Apple Country
Natural Climate Solutions Project

Supporting Community Resilience and Carbon Mitigation by Enhancing the Health of Local Natural Systems

The Apple Country Team

Communities

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Regenerative DesignGroup

MVP Municipal Vulnerability Preparedness

This project is funded by the Massachusetts Executive Office of Energy & Environmental Affairs
Municipal Vulnerability Preparedness Program
www.resilientma.org/mvp

Goals for the Project

To identify and deliver climate solutions that will increase the resilience of our communities and ecosystems by collaborating with Nature.

Delaney Wildlife Management Area

Nature-based Solutions provide cost-effective climate resilience through multiple co-benefits, including reduction of greenhouse gas emissions, improved water quality and water supply, reduced flooding, improved air quality, cooler local temperatures, supporting biodiversity and fish and wildlife habitat, providing recreational and aesthetic opportunities, and improved physical and mental public health for residents.

Bolton Lime Kiln Conservation Area

Step 1: Getting to Know Apple Country

In late 2020, 5 site tours were conducted to observe;

- Farmland
- Soil
- Wetlands
- Floodplains
- Open Space
- And Forests

The goals was to identify specific natural solutions for specific locations and to observe soil and land cover health.

Basis for Recommendations

Use carbon and ecological climate resilience mapping to help define and prioritize areas for Conservation and areas for development,

Restore damaged wetlands, streams, forests, and soils,

Restore stream connectivity at roadway stream crossings to improve habitat and reduce flooding,

Improve land management practices and implement regulations that protect ecosystem carbon and climate resilience ecosystem services.

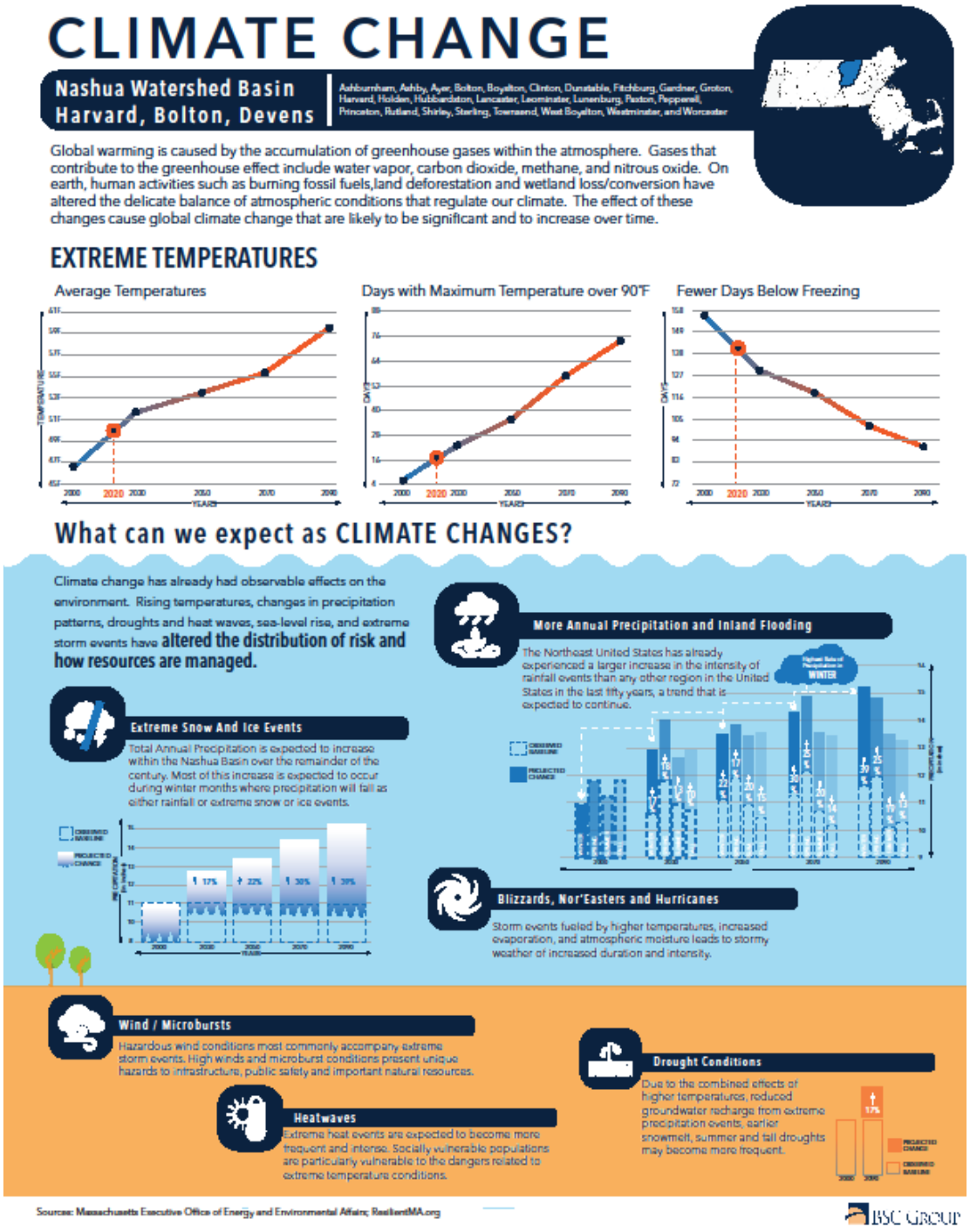
Schultz Farm hay field

Stow Road wetland and culvert

Step 2: Mapping and Analysis

Northeast Climate Adaptation Science Center Projections

Downscaled climate projections for heat and precipitation from the Northeast Climate Adaptation Science Center (2018) as shown on the Resilientma.org website.

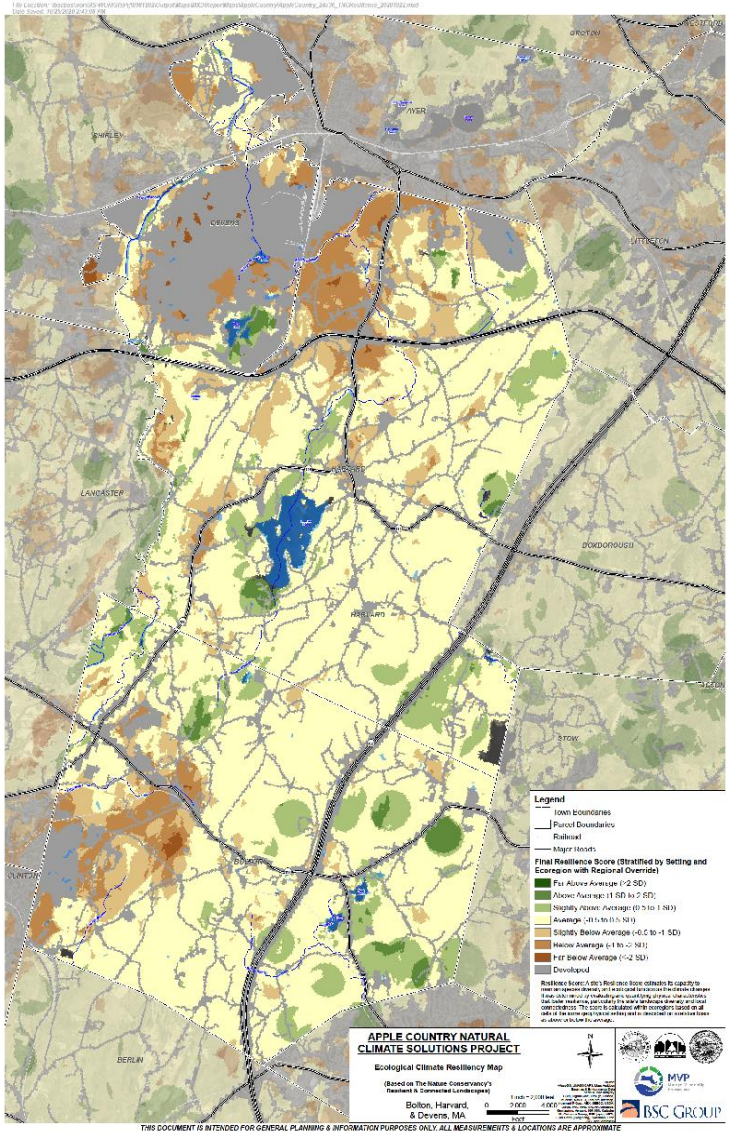


Step 2: Mapping and Analysis
Ecological Climate Resilience

Final Resilience Score (Stratified by Setting and Ecoregion with Regional Override)

- Far Above Average (>2 SD)
- Above Average (1 SD to 2 SD)
- Slightly Above Average (0.5 to 1 SD)
- Average (-0.5 to 0.5 SD)
- Slightly Below Average (-0.5 to -1 SD)
- Below Average (-1 to -2 SD)
- Far Below Average (<-2 SD)
- Developed

Resilience Score: A site's Resilience Score estimates its capacity to maintain species diversity and ecological function as the climate changes. It was determined by evaluating and quantifying physical characteristics that foster resilience, particularly the site's landscape diversity and local connectedness. The score is calculated within ecoregions based on all cells of the same geophysical setting and is described on a relative basis as above or below the average.



Using The Nature Conservancy's (TNC) "Resilient and Connected Landscapes for Terrestrial Conservation" (RCL) GIS datasets, the University of Massachusetts CAPS MA Index of Ecological Integrity dataset, the Massachusetts Natural Heritage and Endangered Species Program BioMap2 Tool, MassAudubon's MAPPR Tool 2.0, Massachusetts Bureau of Geographic Information (MassGIS) floodplain, wetland and open space data layers.

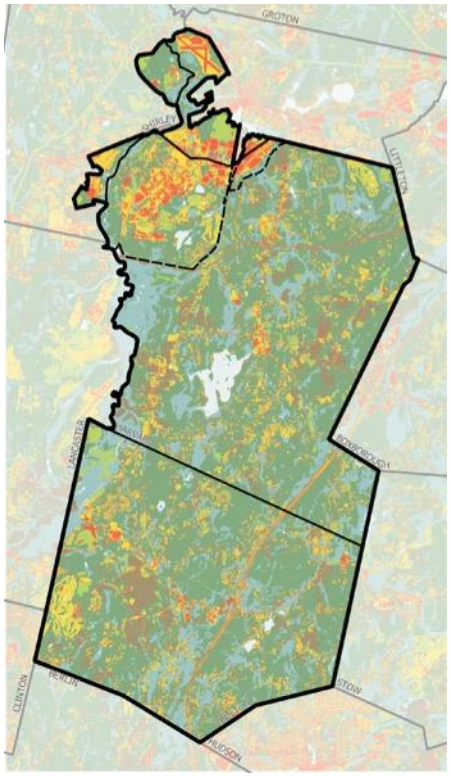
Step 2: Mapping and Analysis
Forest and Tree Carbon

The analysis of carbon sequestration by forests and trees by Woodwell Institute show significant natural sequestration.

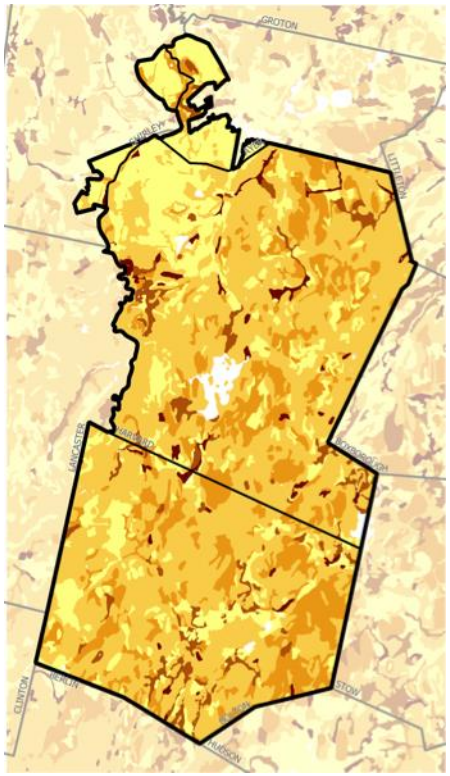
Table 3. Net CO_2 balance of forests and trees outside forests of Apple Country, 2011-2016

	Removals	Emissions
	(t CO2e/yr)	
Undisturbed Forest	-54,907	
Disturbance fire		0
Disturbance insect/disease		0
Disturbance harvest/other		2,086
Non-Forest to Forest	-690	
Forest to Cropland		2
Forest to Grassland		840
Forest to Wetlands		1,440
Forest to Developed		2,337
Forest to Other NF		0
Trees outside of forests	-31,165	3,207
Harvested wood products	0	
TOTAL	-86,762	9,912
Net GHG balance	-76,850	

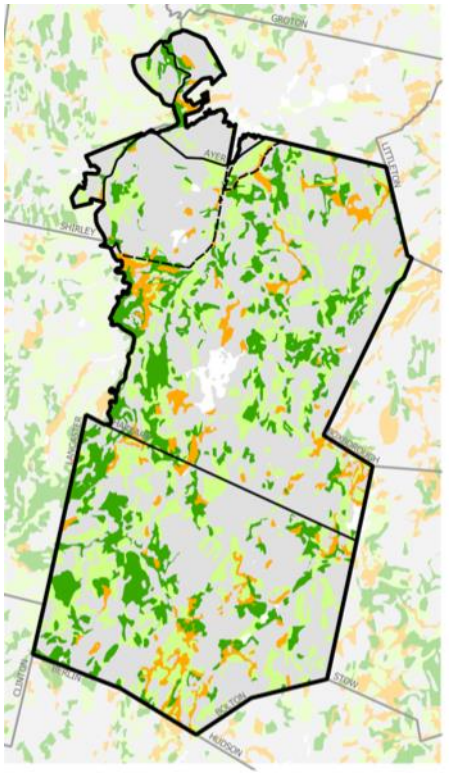
Step 2: Mapping and Analysis
Soil Types and Carbon Loss Vulnerability



Land Cover



Soil Carbon

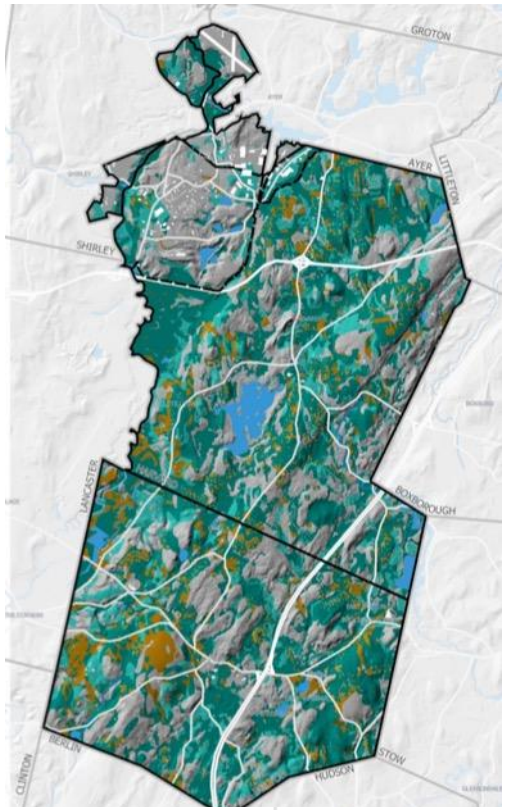


Prime Soils

Assessing priority soils

Step 2: Mapping and Analysis

Soil Types and Carbon Loss Vulnerability



- Lower Soil Conservation Value
- Moderate Soil Conservation Value
- Highest Soil Conservation Value
- High Soil Regeneration Value

Category	Bolton	Harvard Not Devens	Devens	Apple Country Acres
Lower Soil Conservation Value	4,466	5,159	2,771	12,403
Moderate Soil Conservation Value	1,891	2,121	782	4,794
Highest Soil Conservation Value	4,999	6,309	813	12,121
High Soil Regeneration Value	1,495	1,104	64	2,663
Total	12,850	14,693	4,430	31,981

Step 3: Recommendations

Conserve/Protect:

- Keep forests, wetlands and other naturally vegetated lands growing
- Prioritize
  - Sites that score high for ecological climate resilience
  - High carbon sites such as wetlands and healthy natural forests
  - Intact, connected lands such as riparian corridors
- Protect hydrologic connectivity and avoid new stream and river flow constrictions and piping
- Prevent conversion of agricultural land to development

Step 3: Recommendations

Restore:

- Prioritize restoration of land that connects existing healthy ecosystems, that has high ecological climate resilience, and that stores a lot of carbon
- Pursue reforestation: verge plantings, pocket forests, forested riparian corridors, agroforestry
- Upgrade stream and river crossings
- Restore wetlands for full suite of ecological functions
- Restore soil carbon (all land cover types)

Step 3: Recommendations

Manage Better:

- Establish local Apple Country carbon market
- Develop bylaw revisions to require mitigation for unavoidable impacts
- Develop management plans and guidance documents for major land cover types. Tailor to different landowner types.
- Conduct species management – climate adapted species, non-natives that disrupt ecosystem functioning, threatened native species
- Conduct community education and promote participation

Step 4: Report

Nature-Based Solutions Matrix

APPLE COUNTRY MVP ECOLOGICAL RESTORATION AND RESILIENCY OPPORTUNITIES TABLE

Key

Value	GOOD	BETTER	BEST
Feasibility *	low	mid	high

Number = sitemap location, A = multiple locations or entire area

This table is intended for use in conjunction with the Project Location maps attachment #

See also CRB Matrix

* Feasibility is based on property ownership or technical access

TOWN OF HARVARD

#	RESTORATION/RESILIENCY OPPORTUNITY													
	Site Map Reference & Individual Site Map #s	Oak Hill Conservation Areas and Neighboring Properties	Black Pond to High Ridge Conservation Areas	Shaker Hills and Bennett's Brook (North)	Shaker Hills and Bennett's Brook (South)	Old Mill Road Mill Pond/ Bowers Brook	Depot Road Fields/ Bowers Brook	Town Center (Schools, Common, Cemetery)	Still River Road / Bowers Brook	USFWS Oxbow National Wildlife Refuge & Floodplain / Still River Depot Road	Pine Swamp at Bare Hill	Bowers Brook at Woodside Road to West Bare Hill Road	Elizabeth Brook at Stow Road	Horse Meadow Knoll & Reservoir at Sherry Road
	Ownership	Conservation & Agriculture	Conservation & Residence	Conservation & Residence	Conservation & Residence	Conservation & Residence	Conservation & Municipal	Municipal and Commercial	Residential & Infrastructure	Conservation Infrastructure	Conservation	Residential Infrastructure	Residential Infrastructure	Conservation Infrastructure
		Map 1	Map 2	Map 3	Map 4	Map 5	Map 6	Map 7	Map 8	Map 9	Map 10	Map 11	Map 12	Map 13
	Nature Based Solutions (NBS)													
1	Invasive species management	low	mid	high	mid	high	high	mid	high	high				
2	River / pond bank revegetation				mid					low				
3	Grassland meadow management restoration	low	low					mid	high	mid		high		
4	Forest / shrubland heath management or restoration	low					high	mid		mid				
5	Wetland management restoration		low		low					mid		low		low
6	Habitat enhancements	low	low	low	low		high	mid		mid		low	low	high
7	New wetland or floodplain construction / expansion			low	low		mid		low	mid				
8	Pond creation / alteration				high							low		
9	Stream flow alteration			low	low	mid	low		high			low	low	low
10	Species monitoring protocol			low	low		low	low	low			high		high
11	Pollinator hedgerow buffer	mid	low		low		high				mid			
12	Pocket forest	high					high	high						
	Built Environment Best Management Practice (BMP)													
13	Stormwater treatment wetlands						low			mid				
14	Daylighting of streams													
15	Upstream BMPs rain-garden, bio-swale, etc.			mid			high	low	low	mid			low	low
16	Shade-habitat/ Infiltration tree plantings	mid	low	mid	high		high	mid	mid	mid			low	
17	MSCS culvert improvement			low	low	low*	mid		low			high	low	low
18	Dam modification / controls					mid						low	low	
19	Pervious parking walking areas							mid		mid				
20	Aquatic algae / invasive treatment													
21	Lighting modifications / upgrades							mid						
22	Species crossing protections	mid		low	mid				mid			high	high	
23	Beaver deceiver / promoter					mid	mid		mid			low	low	low

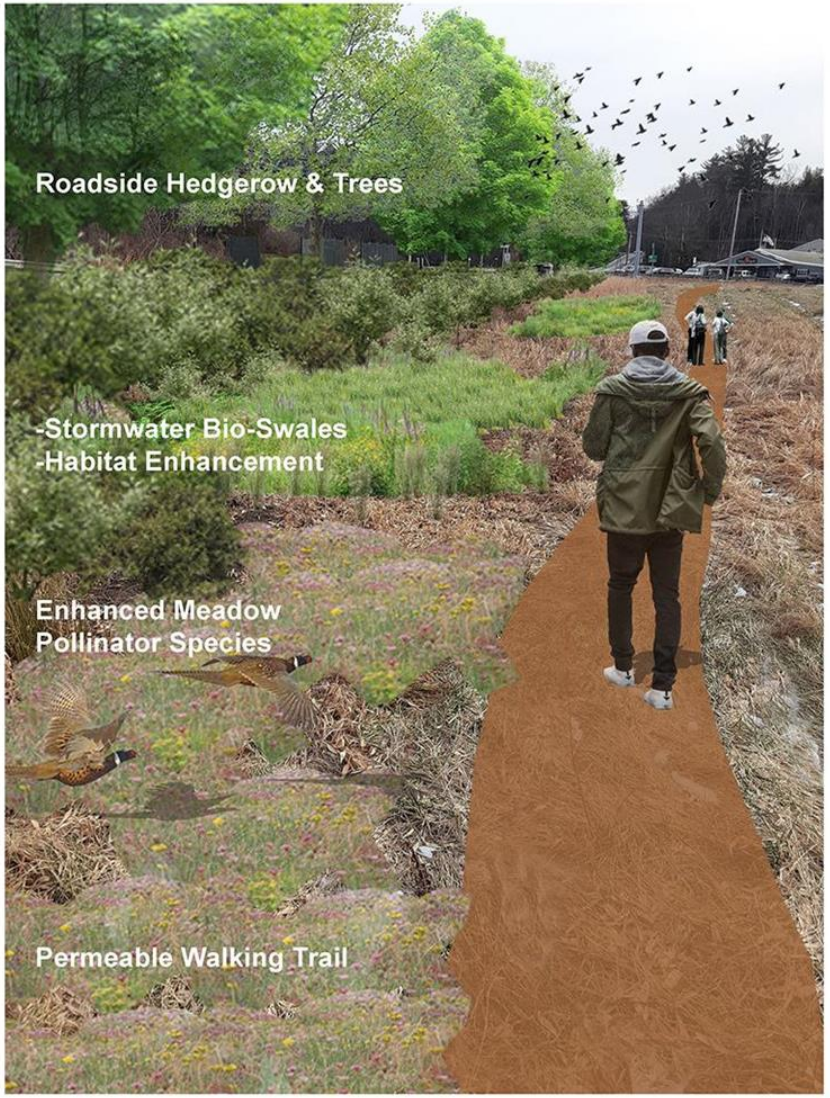
Step 4: Report
Nature-Based Solutions Location Maps

Town Center, Schools
Cemetery, Common

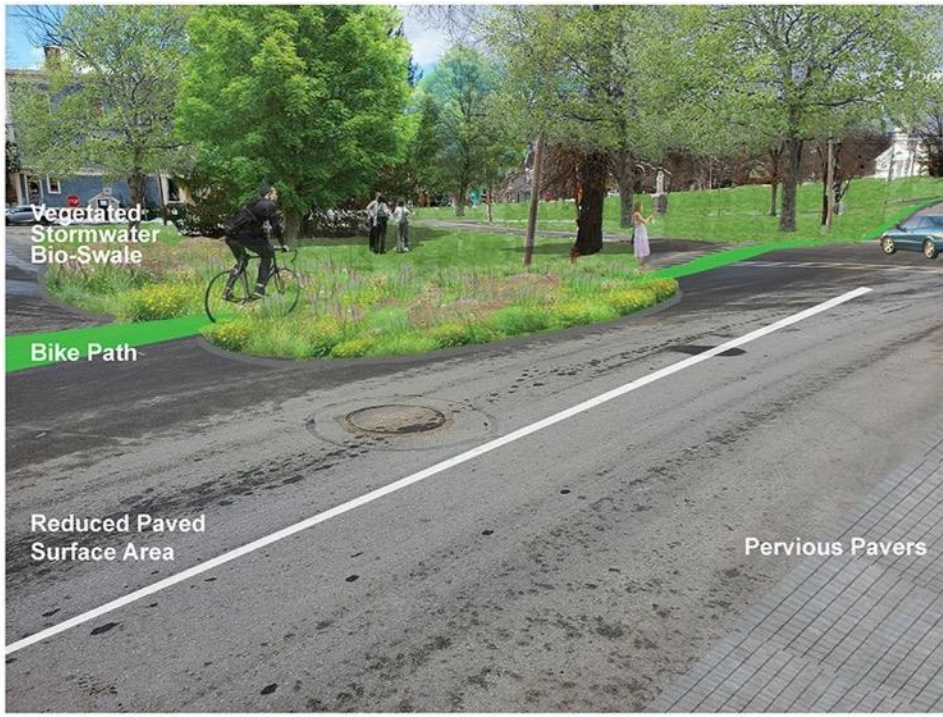
POTENTIAL PROJECTS:

1. Invasive species managment
2. Grassland meadow management restoration
3. Shrubland heath management restoration
4. Habitat enhancements
5. Species monitoring protocol
6. Upstream BMPs rain garden, bio-swale etc.
7. Shade-habitat / infiltration tree plantings
8. Pervious parking walking areas
9. Educational interpretation
10. Furnishings / gathering space
11. Paved trail
12. Pocket forest

Examples - Nature-Based Solutions: Bolton

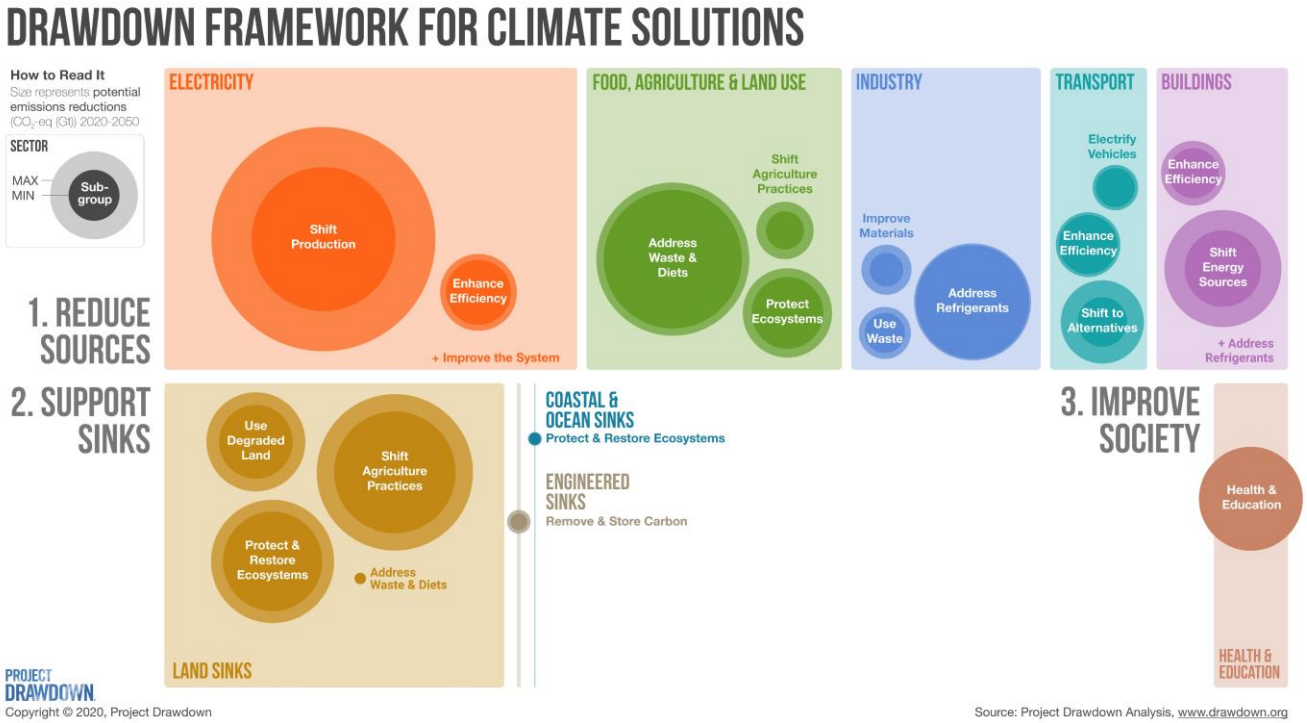


Examples - Nature-Based Solutions: Harvard



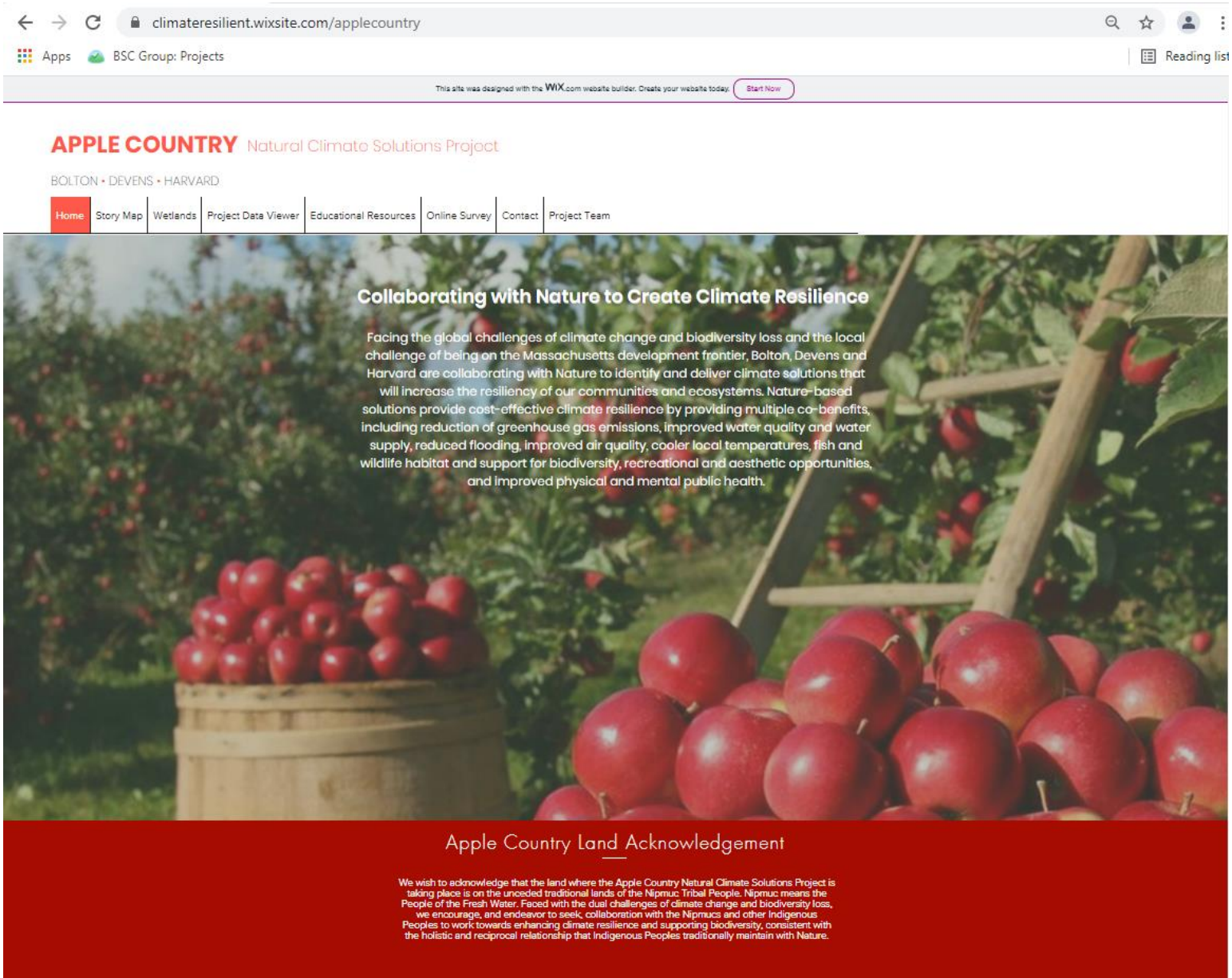
Examples - Nature-Based Solutions: Devens

Aligned With International Goals



Climate adaptation, resilience, and carbon mitigation actions and recommendations from this project are in line with global frameworks and international agreements that attempt to limit global warming, enhance biodiversity, and support sustainable communities.

Website & Data Viewer
www.climateresilient.wixsite.com/applecountry



Website & Data Viewer

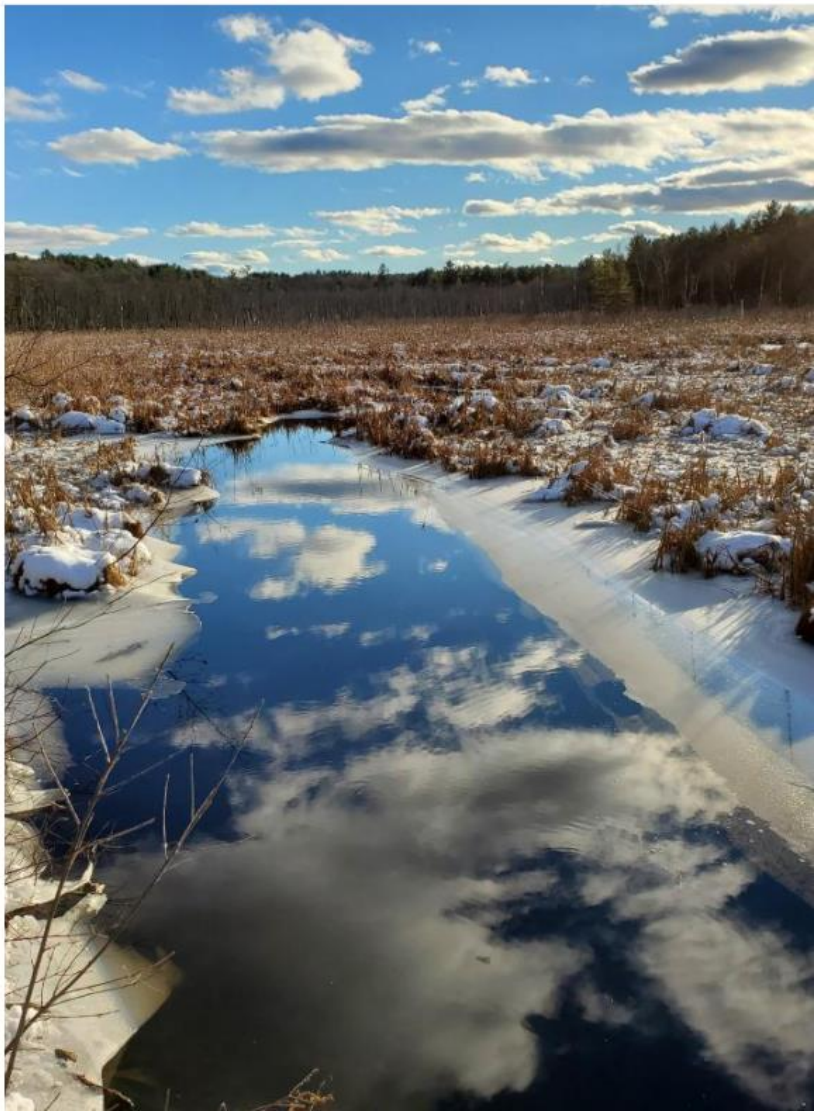
Virtual Tours: Wetlands

Apple Country Wetlands and Habitats Virtual Tour

Apple Country Wetlands and Habitats Virtual Tour

Bolton, Devens, Harvard: We invite you to explore with us: Visit the sites, learn new concepts, and grow stronger together.

By BSC Group | April 19, 2021



Website & Data Viewer

Virtual Tours: Wetlands

Impacts of Climate Change on Wetlands

AUDIO DESCRIPTION

VIRTUAL TOUR

https://climateresilient.wixsite.com/applecountry

The Root Wad and the Hibernacula

AUDIO DESCRIPTION

VIRTUAL TOUR

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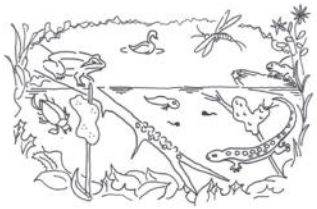


Vernal Pool Climate Vulnerability and Resilience

AUDIO DESCRIPTION

VIRTUAL TOUR

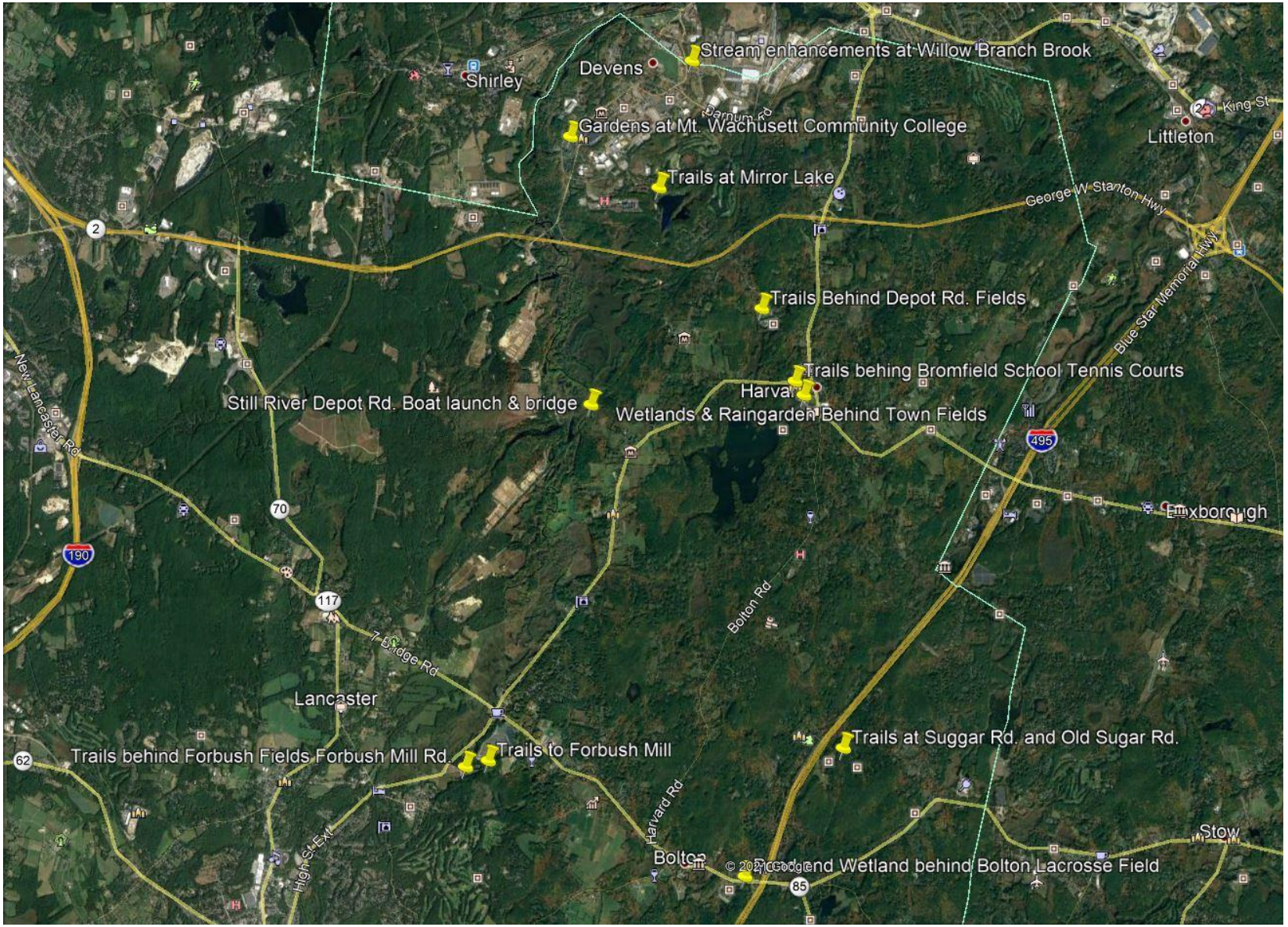
https://climateresilient.wixsite.com/applecountry

SELF-GUIDED TOUR: EASY AS 1-2-3-4!!

1. ACCESS TOUR MAP ON WEBSITE
2. LOOK FOR SIGNS WITH QR CODES
3. SCAN THE CODES
4. LISTEN & WATCH!

Website & Data Viewer

Virtual Tours: Self Guided Field Tour



Website & Data Viewer

Virtual Tours: Self Guided Field Tour

STORY MAP: EASY AS 1-2-3-4!

1. LOOK FOR SIGNS WITH QR CODES
2. SCAN THE CODES
3. LISTEN & or WATCH!, (or save for later)

& MAYBE

4. CONNECT TO LEARN MORE

The Root Wad and the Hibernacula

AUDIO DESCRIPTION

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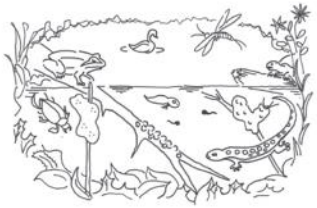

Vernal Pool Climate Vulnerability and Resilience

AUDIO DESCRIPTION

VIRTUAL TOUR

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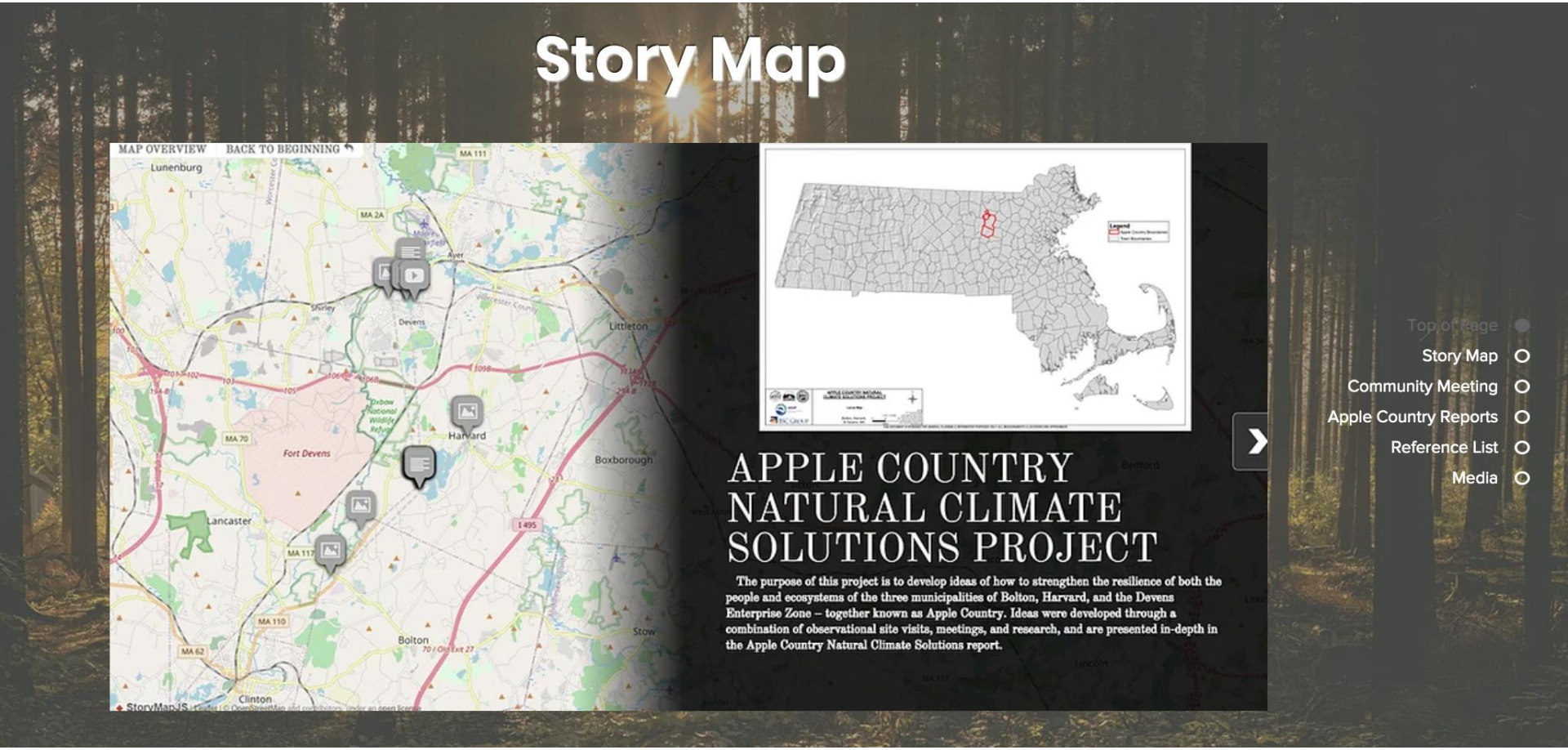
Website & Data Viewer

Virtual Tours: Project Story Map

https://climateresilient.wixsite.com/applecountry/project-story



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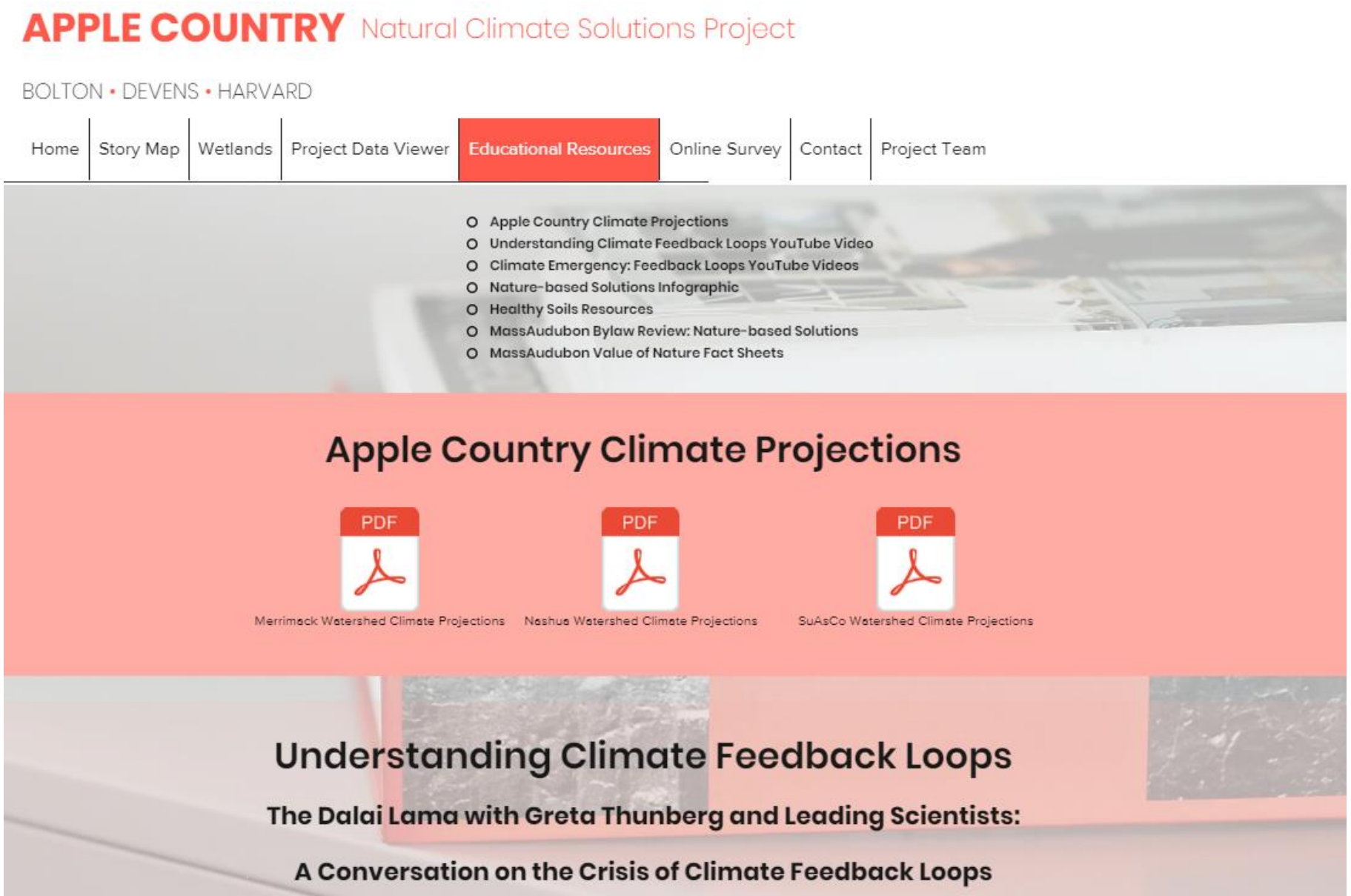

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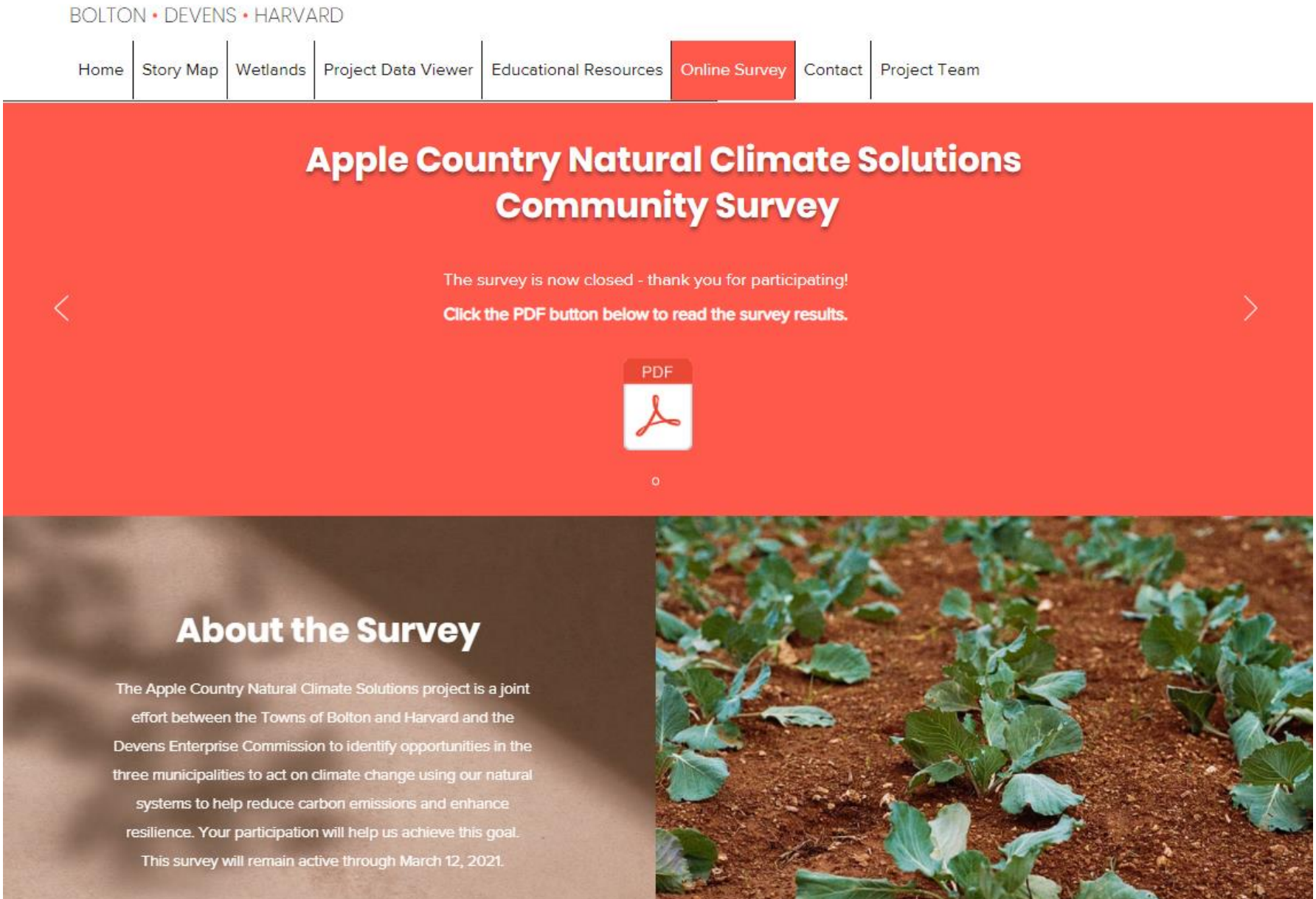

Questions?

Protect

Restore

Manage Better