

APPENDIX

- Small Discussion Group Maps
- Small Discussion Group Risk Matrices
- Master Risk Matrix
- Powerpoint presentation

Wellfleet and Truro Vulnerabilities and Strengths

- Critical Facilities
- Evacuation Route
- Flood Zone Designations
 - A Zones
 - V Zones
- Sea Level Rise: 3 feet
 - Connected to Coast
 - Depression
- Historic Shorelines
 - 1844 - 1897
 - 1909 - 1938
 - 1943 - 1969
 - 1970 - 1982
 - 1994
 - 2000
 - 2001
 - 2007 - 2009

0 0.325 0.65 1.3 Miles



TRURO CULVERTS
 PANNET (2)
 VITRE PANNET (2)
 EAGLE CREEK
 BEAUTY PT / G HARBOR
 HIGH MOUNT
 AND POND
 RD.
 GOLF HILL
 PT. 6

PANNET
 HARBOR
 (FUEL)

SEMI-TRUCK
 TRANSPORT
 ZONE

SHOULDER
 NEW STAY
 HARBOR

WELLFLEET
 HARBOR - OK!
 HARBOR - CRITICAL
 BRIDGE

CULVERTS
 UNDER (2) ON
 CAMPUS (2)
 WEST ROAD
 FRESH BRIDGE (2)
 BLACKFISH CREEK
 MAYO CREEK

SALT
 MARSHES
 INCREASE
 RESILIENCY

MAYO
 CREEK
 VULNERABLE

BLACKFISH
 CREEK
 "CHOKE
 POINT"
 CRT. 6

LT. ISLAND
 BRIDGE

WELLFLEET
 HARBOR
 (FUEL, ETC.)

SHORELINE
 PROTECTION

NODAL PT.

OVERWASH!

PANNET RIVER CRT. 6
 CURRENT RETIC.
 BRISTON BEACH

AMERICAN CORPS
STRENGTH
 • ECONOMIC UTILITY
 V. VULNERABLE

NEWCOMB HARBOR
 BEACH

CANTON HARBOR
 BEACH

OVD SO. CO
 CANTON
 V. CLOSE TO
 OCEAN

MAGUIRE &
 LE CANTON
 HARBOR
 BEACH

MARCONI
 BEACH

Wellfleet and Truro Vulnerabilities and Strengths

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0 0.325 0.65 1.3 Miles



TRURO CULVERTS
 PANSET (2)
 VITRE PANET (2)
 EAGLE CREEK
 BEAUTY PT / G HARBOR
 HIGH MOUNT
 AND POND
 RD.
 GOLF HILL
 PT. 6

WELLFLEET
 HARBOR - OK!
 HARBOR CRATERING
 BRIDGE

CULVERTS
 UNDER (2) ON
 CAMPBELL (2)
 WEST ROAD
 FRESH BRIDGE (2)
 BLACKFISH CREEK
 MAYO CREEK

SALT MARSHES
 INCREASE
 RESILIENCY

BLACKFISH
 CREEK
 "CHOKE POINT"
 CRT. 6

MAYO
 CREEK
 VULNERABLE

LT. ISLAND
 BRIDGE

SHORELINE
 HIGH

Nodal Pt.

AMERICAN CORPS
STRENGTH
 • ECONOMIC UTILITY
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PANSET RIVER CRT. 6
 CURRENT REIC.
 BRISTON BEACH

OVERWASH!

LONG NOOK BEACH

NEWCOMB HARBOR
 BEACH

CANTON HARBOR
 BEACH

OVD SO. CO
 CANTON
 V. CLOSE TO
 OCEAN

WELLFLEET
 HARBOR
 (WATER, ETC.)
 FUEL

MAGUIRE &
 LE CANTON
 HARBOR
 BEACH

MARCONI
 BEACH

CULVERTS

MUNICIPAL

HARBOR RIVER

TRANSFORM

SEMI-TRUCK
 TRANSPORT
 NODAL ZONE

SHORELINE
 NEW STAY

WELLFLEET
 HARBOR

THE GUY

BLACKFISH
 CREEK

BLACKFISH
 CREEK

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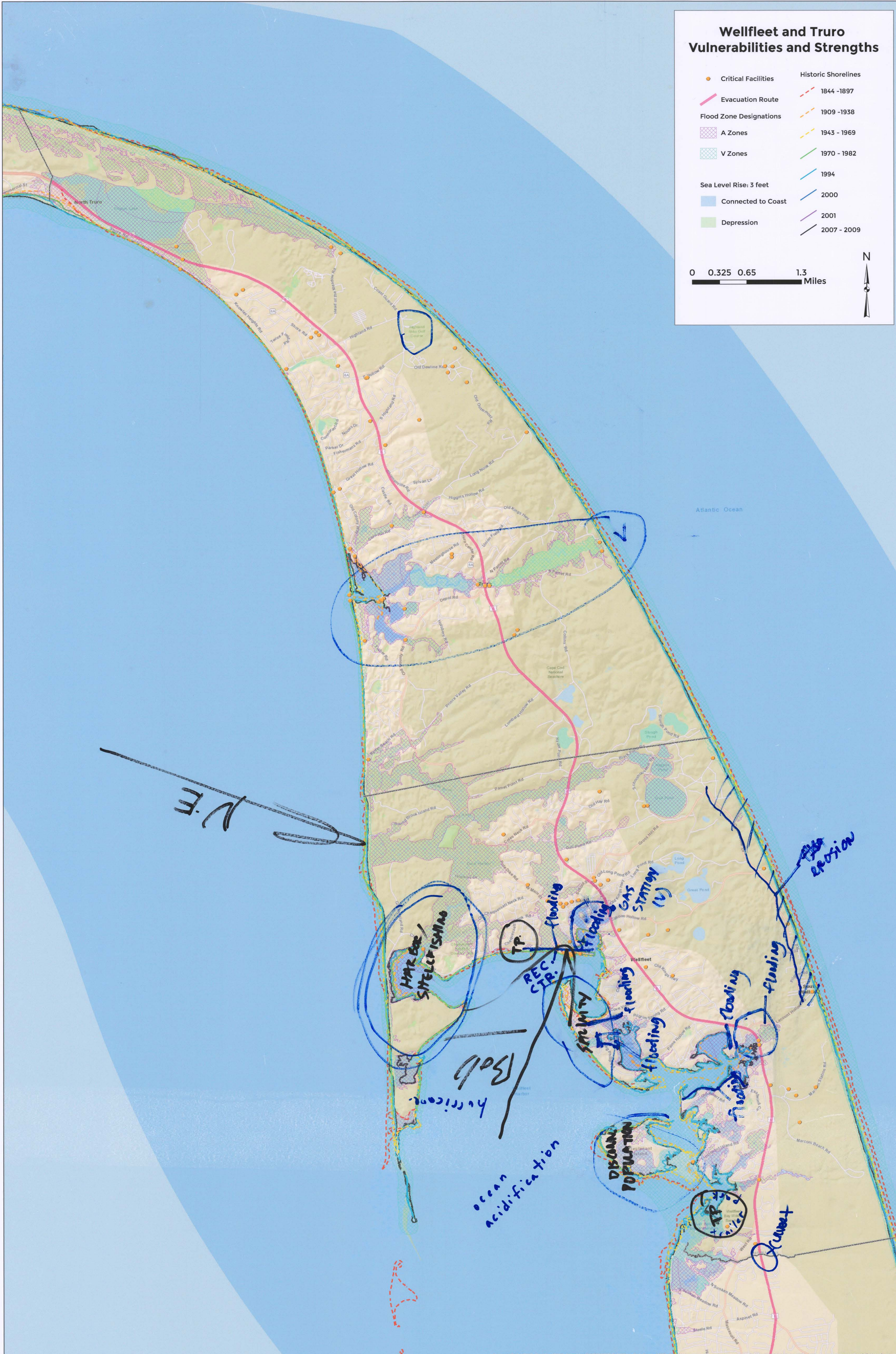
BLACKFISH
 CREEK

Legend:

- Critical Facilities
- Evacuation Route
- Flood Zone Designations**
 - A Zones
 - V Zones
- Sea Level Rise: 3 feet
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- Historic Shorelines**
 - 1844 - 1897
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Source: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community



**Wellfleet and Truro
Vulnerabilities and Strengths**

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0 0.325 0.65 1.3 Miles



TABLE A - SHANNON J. - TRURO

H-M-L priority for action over the Short or Long term (and <u>U</u> ngoing)	Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)	
V = Vulnerability S = Strength	SEA LEVEL	SEVERE
PROBABLY	FLUDDING	
		Short Long

Infrastructural							
CULVERTS IN SEVERAL LOCATIONS	SEE MAP	PUBLIC, MUNIT. JURISDICTIONS	✓	TRURO CTR. ROAD, MILL POND, LITTLE PAMET ← CULVERT REPLACEMENT, POT. ROAD ELEVATION	→	H	ONEBID
WATER SUPPLY/UTILITIES	ROUTE 6A	PUBLIC	✓	ELEVATE/SECURE ROADWAY TO PROTECT FROM HAZARDS	→	M	LONG
REGIONAL SHELTER	PROVINCE-TOWN	OLD H.S.	S/N	PROVIDE TRAINING/STAFFING FOR VOLUNTEERS EXPLORE + POTENTIAL ADDITIONAL CAPACITY		H	SHORT-TERM LONG-PAY
RELIANCE ON WELL WATER	TOWN-WIDE	N/A	✓	WATER BUFFALOES FOR EMERGENCIES PURSUE MUNIC. WATER SUPPLY		H	SHORT-TERM LONG-PAY
BEACH PARKING LOTS	SEE MAP	PUBLIC	✓	PARTNER W/CCNS TO PROVIDE REMOTE PARKING + SHUTTLE TO BEACHES + RTA		H	SHORT-TERM LONG-PAY
COMM. RESIDENTIAL PROPERTIES	TOWN-WIDE	PRIVATE	✓	IMPROVE LOCAL REGULATIONS TO PROHIBIT REDEVELOPMENT IN FLOOD HAZARD AREAS + OTHER HIGH HAZARD AREAS		M	SHORT-TERM LONG-PAY
Societal							
FLUCTUATIONS IN TOURISM	TOWN-WIDE		✓	COMMUNICATIONS/MARKETING PLAN TO IMPROVE IMPLEMENTATION OF RAVE SYSTEM		H	S
PROXIMITY/AVAIL. OF GROCERY	TOWN-WIDE	PRIVATE	✓	EXPLORE EXPANSION OF COA/FOOD PANTRY OPERATIONS/TRANS. OPTIONS		M	S
PHARMACY/MED. CARE	TOWN-WIDE	PRIVATE	✓	" "		A	S
ELDERLY POPULATION	TOWN-WIDE	PRIV./PUB.	✓	- SEE COMMUNICATIONS - SUPPORT CERT.		H	SO
SEASONAL POPULATION/ACCOM.	T.W. + CAMPGROUND	PRIVATE	S/N	- SEE COMMUNICATIONS - EVACUATIONS		H	O
FARMLANDS/MARKET GARDEN	T.W.	PRIVATE	✓	" "		H	5/0
Environmental							
PAMET RIVER TIDAL FLOW	SEE MAP	CONS/PRIV. TOWN	✓	SEE CULVERTS ACTION/DEVELOPING - COLLECT DATA PURSUE ALTERNATIVE OPTIONS TO MIT. FLOODING ON TIDAL SP.		H	O
ALL BEACHES	T/W.	PUBLIC	V/S	EXPAND BEACH MGMT. PLAN FOR NON-CCNS BEACHES		M	O
PAMET HARBOR	OWN MAP	PUBLIC	S/N	- DREDGING -		H	O
AVAILABLE LAND	T/W	PRIV./PUB.	✓	PURSUE LAND ACQUISITION/OTHER ZONING/TOOLS TO REDUCE REPETITIVE LOSS PROPS. FROM REDEV.		M	L
AQUIFER PROTECTION/WQ2	TOWN-WIDE	PUB./PRIV.	✓	EXPAND HAZMAT COLLECTION		A	O

*

2000



Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-M-L priority for action over the S hort or L ong term (and U ngoing)

Y = Vulnerability **S** = Strength

H-M-L priority for action over the short or long term (and ongoing) Y = Vulnerability S = Strength	Location	Ownership	V or S		Flood	(castell Erosion	Extreme Weather	Climate, Change	Priority	Time
									H - M - L	Short Long Ongoing
Features										

Infrastructural

[illegible]

combin w/
loss of power

communication coverage

Action | action
Organizing | plan

Action - shelter space.

C

Community Resilience Building Risk Matrix



www.CommunityResilienceBuilding.org

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-M-L Priority for action over the short or long term (and ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Flood (rain, sea , surge)	Coastal Erosion	Extreme Weather	Climate Change (SLR, drought) species mig.	Priority	Time
								H - M - L	Short Long Ongoing

Infrastructure									
Disconnected Roads	Plaquemine LA Orleans Parish Covington LA	Town State	Public	V	✓	✓	✓	*H	S
Loss of parking lots	NS - state Ocean lots		Public	V/S	✓	✓	✓	M	S
Loss of power / communication	Solar power lines	CLC Evergreen	Private	✓	✓	✓	✓	*H	O
Wells / saltwater intrusion	M1	Private	Private	✓	✓	✓	✓	M	S
Harbor - dredging needed		Town / Fed	S + V	✓	✓	✓	✓	H	O
Critical access - route & disconnection	Oceanside	State	V	✓	✓	✓	✓		
Societal									
Business impacts, loss of inventory	ability to operate / rest, inventory	private	V + S	✓	✓	✓	✓	M	O
Shellfish - commercial, aquaculture		public	V + S	✓	✓	✓	✓	H	O
Tourism		public + private	V + S	✓	✓	✓	✓	M	O
Public safety - roads, rescue	equip. access for	Town, Fed, private	V + S	✓	✓	✓	✓	*H	O
NGOs - funds of HR, others, ARC	CCS funds of HR, others, ARC		S	✓	✓	✓	✓		
Gov Orgs - NS, state , CCC	resources of community		S	✓	✓	✓	✓		
Environmental									
Shellfish / finfish - resources		State, town, private	V + S	✓	✓	✓	✓	✓	✓
Saltwater intrusion - habitat			V + S	✓	✓	✓	✓		
Rising Use / level of ponds	Kelly ponds	Town, Fed, private	V	✓	✓	✓	✓	L	O

merge two

Arterial routes - feasibility study
collect LIDAR data every 10 yrs
(happening now)
smart grid
planning study
implementation

Recognized use of sustainable food.



Community Resilience Building Risk Matrix

Top Priority Hazards (tornado, floods, wildfires, hurricanes, earthquakes, drought, sea level rise, heat wave, etc.)

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features		Location	Ownership	V or S	Coastal Erosion	Flooding	Sea Level Rise	Hurricanes/ High Wind	Priority	Time
									H - M - L	Short Long Ongoing
Infrastructure										
Drinking Water Wells / Water Supply		Town Wide		V/S		H ₂ O	EXPAND, REPAIR H ₂ O SYSTEMS & USE 12" PIPE (HARD PIPES) (REPAIRS)	EXPLORE H ₂ O TREATS IN PARTS OF TOWN FOR EMERGENCIES		
Wastewater		Town Wide		V		REPAIR/REPLACE WASTEWATER TREATMENT PLANT	EXPAND/REPAIR WASTEWATER TREATMENT PLANT	EVALUATE N ₂ O REMOVAL OPTIONS		
HARBOR (SOCIETAL + ENVIRONMENTAL)				S/V			DEEPE HARBOR H ₂ O	REPAIR H ₂ O		
→ LOW LYING ROADS / PARKING (LOTS (BEACHES)		→ OCEAN VIEW DR. CORP. ST LI. ISLAND KENDALL HIMMELT-SERVIS	DRIVE GUMER	V			2 ELEVATE ROADS - L ₂ L	REPAIR H ₂ O		
BROADBAND COMMUNICATIONS / REVERSE 911		Town Wide		V		EXPAND FIBER OPTIC H ₂ O-L	INSTALL CALL BOXES REPAIR TOWN HALL	CREATE MORE RESILIENT INFRASTRUCTURE H ₂ O		
COA GENERATOR / SHELTERS / IN PLACE		OKH		V			BOAT GENERATORS LIBRARY, COA H ₂ S	DEVELOP EDUCATIONAL PACKETS FOR RESIDENTS ON SHELTERING, EMERGENCY LOCAL INFORMATION		
Societal										
ISOLATED POPULATIONS BLUEFISH CREEK				V			BOAT EVACUATIONS? DEVELOP COMMUNICATIONS TREE/SYSTEM	REPAIR H ₂ O		
WELFLEET BASED EMERGENCY SHELTER				V						
EVACUATION ROUTES				V			STUDY ALTERNATIVES TO GET OFF CAPE	L-L		
RECREATION - FIELDS, PLAYGROUND, BEACH		MANO BEACH		V/S			DEVELOP A PLAN TO MOVE RECREATION AREAS TO HIGHER GROUND	L-O		
MOBIL HOME PARKS, HARBOR SIDE, MARINES PARKING LOT				V				SHUTTERING MARINE HELICOPTER LANDING SHELTERS		
VOLUNTEERS AGRICULTURE / COMMUNITY				S			COORDINATE ENERGY USES DEVELOP UNITS TO REDUCE USE	DEVELOP COMMUNICATION TREE/CHAIN		
Environmental										
SALT MARSH RESTORATION - HR CREEK		HR, UNMO		V/S			OPEN HR, MANO RESTORE SALT MARSHES	OPEN HR, MANO H ₂ S-M		
CONSERVATION REGULATIONS + BYLAWS HEALTH				V/S			PROVIDE INCENTIVES FOR TIGHTEN REGULATIONS TO PROTECT NATURAL RESOURCES	H ₂ O		
SHELTERING / AQUACULTURE (RESERVE Mgmt. PLAN)				S/V			DEVELOP RESERVE Mgmt. PLAN FOR SHELTERING NATURAL RESOURCES	M.O		
WETLANDS → MARSHES → NATURAL FUNCTIONING				S			ALLOW WETLANDS TO FUNCTION NATURALLY	H ₂ O	No P.T.	
HEALTH AND CONSERVATION BARRIERS				S						
CCNS				S			INCLUDE IN PLANNING EFFORTS	H ₂ O		

Fire suppression - V
Gas stations - V
Underground utilities

Evacuation Routes

InterGovernmental - S
Cooperation - S

Farming / Agriculture - S
Highland Center - S

Church shelters
Elementary school shelter

Elderly population - V
→ KEME PROTECTS
EMT TRAINING - S

1. Bluefish Creek
(CREEK) -
ENLARGE CREEK
TO PREVENT RT. 6
FLOODING

2. HINES POND CULVERT
- RESUME TYPICAL FLOW
PERMISSIBILITY STUDY

SEDIMENT BUDGETS + SEDIMENT MGMT PLAN (DUNES/BARRIERS)
EROSION

3. CULVERT WIDENING / REPAIR
→ SURVEY IF CULVERTS, ASSESSMENT OF
CONCRETE

DEVELOP PLAN FOR SAND PROTECT + HARVESTING (HMO)

CLEAN CHANGE
ACIDIFICATION
→ FLEXIBILITY FOR REMOVAL /
REDUCTION OCEAN ACIDITY
→ DEVELOP TALKING POINTS FOR
BUSINESSES ALONG THE
COAST
→ IDENTIFY AND CONSIDERATION
INCREASE VULNERABILITY OF
TOWN

→ CONDUCT SHORELINE SURVEY
→ ANALYZE DATA - PH FEMPHICS
→ DEVELOP AN ADAPTIVE PLAN

CONSIDER VISITORS
SEASONAL

Master Matrix



www.CommunityResilienceBuilding.org

V = Vulnerability **S** = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

H-M-L priority for action over the Short or Long term (and Ongoing) V = Vulnerability S = Strength				Erosion	Sea Level Rise	Flooding	Storms	Group	Priority	Time
Features								A (Truro), B (Mixed), C (Mixed), D (Wellfleet)	H-M-L	Short Long Ongoing
Infrastructural										
Culverts -	Several locations - see map	Public	V	Repalce culverts, with potential road elevation ((Truro Center Road, Mill Pond, Little Pamet)				A	H	Ongoing
Well Water/Reliance on well water	Town-wide	N/A		Provide water "buffalos" for emergencies (1) and pursue municipal water supply (2)				A	H (1), L(2)	S(1), L (2)
Beach parking lots	see map	Public	V	Partner with CCNS and RTA to provide and promote shuttle to beaches				A	H	S -O
Regional Shelter	Provincetown	Public	S & V	Provide training/staffing for volunteers & explore potential additional capacity				A	H	S&L
Communications/broadband	Townwide	Multiple	V	Public education on emergency preparedness. Pursue complete coverage of broadband.				A	H	O
Electrical supply	Townwide	Public utility	V	Work with Eversource and tree companies to trim trees.				A	H	S
Culverts/low-lying roads (C: Herr,River@ OKH & Patience Brook; West Road, Fresh Brook (2), Blackfish Creek (2), Mayo Creek; Pamet (2);Little Pamet (3), Eagle Neck Creek, East Harbor/High Head, Mill Pond Rd	see map	Mixed -	S & V	Widen culverts to enable salt marsh restoration & Carbon storage; prioritize & seek funding from Town, State, foundations, etc.				B	H	S & O
Culverts - Blackfish Creek @ Rte 6, Rte 6 @ Pamet & Wilders			V/S, V	Communicate with MasasDOT				B	H	O
Title V & Private Wells		Mixed -	V	Decrease nutrients - BOH - I/A systems in sensitive areas				B	H	
Disconnected Roads & critical access (Rte 6)	Lieut.Island, Orl.rotary, Chenuesset	Town, state, private	V	Several actions: evacuation plan, determine which roads will be disconnected, alternate routes, protecting roads from flooding				C	H	S
Loss of power/communitication	Solar generators, power lines	Eversource, CLC, private	V&S	Bury lines, develop smartgrid, renewable energy, program at Eversource for battery storage				C	H	O
Wellfleet Harbor		town, fed	V	Pursue funds for dredge, need clamshell dredge				C	H	O
Drinking Water/Wells	Townwide		V/S	Expand, replace Coles NeckH2O system with 12" pipe;explore alternate H2O systems				D	H	S
Wastewater	Townwide		V	Evaluate nitrogen removal options				D	H	O
Low lying roads & beach prking lots	Comm. St, Indian Neck. Lt Isl, Kendrick, etc.		V	Identify vulnerable roads, elevate roads				D	H	O, L
Harbor			V&S	Dredge harbor, develop action plan for shellfishing during climate change				D	H	S & O
COA generator/shelters			V	Buy generators for library, COA, etc., develop educational packets for residents, develop shltering feasibility study for sheltering				D	H	S
Societal										

Fluctuations in tourism	townwide		V	Develop communications/marketing plan to improve implementation of Rave system	A	H	S
Seasonal population	townwide & campgrounds	private	V & S	See communications above - evacuation	A	H	
Farmlands -farmer markets, gardens	townwide	private		See communications	A	H	s/o
Elderly population	townwide	private/public	V	See communications suggestion above	A	H	O
First responders		town/NPS	S	Support these community assets - ID vulnerable populations - need system	B	H	S & O
Regional shelter system			V&S	" Triage by messaging system - need system	B	H	S
Neighborhood Associations, Volunteers			S	Mapping to communicate vulnerabilities, collection of resources at public libraries, series of lectures, more stakeholders	B	H	S & O
Sense of community			S	Outer Cape Town committees should coordinate & meet monthly about the community's resiliency needs to develop a strategy for seeking Town Meeting funding for address climate change impacts. Support the Energy and Climate Change committees with town staffing.	B	H	
Shellfish - comercial, aquaculture		public & private	S&V	Open new areas for grants, promote & preserve access, culvert upgrades to prevent runoff.	C	H	O
Public Safety		Town, REPC	S&V	Obtain adequate equipment to provide access during events	C	H	O
Age of population-			V	Evacuation plan, transport after emergency plan	C	H	S
Route 6 OCHS Clinic			S&V	Plan for urgent care facility & stocking of medications	C	H	S
Environmental							
Pamet River tidal flow	See map	CCNS, Town, private	V/S	See culverts action; Pursue alternative actions to mitigate flooding. dredging - collect data & on tidal system.	A	H	
Pamet Harbor	on map	Public	V/S	Dredging	A	H	O
Barrier beaches - Mayo Beach & Beach Point	Mayo -W, Beach Point -T	Mixed	S & V	Provide education about natural mitigation & migration of resources, managed retreat, and pursue regulatory changes, zoning changes, moratorium on bldg in floodplain - so as to not make situation worse	B	H	s & o
Salt Marsh restoration - herring river, Mayo creek			S&V	Open Herring River, Mayo, restore salt marshes	D	H	S-M
Dunes & banks - Sediment budgets			S	Develop plan for sand placement and harvesting	D	H	O
Blackfish Creek -culvert, Hawes pond culvert			S	Enlarge Blackfish Creek culvert to prevent Rte 6 flooding; feasibility study for restoring tidal flow, also culvert assessment	D	H	O

Municipal Vulnerability Preparedness Workshop

TOWNS OF WELLFLEET AND TRURO

March 12, 2019



Today's Agenda

Morning

- 8:45 Workshop Overview and Introductions – Hillary Lemos and Emily Beebe
- 9:00 MVP Program Background – Martha Hevenor
- 9:15 Science, Climate Projections, Resources – Greg Berman
- 9:35 Short Break
- 9:45 Small Team Exercise
 - Team Orientation
 - Discuss and Identify Priority Hazards
 - Identify Vulnerable Features and Strengths
 - Prepare for Report-out
- 11:15 Break
- 11:30 Teams Report on Hazards, Vulnerabilities, Strengths
- 12:00 Summary Discussion
- 12:15 Lunch!

Today's Agenda

Afternoon

12:45 Small Team Exercise

- Discuss and Identify Actions

1:45 Short Break

1:50 Small Team Exercise (continued)

- Identify Priority and Urgency of Actions
- Prepare for Report Out

2:30 Break

2:45 Small Teams Report on Top Actions

3:00 Summary Discussion – Compile Top Actions

3:30 Wrap Up and Next Steps

Adjourn!

Project Team

MVP PROVIDER | CAPE COD COMMISSION

- Sharon Rooney - *Chief Planner*
- Heather McElroy - *Natural Resources Manager*
- Erin Perry – *Deputy Director*
- Chloe Schaefer - *Community Design Planner*
- Martha Hevenor - *Planner II*
- Anne Reynolds - *GIS Director*

MVP PROVIDER | COOPERATIVE EXTENSION

- Greg Berman - *Coastal Processes Specialist, Woods Hole Sea Grant/
Cape Cod Cooperative Extension*
- Shannon Jarbeau - *Floodplain Specialist & CRS Coordinator,
Woods Hole Sea Grant/Cape Cod Cooperative Extension*

TOWN PROJECT MANAGERS

- Hillary Lemos – *Wellfleet Health and Conservation Agent*
- Emily Beebe – *Truro Health/Conservation Agent*

MVP Program Background



MVP Program Background



EXECUTIVE ORDER 569: AN INTEGRATED CLIMATE CHANGE STRATEGY FOR THE COMMONWEALTH 9.16.16



- Reducing greenhouse gas emissions to combat climate change
- Preparing for the impacts of climate change
 - State Adaptation Plan
 - Agency Vulnerability Assessments
 - Municipal Support
 - Climate Coordinators

ENVIRONMENTAL BOND BILL, 3.15.18



- \$1.4 billion bond bill with focus on climate change resiliency
- \$300 million for climate change adaptation
- Codifies EO 569

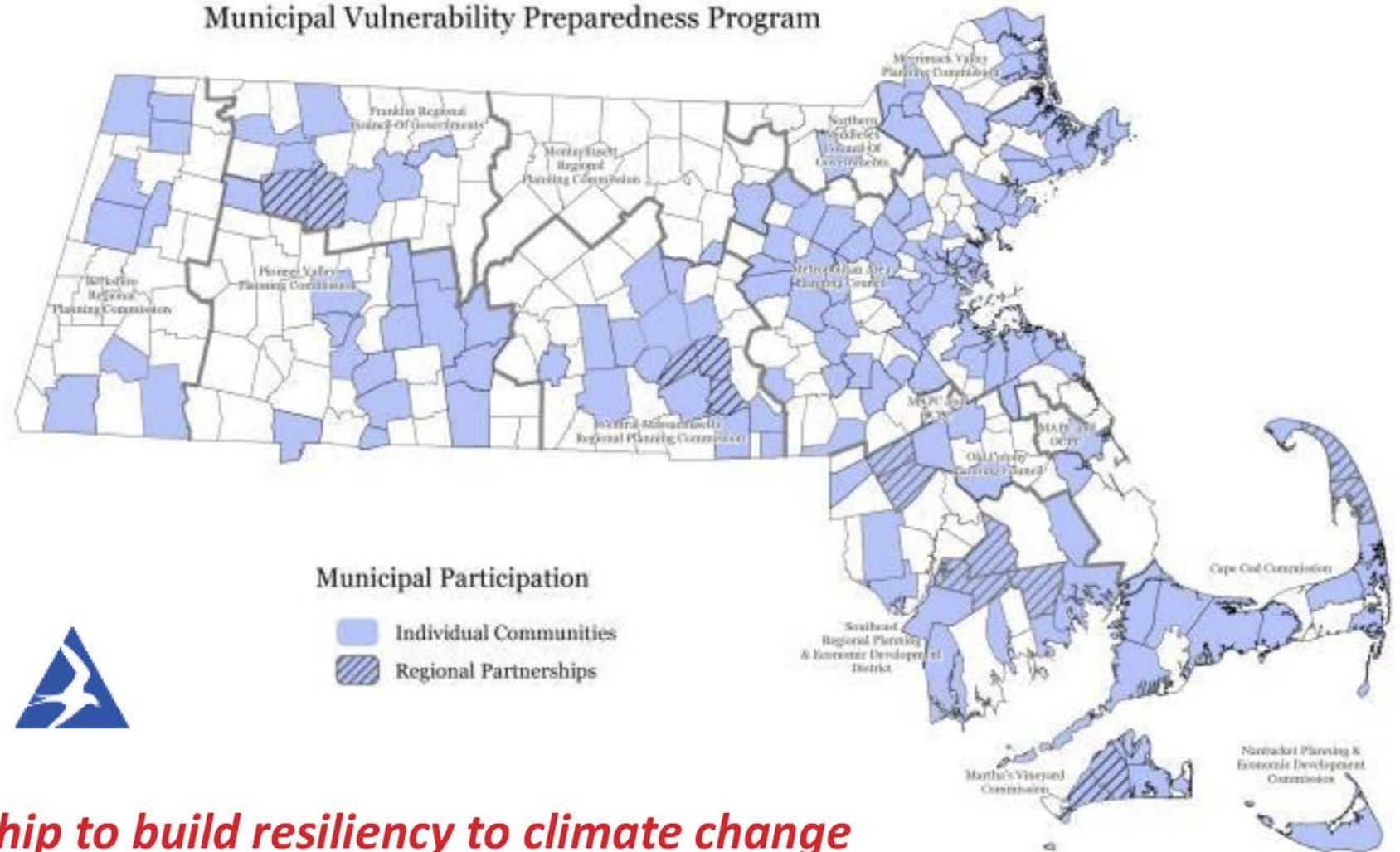


Massachusetts State Hazard Mitigation and Climate Adaptation Plan

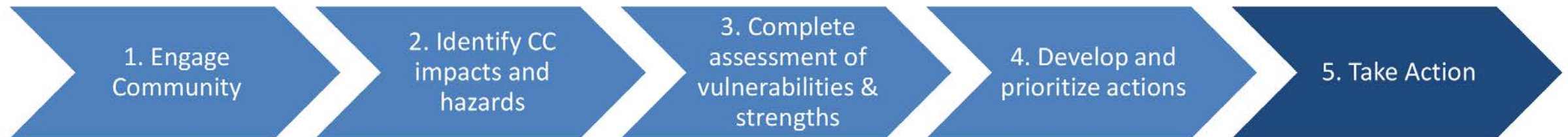
- www.resilientma.com
- **Integrated Plan:** First in the nation Climate Adaptation and Hazard Mitigation plan
- **Mainstreaming climate change:** Incorporating climate change into current planning, budgeting, and policy frameworks

Municipal Vulnerability Preparedness Program

2017-2019



State and local partnership to build resiliency to climate change



MVP 2018



- ❖ 82 new planning grants, now 43% of the Commonwealth
- ❖ 39 Action Grant projects
- ❖ \$7.2 million dollars committed
- ❖ Have budgeted \$10 million for action grants next year in Governor Baker's Capital Plan



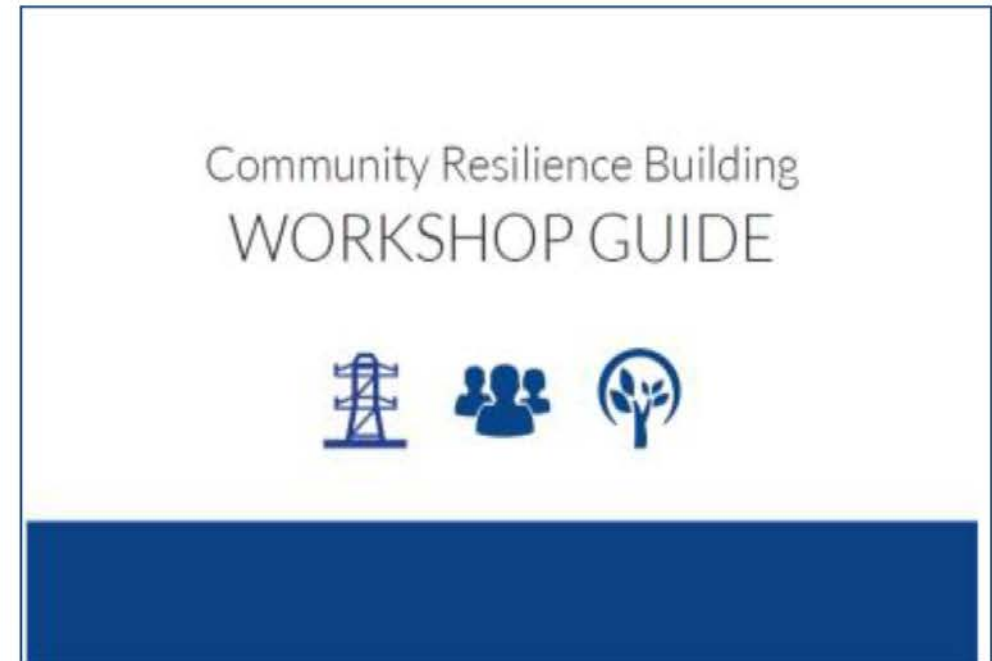
MVP Action Grant

- **Who's eligible?**
 - Municipalities with MVP designation
 - Municipalities completing 2017 MVP process who have completed workshop(s) and have identified prioritized actions
- Funding: \$10,000 - \$400,000 per project
- Match: At least 25% of total project cost required



MVP Principles

- **Community-led process** that employs local knowledge and requires local buy-in and support
- **Accessible**
- **Utilizes partnerships** and leverages existing efforts
- **Mainstreams** climate change
- **See communities** as local innovators
- **Frames** coordinated statewide efforts.



Overview of the Process



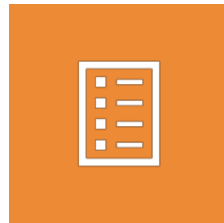
**PREPARE FOR
THE WORKSHOP**



**CHARACTERIZE
HAZARDS**



**IDENTIFY COMMUNITY
VULNERABILITIES AND
STRENGTHS**



**IDENTIFY AND
PRIORITIZE
COMMUNITY
ACTIONS**



**DETERMINE
OVERALL
PRIORITY
ACTIONS**



**PUT IT ALL
TOGETHER –
FINAL REPORT**



**MOVE
FORWARD**

Science, Climate Projections, and Resources

Greg Berman, Coastal Processes Specialist
Woods Hole Sea Grant & Cape Cod Cooperative Extension





Coastal Erosion



Flood



Severe Winter Weather



Dam/Culvert Failure



High Winds



Thunderstorms



Drought



Hurricane



Tornados



Earthquake



Landslide



Tsunami



Extreme Temperatures



Nor'easters



Fire (Urban & Wild)



Sea Level Rise



Coastal Erosion



Flood



Severe Winter Weather



Dam/Culvert Failure



High Winds



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Extreme Temperatures



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Sea Level Rise

WELLFLEET HAZARD PLAN



Coastal Erosion



Flood



Severe Winter Weather



Dam/Culvert Failure



High Winds



Thunderstorms



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Hurricane



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Earthquake



Landslide



Tsunami



Extreme Temperatures



Nor'easters



Fire (Urban & Wild)



Sea Level Rise

TRURO HAZARD PLAN

Examples of Vulnerability/Hazards

From State Hazard Mitigation Plan



Changes in Precipitation

- Inland Flooding
- Drought
- Landslide

Sea Level Rise

- Coastal Flooding
- Coastal Erosion
- Tsunami



Rising Temperatures

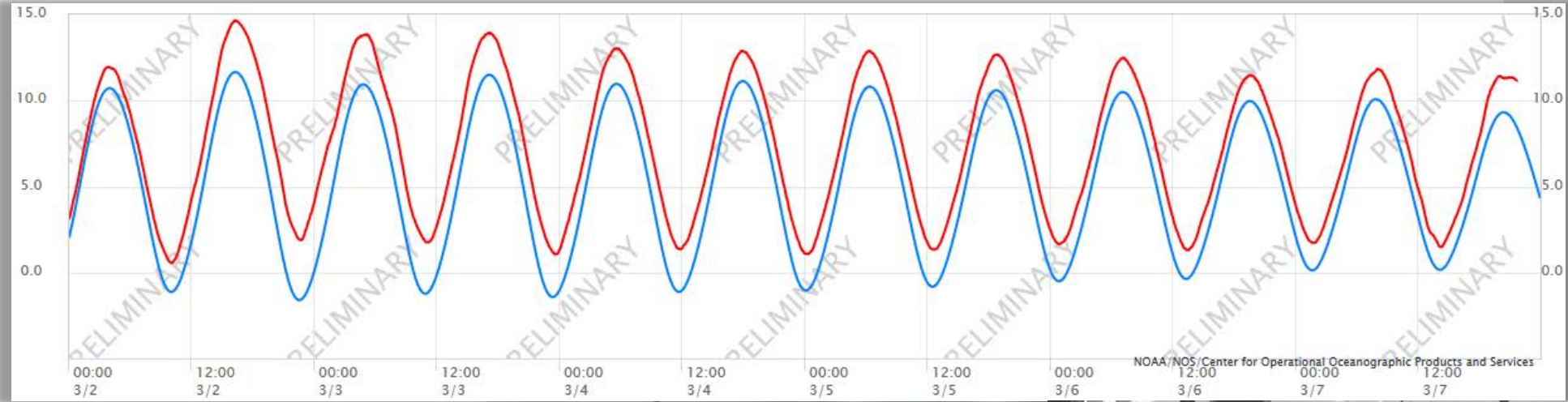
- Average/Extreme Temperature
- Wildfires
- Invasive Species

Extreme Weather

- Hurricanes/Tropical Storms
- Severe Winter Storm / Nor'easter
- Tornadoes

Earthquake

HAZARD Storms



HAZARD Sea Level Rise

Nor'Easter (January 2018)

Hurricane Sandy (10/29-30/2012)
Predicted High WL = 10.3 MLLW
Actual High WL = 12.8 MLLW

Max Surge: 4.5'
High Tide Surge: 2.5'

Nor'easter Nemo (2/8-2/9/2013)
Predicted High WL = 10.0 MLLW
Actual High WL = 13.0 MLLW

Max Surge: 3.9'
High Tide Surge: 3.0'

Nor'easter Grayson (1/4-5/2018)
Predicted High WL = 12.1 MLLW
Actual WL = 15.2 MLLW

Max Surge: 3.1'
High Tide Surge: 3.1'

SL has risen
~4.5" in the 40
years since
1978...so SLR is
the reason the
record was
broken!!!

In Boston, a storm tide of 15.16' was recorded which beat the record set by the Blizzard of 1978 (15.0')

~2"



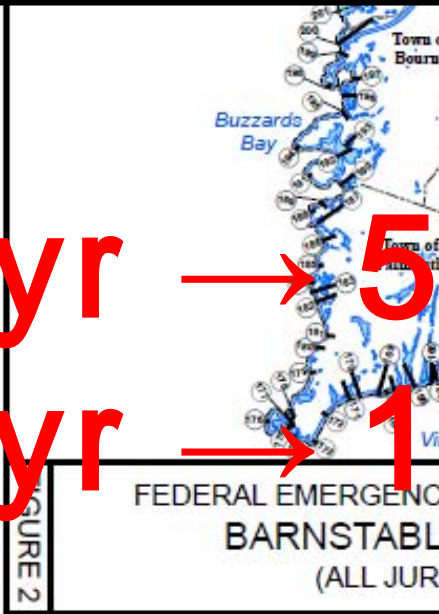
HAZARD SLR & Storms

TABLE 10 – TRANSECT DATA – 2013 COASTAL
STILLWATER ELEVATIONS (FEET NAVD88³)

TRANSECT	10- PERCENT- ANNUAL- CHANCE	2- PERCENT- ANNUAL- CHANCE	1- PERCENT- ANNUAL- CHANCE	0.2- PERCENT- ANNUAL- CHANCE
053	9.4	10.4	10.7	11.7
054	9.1	10.1	10.4	11.4

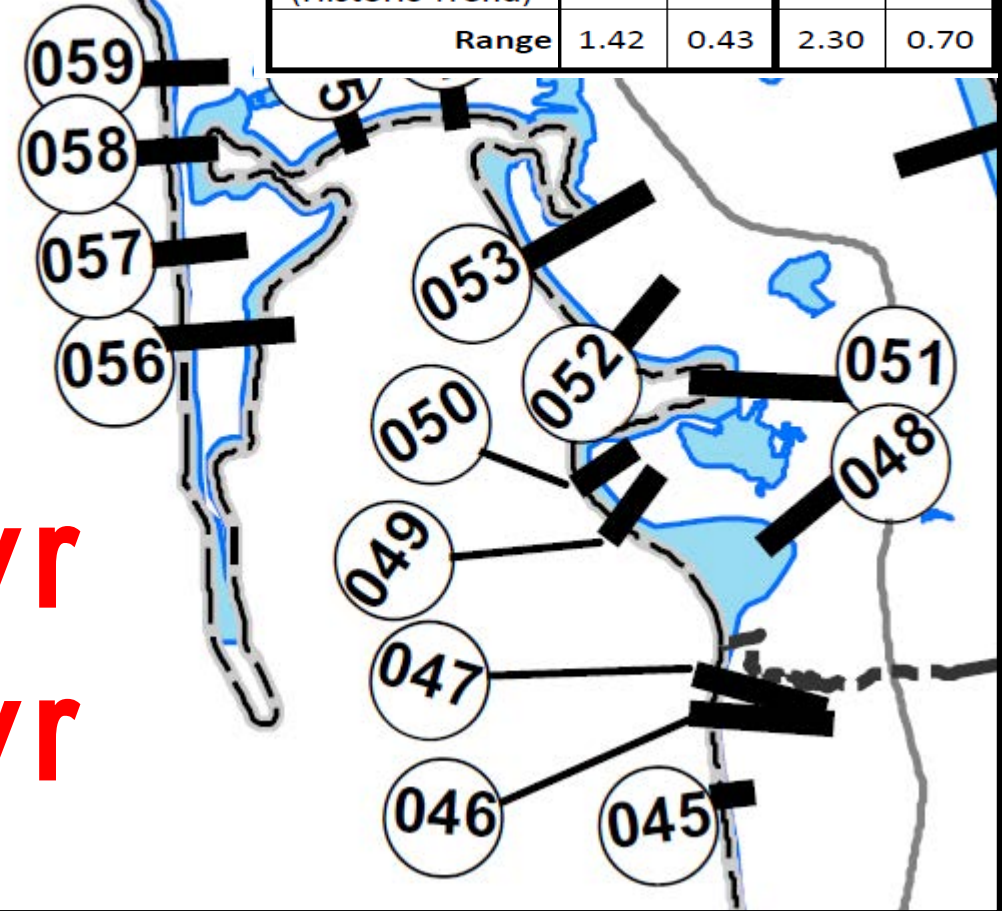
1.3'

500 yr → 50 yr
100 yr → 10 yr



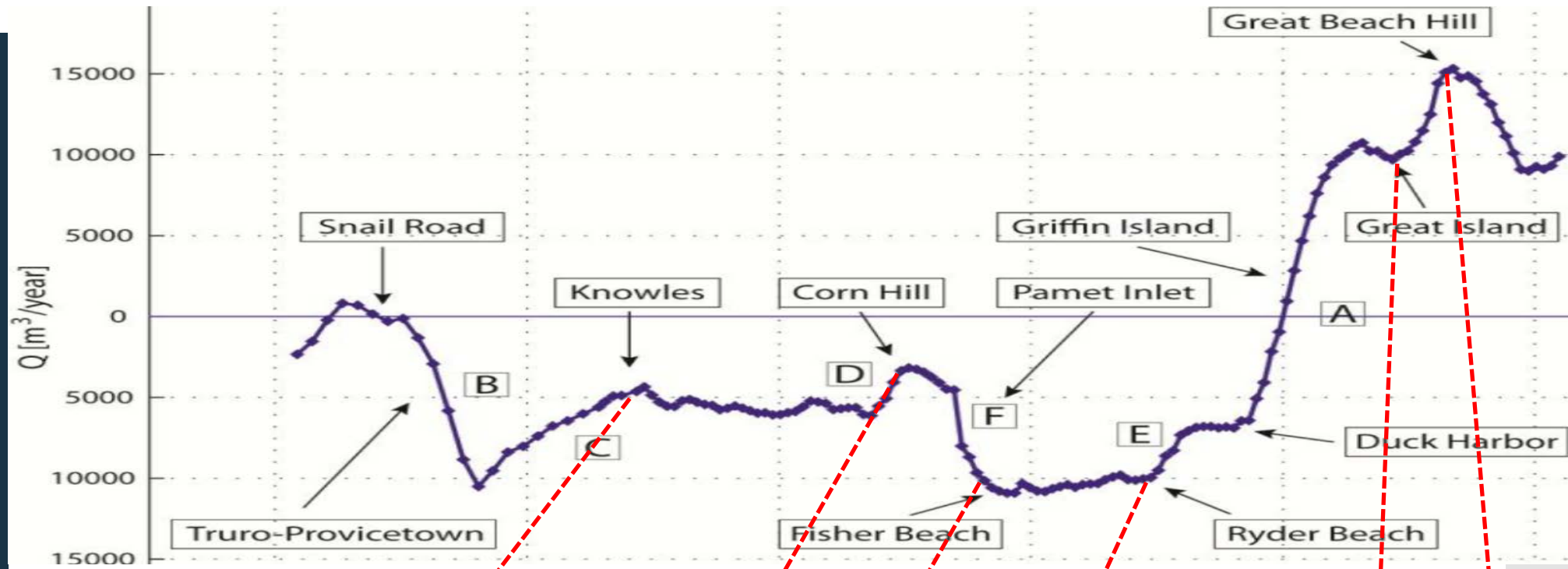
Town of Provincetown

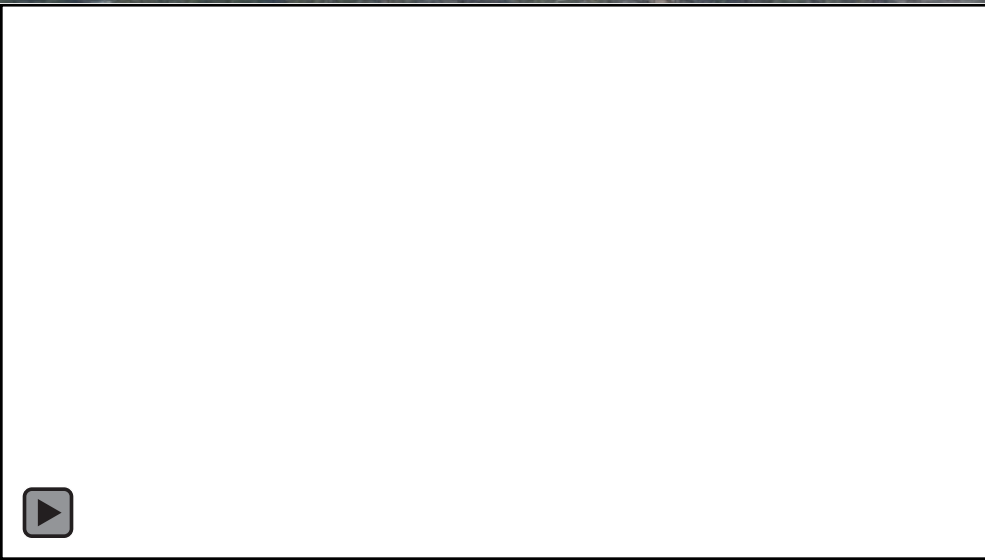
Scenario	2050		2063	
	ft	m	ft	m
Highest	1.81	0.55	2.80	0.85
Intermediate High	1.19	0.36	1.80	0.55
Intermediate Low	0.65	0.20	0.92	0.28
Lowest (Historic Trend)	0.39	0.12	0.50	0.15
Range	1.42	0.43	2.30	0.70



Changing the return period of flooding

HAZARD Erosion





HAZARD Erosion



Overview of Data and Maps



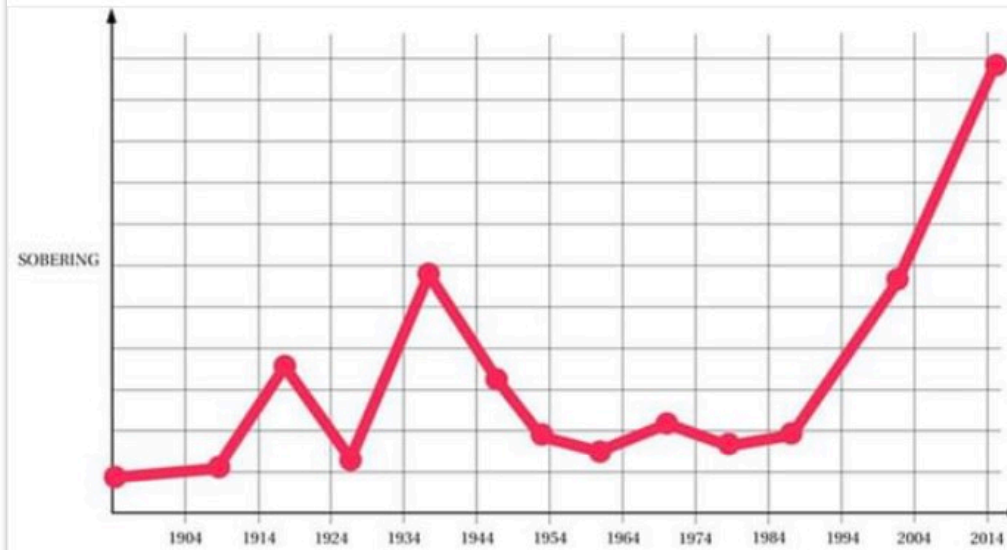


The Onion

19 mins • 🌐



"As recently as 15 years ago, there were relatively few statistics that were concerning, let alone troubling, but our research found that the vast majority of current statistical figures are unsettling, alarming, or even, in some cases, chilling."



THEONION.COM

Study Finds 79% Of Statistics Now Sobering

CAMBRIDGE, MA—Noting a sharp increase over rec...



☒ Layers ☒ Controls & Legends 2 Quick Zoom

[Collapse All](#) [Hide All](#) [Remove All](#)

▼ Sea Level Rise & Coastal Flooding (NOAA)

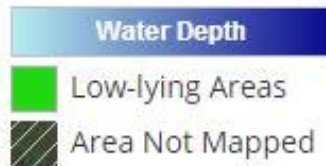


Opacity: 70%

Predicted Rise: 4 ft.

Layer:

Legend



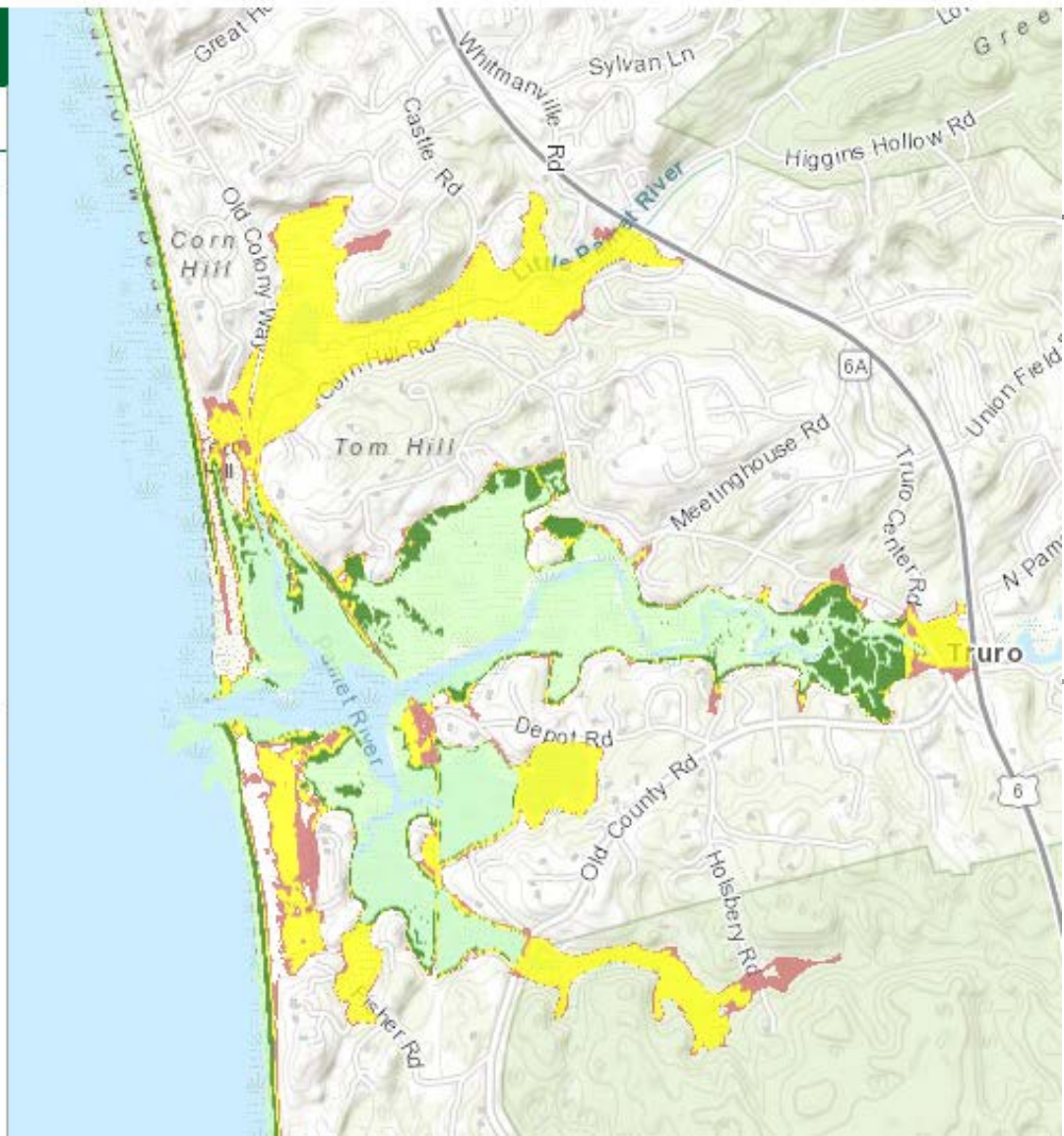
▼ Hurricane Surge Inundation Zones



Opacity: 85%

Legend

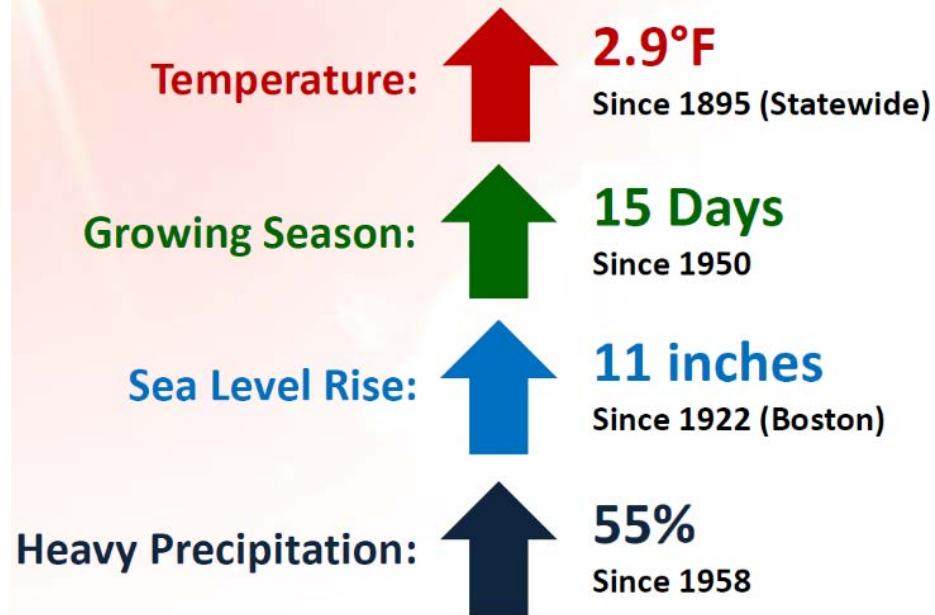
Hurricane Surge Inundation Zones



Massachusetts Climate Change Projections

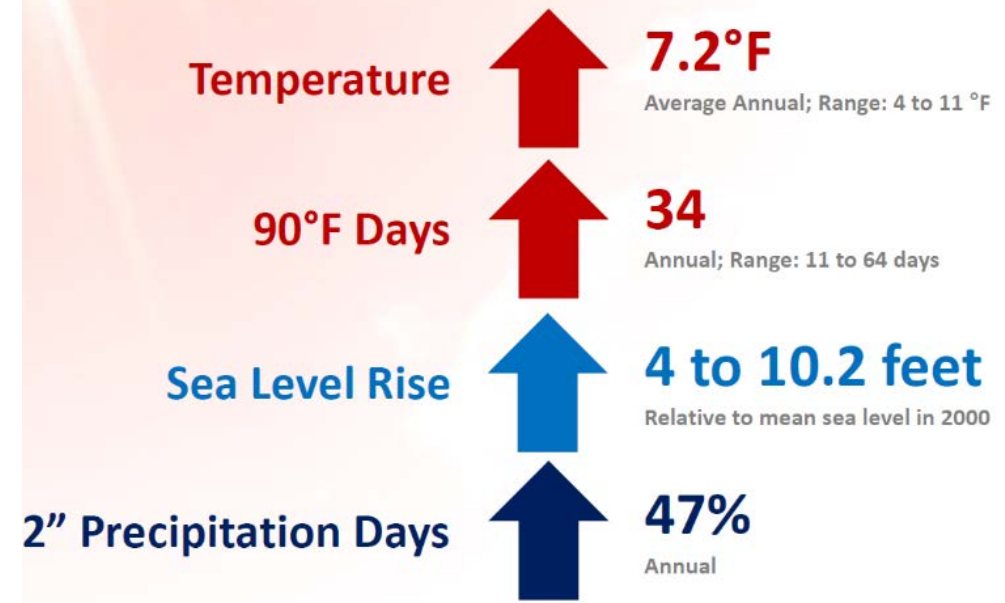
MARCH 2018

Massachusetts Observed Climate Changes



Source: Climate Science Special Report, 2017;
NOAA NCEI nClimDiv; NOAA Ocean Service

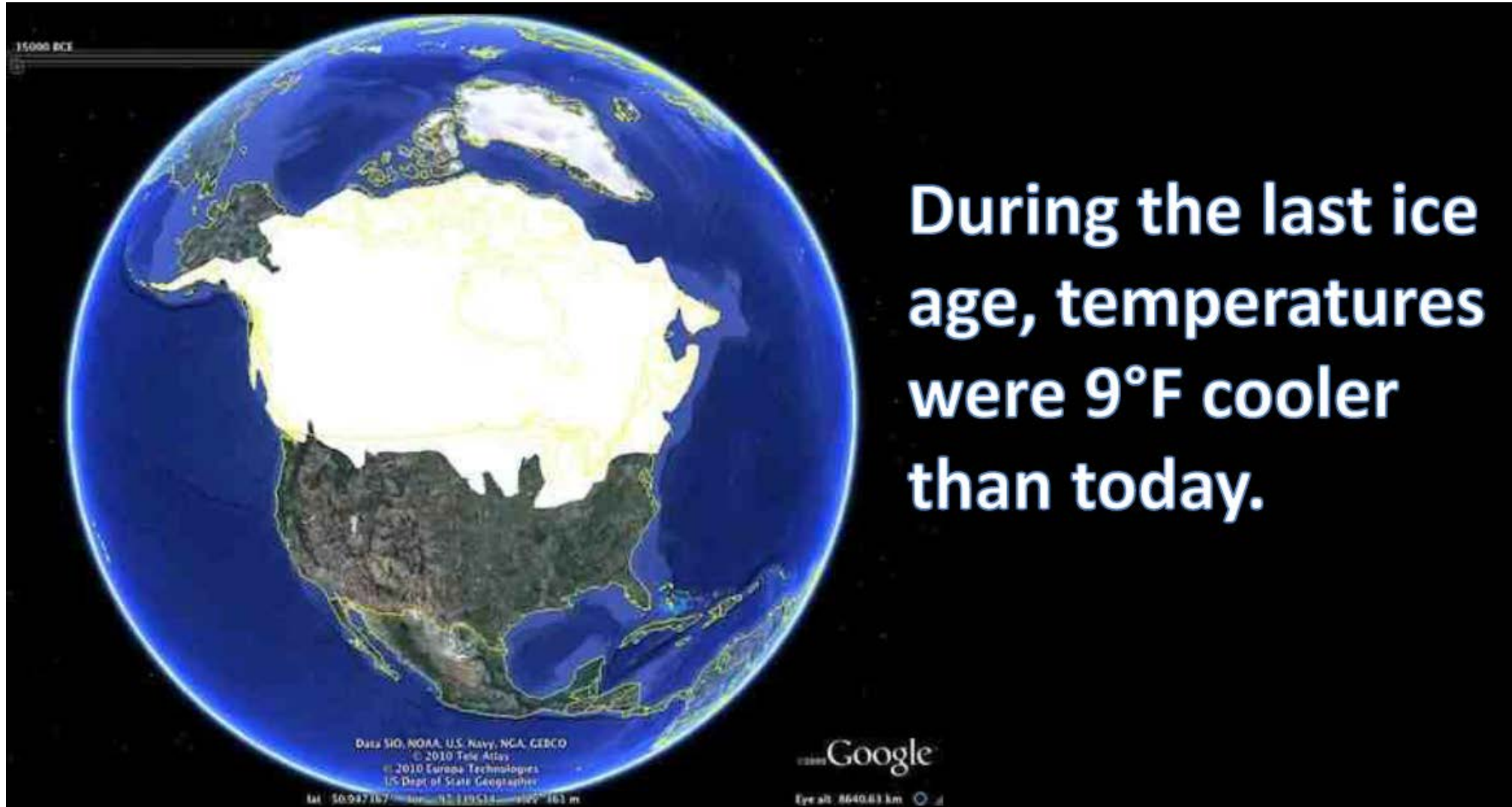
Massachusetts Climate Changes Projected by the 2090s



Source: Northeast Climate Adaptation
Science Center

Massachusetts Climate Changes Projected by the 2090s | Temperature

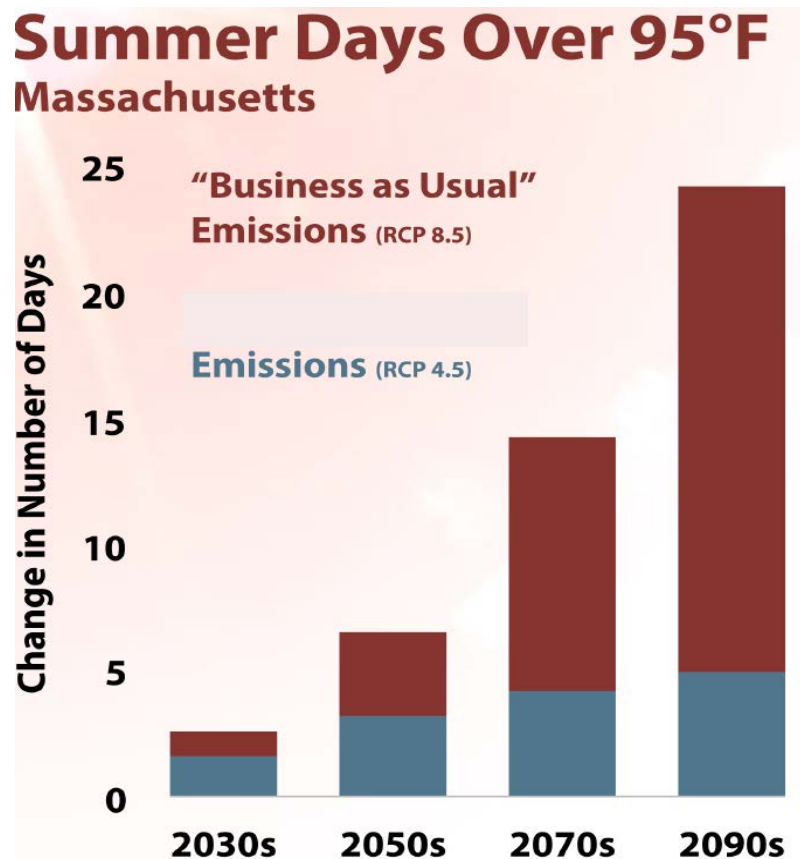
↑ 7.2° F
Average Annual



Massachusetts Climate Changes Projected by the 2090s |

Temperature  **7.2° F**
Average Annual

 **34**
Annual



Data courtesy A. Karmalkar, Northeast Climate Adaptation Science Center.
Figure by D. Brown

More Warm Winter Days,
Less Heating Demand



26.2%
by the 2090s

More Warm Summer Days,
More Cooling Demand

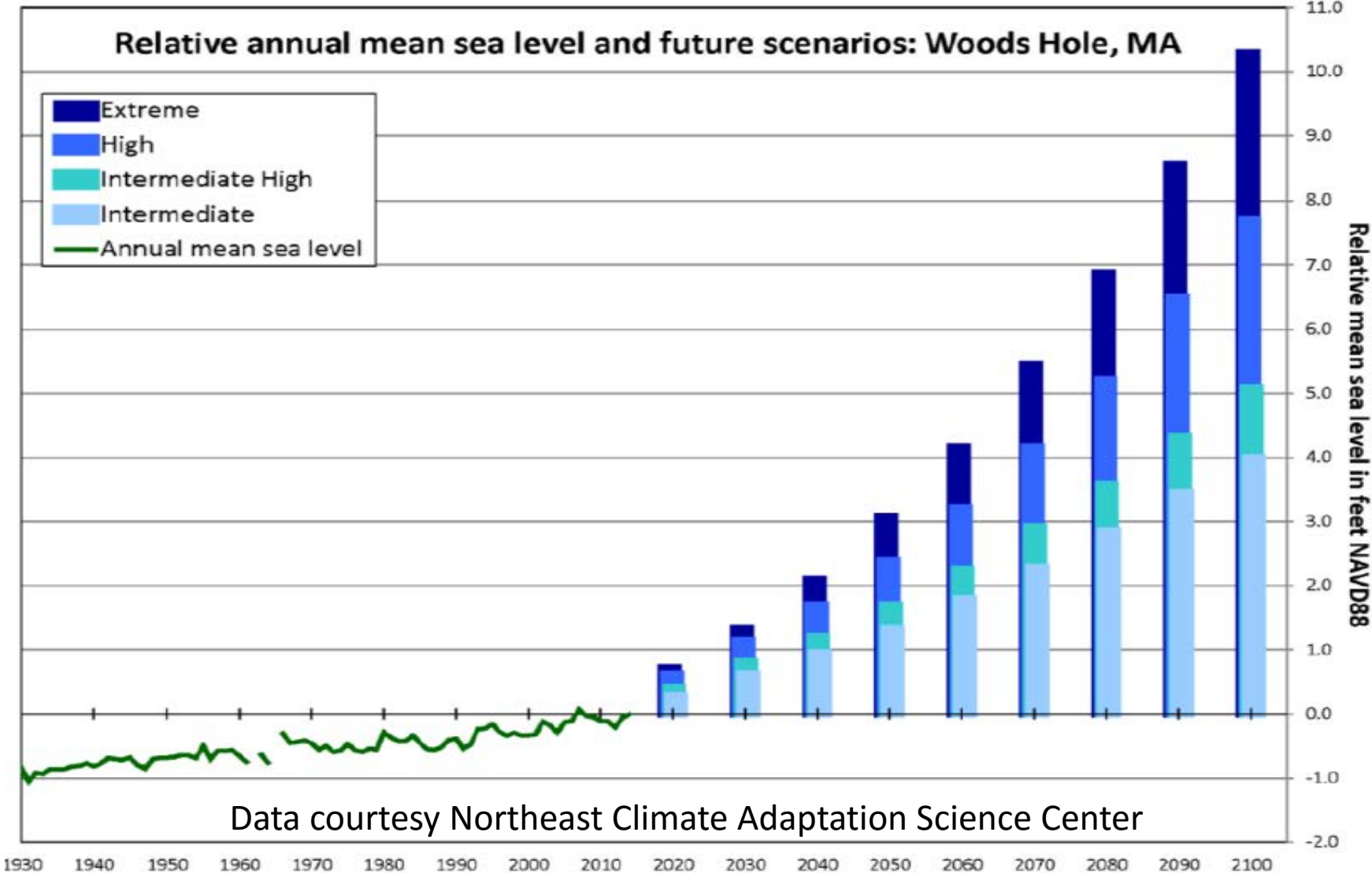


178%
by the 2090s

Source: Northeast Climate Adaptation Science Center, ResilientMA.org, accessed 2018.

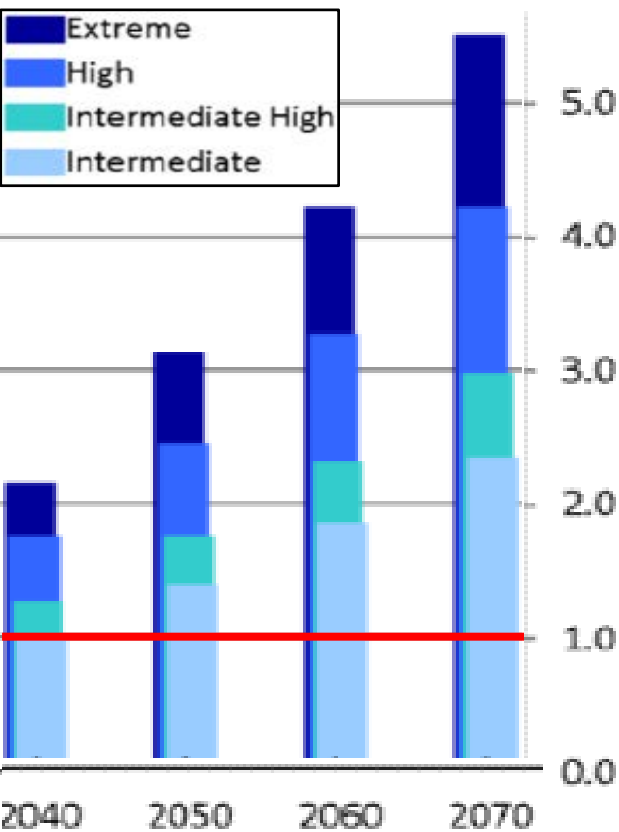
Massachusetts Climate Changes Projected by the 2090s | SLR

 **4 to 10.2 feet**
Relative to mean sea level in 2000



Massachusetts Climate Changes Projected by the 2090s | SLR




 **4 to 10.2 feet**
Relative to mean sea level in 2000



Cape Cod Sea Level Rise

Cape-wide impacts at 3ft of Sea Level Rise:

At present Cape Cod is 383 square miles with 116,031 acres of Priority Habitat. There are 960 Critical Facilities and 3,121 miles of roadway. Annual sales equal \$19.7 billion and 127,412 people are employed in 14,658 businesses.

-  Low-lying Areas
-  Disconnected Roads
- ☒ Critical Facilities (Filter Types)
-  Unaffected





Land-use Change | Population

↑ 4.75x 1950s

CAROL: 65 deaths,
\$15 million in crop
damage (\$461
million total), 10,000
houses damaged



Massachusetts Climate Changes Projected by the 2090s | Precipitation 2"

↑ 47%
Annual

PART OF THE BEACHCOMBER'S PARKING LOT WASHED AWAY



Break



Small Team Exercise



Small Team Exercise

OVERVIEW

- Introductions
- Identify Small Team Spokesperson
- Clarifying Questions

EXERCISE

1. Identify Top Community Hazards
2. Identify Community Features and Categorize as Vulnerability or Strength
 - Infrastructure
 - Societal
 - Environmental
3. Identify Location and Ownership on Map/Matrix



Coastal Erosion



Flood



Severe Winter Weather



Dam/Creek

Thunderstorms



Drought

Tornadoes



Earthquake

Tsunami



Extreme Heat



Fire (Urban & Wild)



Sea Level Rise

1.

Identify Top Community Hazards

1.

[illegible]

2.

Identify Community
Features and
Categorize as
Vulnerability or
Strength

2.

Community Features

[illegible]

3.

Identify Location and
Ownership of
Community Features
on Map/Matrix

3.

Location and Ownership

[illegible]



Municipal Vulnerability Program



Small Team Exercise

OVERVIEW

- Introductions
- Identify Small Team Spokesperson
- Clarifying questions

EXERCISE

1. Identify Top Community Hazards
2. Identify Vulnerabilities and Strengths of Community Features
 - Infrastructure
 - Societal
 - Environmental
3. Identify Location and Ownership of Community Features on Map/Matrix

Break



Small Teams Report Out



Summary Discussion



Lunch!



Today's Agenda

Afternoon

12:45 Small Team Exercise

- Discuss and Identify Actions

1:45 Short Break

1:50 Small Team Exercise (continued)

- Identify Priority and Urgency of Actions
- Prepare for Report Out

2:30 Break

2:45 Small Teams Report on Top Actions

3:00 Summary Discussion – Compile Top Actions

3:30 Wrap Up and Next Steps

Adjourn!

Small Team Exercise



Small Team Exercise

OVERVIEW

- Identify Small Team Spokesperson
- Clarifying questions

EXERCISE

1. Identify Actions to Reduce Vulnerability or Reinforce Strengths

2. Assign Priority and Urgency of Each Action

- Infrastructure
- Societal
- Environmental

3. Identify Top 3 -4 Priority Actions

1.

Identify Actions

[illegible]

2.

Assign Priority and Urgency

[illegible]

3.

Identify Top Priority Actions

Community Resilience Building Risk Matrix					www.CommunityResilienceBuilding.org				
H-M-L priority for action over the Short or Long term (and Ongoing) V = Vulnerability S = Strength					Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)				
								Priority	Time
Features	Location	Ownership	V or S					H - M - L	Short Long Ongoing
Infrastructural									
Societal									
Environmental									



Small Team Exercise

OVERVIEW

- Identify Small Team Spokesperson
- Clarifying questions

EXERCISE

1. Identify Actions to Reduce Vulnerability or Reinforce Strengths



2. Assign Priority and Urgency of Each Action
 - Infrastructure
 - Societal
 - Environmental

3. Identify Top 3 -4 Priority Actions

Break



Small Teams Report Out on Top Priority Actions



Summary Discussion – Compile Top Actions

Wrap-up and Next Steps

Municipal Vulnerability Preparedness Workshop

TOWNS OF WELLFLEET AND TRURO

March 12, 2019

