



4TH ANNUAL CAPE COASTAL CONFERENCE

Habitats, Roads, Cultural and Recreational Resources, Buildings and Bathrooms: In a Changing Climate, What Should We Protect?

Coastal Vulnerability Indexing, Mapping, Assessment And Adaptation On The Trustees Of Reservations Coastal Properties

Thomas O'Shea, Russell Hopping, Trustees of Reservations
Ted Wickwire, Brittany Hoffnagle, Joe Famely, Kirk Bosma, Woods Hole Group

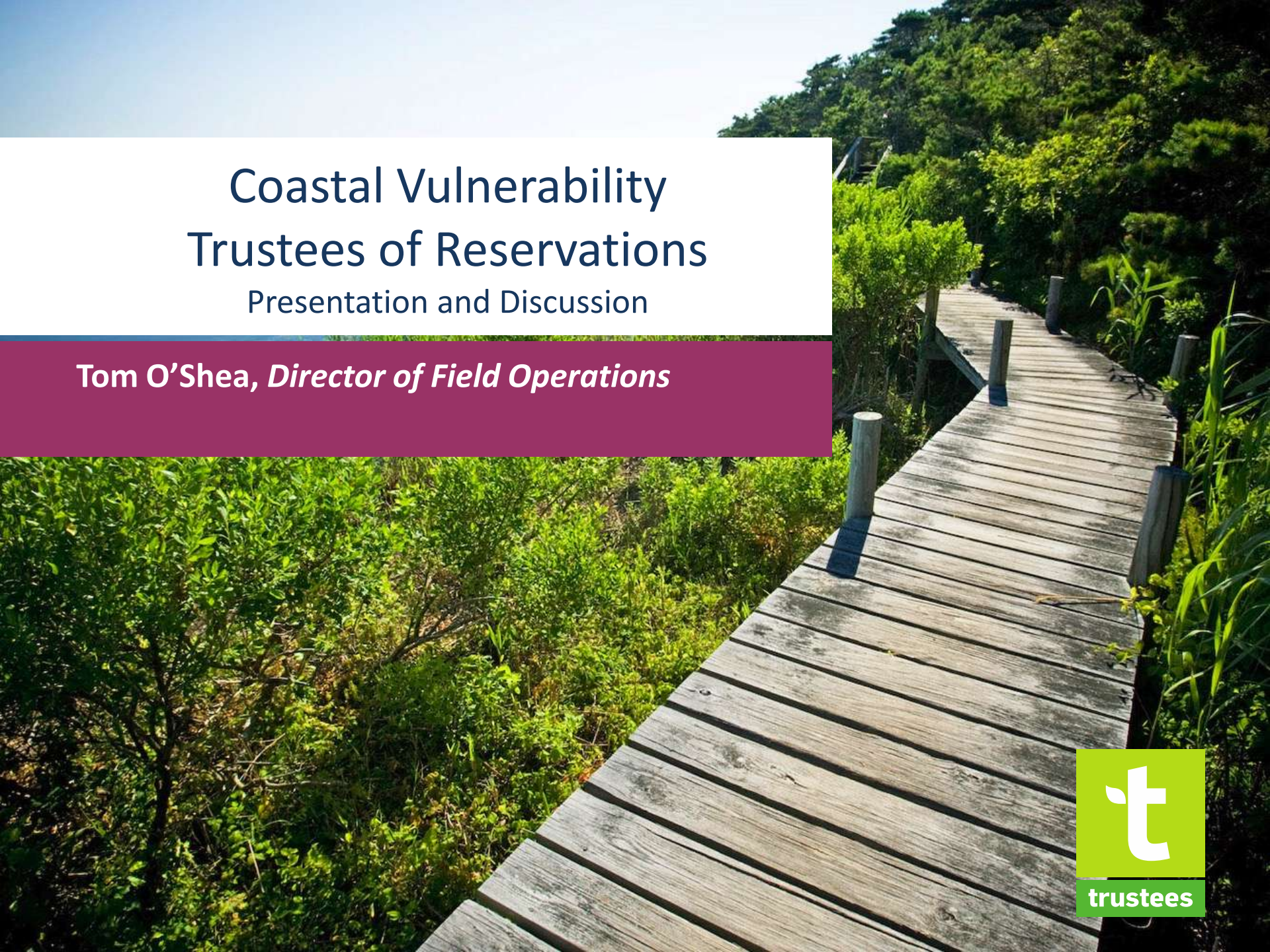
December 7, 2016

Objectives

- Trustee's Perspective
  - Mission
  - The Reservations
  - Management background
  - Why pursue vulnerability planning?
  - The study sites

- Climate Vulnerability Modeling
  - Background
  - Vulnerability Modeling
  - Asset Valuation
  - Climate Vulnerability Index
  - Case Studies: Mashpee River Reservation and Coskata-Coatue Wildlife Refuge

Trustees' Perspective



Coastal Vulnerability
Trustees of Reservations

Presentation and Discussion

Tom O'Shea, *Director of Field Operations*

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Trustees' Mission

- Founded in 1891, The Trustees of Reservations preserve, for public use and enjoyment, properties of exceptional scenic, historic, and ecological value in Massachusetts and work to protect special places across the state.

Trustees – Who we are

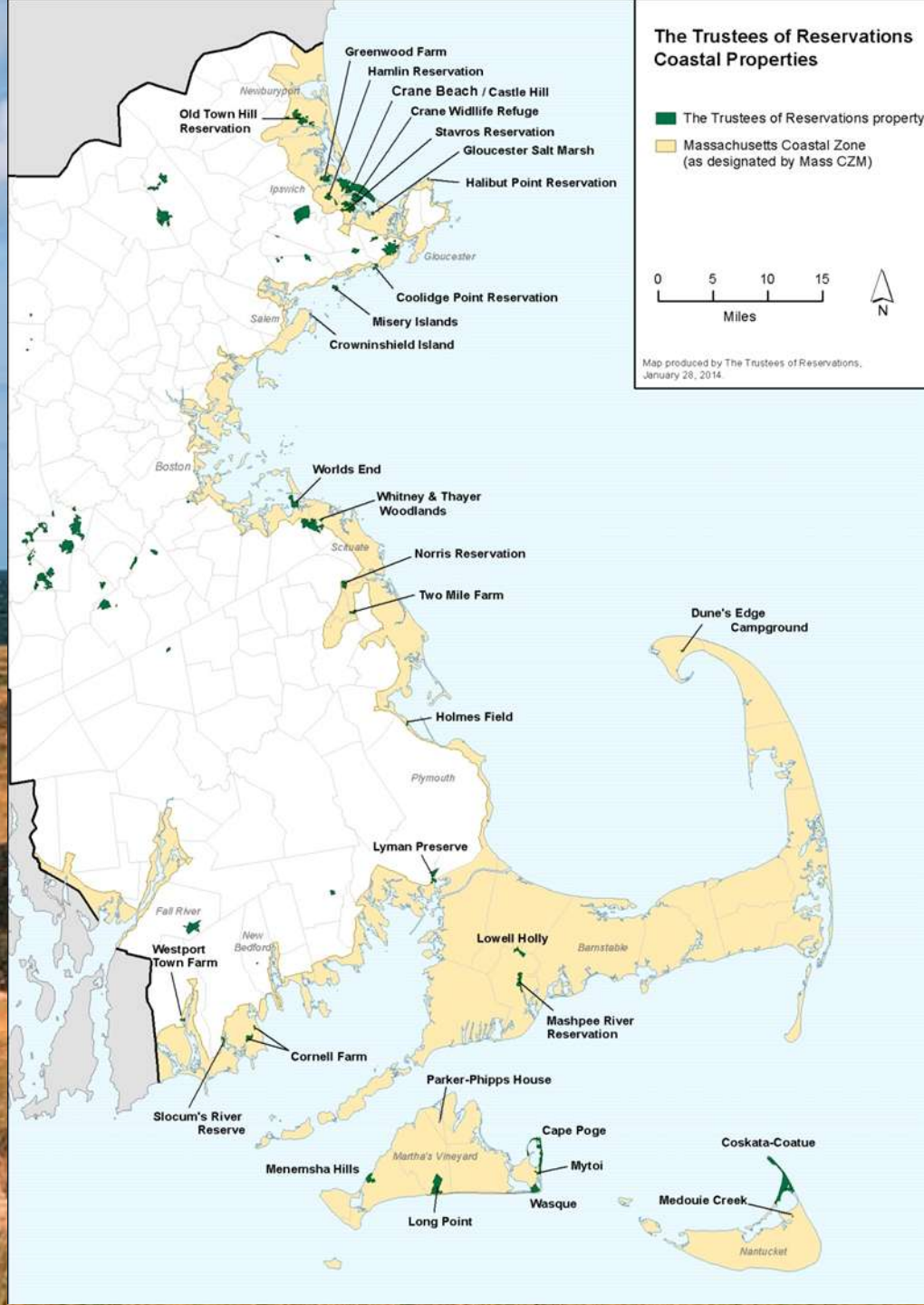
- Nonprofit conservation organization
- 50,000 acres, including 25,000+ acres on 116 reservations
- Open to the public.
- 1M+ visitors annually
- Over 40,000 household members

Trustees – Coastline Stats

- 32 Reservations (8,000 acres)
- 39 Parking Areas
- 103 Buildings
- 106 Other Structures
- 60 miles of trail (320 segments)
- 158 Cultural Resources points
- 48 State-listed Species
- Over 100 Vegetation Communities

Trustees Coast

LEADER IN COASTAL PROTECTION



Coastline Ownership

OWNER	Miles	% of Shoreline
Federal	191	8%
State	98	4%
Municipal/Local	252	10%
Trustees-held CRs	44	2%
Trustees Reservations	76	3%
Other Non-Profit/Land Trust	106	4%
Other Private (mostly CRs)	33	1%
Total Miles of Shoreline	800	33%

Total Shoreline	2450	100%

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Open Space Ownership

OWNER	% of Open Space
Federal	24%
State	12%
Municipal/Local	32%
Trustees Reservations	10%
Trustees-held CRs	6%
Other Non-Profit/Land Trust	13%
Other Private (mostly CRs)	4%
Total Open Space	**100%**

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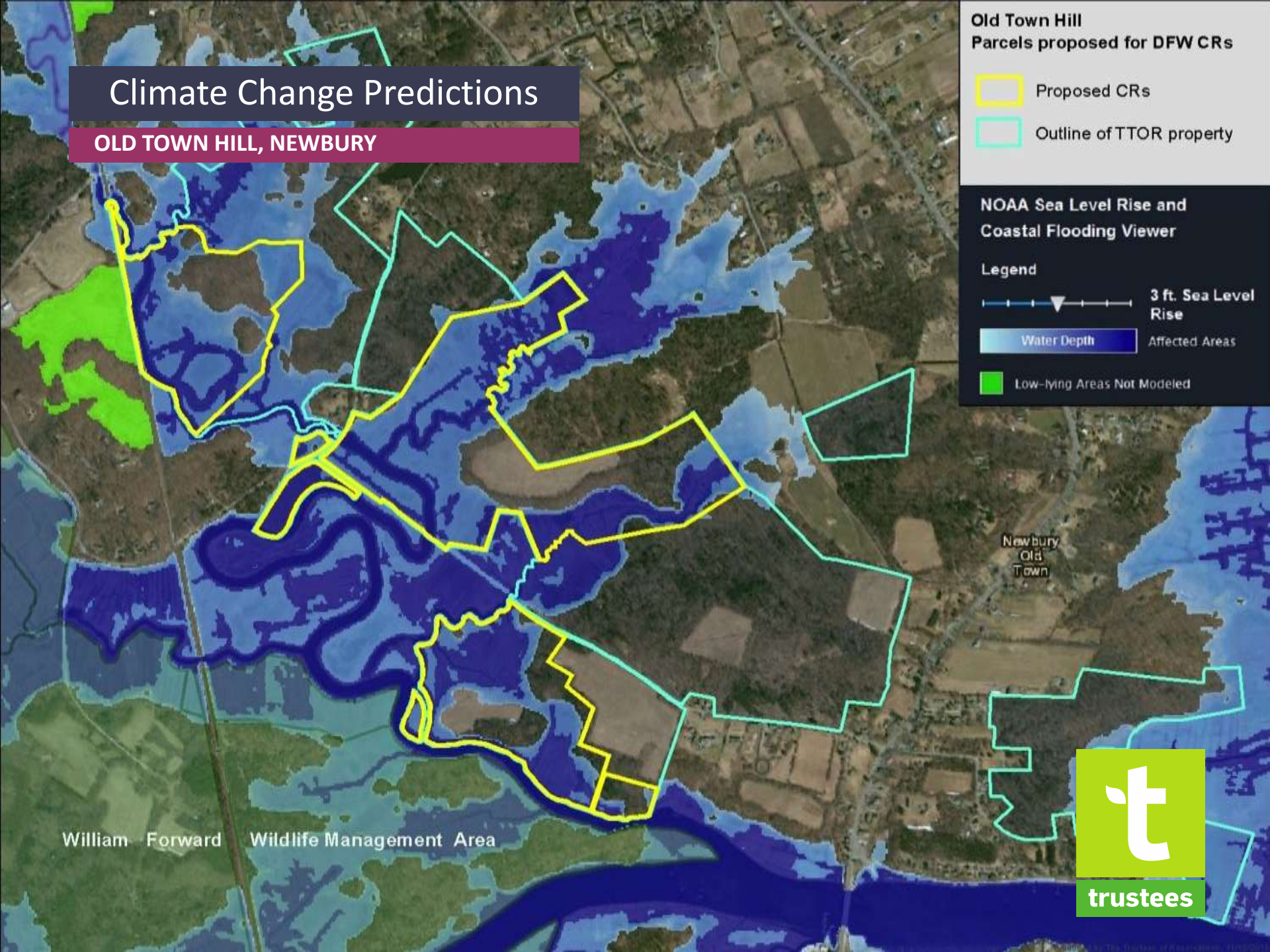
Why a CVA?


Climate Change Predictions
OLD TOWN HILL, NEWBURY
Old Town Hill
Parcels proposed for DFW CRs
Proposed CRs
Outline of TTOR property
NOAA Sea Level Rise and
Coastal Flooding Viewer
Legend
3 ft. Sea Level Rise
Water Depth
Affected Areas
Low-lying Areas Not Modeled
Newbury
Old
Town
William Forward Wildlife Management Area
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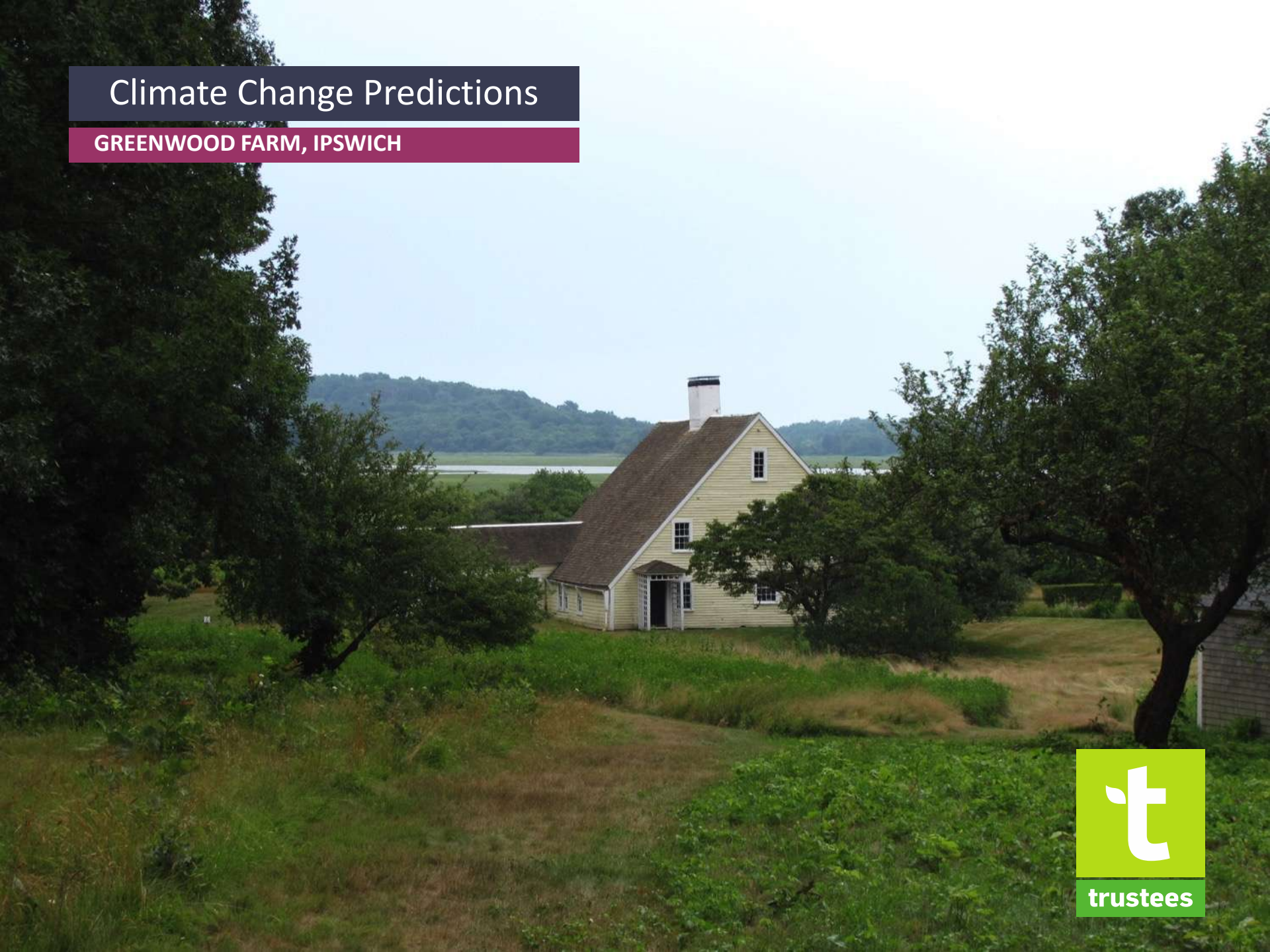
Climate Change Predictions

GREENWOOD FARM, IPSWICH



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Climate Change Impacts

PLUM ISLAND, NEWBURYPORT

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National Park Service
HERRING COVE, CAPE COD NATL SEASHORE

Trustees Coast Examples

How Vulnerable Is Our Coast?

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Halibut Point

GLOUCESTER – ROCKY SHORELINE

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Castle Neck
IPSWICH – SALT MARSH / ESTUARY
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Coskata- Coatue

NANTUCKET – BARRIER BEACH

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Mashpee River
MASHPEE – TIDAL RIVER, MARSH, WETLANDS
trustees

The Farm Institute

EDGARTOWN – AGRICULTURAL LANDSCAPE

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World's End
HINGHAM – HARBOR ISLAND
trustees

Trustees Values

What are the impacts?

Natural Resources

COASTAL HABITATS AND SPECIES

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Cultural Resources

MYTOI, MARTHA'S VINEYARD

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Visitor Experience

LYMAN RESERVE
BOURNE, PLYMOUTH, WAREHAM

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Public Programs

WORLDS END, HINGHAM

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Education & Exploration

Financial

CRANE BEACH, IPSWICH

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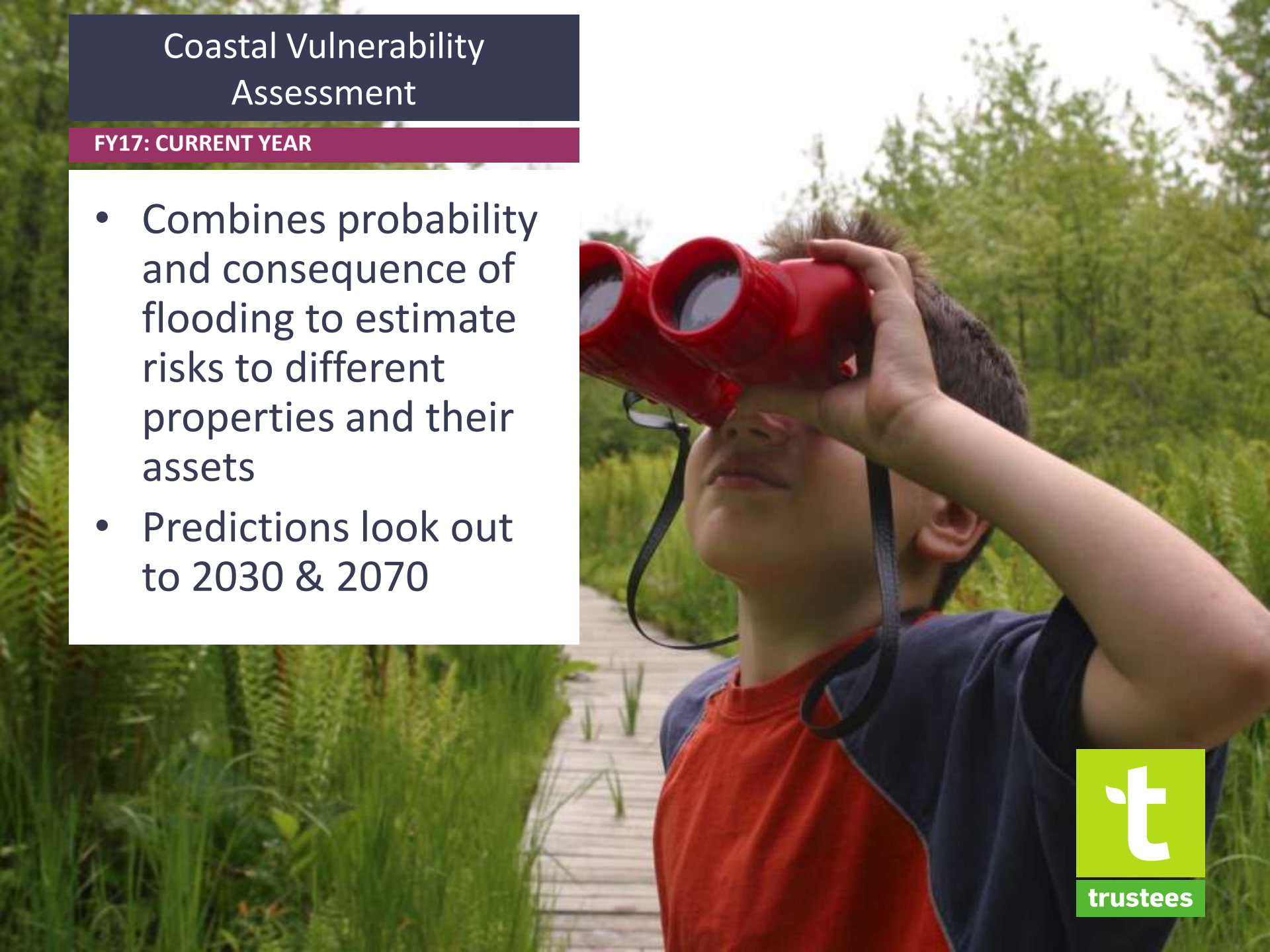
Coastal Strategy

Coastal Vulnerability Assessment

FY17: CURRENT YEAR

- Combines probability and consequence of flooding to estimate risks to different properties and their assets
- Predictions look out to 2030 & 2070



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Coastal Assessment Process

FY17: CURRENT YEAR

STEP 1

Identify properties and map resources

STEP 2

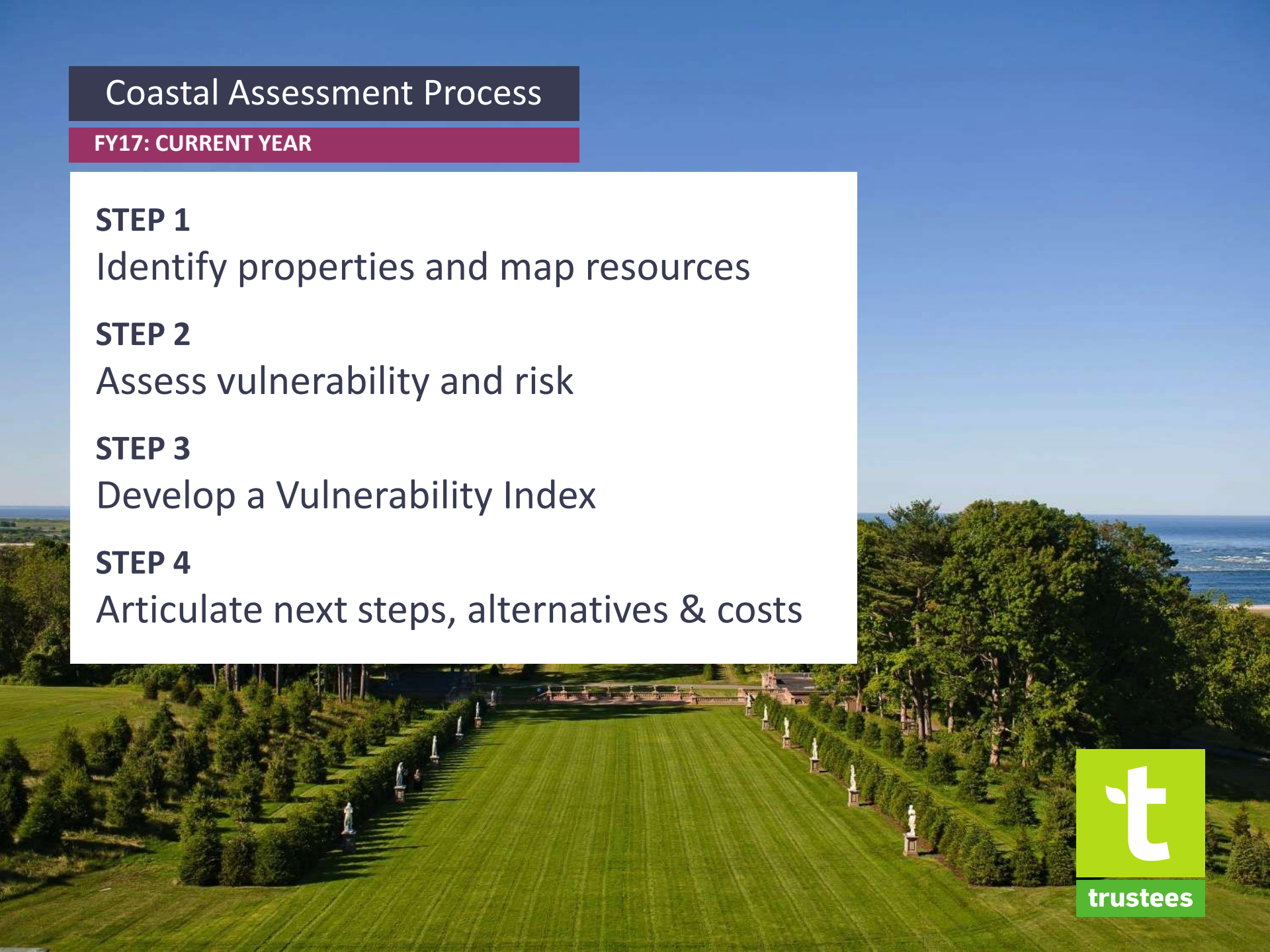
Assess vulnerability and risk

STEP 3

Develop a Vulnerability Index

STEP 4

Articulate next steps, alternatives & costs



Current Coastal Activity

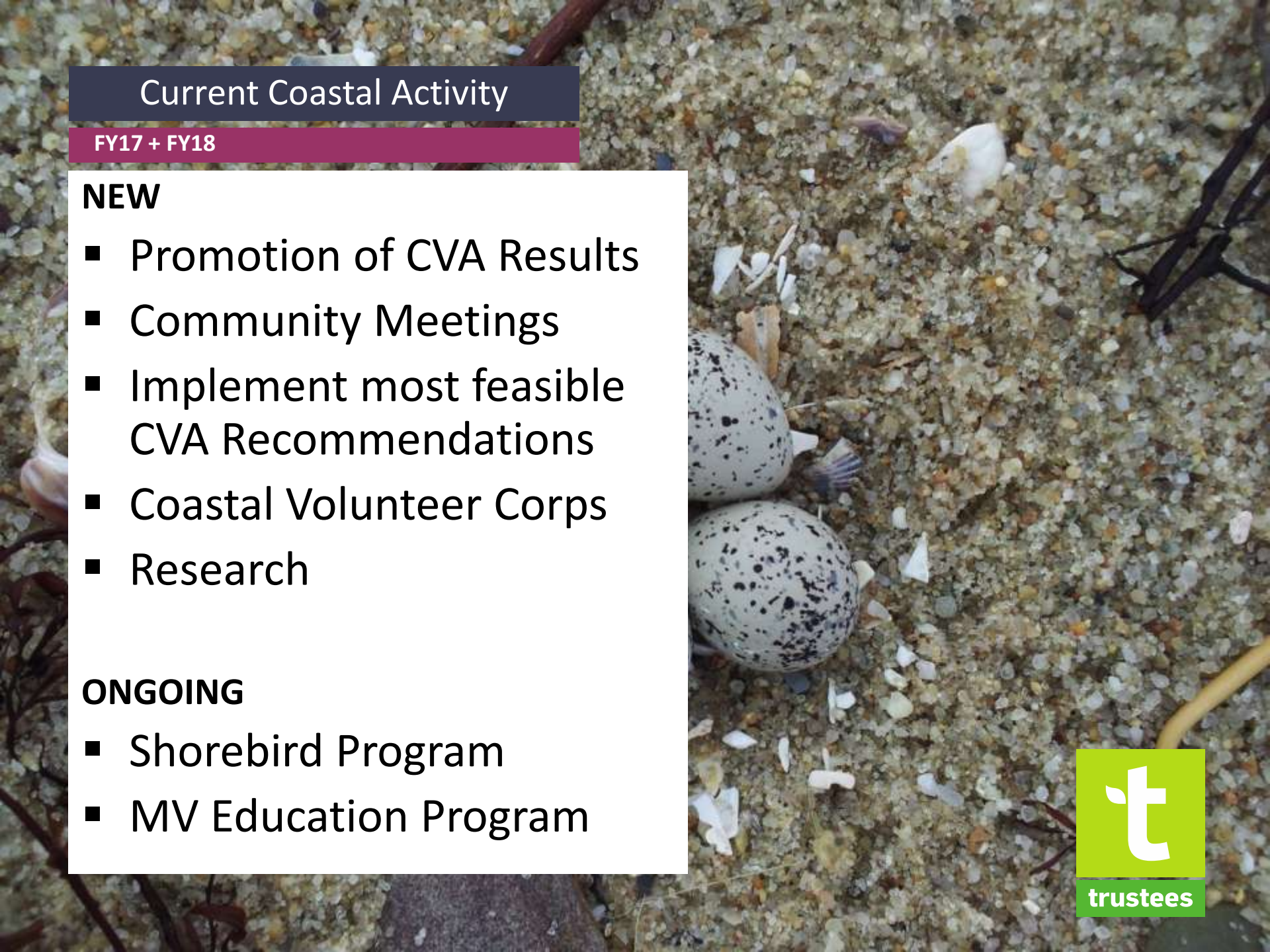
FY17 + FY18

NEW

- Promotion of CVA Results
- Community Meetings
- Implement most feasible CVA Recommendations
- Coastal Volunteer Corps
- Research

ONGOING

- Shorebird Program
- MV Education Program



Coastal Strategy: In Process

Land Conservation
Adaptation / Restoration
Retreat
Design and Innovation
Education and Raising Awareness
Community Action
Policy and Advocacy

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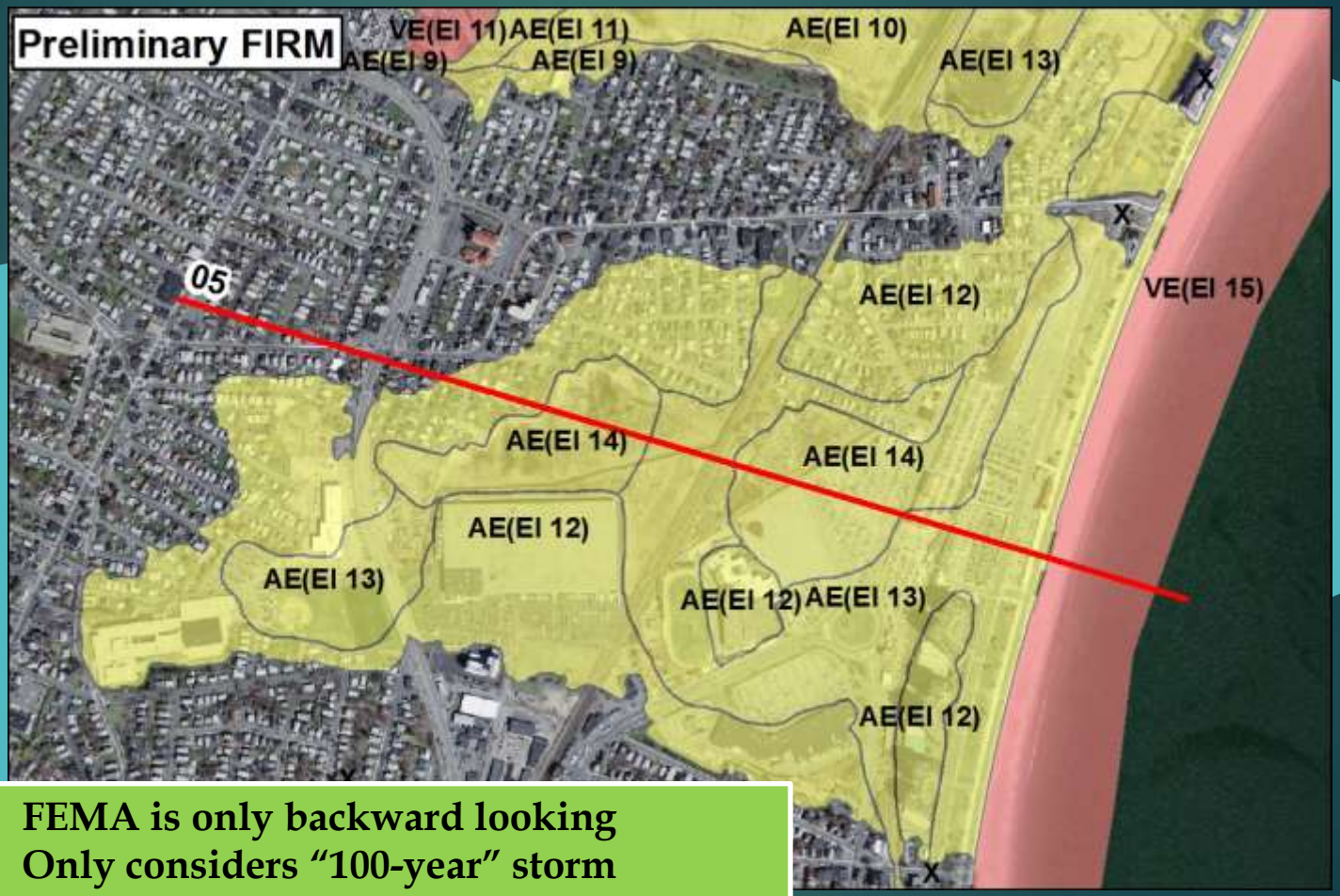
Climate Vulnerability Modeling

Modeling Overview

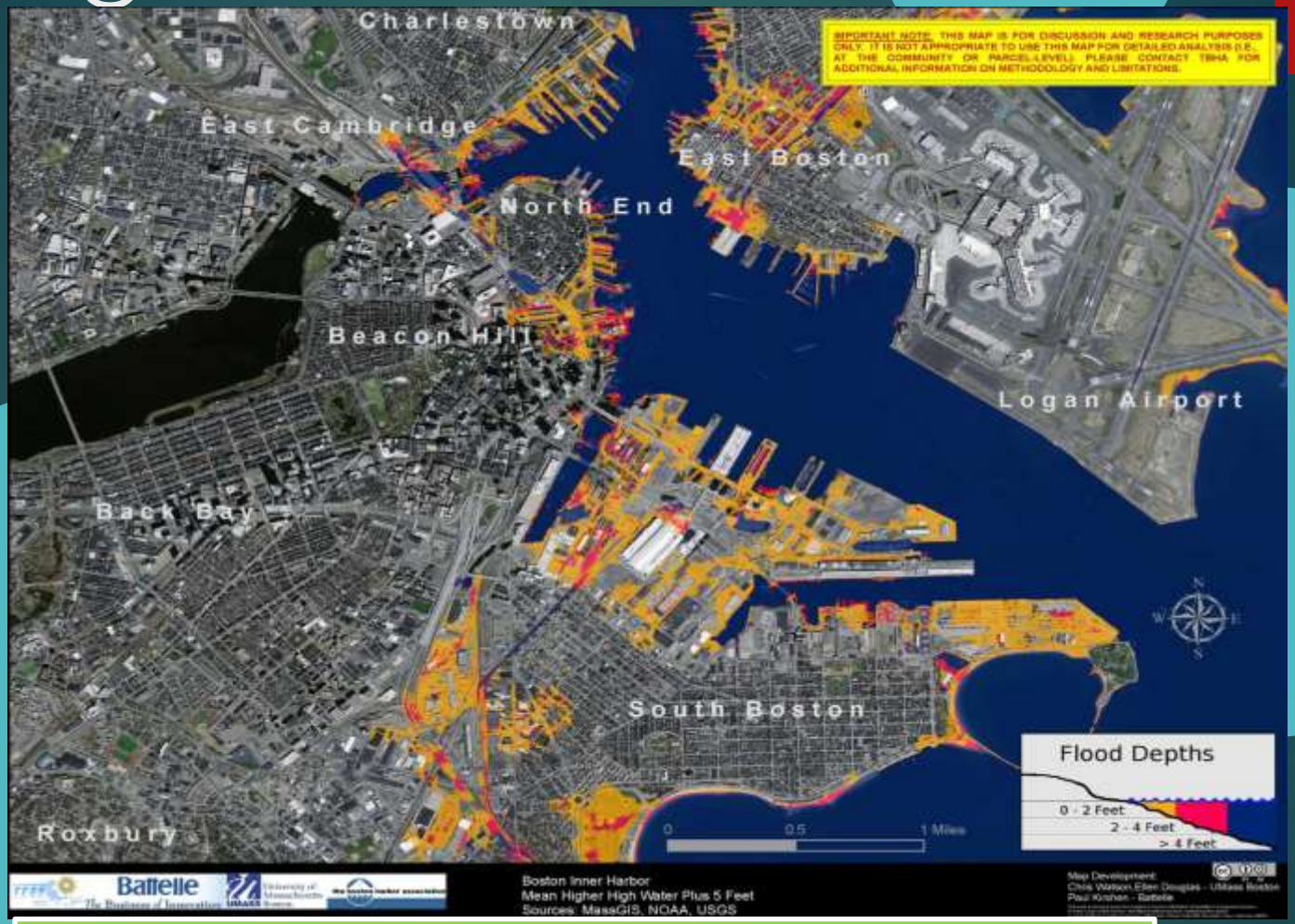
- Background
- Vulnerability Modeling
- Asset Valuation
- Climate Vulnerability Index
- Case Studies

Background



- **FEMA is only backward looking**
- **Only considers "100-year" storm**
- **Region I does not use dynamic modeling**
- **Transect based analysis**

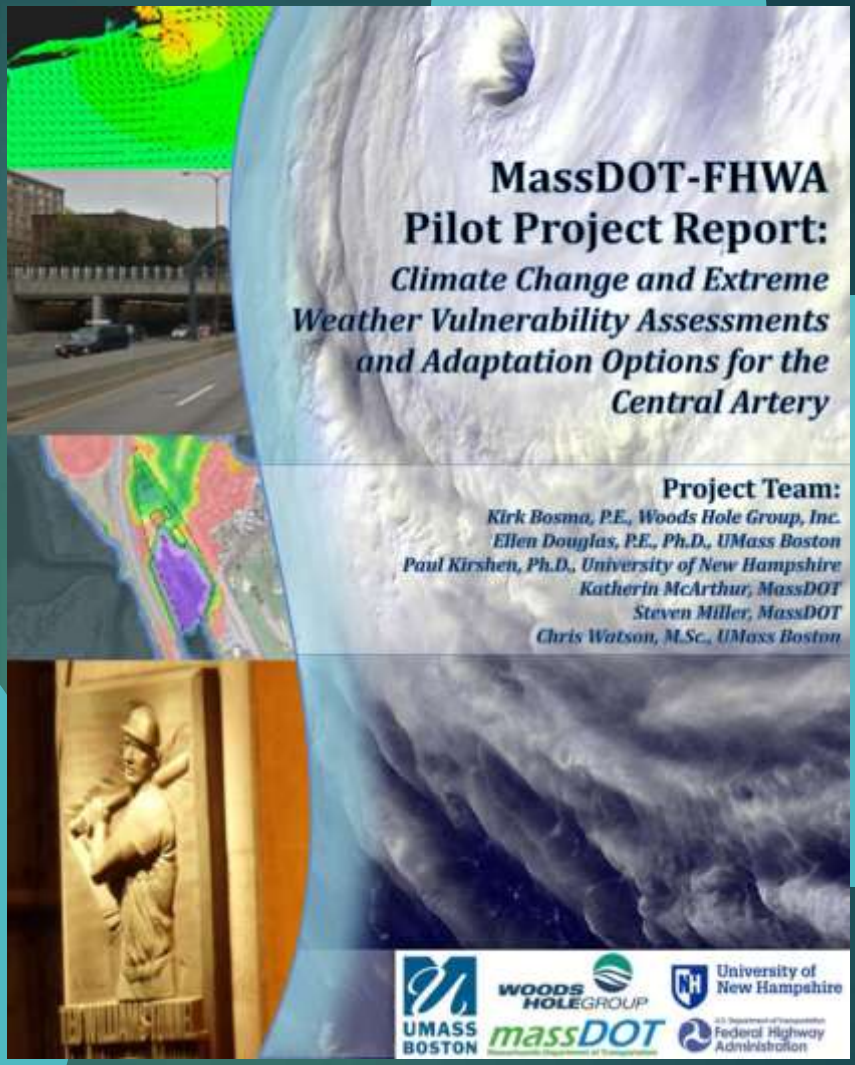
Background



- **Inundation maps based on standard "bathtub" model do not reflect dynamic nature of coastal flooding**
- **Does not account for joint flooding conditions**
- **Does not include effects of infrastructure (e.g., dams)**
- **Does not account for tides**

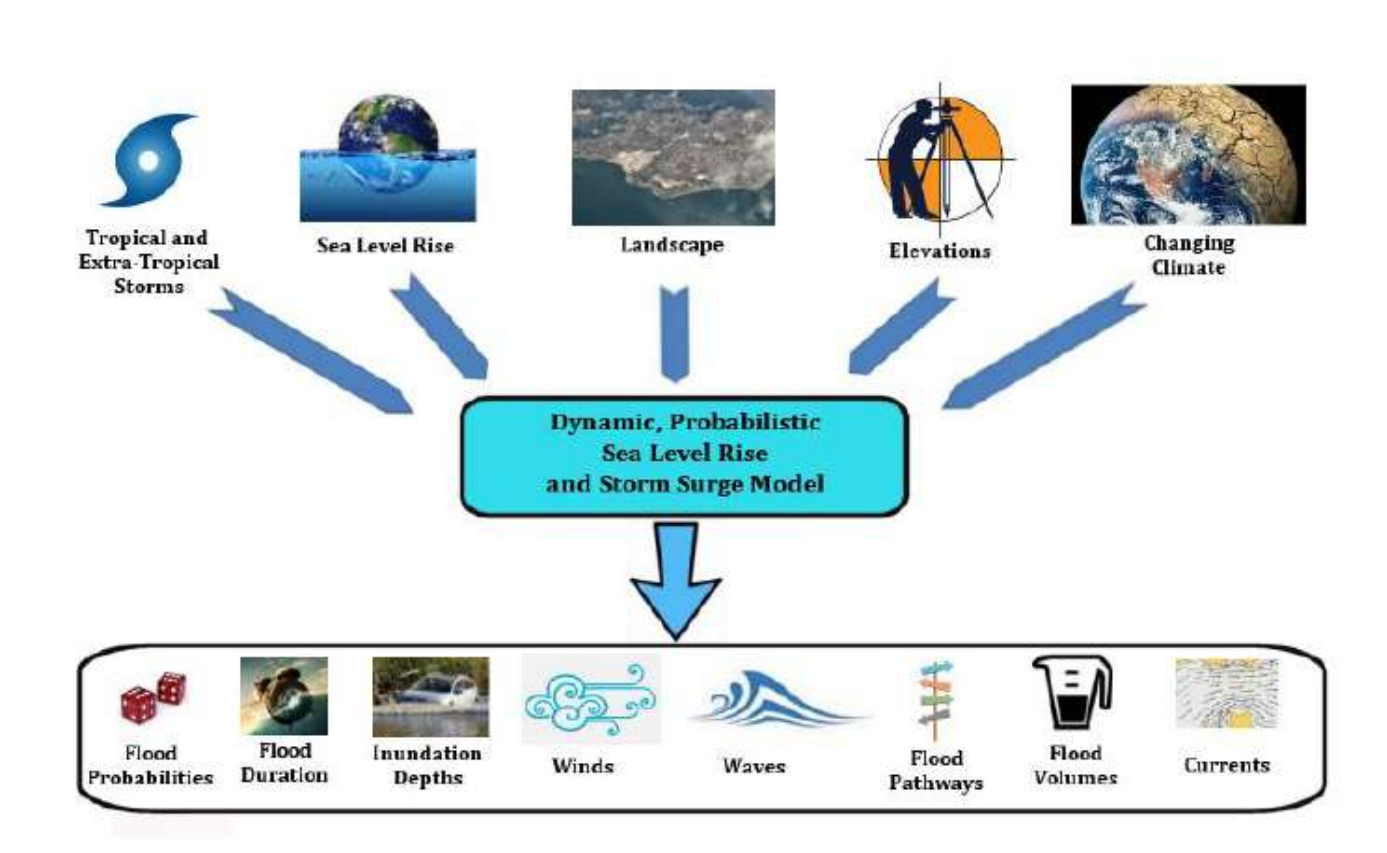
Background

1. What is the probability of flooding?
2. What is vulnerable and what is the priority?
3. What interventions are available and what is the plan?



https://www.massdot.state.ma.us/Portals/8/docs/environmental/SustainabilityEMS/Pilot_Project_Report_MassDOT_FHWA.pdf

Background



- Probabilistic inundation model includes relevant physical processes (tides, storm surge, wind, waves, wave setup, river discharge, sea level rise, future climate scenarios)

Background

Risk of Exceedance

Time horizon	Probability of exceedance	Consequence score	Risk score	Weight	Composite risk score
Present	2	52	104	0.5	442
2030	5	52	260	0.3	
2070	30	52	1560	0.2	

Figure 27 - Probability of Flooding along Route 3A in 2030

Climate Change Vulnerability, Risk Assessment and Adaptation Study
Town of Hingham, MA
June 29, 2015

KLEINFELDER
Bright People. Right Solutions.

Vulnerability Assessment

Project Objectives

- Assess vulnerabilities of Trustees' coastal properties (assets on those properties) to flooding and inundation under future sea level rise and storm scenarios
- Probability-based approach for inundation
- Combine vulnerability with consequence (driven by the value assigned by Trustees) into a Coastal Vulnerability Index (CVI)
- Use the CVI to prioritize adaptation alternatives

Climate Vulnerability Modeling

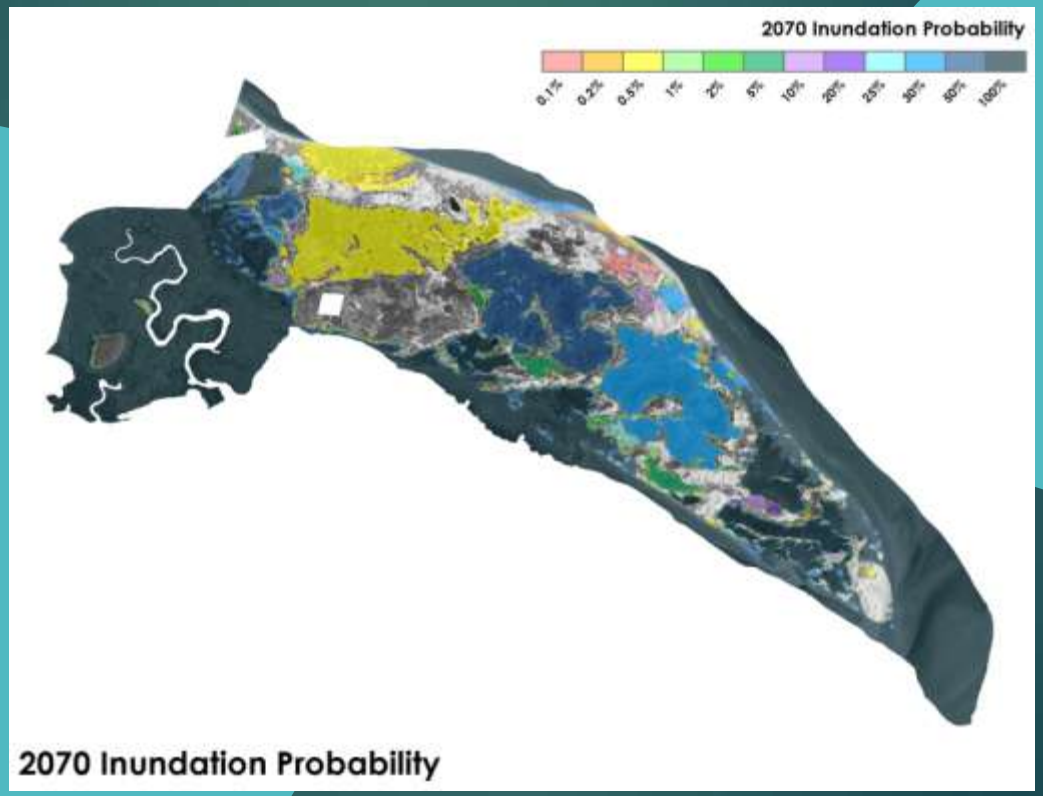
Inundation Modeling: Data Sources

- Utilize existing information (if appropriate)
  - FEMA flood zones
  - Existing model results (where available)
  - Sea level rise rates
  - MCZM shoreline change rates
  - USGS National Assessment of Coastal Vulnerability to SLR
  - NOAA and others basic bathtub model

- Focused probabilistic inundation mapping
  - MassDOT model results (Woods Hole Group)
  - North Atlantic Coast Comprehensive Study (USACE)
  - Sea Level Affecting Marshes Model (SLAMM) results (CZM – Woods Hole Group)

Inundation Modeling: Outputs

- Probability of Inundation Results for 2030 and 2070
- Maximum, minimum and spatially weighted average for given assets



Asset Valuation

(Also referred to as 'Consequence Scoring')

Valuation Objective

- Independent of vulnerability, assign a value to each asset

Asset Valuation: the Assets

- Buildings and Structures
- Roads, Trails, Parking Areas
- Cultural Resource Points
- Priority Species Habitats
- Vegetation Communities

Asset Valuation: Development of Criteria

- Development of valuation criteria required extensive discussions and input from a large group of Trustee experts and Woods Hole Group scientists
- Multiple iterations and case study testing
- Based on a set of criteria that reflect the mission of TOR
- Final asset values assigned by TOR experts

Asset Valuation: The Scoring Process

- Draw on multi-disciplinary expertise. Obtain input and buy-in from all experts. The more input the better
- All assets are scored based on the same criteria. Not all criteria will apply to all assets – that is by design so that assets from different classes can be compared directly.
- Focus on value (don't think about vulnerability)
- There is a benefit in 'talking it out' – don't score in isolation. It is important to provide a rationale for the scores.

Asset Valuation: The Scoring Criteria

Each given a score of 1-5

Higher score = higher value or greater impact if lost

Total Score =

$$\frac{\text{Sum of Scores}}{\text{Total Possible Score}} \times 100$$

Category of Consequence Criteria	Proposed Combined Criteria (per individual asset) Scoring from 0-5 0 = not impacted, 1 = slight value impact, 3 = moderate value impact, 5 = high value impact	Weighting Factor	Note
Ecological	**Natural Resource Integrity**	1	the structure, composition, viability, and function of an ecosystem or habitat / community type
	Natural Resource Significance	1	rarity, uniqueness, and importance within a local or regional context
Cultural / Historic	**Cultural Resource Integrity**	1	retains material attributes associated with its social values, including ways in which materials were put together, relationship between different parts of a resource and the aesthetic qualities that resulted; it is the exact geographic location of a resource and the nature of its setting
	Cultural Resource Significance	1	rarity, uniqueness, and importance within a local or regional context
Recreation / Visitor Experience	**Visitor Experience Quality**	1	the enjoyment and experience that the visitor takes away with them. Includes trails, amenities, recreational sites, and scenic experience and enjoyment of the landscape
	Visitor Experience Significance	1	rarity, uniqueness, and importance within a local or regional context
Public Programming	**Public Programs**	1	relevancy of asset or resource to public programming, events, tours, education (1 <= 25% impact, 3 >= 50% impact, 5 = all programming affected).
Financial	**Revenue Impact**	1	Impact to revenue income
Operations	**Operational Support**	1	Impact to access and support for operations / facilities
Resiliency	**Sensitivity to Coastal Flooding**	1	Sensitivity to damage or loss from changing environmental conditions driven by coastal flooding (1 = slight sensitivity, quick recovery, 3 = moderate sensitivity, slow recovery, 5 = no recovery, complete loss)
Financial	**Replacement Cost**	1	Cost to replace or restore asset or resource if lost or significantly damaged (1 <= $10k, 3<= $100k, 5 >= $1M

Climate Vulnerability Index

Climate Vulnerability Index: Defined

- For each asset:

CVI = probability of flooding x asset value

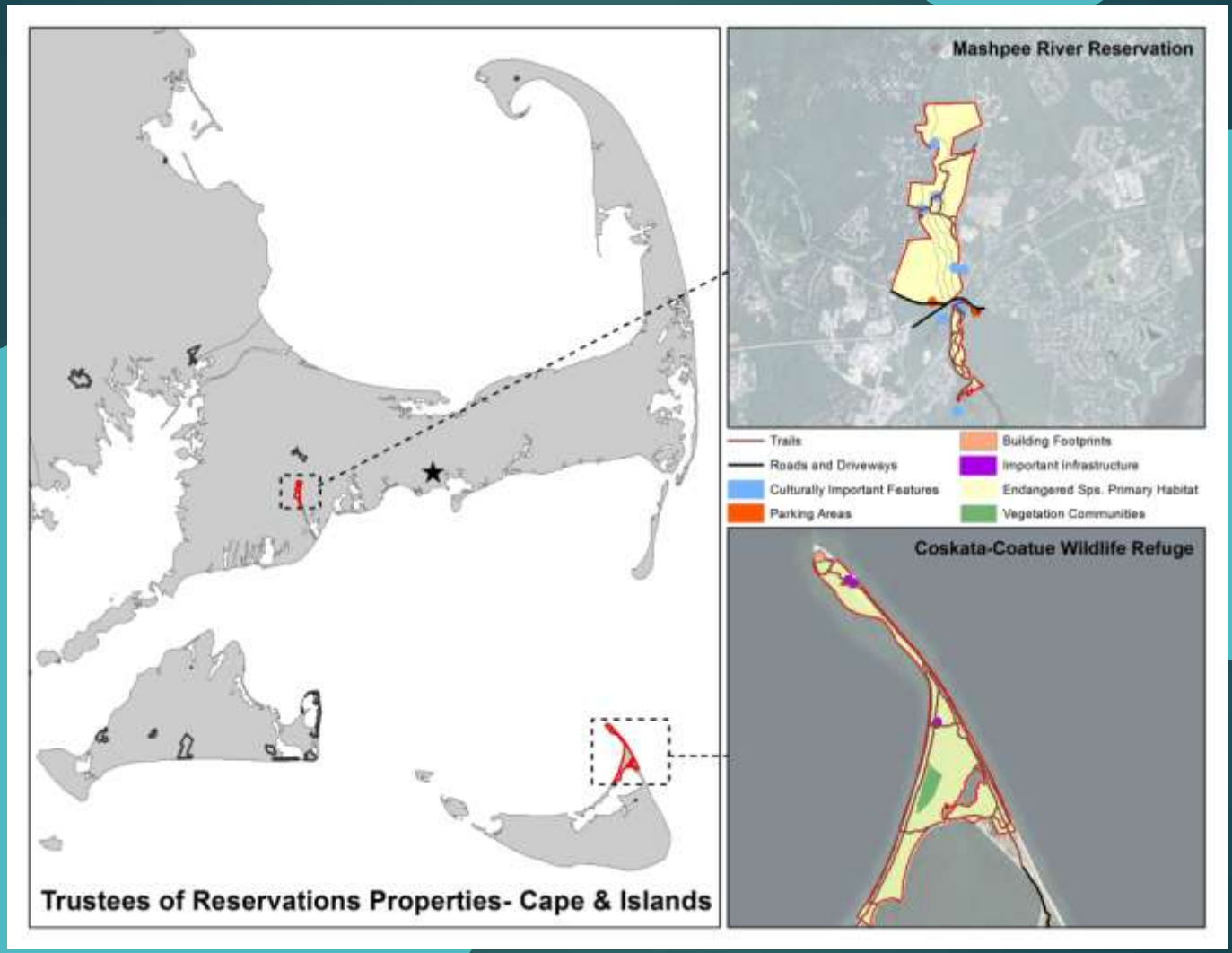
- Rank all assets and prioritize adaptation projects
- Focus on comparative CVIs (not the absolute scores)

Climate Vulnerability Index: Example of Summary Table

Asset	Property	Vulnerability (Probability of Inundation to Critical Depth)		Consequence	CVI (by Year)
		2030	2070		
Beach A	Property E	1%	5%	5	Prob x Consequence
Habitat B	Property F	2%	8%	2	Prob x Consequence
Habitat C	Property E	5%	15%	5	Prob x Consequence
Building D	Property G	6%	25%	3	Prob x Consequence

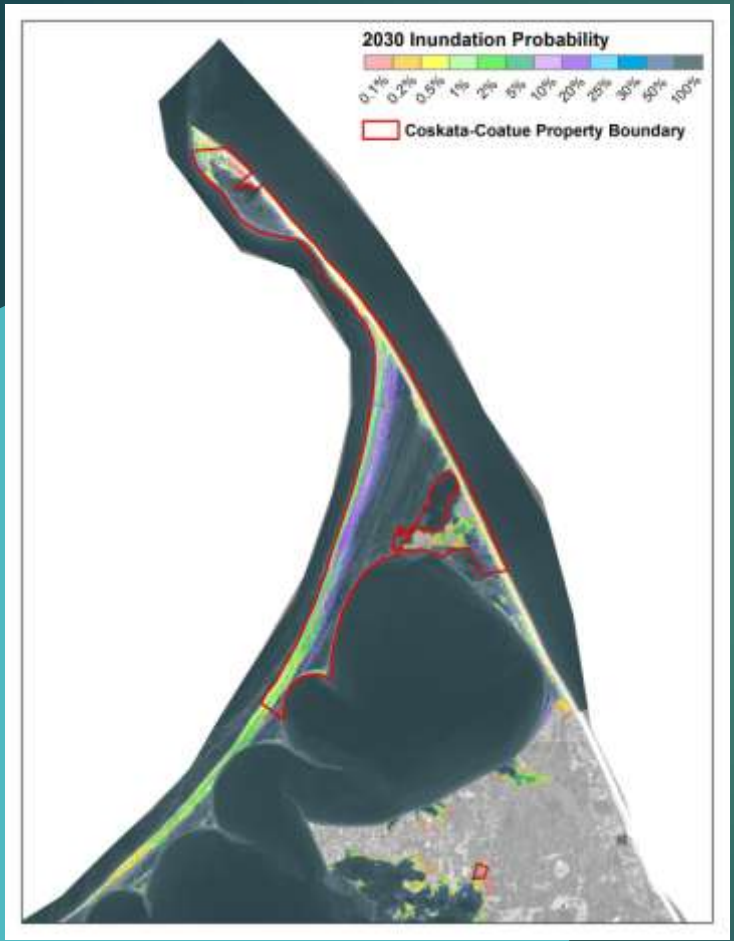
Case Studies

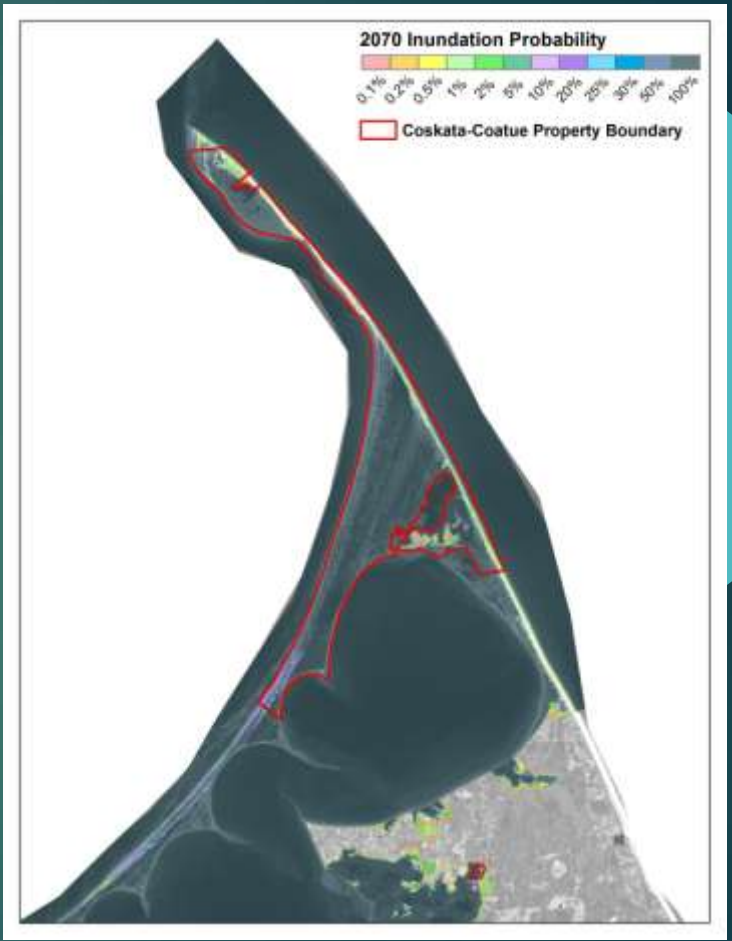
Case Studies



Asset Categories

Case Studies: Coskata-Coatue Wildlife Refuge





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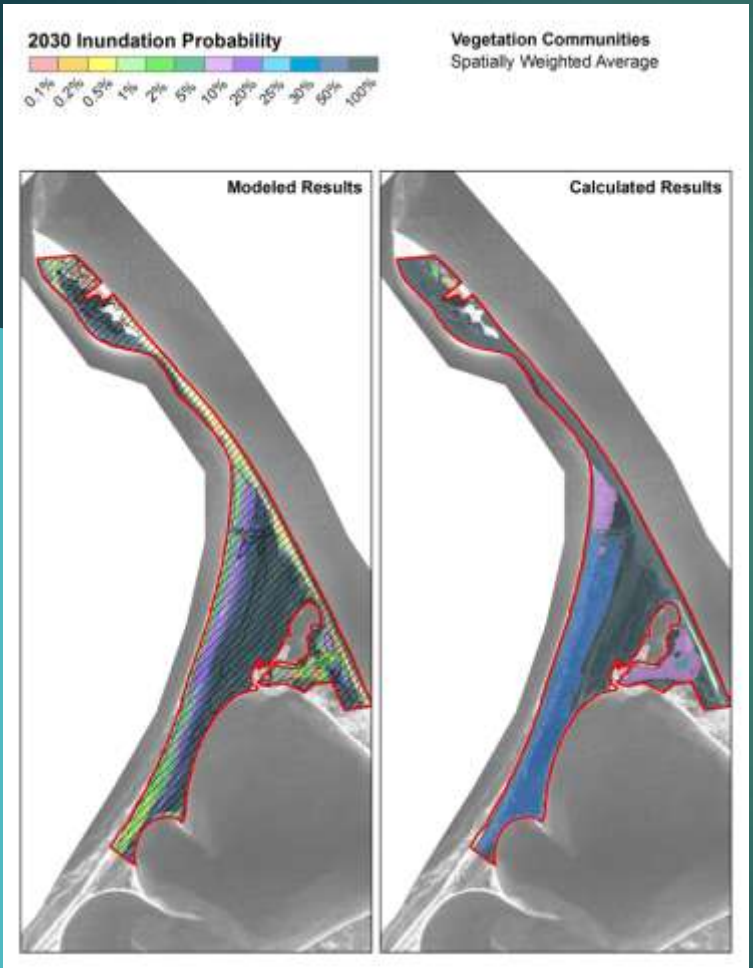
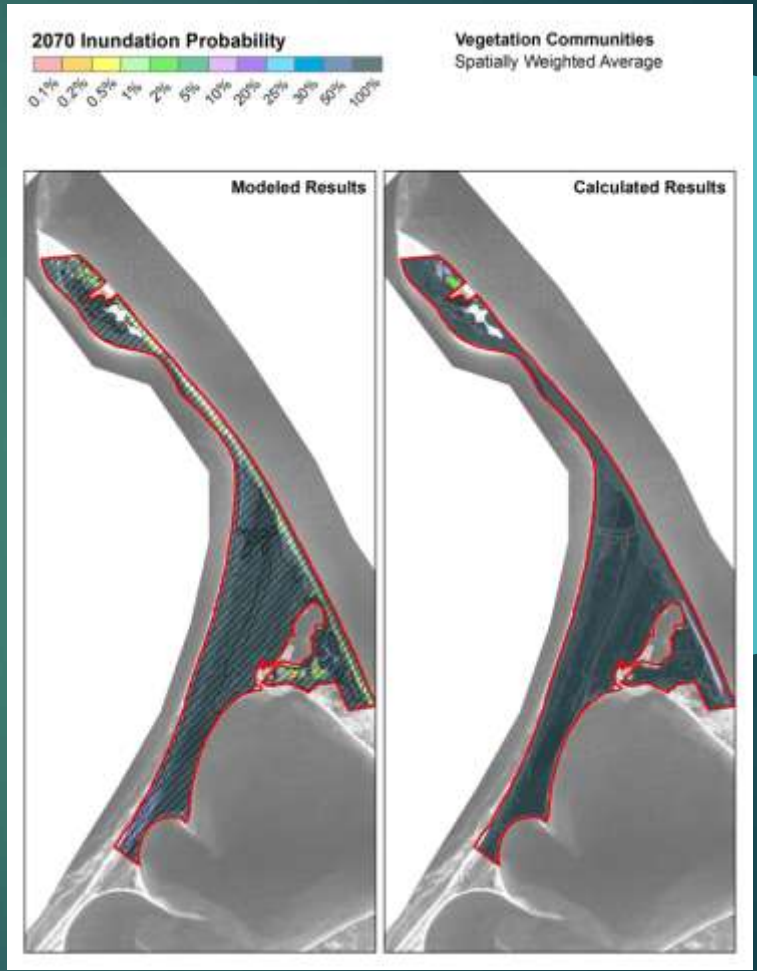
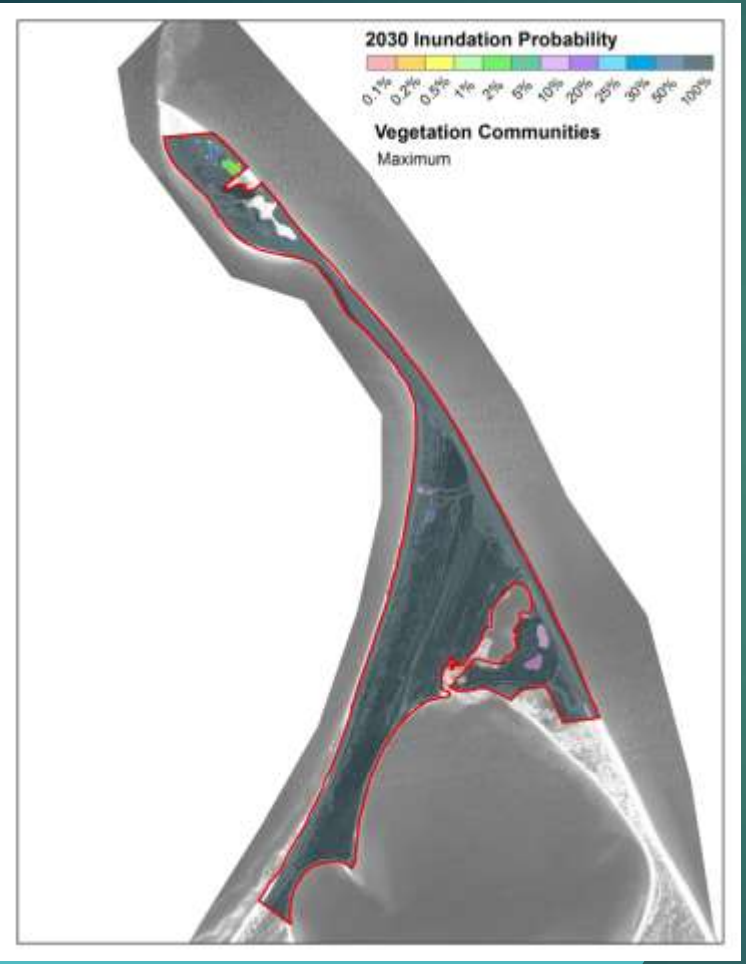
WOODS HOLE GROUP | 30 YEARS

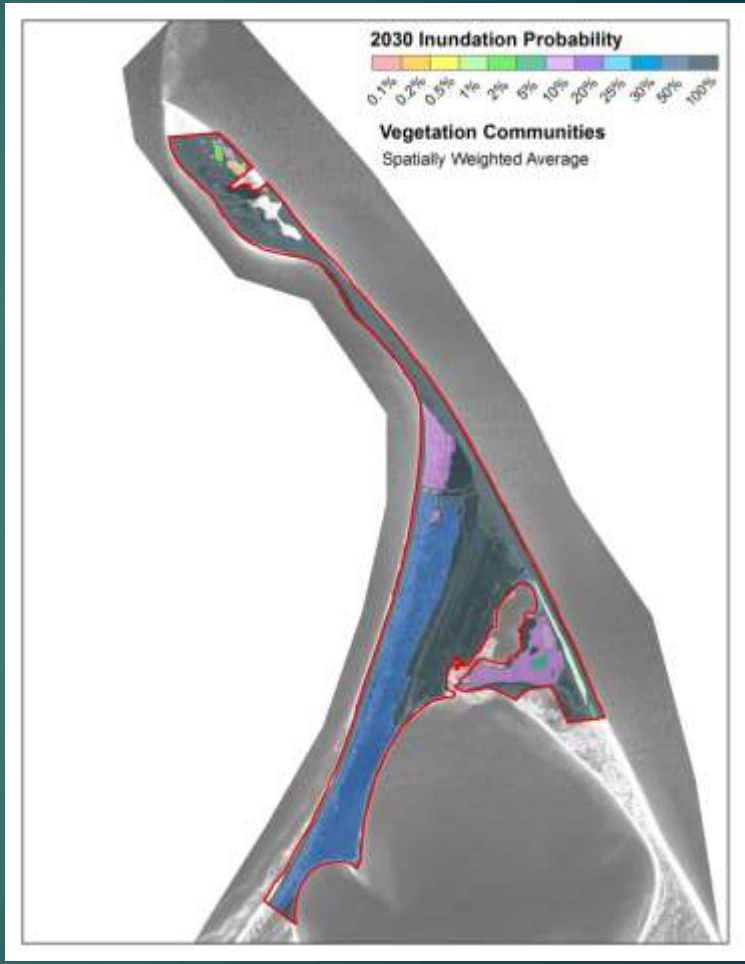
Case Studies: Coskata-Coatue Wildlife Refuge





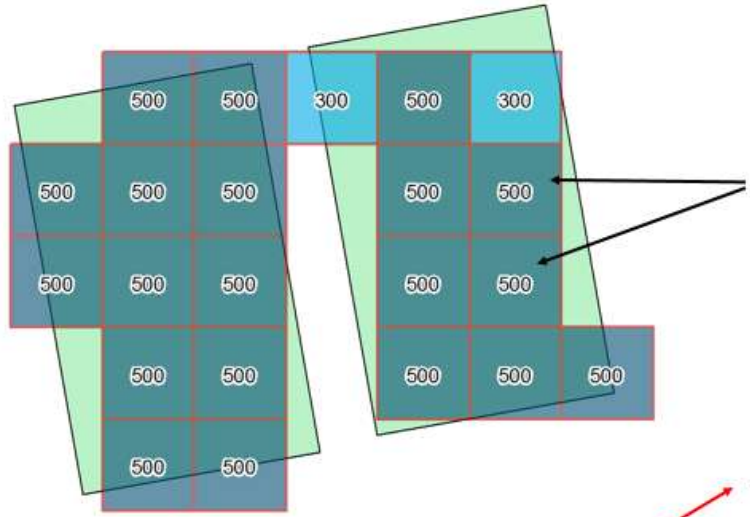
Case Studies: Coskata-Coatue Wildlife Refuge





Maximum versus Spatially Weighted Average

Case Studies:



Resampling allows for grouped cells to return to a 1 x 1 m resolution.

...which means

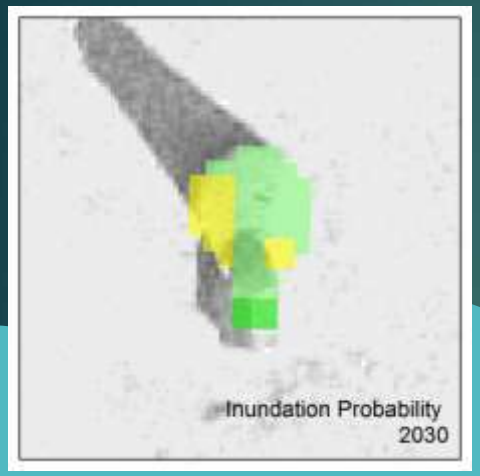
Average = [(8*500) + (2*300)]/10

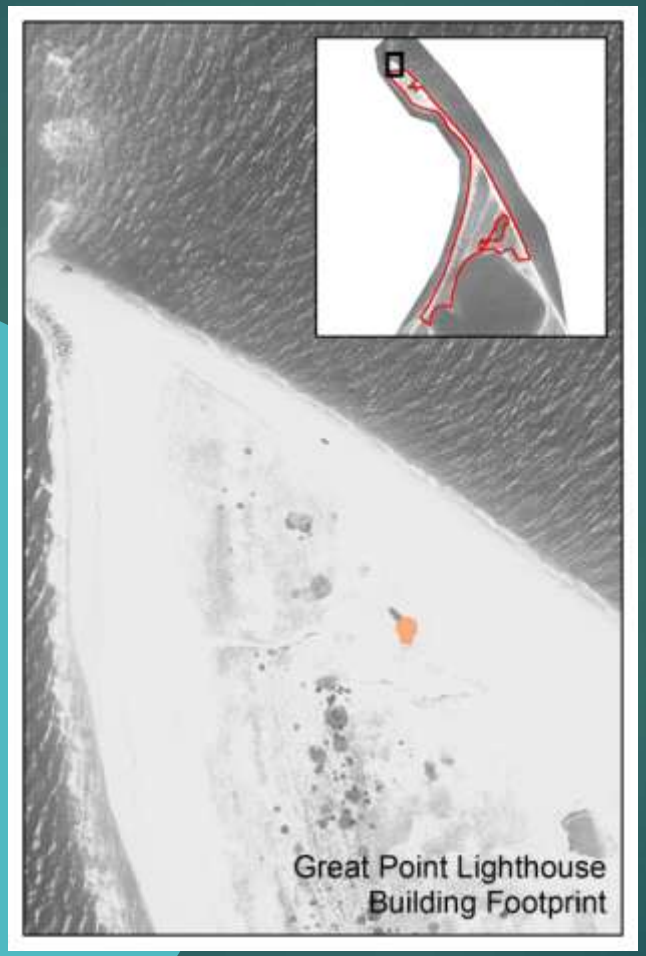
Spatially Weighted Average

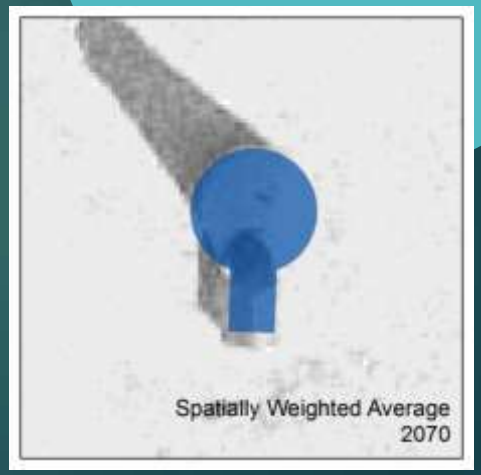
FID	Name	Average Probability	Min Probability	Max Probability
5	Bathhouse Septic Tank	460	300	500
6	Bathhouse Septic Tank	500	500	500

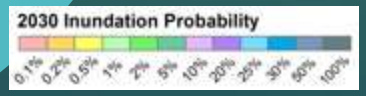
Maximum versus Spatially Weighted Average

Case Studies: Coskata-Coatue Wildlife Refuge









Case Studies: Coskata-Coatue Wildlife Refuge

Coskata-Coatue – Vegetation Communities

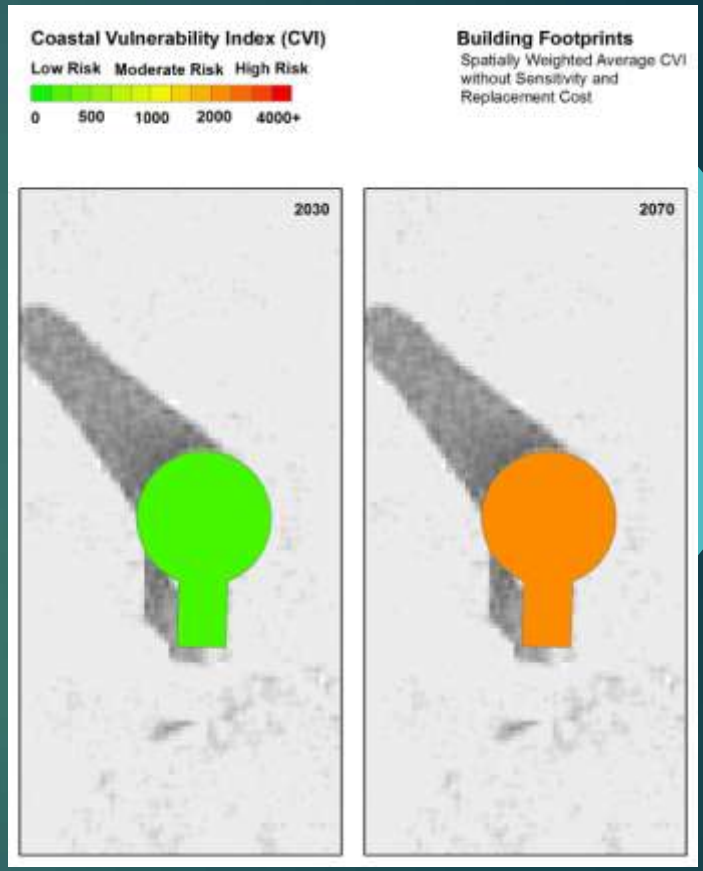
FID	Property	Name	Cultural	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
374	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
375	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
376	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
379	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
423	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	100	100	100	4222	4222	4222
377	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	0.1	100	83	5	5111	4222
424	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	50	100	100	2111	4222	4218
421	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	20	100	100	844	4222	4217
425	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	5	100	100	211	4222	4205
380	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	0.1	100	75	5	5111	3840
426	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	0.1	100	86	4	4222	3623
388	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
389	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
395	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
396	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
397	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
399	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
413	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
414	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	100	100	100	3556	3556	3556
419	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	50	100	100	1778	3556	3556
387	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	50	100	100	1778	3556	3554
390	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	50	100	100	1778	3556	3554
417	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	20	100	100	711	3556	3543
405	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	10	100	100	356	3556	3540
418	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	2	100	99	71	3556	3533
400	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	2	100	99	71	3556	3532
382	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	5	100	97	178	3556	3463
393	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	50	100	97	1778	3556	3456
384	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	2	100	97	71	3556	3449
420	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	0.1	100	97	4	3556	3443
391	Coskata-Coatue Wildlife Refi	MARITIME SHRUB THICKET		3	5	0	0	2	3	3	0	0	36	0.1	100	95	4	3556	3385
412	Coskata-Coatue Wildlife Refi	SALT MARSH		3	5	0	0	2	3	3	0	0	36	0.1	100	95	4	3556	3369

Case Studies: Coskata-Coatue Wildlife Refuge

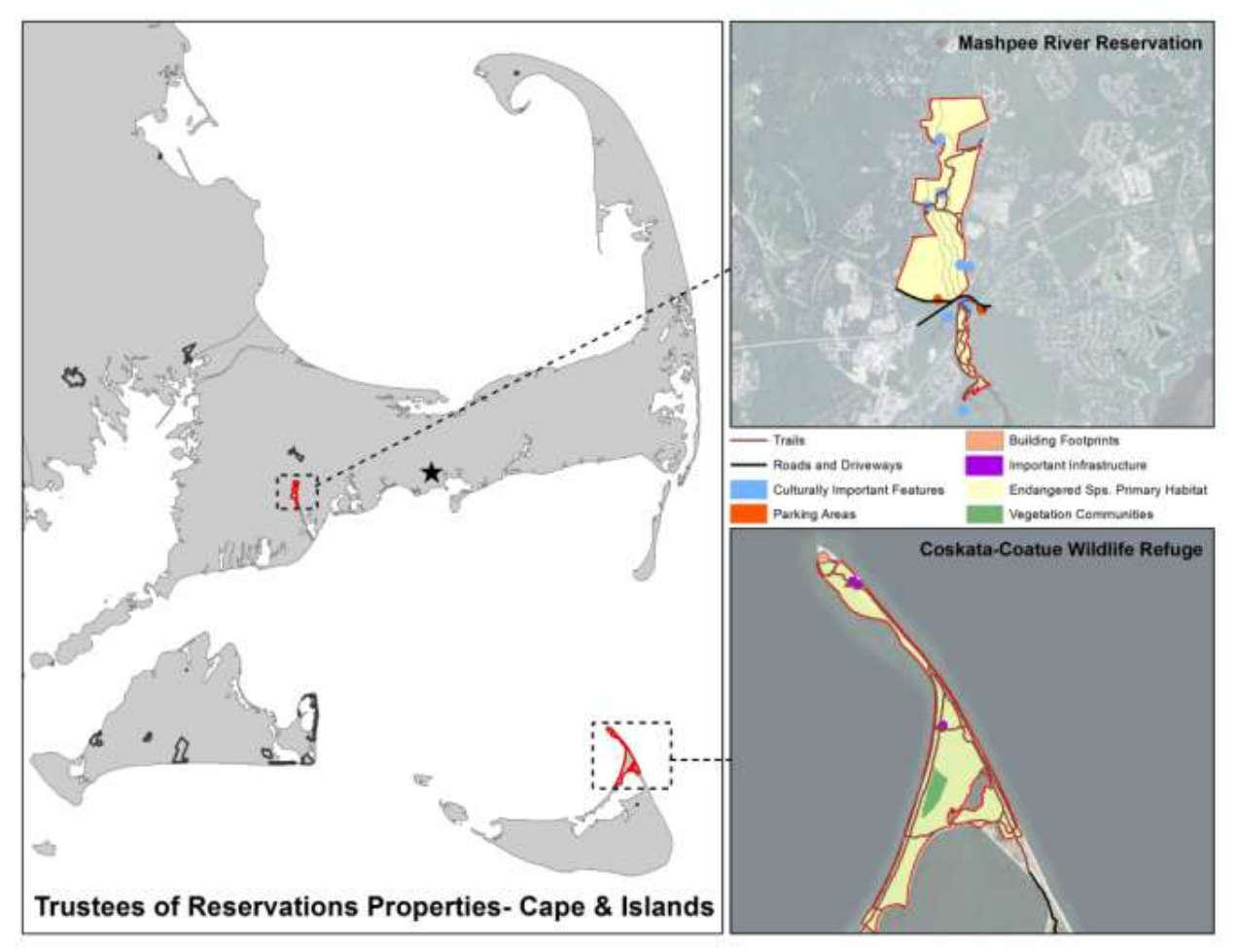
Coskata-Coatue – Building Footprints

FID	Property	YearBuilt	Name	Cultural	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
80	Coskata-Coatue Wildli	0	Great Point Lighthouse	Historic Interest	0	0	5	5	4	5	5	3	1	62	10	100	39	622	6222	2441
81	Coskata-Coatue Wildli	1999	Superintendent's House		0	0	1	0	0	0	0	0	5	13	0.1	0.2	0.2	1	3	2

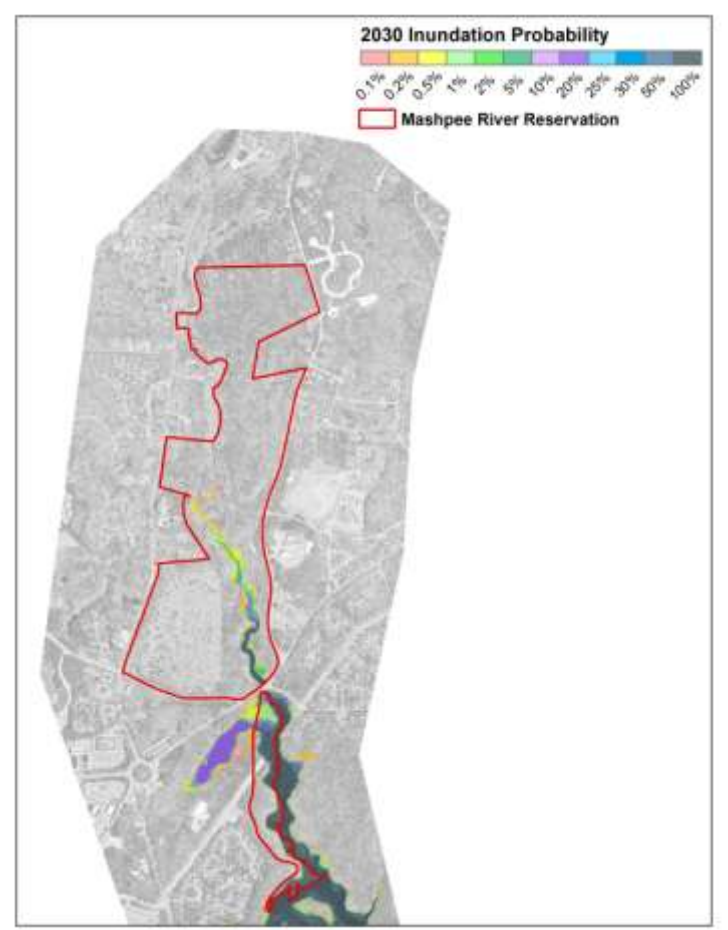
Case Studies: Coskata-Coatue Wildlife Refuge (CVIs)

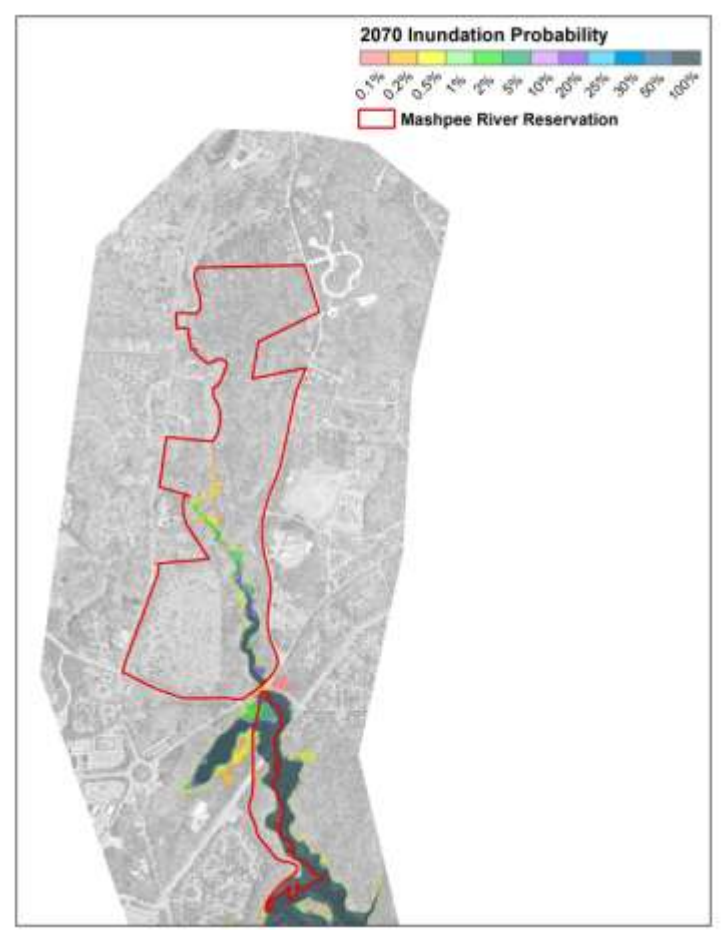


Case Studies



Case Studies: Mashpee River Reservation

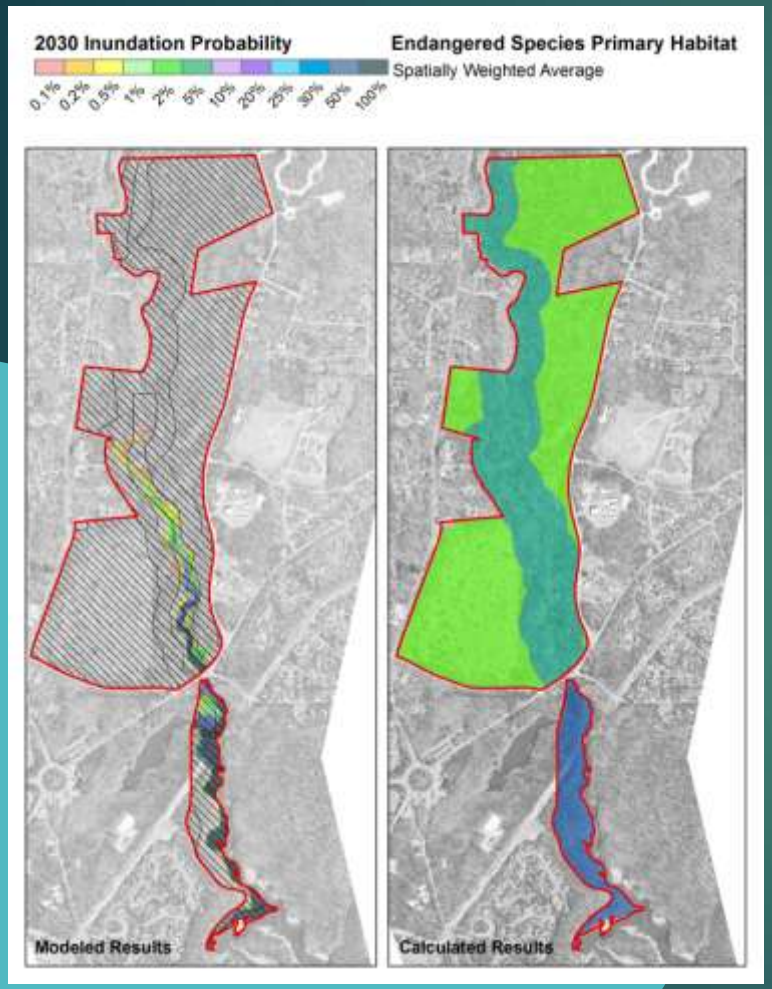


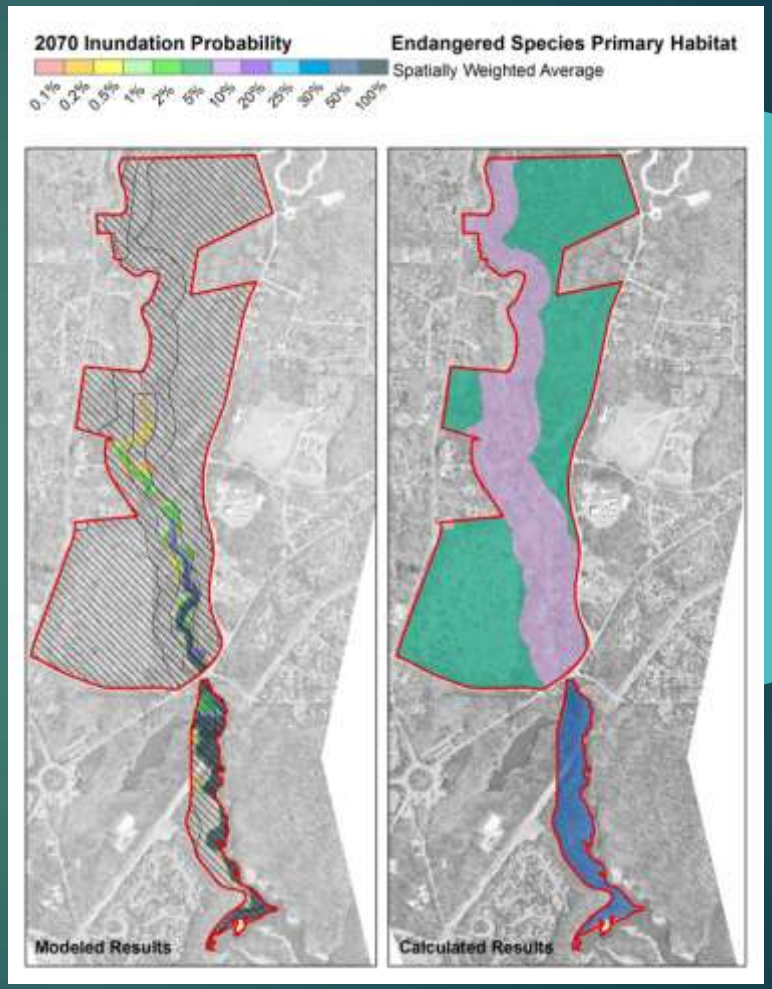


trustees

WOODS HOLE GROUP 30 YEARS

Case Studies: Mashpee River Reservation

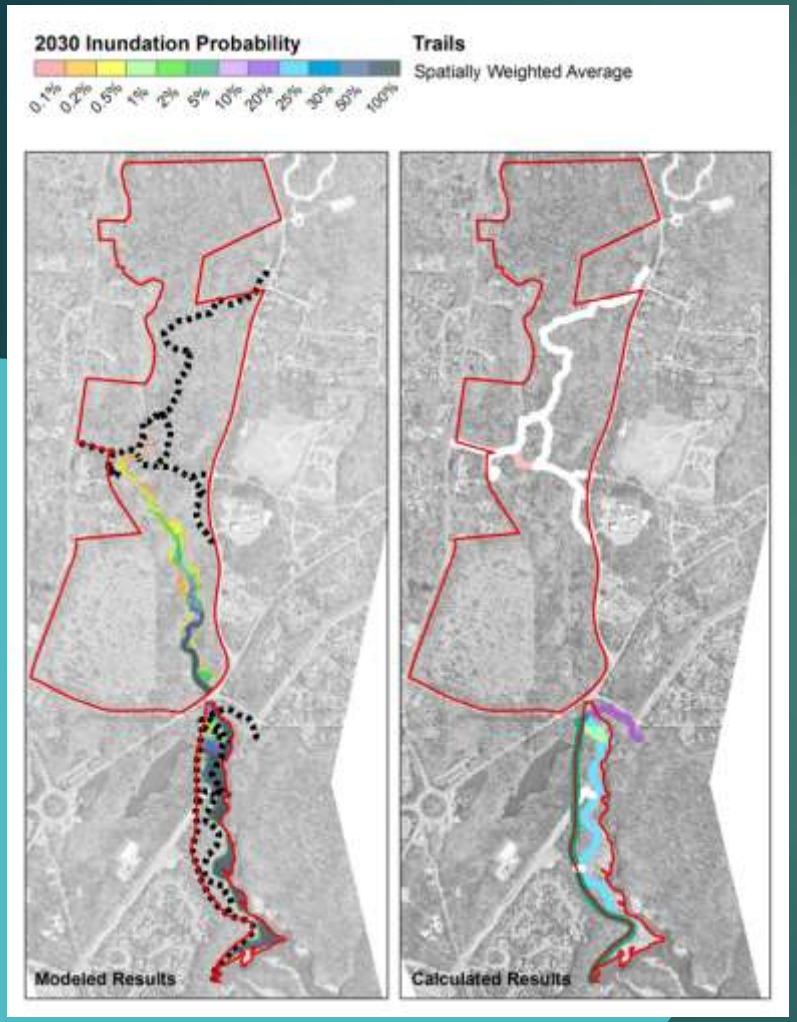


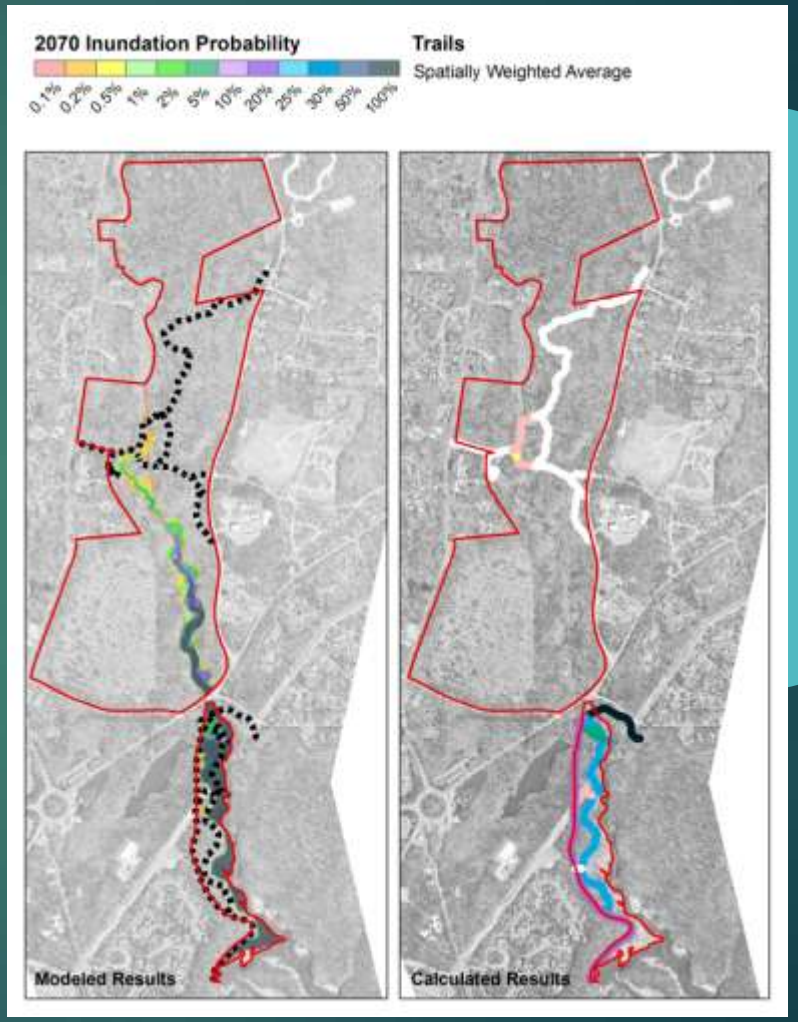


trustees

WOODS HOLE GROUP 30 YEARS

Case Studies: Mashpee River Reservation





Case Studies: Mashpee River Reservation

Mashpee River- Endangered Species Primary Habitat

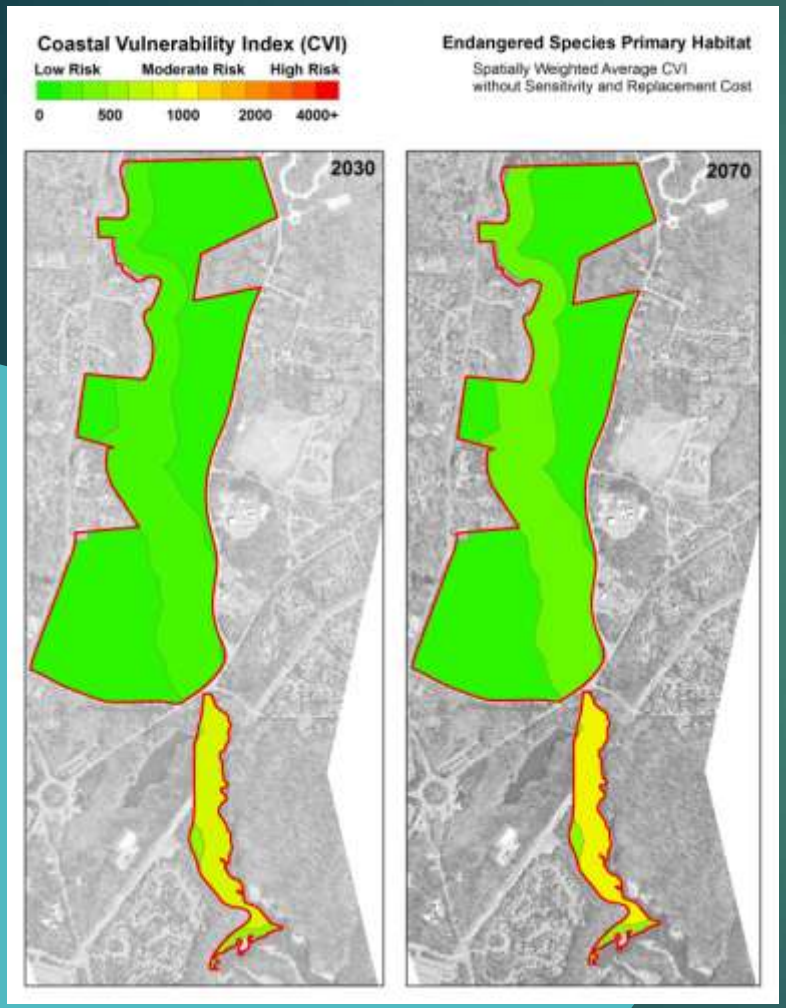
FID	Property	Type	Name	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
265	Mashpee River Reservation	T	Northern Parula	4	4	0	0	0	0	0	0	0	18	1	100	73	18	1778	1291
202	Mashpee River Reservation	T	American Brook Lamprey	5	4	0	0	0	0	0	0	0	20	0	100	46	0	2000	926
60	Mashpee River Reservation	SC	Eastern Box Turtle	5	3	0	0	0	0	0	0	0	18	0	100	43	0	1778	763
264	Mashpee River Reservation	T	Northern Parula	4	4	0	0	0	0	0	0	0	18	0	100	19	0	1778	329
201	Mashpee River Reservation	T	American Brook Lamprey	5	4	0	0	0	0	0	0	0	20	0	100	5	0	2000	110
59	Mashpee River Reservation	SC	Eastern Box Turtle	2	3	0	0	0	0	0	0	0	11	0	100	2	0	1111	25
25	Mashpee River Reservation	T	Water-willow Stem Borer	2	4	0	0	0	0	0	0	0	13	0	0	0	0	0	0

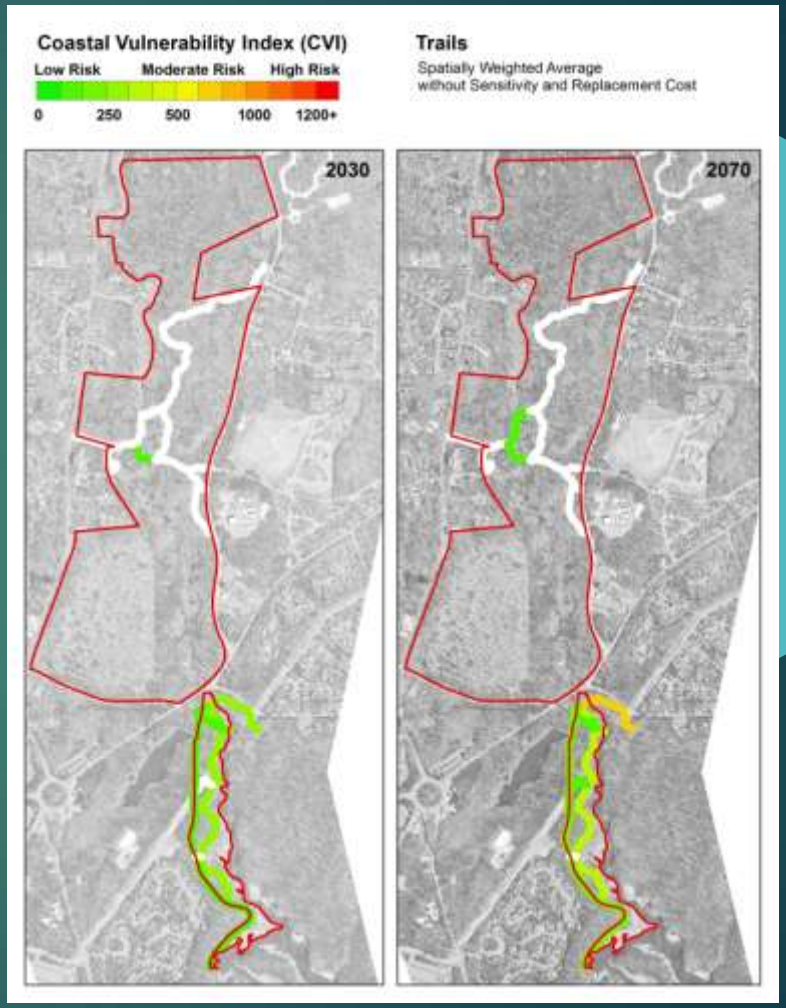
Case Studies: Mashpee River Reservation

Mashpee River- Trails

FID	Property	Name	Type	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PR	REV_IMPA	OP_SUPPC	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
81	Mashpee River South	Entrance Trail	Trail	0	0	0	0	3	2	0	0	1	13	0	100	51	0	1333	679
82	Mashpee River South	Thorpe Trail	Trail	0	0	0	0	3	2	0	0	0	11	0	100	29	0	1111	319
83	Mashpee River South	Other Trail	Trail	0	0	0	0	1	1	0	0	0	4	2	10	45	9	44	200
85	Mashpee River South	River Road Trail	Trail	0	0	0	0	3	3	0	0	2	18	0	100	10	0	1778	183
63	Mashpee River North	ASHER'S PATH EAST	Trail	0	0	0	0	1	1	0	0	0	4	0	1	0.3	0	4	1
84	Mashpee River South	Other Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0.1	0.03	0	0.4	0.1
62	Mashpee River North	ASHER'S PATH EAST	Trail	0	0	0	0	1	1	0	0	0	4	0	1	0.02	0	2	0.1
69	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0.2	0.02	0	1	0.1
70	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0.2	0.008	0	1	0.04
61	Mashpee River North	ASHER'S PATH EAST	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
64	Mashpee River North	ASHER'S PATH EAST	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
65	Mashpee River North	ASHER'S PATH EAST	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
60	Mashpee River North	Mashpee North Trails	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
66	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
67	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
68	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
71	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
72	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
73	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
74	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
75	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
76	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
77	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
78	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
79	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
80	Mashpee River North	Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0
86	Mashpee River South	Other Trail	Trail	0	0	0	0	1	1	0	0	0	4	0	0	0	0	0	0

Case Studies: Mashpee River Reservation (CVI)





Next Steps

Next Steps

Adaptation Alternatives/Recommendations

Management Recommendations

- Identify vulnerable locations and assets of high priority to TTOR (hot spots) based on the CVI
- Compare CVI findings to existing management plans
- List possible site-specific *local* adaptations to minimize/mitigate risk, increase resiliency or adapt for hot spots
- Evaluate overall results to identify potential *regional* adaptations

Next Steps

Coskata-Coatue – Vegetation Communities

FID	Property	Name	Cultural	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
374	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
375	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
376	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
379	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	100	100	100	5111	5111	5111
423	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	100	100	100	4222	4222	4222
377	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	0.1	100	83	5	5111	4222
424	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	50	100	100	2111	4222	4218
421	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	20	100	100	844	4222	4217
425	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	5	100	100	211	4222	4205
380	Coskata-Coatue Wildlife Refi	MARITIME BEACH		3	5	0	0	5	5	5	0	0	51	0.1	100	75	5	5111	3840
426	Coskata-Coatue Wildlife Refi	MARITIME FOREST		5	5	0	0	2	4	3	0	0	42	0.1	100	86	4	4222	3623

Coskata-Coatue – Building Footprints

FID	Property	YearBuilt	Name	Cultural	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
80	Coskata-Coatue Wildli	0	Great Point Lighthouse	Historic Interest	0	0	5	5	4	5	5	3	1	62	10	100	39	622	6222	2441
81	Coskata-Coatue Wildli	1999	Superintendent's House		0	0	1	0	0	0	0	0	5	13	0.1	0.2	0.2	1	3	2

Mashpee River- Endangered Species Primary Habitat

FID	Property	Type	Name	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PRO	REV_IMPACT	OP_SUPPORT	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
265	Mashpee River Reservation	T	Northern Parula	4	4	0	0	0	0	0	0	0	18	1	100	73	18	1778	1291
202	Mashpee River Reservation	T	American Brook Lamprey	5	4	0	0	0	0	0	0	0	20	0	100	46	0	2000	926
60	Mashpee River Reservation	SC	Eastern Box Turtle	5	3	0	0	0	0	0	0	0	18	0	100	43	0	1778	763
264	Mashpee River Reservation	T	Northern Parula	4	4	0	0	0	0	0	0	0	18	0	100	19	0	1778	329
201	Mashpee River Reservation	T	American Brook Lamprey	5	4	0	0	0	0	0	0	0	20	0	100	5	0	2000	110
59	Mashpee River Reservation	SC	Eastern Box Turtle	2	3	0	0	0	0	0	0	0	11	0	100	2	0	1111	25
25	Mashpee River Reservation	T	Water-willow Stem Borer	2	4	0	0	0	0	0	0	0	13	0	0	0	0	0	0

Mashpee River- Trails

FID	Property	Name	Type	NR_INTEG	NR_SIGNIF	CR_INTEG	CR_SIGNIF	VE_QUALITY	VE_SIGNIF	PUBLIC_PR	REV_IMPA	OP_SUPPC	Total Consquence Score (NO Sensitivity or Replacement)	Min Prob	Max Prob	Spatial Ave Prob	Min CVI (No Sens/Repl)	Max CVI (No Sens/Repl)	Spatial Ave CVI (No Sens/Repl)
81	Mashpee River South	Entrance Trail	Trail	0	0	0	0	3	2	0	0	1	13	0	100	51	0	1333	679
82	Mashpee River South	Thorpe Trail	Trail	0	0	0	0	3	2	0	0	0	11	0	100	29	0	1111	319
83	Mashpee River South	Other Trail	Trail	0	0	0	0	1	1	0	0	0	4	2	10	45	9	44	200
85	Mashpee River South	River Road Trail	Trail	0	0	0	0	3	3	0	0	2	18	0	100	10	0	1778	183

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WOODS HOLE GROUP 30 YEARS

Thank you!

Questions?

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