scenario size (length of user-selected segments)

• **INFRASTRUCTURE VALUES** Public Building Value, Private Land and Building Value



Output Panel

- Ecosystem Services
 - Salt Marsh Change
 - Beach Area Change
 - Rare Species Habitat
- Critical Facilities
 - Relocated/Protected or Lost

STRATEGY OUTPUT					
NO ACTION	SALT MARSH	RESTORATION			
selected No Ac					
Low (<\$200) COST [@]	Short	Site Neighborhood Community Region SCALE			
SCENARIO ADDRESSES Erosion	LOCATION: Barnstat DURATION: 40 years SCENARIO SIZE: 1500	ole Harbor area ; •) linear ft. •			
SCENARIO OUTPUTS All outputs are relative to the	user taking no action with	in the planning area.			
	\$25.4M	\$18.2M			
NO CHANGE 🛛					
Public Building	Private Shoreline	Private Building			
Value	Land Value	Value			
Salt Marsh Ch ACRES LOS 2.77 Critical Facilities	ange Beach • A Rare	Area Change CRES LOST O 0.81 Species Habitat			
васк		CLEAR			

Ecosystem Services

A COMPROMISE

Inclusion of ecosystem services critical to tool's purpose and outputs

Direct comparison to infrastructure values was problematic and misrepresented with available data

Currently include impacted acres for scale, and use information hovers to educate

Next Steps

Barnstable Pilot Project



"Advance the Towns of Barnstable's resiliency planning efforts, improve property owner understanding of the threats of climate change and SLR, identify and highlight the costs of doing nothing, as well as the costs and benefits of different adaptation scenarios."

Stakeholder Workshops

to define the potential damage and loss of properties within a hazard area boundary, communicate those potential losses, and identify potential solutions.

Test Decision-Support Tool

in its ability to effectively communicate resiliency issues

PROJECT WEBSITE capecodcommission.org/resiliency

THE RESILIENT CAPE COD PROJECT



CAPE COD







