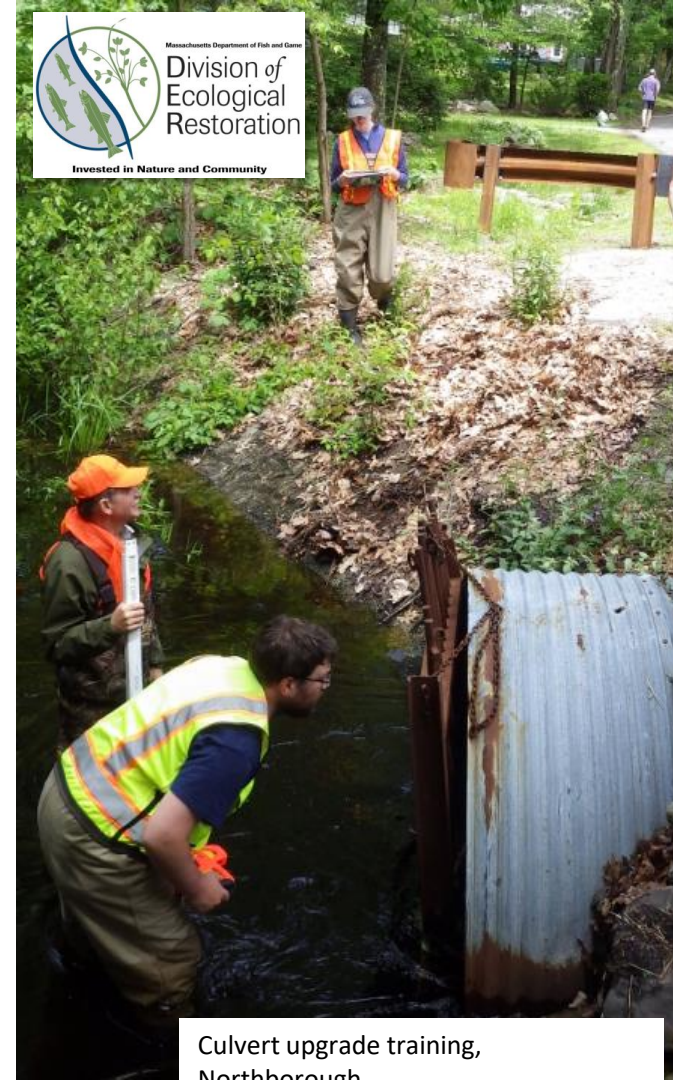
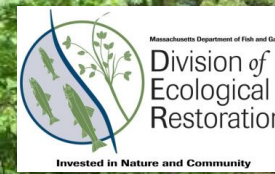


DER's Focus Areas

- Dam removal
- Culvert replacement
- Tidal wetland restoration
- Wetland restoration in retired cranberry bogs
- Streamflow restoration
- Water conservation
- Water quality protection

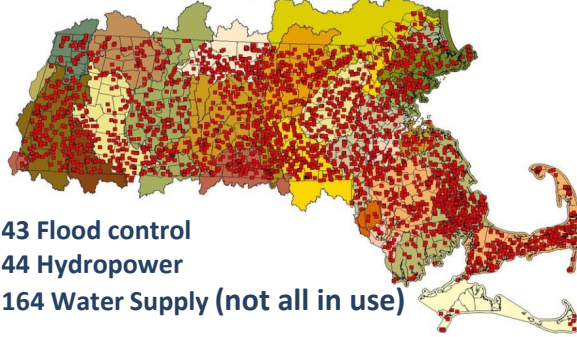
30 projects in planning; 5-7 completed each year



Culvert upgrade training,
Northborough

Aging Dams are a Problem in Massachusetts.

More than 3,000 dams in MA



- 43 Flood control
- 44 Hydropower
- 164 Water Supply (not all in use)

Most dams in MA have outlived their design lives and do not serve their original purpose. More frequent large storms are stressing this aging infrastructure and extended droughts can exacerbate some of their worst ecological impacts.



These dams

- May pose a risk to communities from failure during large storms.
- Block natural fish and wildlife movement.
- Increase water temperatures which can be lethal to some species.
- Impound sediment that is often contaminated.
- May be an attractive nuisance in their community.



Nick Wildman, Nick.Wildman@mass.gov

Dam Removal is Climate Smart!

Community Resiliency

- Eliminates threat of dam failure.
- Can reduce upstream flooding.
- Can result in increased floodplain storage for flood waters.
- Typically includes measures to bolster adjacent infrastructure.



The Ballou Dam in Becket, 2006

Ecological Resiliency

- Restores natural fish and wildlife passage for seasonal adaptation.
- Restores natural sediment supply to help build resilient downstream wetlands.
- Eliminates impoundment heating and low D.O.
- Can reduce methane production from the impoundment.
- Allows for CO2 uptake from new plants.



Yokum Brook in 2007, after dam removal.

Investment in dam removal also generates economic output and creates jobs!



Nick Wildman,
Nick.Wildman@mass.gov

Stream Continuity Program



Before



After

Culvert Replacements
Fish Friendly, Flood Resilient



Carrie Banks, Carrie.Banks@mass.gov
Brian Kelder, Brian.Kelder@mass.gov

Culvert Replacements



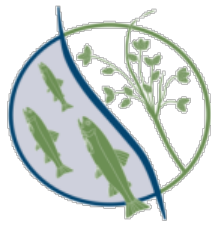
Traditional Culverts

- Blocks movement of fish and wildlife
- Disrupts stream processes
- Vulnerable to clogging with sediment and wood
- Downstream scour and erosion of structural components
- Often reduced hydraulic capacity
- Susceptible to failure and damages
- Higher maintenance and repair costs



Meets MA Stream Crossing Standards

- Reconnects access to critical habitat for fish and wildlife
- Allows natural stream channel adjustment and movement of sediment and wood
- Reduces lifetime maintenance costs
- Improved flood resiliency and reduces probability of flood-related damages
- Maintains road access for emergency, residential and community services
- Cost effective over lifespan of the structure



DEPARTMENT OF FISH AND GAME
Division of
Ecological
Restoration

Stream Continuity Program

Increase Town's ability to replace culverts meeting the Massachusetts Stream Crossing Standards.



- Road-Stream Crossing Assessments
- Technical Assistance to Towns
- Long Term Culvert Replacement Training Sites
- Grants, Tools & Resources

Carrie Banks, Carrie.Banks@mass.gov

Brian Kelder, Brian.Kelder@mass.gov

Tidal Restoration in Massachusetts.



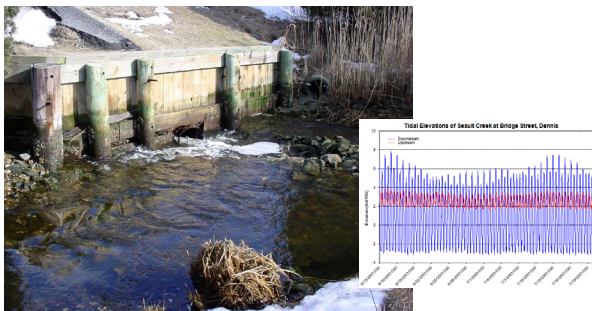
- Hundreds of tidal river, stream, and wetland crossings in Massachusetts represent tremendous potential for habitat restoration.
- Most opportunities go unrealized.
- In-kind replacement without assessment of restoration potential exacerbates damage to the environment and is an inefficient use of public resources.
- Restoring Tidal Marshes not only benefits the ecological services (habitat, air and water quality, flood mitigation, etc.) but also aids in protecting their resiliency in the face of Climate Change.



Tidal Wetland Restoration is Climate Smart!

Community Resiliency

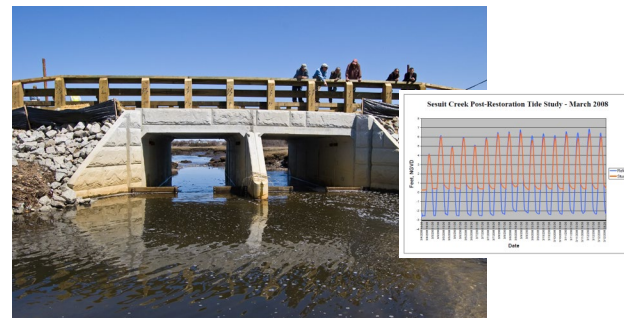
- Protect against the impacts of coastal flooding.
- Minimize impact of coastal storms by slowing or absorbing erosive wave and wind energy.
- Sequester nutrients and pollutants protecting coastal waters.
- Typically includes measures to improve outdated and failing infrastructure such as culverts and bridges.



Sesuit Creek Tidal Restriction, 2005

Ecological Resiliency

- Restores natural fish and wildlife habitat.
- Restores natural tidal flow sustaining resilient marsh health.
- Facilitates natural marsh migration and protects marsh capital in light of Sea Level Rise
- Protects against unnatural conversion of habitat and spread of invasive species.
- Act as sinks, sequestering significant stores of Carbon.



...after tidal restoration in 2008.

Cranberry Bog Program



Before



After

***Wetland and stream restoration on
retired cranberry farmland to
benefit local communities***



COMMONWEALTH OF MASSACHUSETTS
Division of
Ecological
Restoration

Wetland Restoration on Retired Cranberry Farmland



- Legacy farming impacts degrade wetland ecosystems
- Common stressors are **fill** (several feet of sand), **ditching**, and **water controls**
- Leads to transition toward upland communities if not addressed
- Leads to **loss of ecosystem services** associated with healthy wetlands



- Restoration actions **repair site hydrology** by removing fill, plugging ditches, and removing small dams
- Restoration actions are a short-term disturbance that leads to **system rejuvenation**
- Goal = **Self-sustaining and dynamic systems** that can adjust over time

Cranberry Bog Program

Working with landowners and partners to restore wetlands for the benefit of local communities



- Development of restoration visions with landowners
- Assessment, design, permitting, fundraising services
- Science based learning agenda to assess outcomes
- Grants, Tools & Resources

Who we are

- 15 staff. 13 in Boston; 2 at Westfield State University
- Project managers have 10+ years of experience
- Senior staff have 15-20 years of relevant experience
- Expertise in hydrology, wetland ecology, engineering, fish biology, natural resource economics, water quality



Why should I join CAKE?

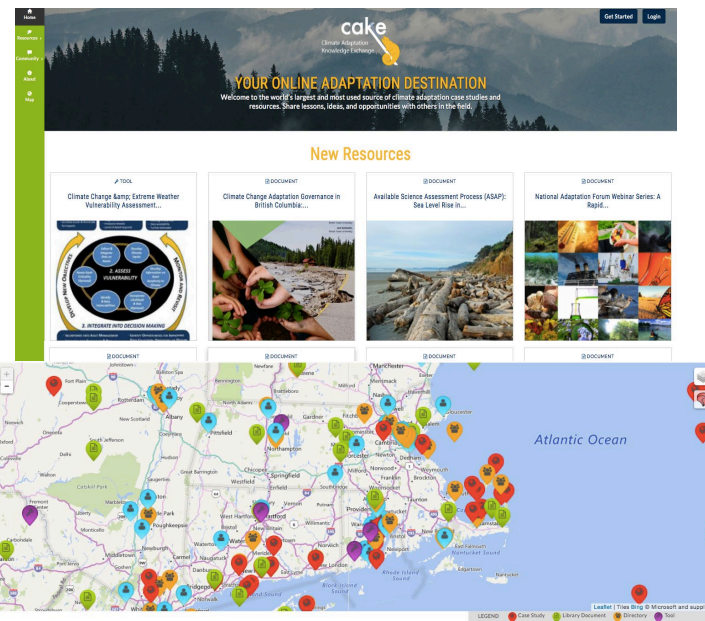
- **Publish** and **promote** your work on climate adaptation
- **Find** case studies, people, and projects on our georeferenced map
- Get **advice** from adaptation experts
- **Browse** a **Directory** of practitioners and organizations, and a **Community** section with the latest events and opportunities from around the field

*"The **case studies** provide **real-world examples** of what works and what doesn't."*

*"I have submitted **a funding proposal** to a funder or **opportunity** that I found on CAKE."*

*"CAKE has helped me to **identify career opportunities** and **connect with others** in the field."*

*"I am able to **connect with practitioners** in my region."*



443 Case Studies



1,560 Documents



189 Tools

....and more every day!

Assessing the State of Climate Adaptation in the Marine & Coastal United States



Project Activities

- Survey/interview practitioners and assess adaptation efforts
- Develop case studies
- Synthesize trends, opportunities, and challenges
- Connect people to case studies, tools, plans, and other resources to share lessons learned and build the adaptation field



To participate, contact
Rachel M. Gregg
Rachel@EcoAdapt.org

Climate change can be controversial to some, however with sea level rise and coastal land loss being indisputable, adaptation is something we all should be engaged in. Information is knowledge, knowledge is power. [The State of Adaptation] effort is a call to action to overcome the stubbornness and ennui towards climate change.

Gregory J. DuCote, Louisiana Department of Natural Resources, Office of Coastal Management

Advancing Climate Adaptation in the Public Health Sector

Project Goals

- Assess the state of adaptation to identify needs, challenges, and opportunities for climate adaptation action in public health
- Document activities – planned and underway – to prepare for, respond to, and recover from climate-related health challenges
- Synthesize findings into case studies and a summary report

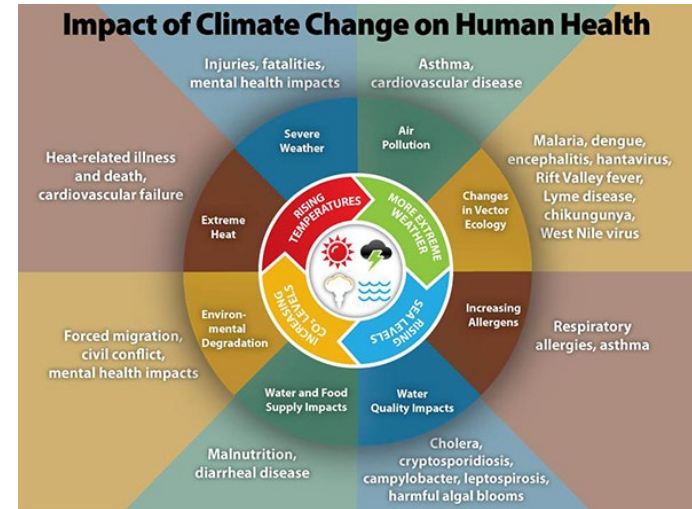
Do you work in public health?

Are you interested in how climate change is affecting your efforts?

Are you planning to or actively incorporating climate change into your work?

Submit a project!

bit.ly/AdaptationProject



Contact

Rachel M. Gregg
Rachel@EcoAdapt.org

Climate Change Adaptation for Contaminated Site Assessment and Rehabilitation



EcoAdapt™



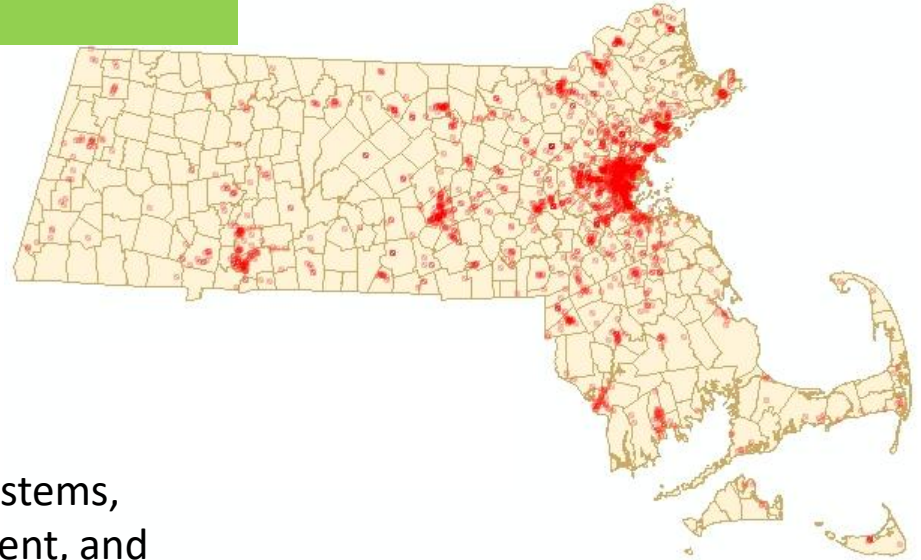
MassDEP



SUSTAINABLE REMEDIATION FORUM

Project Activities

- Design a screening process to assess climate change vulnerability on contaminated sites in MA
- Develop adaptation strategies and best practices for site management
- Include consideration of remediation systems, engineered barriers, contaminants present, and surrounding natural and human systems
- Select 2-3 priority sites to demonstrate vulnerability assessment and adaptation planning



Contact

Eric Mielbrecht

Eric@EcoAdapt.org



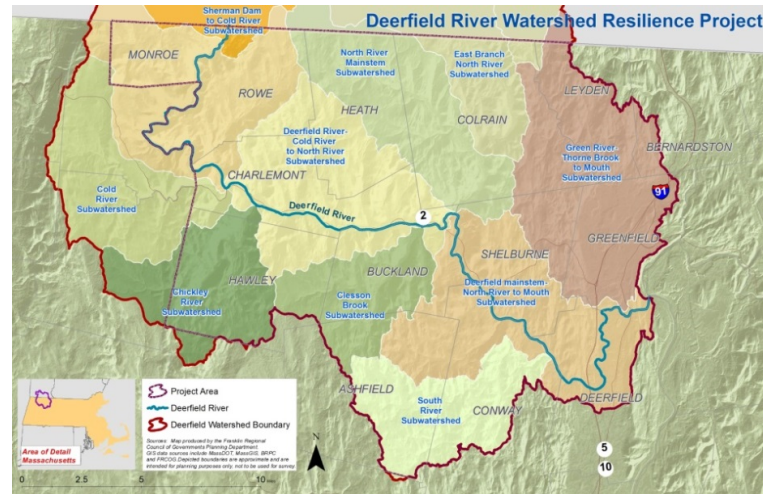
Franklin Regional Council of Governments

Contact: Kimberly Noake MacPhee, P.G., CFM
Land Use & Natural Resources Program Manager
kmacphee@frcog.org

413.774.3167 x130

Project:

Watershed-Based Plan to Maintain the Health and Improve the Resiliency of the Deerfield River Watershed.



- Integrates the 9 elements of a s.319 Watershed-Based Plan, the tenets of EPA's Healthy Watersheds Initiative, and Climate Change Adaptation planning
- Focus on protecting the watershed's Green Infrastructure – a cost effective adaptation strategy
- Includes projects and tools that address multiple problems and provide multiple benefits:
 - Minimize the threat of flooding and fluvial erosion
 - Protect water quality and habitat and working lands
 - Improve air quality, manage stormwater and cool more urbanized environments
- Recommendations that apply to various scales – Deerfield Watershed, its HUC 12 subwatersheds and the 14 watershed towns.

Example of HUC 12 Subwatershed Plan

**Table 22: Summary Findings:
Clesson Brook Subwatershed**

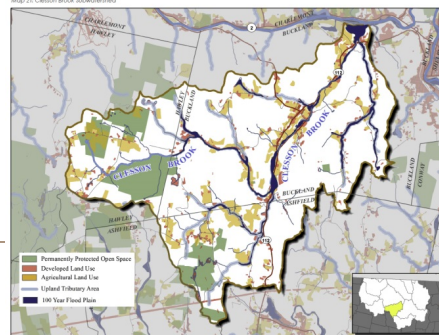
● Overall Watershed Health:	Good - overall, very healthy
● Water Quality Vulnerability:	Highly vulnerable to impacts
● Water Quality Restoration Potential:	Average
● Flood Risk Vulnerability:	Average
● Upland Tributary Protection:	Very little protected upland tributary areas
● Pollutant Loading Analysis:	Relatively low pollutant loads; moderate to high sediment yields
● 2017 Geomorphic Assessment:	Significant erosion and sediment loading; implementation project identified
● Green Infrastructure Analysis:	High level of ecological services; low level of protection
● Land Use Regulatory Review:	Could better address development in floodplains & river corridors; could encourage LID

● Great/good - Few or no issues
 ● Fair - some issues need improvement
 ● Poor - critical issues need resolution

Table 23: Summary Recommendations: The Deerfield River Watershed Action Plan, beginning on page 63, contains recommendations and action items applicable to the entire watershed. In addition to the Action Plan, high priority recommendations specific to the Clesson Brook subwatershed are described on the previous page and summarized here:

- **Action Item #1:** Conduct fluvial geomorphic including upland tributary assessments to better refine the location, severity, and likelihood of erosion hazards and the potential impacts restoration/mitigation projects might have on channel stability and aquatic habitat, not only at the proposed site but also to downstream and upstream locations.
- **Action Item #2:** Conduct a river corridor mapping and management plan project to delineate the location of the future river channel, identify locations most susceptible to future flooding and fluvial erosion, and describe river corridor management strategies.
- **Action Item #3:** Adopt river corridor protection bylaws and/or floodplain protections that would limit development within areas of river corridors susceptible to erosion and flooding.
- **Action Item #4:** Review MassDot culvert/crossings database; prioritize structures for upgrades.
- **Action Item #5:** Use MAPPR to prioritize parcels for protection.
- **Action Item #8:** Work with farmers to implement agricultural BMPs to protect water quality.
- **Action Item #9:** Work with landowners to protect upland tributary areas and the areas identified as BioMap2 Core Habitats from future development through land acquisition, conservation easements, and other mechanisms.
- **Action Item #10:** Provide incentives for forest owners, through carbon trusts or other mechanisms, to protect their land for carbon storage.
- **Action Item #11:** Consider amending or adopting Open Space Residential / Natural Resource Protection zoning to balance new development in rural areas with land protection (Buckland, Ashfield, and Hawley).
- **Action Item #12:** Encourage the use of LID site planning and stormwater techniques in new development and redevelopment (Buckland, Ashfield, and Hawley).
- **Action Item #13:** Conduct a Rural Roads Assessment to identify road drainage and stormwater management problems and to determine priority projects and BMPs. Include training for DPW.

Map 12: Clesson Brook Subwatershed

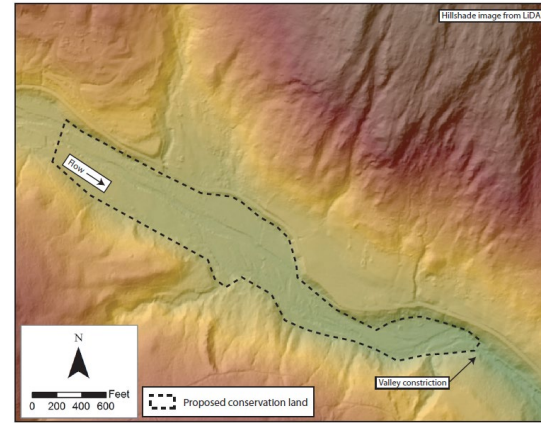


Example of Flood Resilience & Water Quality Enhancement Projects

Conservation of Attenuation Assets using River Corridor Easement and Floodplain Encroachment Removal.
Potential sites identified in 3 HUC 12 subwatersheds.

Project Benefits:

- ✓ Sediment storage
- ✓ Removal of floodplain encroachments (berms)
- ✓ Riparian corridor improvements
- ✓ Floodplain reconnection and flood water attenuation
- ✓ Habitat and water quality enhancements
- ✓ Protection of regionally significant infrastructure



Conservation of attenuation assets and encroachment removal - West Branch North River. 2014 aerial photo showing flood-damaged riparian lands and extent of agricultural use prior to Tropical Storm Irene.

Fuss & O'Neill

Phil Moreschi, PE, CFM

Diane Mas, PhD

Climate Change Water Resource Vulnerability & Adaptation Strategy Assessment – Carver, MA

- EEA Municipal Vulnerability Preparedness (MVP) Program Action Grant
- Community Resilience Building (CRB) process identified water availability for agricultural use (cranberry industry) and firefighting as high priority
- Climate change vulnerability assessment and management plan
- Drought vulnerability of natural impoundments, watercourses, agricultural ponds and canals, and fire suppression sources
- Prioritized site-specific and town-wide recommendations to support future implementation projects
- Water infrastructure and natural systems solutions



Fuss & O'Neill

Erik Mas, PE

Julianne Busa, PhD



Integrated Water Infrastructure Vulnerability Assessment and Climate Resiliency Plan - Charlton and Spencer, MA

- EEA Municipal Vulnerability Preparedness (MVP) Program Action Grant
- Community Resilience Building (CRB) process identified risks to water infrastructure from inland flooding and climate change
- Regional climate change vulnerability assessment and management plan
- Assessment of culverts and bridges, dams, stormwater, water, and wastewater infrastructure
- Building flood resiliency through infrastructure and natural systems solutions
- Conceptual designs to support future implementation projects



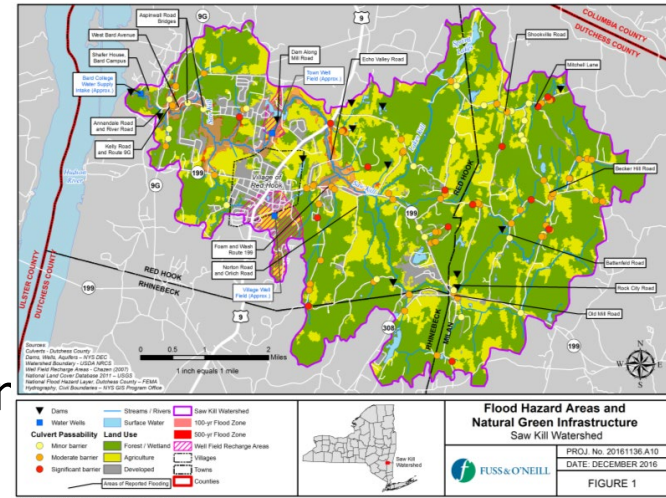
Fuss & O'Neill

Phil Moreschi, PE, CFM

Erik Mas, PE

Saw Kill Watershed and Flood Mitigation Assessment Red Hook, NY

- NEIWPCC and NYSDEC Hudson River Estuary Program Funding
- Saw Kill watershed susceptible to historic and ongoing flood damage
- Watershed-based approach to enhancing flood resiliency using infrastructure and natural systems solutions
- GIS analysis, geomorphic assessment, rapid windshield surveys, and hydraulic modeling to evaluate flood risks and potential solutions
- Culvert upgrades, bridge replacement, dam removal, riparian restoration, floodplain reconnection, and open space conservation
- Conceptual designs to support future implementation projects



Geosyntec Consultants

David Roman, PE, CFM

TIDEGateway

Web-based tide gate planning tool:

- State-wide tide gate inventory and geodatabase
- Interactive assessment tool to aid management of tide gates
- Standardized field data collection protocols
- Recommendations for future actions



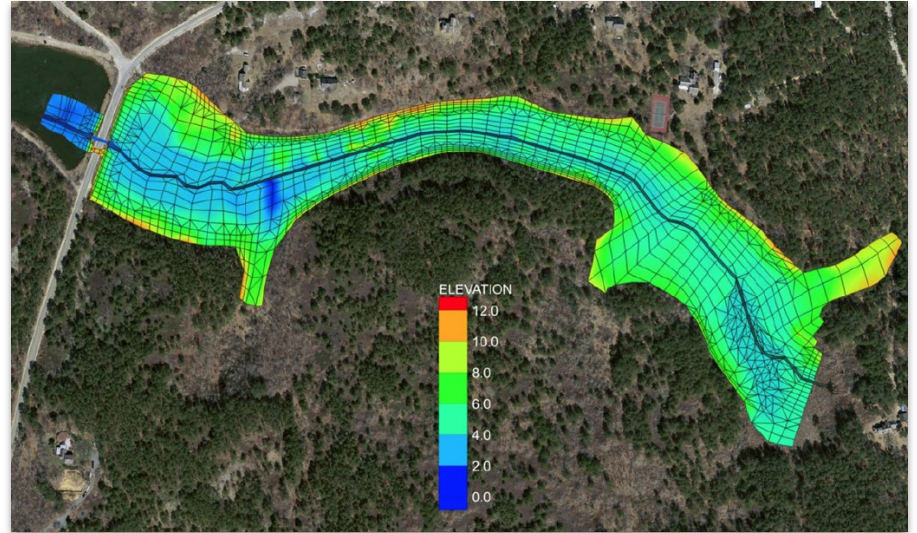
Geosyntec developed TIDEGateway as a web-based tool to help coastal resource managers assess ecological restoration potential and plan for climate change adaptation.

Geosyntec Consultants

Brandon Raymond, PE

Salt Marsh Restoration (Multiple MA Sites)

- Improving salt marsh ability to protect against storm surge and adapt to climate change
- Hydraulic / hydrologic modeling
- Water level and salinity monitoring
- Evaluating potential sea level rise implications
- Ecological and environmental permitting support



Geosyntec conducted ecological investigations, tidal monitoring, and modeling to determine optimal culvert sizing for restoration of tidal flows for Eagle Neck Creek in Truro.

- Performed flood modeling of various conditions, including Superstorm Sandy, to identify potential localized flood risk
- Conducted site-specific resiliency audits to identify flood vulnerability and potential solutions
- Developed fact sheets and designed designed floodproofing measures, including flood barriers



Geosyntec performed flood modeling and site-specific resiliency audits at 30 small businesses in New York City, then designed flood proofing measures at 3 pilot sites to increase future resiliency..

MA Office of Coastal Zone Management

Contact: patricia.bowie@mass.gov

Coastal Resilience Grant Program

www.mass.gov/czm/stormsmart

- Advancing local efforts to reduce coastal storm & climate risks through:
 - communication & public outreach
 - vulnerability assessments
 - adaptation planning
 - engineering redesigns & retrofits
 - natural storm damage protection approaches
- Over \$14 M in grants (+ \$7 M in local match) invested in 105 coastal resilience projects since 2014



Gray's Beach Restoration, Kingston, MA (during pl

Mapping and Prioritizing Parcels for Resilience(MAPPR) Tool

This user-friendly online tool helps **prioritize land protection** parcels in your community – for **climate resilience** and other factors

massaudubon.org/mappr

1

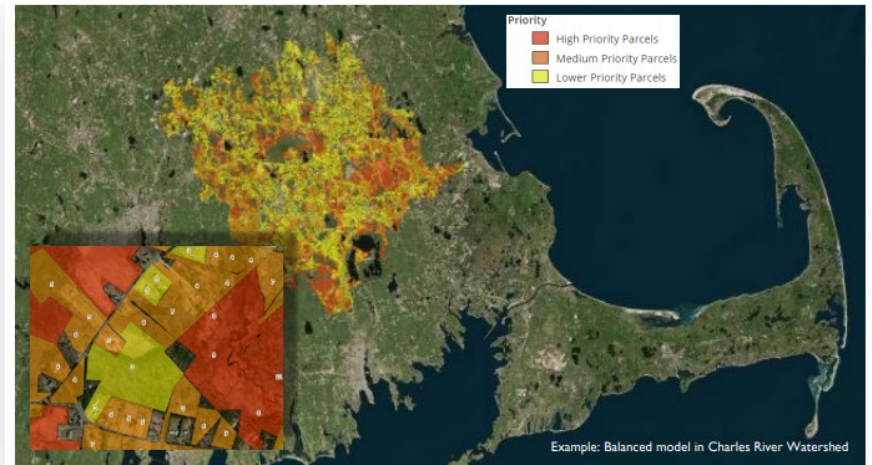
Select a study area

2

Choose model/values

3

Run & Review Results



5 Fact Sheets on Low Impact Development (LID)

Want to learn about LID? Start here.

These fact sheets can help you navigate the many aspects of LID – from reducing flooding through bioswales to updating your open space.

Check out:

- cost breakdowns
- success stories
- answers to common questions





Resilient Taunton Watershed Network (RTWN)

Collaboration of 19 organizations focused on **improving ecological, economic, social, and environmental resilience** in the Taunton watershed

Check out our free resources:

- Natural green infrastructure maps
- Nature-based solution case studies
- Climate communication materials

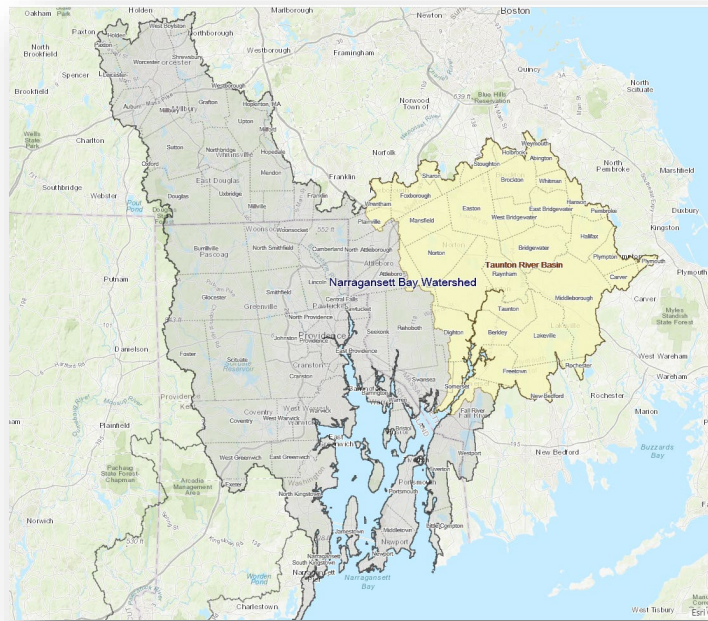
Learn more: srpedd.org/rtwn



Sara Burns (TNC), Galen Laurence (TNC), Eivy Monroy (NBEP)

Habitat Restoration and Protection Mapping and Tracking Tool

- Geographic Scope: Narragansett Bay Watershed
- Documents projects that have been implemented, are ongoing, are identified as priorities, and were planned but not completed.
 - Cultivates and relies on Bi-State and Multilevel Partnerships. Partners will contribute data and resources, utilize the tool to support their work in the watershed, and more easily identify funding opportunities.
- Will be used to prioritize and inform restoration and protection projects to aid in overall resilience and adaptation in the watershed.



The Nature Conservancy

Eric Roberts, Coastal Resilience Specialist

Advancing Living Shoreline Science and Policy

- Constructing living shoreline pilot projects
- Creating a regional, standardized monitoring protocol for living shoreline projects
- Generating data to assess project performance and inform future siting, design, and maintenance activities
- Producing technical and policy guidance



New England Forestry Foundation

Lisa Hayden

Climate Adaptation for Woodland
Owners



Tools Available:

- Climate- smart forestry communications to private landowners
- Parcel- level forest adaptation site visits by trained professionals



To access resources developed for the
MassConn Woods RCP, visit:

<http://www.forestadaptation.org/massconn>

Keeping Your Woods Healthy through the Years Ahead

How do we incorporate
climate change into
stewardship?

*...Help foresters talk
with landowners...*



Punchard Consulting



Darrin Punchard, AICP, CFM

Community Resiliency Planning

- Hazard Mitigation + Climate Adaptation
 - Risk Assessment & Communication
 - Coastal & Floodplain Management
 - Project Funding & Implementation
 - Disaster Recovery & Redevelopment
- Integrated Urban Resiliency Planning

www.punchardconsulting.com

