Stream Continuity Workshop

October 29, 2015

Mass Audubon's Oak Knoll Wildlife Sanctuary

Stefanie Covino, Mass Audubon
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Welcome!

- **Acknowledgements** – Heidi Ricci
- **Introduction** – Stefanie Covino
- **Ecological Assessment Report** – Priscilla Chapman
- **Planning & Funding** – Bill Napolitano
- **Regulations** – Lealdon Langley
- **Economics & Resources** – Tim Chorey
- **RTWN & Wrap Up** – Trish Garrigan
- **Q & A**

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Culverts - The Good and the Bad

Allow streams and rivers to flow, despite our infrastructure

Or not.

Flow depth & pressure
Outlet drop
Openness

vs.

Stream Crossing Standards

A Well Designed Crossing

Large size suitable for handling high flows

Open-arch design preserves natural stream channel

Openness ratio greater than 0.5m, suitable for most settings

Crossing span helps maintain dry passage for wildlife

Water depth and velocity are comparable to conditions upstream and downstream

Natural substrates create good conditions for stream-dwelling animals

Massachusetts Stream Crossings Handbook

Undersized and Failing Culverts Can Affect…

- Water quality
- Flooding and infrastructure
- Local resiliency
- Human health – mosquito habitat
- Wildlife habitat – loss and degradation
- Wildlife population – fragmentation, isolation, loss (roadkill)

Both people & wildlife benefit when streams flow freely

North Atlantic Aquatic Connectivity Collaborative

(Formerly Stream Continuity Project)

"The NAACC is a participatory network of practitioners united in their efforts to enhance aquatic connectivity."

- Started at UMass Amherst
- Partnership with TNC, American Rivers, Riverways/DER
- Grown to 13 states Virginia – Maine
- Numerous additional public & private partners

Local Efforts

In the Taunton watershed, there's been a coordinated effort to inventory >500 crossings

- The Nature Conservancy
- Save the Bay
- Mass Audubon
- Southeastern Regional Planning & Economic Development District (SRPEDD)
- Taunton River Watershed Alliance (TRWA)

Aquatic Connectivity

A resilient system

How?

Identifying and prioritizing crossings that create the worst barriers to passage and replacing them with structures that maintain natural flow.

Our Goals: For Taunton & Beyond

- Restore
  - stream continuity
  - healthy aquatic ecosystems
  - capacity of ecosystem services, including flood protection
- Reduce
  - infrastructure damage
  - health and safety concerns
- Meet regulations cost effectively

Not just in Taunton, but throughout the Narragansett Bay Watershed

Stream Continuity in the Taunton River Watershed

Priscilla Chapman, Taunton River Watershed Alliance (TRWA)

Protecting
Aquatic Passage
from headwaters
to Mount Hope Bay

Mill Brook, Bell Rock Road, Fall RIver

Wild and Scenic Taunton River

40 miles of free-flowing water

The Taunton River Watershed

Portions of 43 cities or towns; 562 square miles;
hundreds of miles of major tributaries and small streams

Throughout the watershed, **dams** interrupt free-flow of water on major tributaries and smaller streams. On major tributaries, dams are located on the Three Mile, Forge, Satucket, Nemasket and Assonet Rivers. On the Mill River, two dam removal projects have already been completed and a third is in progress.

Cotton Gin Mill Dam on Satucket River

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Crossings of rivers and stream by **roads, highways, trails, rail lines** also impact stream continuity and aquatic passage.

What is stream continuity and why is it important?

Stream continuity is the uninterrupted connection of a river network where the natural physical characteristics of the stream have not been significantly altered and few or no barriers exist that would hinder or block movement up and downstream through the system.

Natural stream systems include: water, stream channel, substrate and banks.

Under natural conditions in a stream or river, water, organisms and organic material move freely.

The movement is affected by seasonal cycles of flooding and low flow. Over time, natural changes to a stream system occur, including water depth, flow velocity, stream shape, temperature, chemistry and shifting habitats and food sources. These conditions allow processes that support aquatic life to function.

Maintaining the health and diversity of aquatic life requires keeping these systems intact.

The need for travel lanes: many aquatic species must keep moving to survive

- Breeding season – need to find mates
- Need to find spawning and nursery habitat, e.g., floodplains and headwaters
- Dry season – need to find wet areas

- Search for food
- Find cover from predators –banks, vegetation
- Find emergency shelter and refuge when conditions change

(natural or human-caused events}

Overall, small streams in a river system provide more habitat than large river segments downstream.

Some stream crossings preserve the natural condition of the stream or river, or cause minimal alteration.

Spring Street, East Bridgewater

Forest Street, West Bridgewater

Washington Street, Easton

Others don't. Undersized culverts constrict the natural flow of the stream, causing water backup.

Maple Street, Mansfield

Mountain Street, Mansfield

East Foxboro Street, Sharon

Blocked culverts can lead to severe flooding following intense rainstorms. Culverts that are elevated above normal stream heights also cause water backup.

Sea level rise and more intense storms
require free-flowing river systems as well as protection of wetlands and floodplains to reduce flooding of roads and property.

Scenes from April 2010 Rainstorms

Water impoundment also causes algae bloom, lowered dissolved oxygen levels, and other pollution problems. These areas are also prime breeding ground for mosquitoes.

Maple Street, Mansfield

Drops in elevation at the inlet or outlet of a culvert create barriers for passage of small fish and other organisms, such as turtles.

Outlet at Smith Street, Attleboro; Inlet at Maple Street, Mansfield, and Inlet at North Walker Street, Taunton

Crossings with a natural substrate such as gravel, pebbles, woody debris vegetation and muck assist many organisms like salamanders and turtles to travel upstream.

While bridges and open-bottom culverts may retain the natural substrate, concrete or metal round culverts do not. Organisms may not be able to cross on concrete and metal bottoms.

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Stream Continuity Project

- created through a collaboration of the University of Massachusetts at Amherst, state environmental agencies and environmental groups, including The Nature Conservancy and Mass Audubon;

- included development of common protocols and training for assessing road crossings and rail crossings of streams, and a regional database of field data;

- goal of the Project: to use the information to identify high priority bridges and culverts for upgrade and replacement.

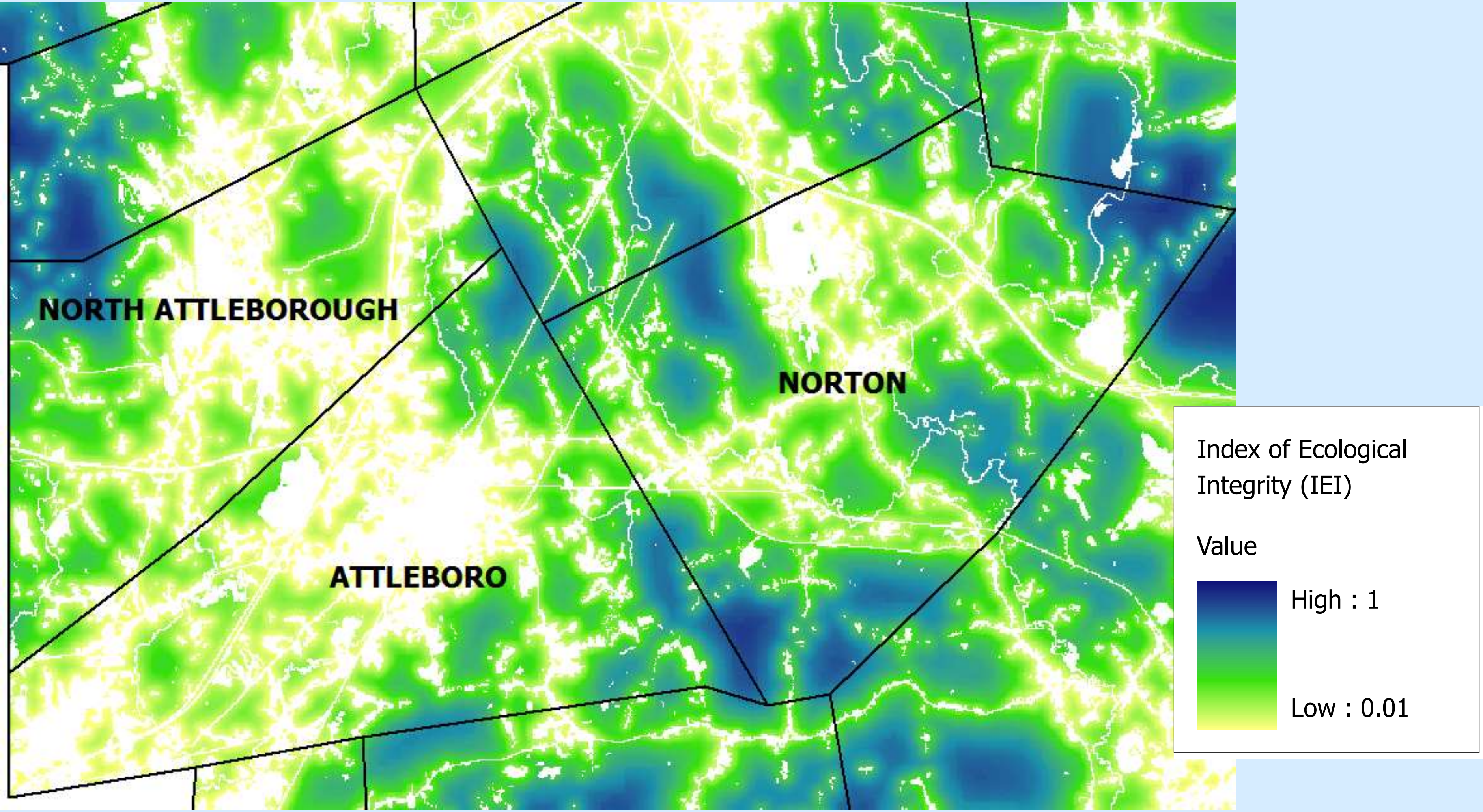
Sites to be surveyed were identified by using two other tools:

Conservation Assessment and Prioritization System (CAPS)

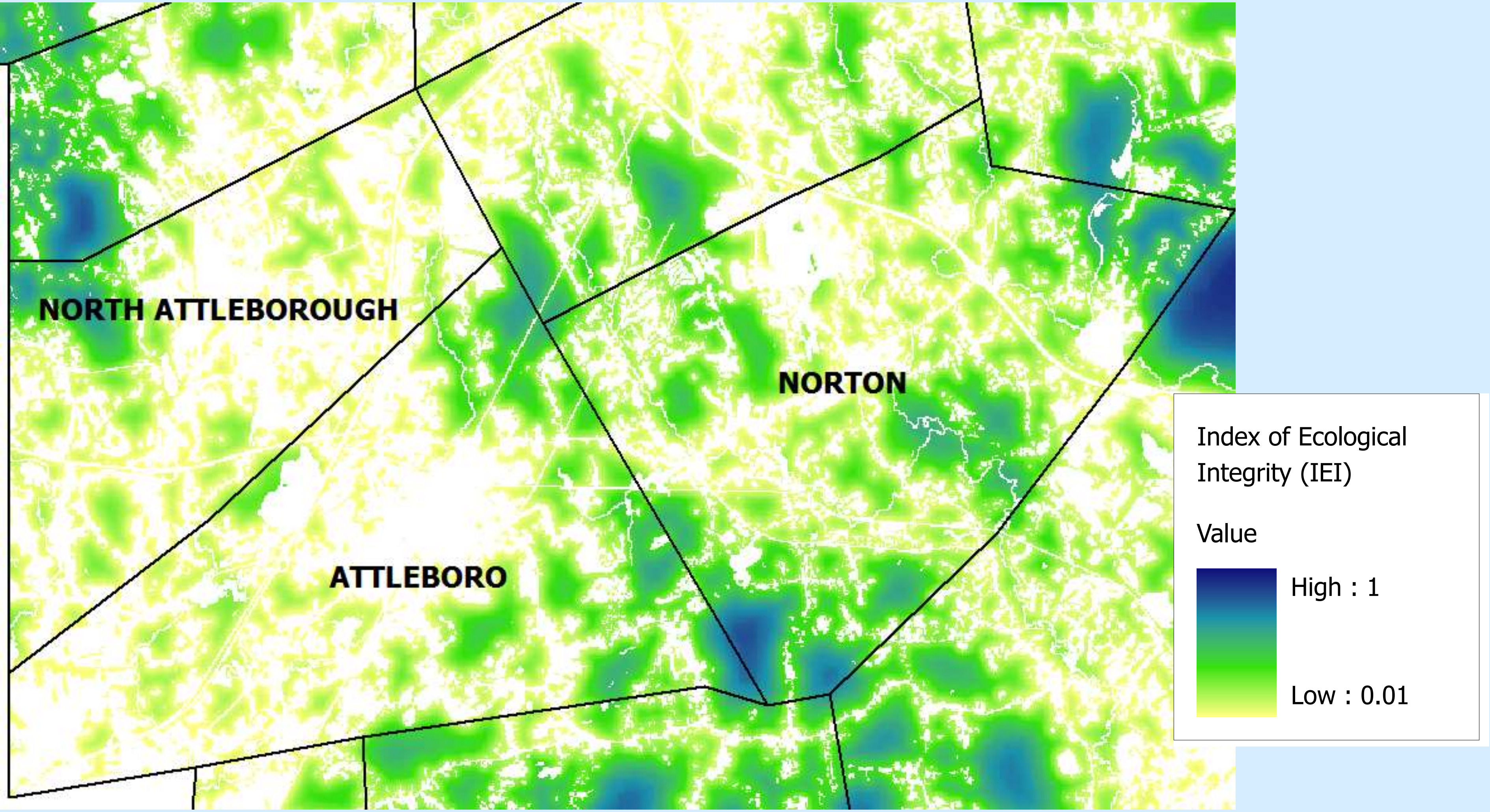
developed by researchers at the Department of Natural Resources Conservation at the University of Massachusetts in partnership with Mass Audubon

- CAPS identifies intact areas of high ecological integrity by evaluating developed and undeveloped elements of the Massachusetts landscape, statewide.
- It presumes that by preserving intact areas of high ecological integrity we can conserve most species and ecological processes
- Factors evaluated include edge effects, road traffic in the vicinity, nutrient loading to aquatic ecosystems or the effects of human development and others
- Portrays past and present ecological health for an area -- Index of Ecological Integrity (IEI).

Ecological Value in 1971



Ecological Value in 2005

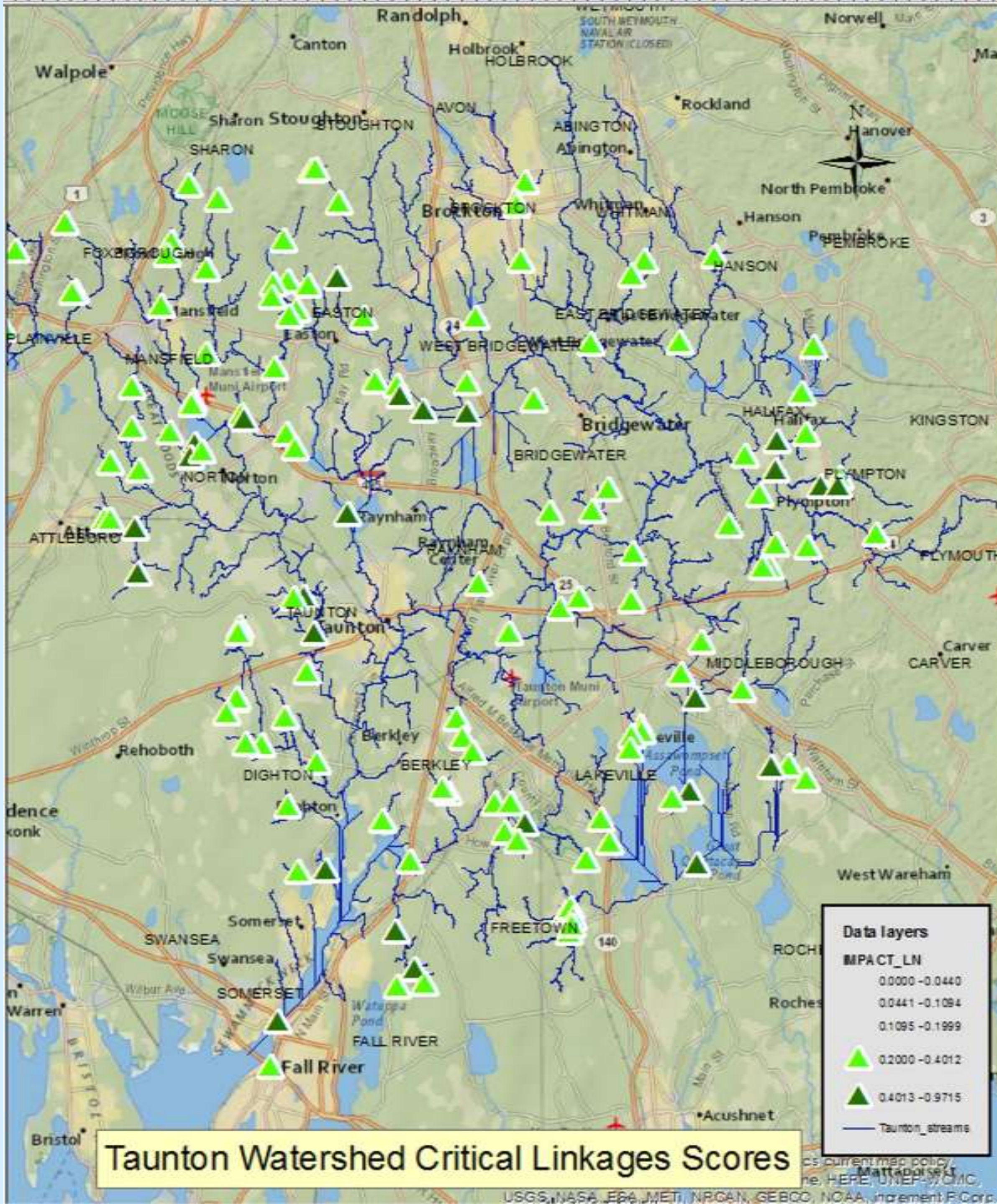


Critical Linkages Project

- Assessed connectivity of over 23,000 stream crossings in Massachusetts through aerial photography.
- Computer model predicted the condition and passability of crossings.
- Aquatic Score predicted degree to which crossing creates a barrier to passage for aquatic organisms.
- Using IEI score from CAPS and the Aquatic Score, the project calculated an "Impact" score for each identified crossing.

  Impact Score estimates **ecological restoration potential** –
  the amount of improvement in the ecological health of a water body
  if a crossing structure were removed or replaced.
- Impact scores were ranked in 5 Tiers, with Tier 1 indicating highest potential for ecological restoration.
- Over 1200 crossing sites were identified in Taunton River Watershed; 24 received Tier 1 Impact Scores, and 119 received Tier 2 Impact Scores.

Taunton Watershed Critical Linkages Scores



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Stream Continuity Project:

Survey teams filled out a “ Field Data Form” for each stream crossing that was inventoried, photographed crossings and entered data in UMass Stream Continuity Database.

Database generated an Aquatic Score for each site using 12 variables from the field assessment. This score ranges from 0 to 1.0. 1.0 indicates that the crossing allows full passage. 0 indicates a total barrier to passage.

Based on Aquatic Score, crossings were determined to create **severe, significant, moderate, minor or insignificant** barriers to passage of fish and wildlife

Stream Continuity Project: Survey teams filled out a “ Field Data Form” for each stream crossing that was inventoried.

5/12/2012

Data entry by ______ Date ________
Reviewed by ______ Date ________

Field Data Form: Road-Stream Crossing Inventory

Coordinator ____________ **Crossing ID#** ____________
Stream/River: ____________ **Road:** ____________ **Town:** ____________
Flow condition: ☐ Unusually low ☐ Typical low-flow ☐ Average flow ☐ Higher than average

GPS Coordinates (lat/long):
☐ Decimal degrees N__ __ . __ __ __ __ __ W__ __ . __ __ __ __ __
OR ☐ Degrees, minutes, seconds North: D ______ M ______ S ______
West: D ______ M ______ S ______

Date: ______ **Location:** ____________ **Observer:** ____________
Photo IDs: ____________

Road/Railway Characteristics

Road surface: ☐ Paved ☐ Unpaved ☐ Railroad
Road type: ☐ 1-Lane road ☐ 2-Lane road ☐ Multilane road ☐ Divided highway ☐ Railroad ☐ Buried stream

Crossing/Stream Characteristics *(during generally low-flow conditions)*

Crossing type: ☐ Ford ☐ Bridge ☐ Open bottom arch ☐ Single culvert ☐ Multiple culverts (# ____) ☐ Removed ☐ No crossing
Condition of crossing: ☐ New ☐ Excellent ☐ Fair ☐ Poor
Does the stream at the crossing support fish? ☐ Yes ☐ Not likely ☐ Don't know
Is the stream flowing? ☐ Yes ☐ No
Crossing span: ☐ Severe constriction ☐ Mild constriction ☐ Spans bank to bank ☐ Spans channel & banks
Tailwater Scour pool: ☐ None ☐ Small (wider or deeper than stream) ☐ Large (width or depth 2X stream)
Crossing alignment matches stream? ☐ Yes (flow aligned) ☐ No (skewed)

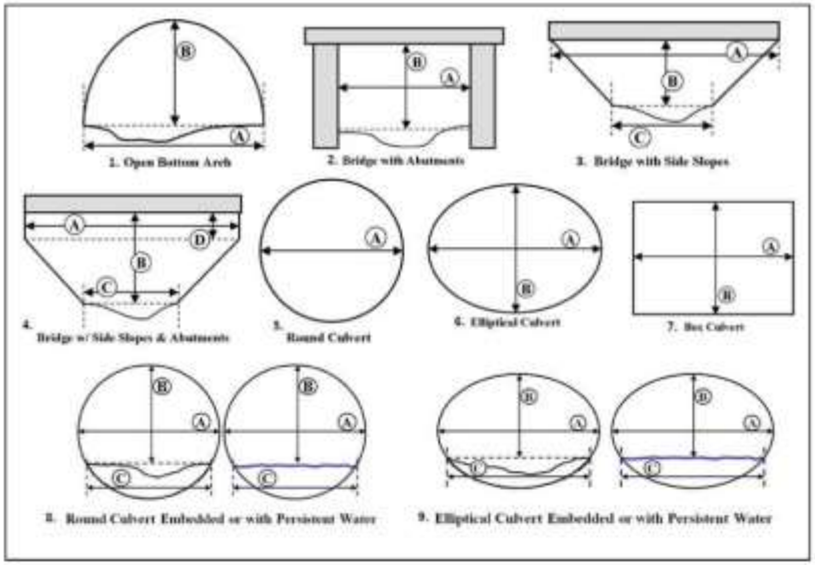
Culvert/Bridge Cell Characteristics *(Culvert/cell #1; use page 3 for additional culverts or cells)*

Structure embedded? ☐ Not embedded ☐ Partially embedded ☐ Fully embedded ☐ No Bottom
Structure substrate: ☐ None (smooth) ☐ None (rough/corrugated) ☐ Inappropriate ☐ Contrasting ☐ Comparable
Internal features ☐ None ☐ Slip lined ☐ Baffles/Sills ☐ Weir(s) ☐ Support structures
Physical Barriers to fish and wildlife passage: ☐ Severe ☐ Moderate ☐ Minor ☐ None
Describe any barriers: ____________
Is there a clear line of sight through the structure? ☐ Yes ☐ No
Does the structure provide dry passage suitable for use by terrestrial wildlife? ☐ Yes ☐ No
If yes, what is the maximum structure height in the portion that offers dry passage? ______ Feet
Comments ____________

For the following questions use as a reference a portion of the natural stream channel that is outside the influence of the crossing structure and not otherwise altered.

Water depth matches stream? ☐ Yes (comparable) ☐ No (deeper) ☐ No (shallower) ☐ Dry
Water velocity matches stream? ☐ Yes (comparable) ☐ No (slower) ☐ No (faster) ☐ Dry
Crossing Slope matches stream? ☐ Yes (comparable) ☐ No (flatter) ☐ No (steeper)

5/12/2012 Page 2



Length of stream through crossing: ____________ Feet
Inlet Structure Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐ Ford
Inlet Dimensions: A) ______ (ft.) B) ______ (ft.) C) ______ (ft.) D) ______ (ft.) ☐ Submerged
Inlet Water Depth (max depth inside the structure at the inlet): ____ Inches ☐ Measured ☐ Estimated
Inlet Drop ☐ None, or if present ____ Inches ☐ Measured ☐ Estimated
Outlet Structure Type (from above): ☐ 1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐ 7. ☐ 8. ☐ 9. ☐ Ford
Outlet Dimensions: A) ______ (ft.) B) ______ (ft.) C) ______ (ft.) D) ______ (ft.) ☐ Submerged
Outlet Water Depth (max depth inside the structure at the outlet): ____ Inches ☐ Measured ☐ Estimated
Outlet Drop
a. Culvert bottom to water surface ☐ None, or if present ____ Inches ☐ Measured ☐ Estimated
b. Culvert bottom to stream bed ☐ None, or if present ____ Inches ☐ Measured ☐ Estimated
c. With an outlet drop, check one: ☐ Cascade ☐ Freefall ☐ Freefall onto cascade ☐ No drop
Armored streambed at outlet? ☐ Extensive ☐ Not extensive ☐ None
Comments ____________

Sample of Stream Continuity Database Page

Survey ID	Crossing Code	Date Observed	Last Updated	Town	Stream	Road	Evaluation	Culvert
3005	xy4195354971280015	2008/01/08	2008/01/24	Attleboro MA	Bungay River	Holden Street	Insignificant barrier	1
3057	xy4193741971290251	2008/02/15	2008/02/21	Attleboro MA	Bungay River	Olive Street	Insignificant barrier	1
3059	xy4195064071284387	2008/02/15	2008/02/21	Attleboro MA	Bungay River	Bank Street	Insignificant barrier	1
6364	xy4193103571245070	2012/10/24	2013/02/19	Attleboro MA	Unknown	Pike Avenue	Significant barrier	1
6365	xy4192231071237215	2012/05/30	2013/02/19	Attleboro MA	Chartley Brook	Wilmarth Street	Significant barrier	1
6373	xy4195394171257873	2012/10/11	2013/02/19	Attleboro MA	Unknown	Pleasant Street	Minor barrier	1
6382	xy4193708771255283	2012/10/24	2013/02/19	Attleboro MA	Unk	Bishop Street	Moderate barrier	1
6383	xy4192275871244807	2012/10/24	2013/02/19	Attleboro MA	Unknown	Thayer Farm Road	Minor barrier	1
6384	xy4194169971250161	2012/10/24	2013/02/19	Attleboro MA	Unknown	Pike Avenue	Minor barrier	2
6385	xy4194271671266266	2012/10/24	2013/02/19	Attleboro MA	Unknown	Garfield Avenue	Moderate barrier	3
7384	xy4195209971262592	2013/07/09	2013/10/23	Attleboro MA	unknown	East Access Road	Moderate barrier	1
7590	xy4194174471239039	2012/10/24	2013/11/11	Attleboro MA	Chartly Brook	Peckham Street	Significant barrier	1
8469	xy4192364071240211	2013/07/09	2013/12/06	Attleboro MA	Unk	Sheridan Circle	Minor barrier	1

Taunton River Watershed Stream Continuity Project

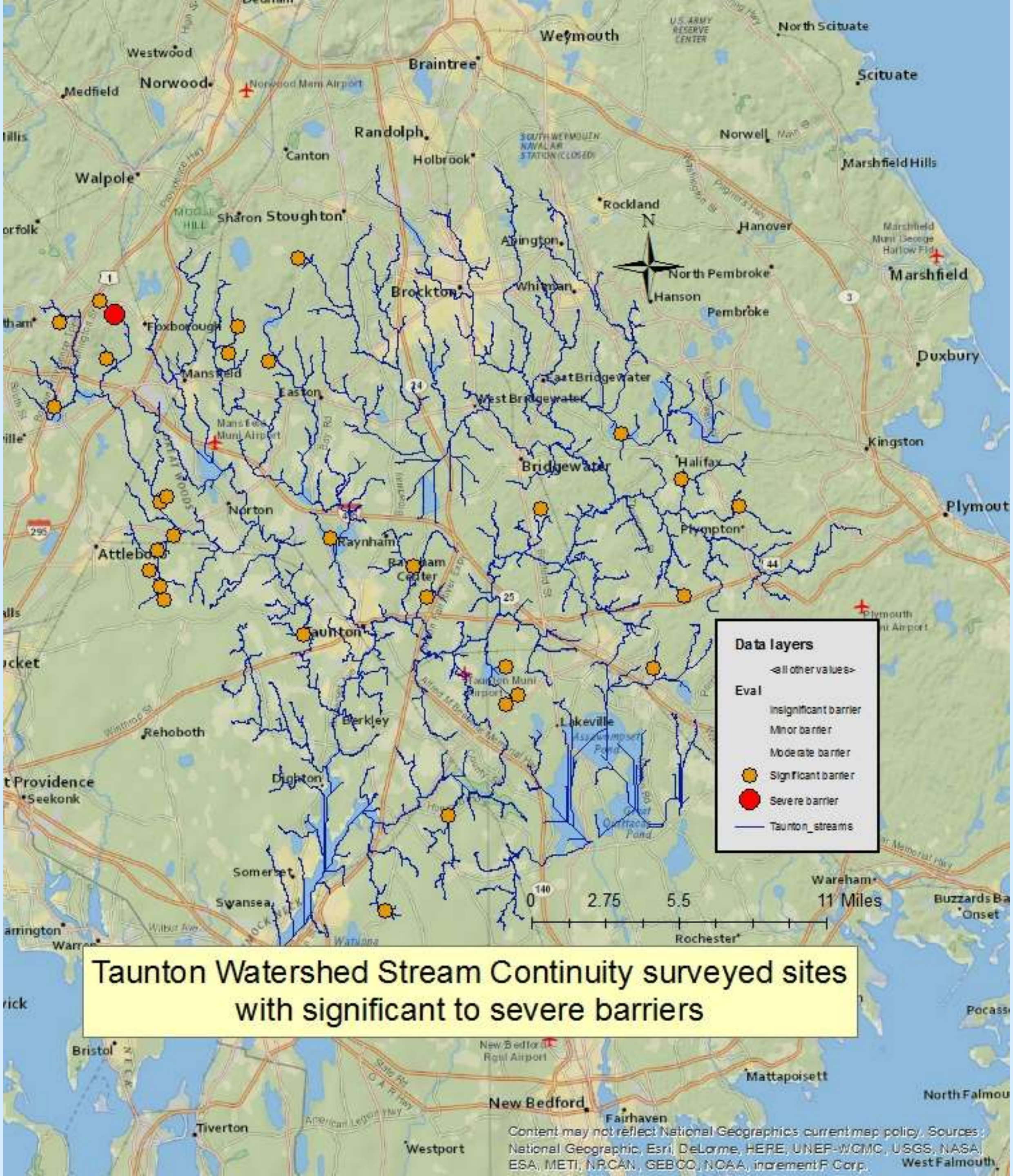
2006-2013: Volunteers surveyed 516 stream crossings in the Taunton River Watershed to determine if they create a barrier to fish and wildlife passage. Selection of sites was primarily based on Critical Linkage Impact Scores.

Findings

Out of 516 crossing records for streams in the Taunton River Watershed entered in the UMass Stream Continuity Database, 45 were bridges, 18 open-bottom arches, 2 fords, 237 single culverts and 199 multiple culverts

- **One severe barrier to passage**: culvert on Cocasset Brook at Lakeview Road in Foxborough
- **31 significant barriers to passage** located in seventeen municipalities;
- **108 moderate barriers to passage;**
- **247 minor barriers to passage;**
- **116 insignificant barriers to passage.**

Note that the Stream Continuity Project focused on sites with high potential for ecological restoration. Others may present problems for communities in terms of flood risks, creation of stagnant water, mosquito breeding, pollution or severe erosion. Factors evaluated in the surveys that are likely to be relevant to these issues include: condition of crossing, streamflow constriction, skewed alignment and others. Our full report includes town-by-town tables of crossings where these factors were observed.



Taunton Watershed Stream Continuity surveyed sites with significant to severe barriers

Potential for ecological restoration – The Top Ten

Of the 31 "significant barrier" crossings and the one "severe barrier" crossing, 10 received Critical Linkage Impact Scores higher than 0.2 (Tier 1 and Tier 2 sites)

1. Palmer Brook, Franklin Street, Halifax: 0.7831. Three round culverts, each with outlet drop.

2. Chartley Brook, Peckam Street, Attleborough: 0.6820. The outlet is clogged, collapsed or submerged. Large cement barriers block both sides of the crossing.

3. Chartley Brook, Wilmarth Street , Attleborough: 0.6244. Severe restriction, large scour pool.

4. Mill Brook on Bell Rock Road, Fall River: 0.5971. Four culverts in poor condition, severe constriction with skewed alignment. All inlets are clogged collapsed or submerged, and two outlets.

5 and 6. Two unnamed streams, Bay Street in Taunton: 0.5053. Inlet drops of 31" at both crossings.

7. Fall Brook, North Walker Street, Taunton: 0.4938. Inlet drop of 36"

8. Poquanticut Brook, Mill Street, Easton: 0.3444. Single culvert in collapsing condition, blocked with big rocks and tree limbs.

9. Wading River off Walker Street, Norton: 0.2771. Box culvert with outlet drop.

10. Tributary to Meadow Brook, Thurston Street, Wrentham : 0.2309. Two round culverts with outlet drops.

Why weren’t more sites in my town surveyed?

The numbers of surveyed sites per watershed town ranged from 1 to 54

Reasons for this range may include:

- difference in total land area;
- percentage of town’s land area within Taunton River Watershed;
- varying terrain and topography;
- towns with large areas of open space (e.g., Hockomock Swamp) may have fewer road crossings per stream mile ;
- cranberry bogs are often channelized or otherwise altered; most were excluded.

Were densely developed areas underrepresented, and if so, why?

Densely developed areas are likely to have many crossings. Those crossings may have received low Critical Linkage Scores because:

- they are not contiguous to undeveloped or low-development areas with high Ecological Integrity;
- streams are channelized or piped.

Cities and Towns, Officials and Residents Have a Key Role in Restoring Stream Continuity

Mayors/Selectmen and Selectwomen, City Councillors:

Provide leadership and make key decisions

Departments of Public Works: plan and supervise repair and replacement of local streets and roads; can incorporate upgrade or replacement of problem crossings in road projects in the early planning stages

Planning Boards: review and approve plans for new roads and in some cases review repair/replacement of existing roads; also responsible for preparing municipal Master Plans

Conservation Commissions: review and permit all projects that involve work in wetland resource areas, including rivers and streams

Emergency Management Personnel: prepare and submit Local Hazard Mitigation Plans to the Federal Emergency Management Agency (FEMA) and implement those plans during extreme weather events.

What you can do

Observe local stream crossings for yourself. Use the Field Data form as a guide for what to look for, and record your own observations. Convey any concerns to DPW, Conservation Commissions, Water Departments Please share information with us about crossings that were not surveyed in this project, or if your observations differ from the information recorded in the database.

Visit the Stream Continuity Database: www.streamcontinuity.org/cdb2 for a first-hand look at the observations made on your local streams.

Advocate in your town for upgrade or replacement of crossings that create barriers to aquatic passage as well as those that cause flooding, stagnation or pollution, and are potential mosquito breeding areas. Support efforts of local boards and officials who attempt to advance these projects.

Replacement of stream crossings that are barriers to aquatic passage and free- flowing water saves money in the long-term, restores the health of the watershed and increases communities' resilience to changing climate, sea level rise and flooding.

Your efforts to help will be appreciated.

Integrating Biodiversity & Infrastructure Priorities

Alison Bowden

Freshwater Program Director, The Nature Conservancy in Massachusetts

Bill Napolitano

Director of Environmental Planning, Southeastern Regional Planning and Economic Development District

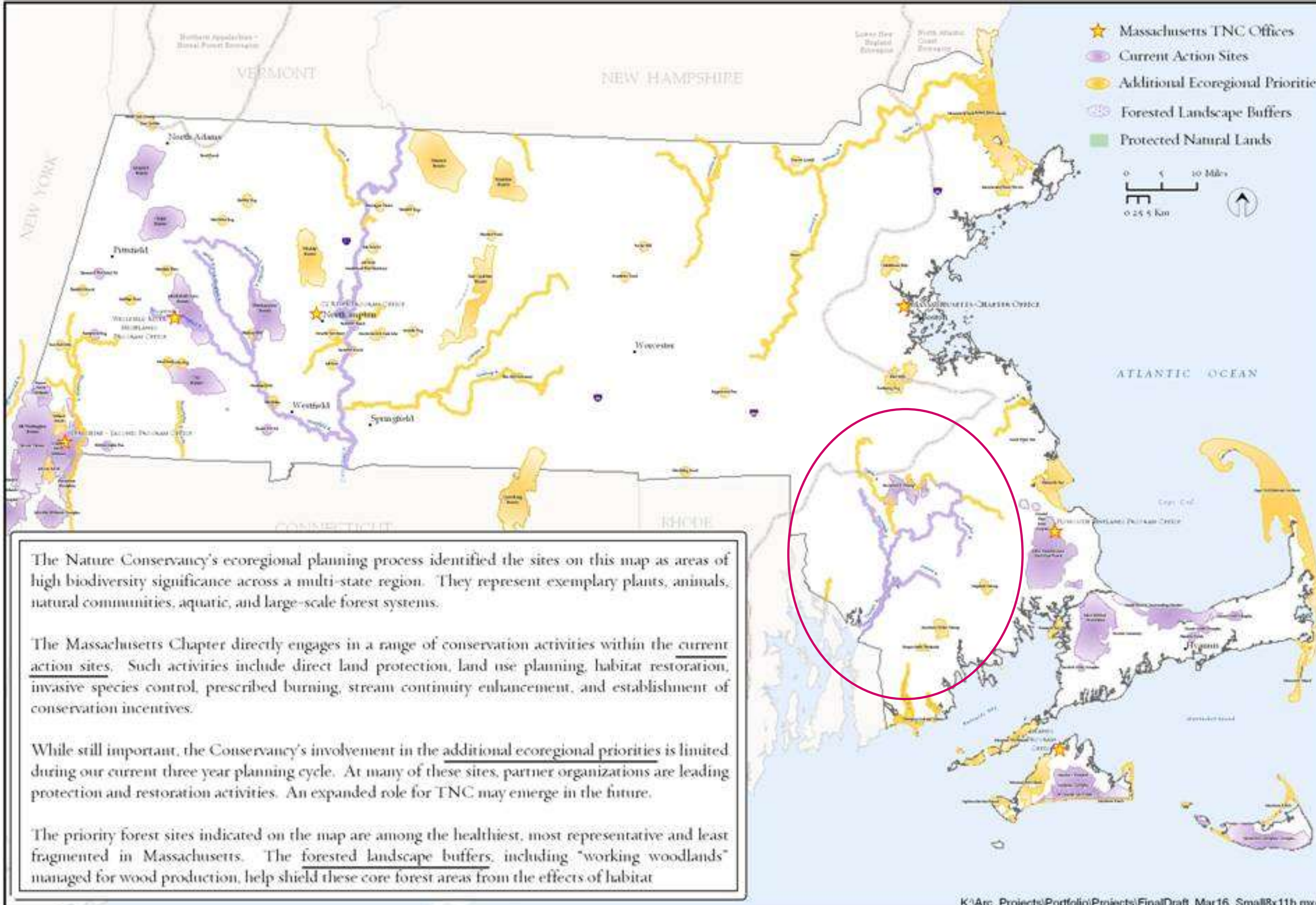
Joint Project Themes

- **Objective: Assess environmental impacts of roads & prioritize projects for multiple benefits**
- **The opportunity: Taunton River Watershed Study**
- **Case Study:**

GRRIP + River Continuity

MASSACHUSETTS CHAPTER OF THE NATURE CONSERVANCY

ECOREGIONAL PRIORITIES FOR BIODIVERSITY CONSERVATION



The Nature Conservancy's ecoregional planning process identified the sites on this map as areas of high biodiversity significance across a multi-state region. They represent exemplary plants, animals, natural communities, aquatic, and large-scale forest systems.

The Massachusetts Chapter directly engages in a range of conservation activities within the current action sites. Such activities include direct land protection, land use planning, habitat restoration, invasive species control, prescribed burning, stream continuity enhancement, and establishment of conservation incentives.

While still important, the Conservancy's involvement in the additional ecoregional priorities is limited during our current three year planning cycle. At many of these sites, partner organizations are leading protection and restoration activities. An expanded role for TNC may emerge in the future.

The priority forest sites indicated on the map are among the healthiest, most representative and least fragmented in Massachusetts. The forested landscape buffers, including "working woodlands" managed for wood production, help shield these core forest areas from the effects of habitat

The Taunton River Watershed

- **Important resources; many threats**
- **Fastest growing region in MA**
- **OLD infrastructure--road crossings and drainage built *without* growth or the environment in mind**

Example Strategies

- **Land protection for water supply & habitat**
- **Dam removal & road crossing upgrades**
- **Stormwater retrofits**
- **Defining areas for road safety, water quality improvement and habitat restoration opportunities**

Geographic Roadway Runoff Inventory Program (SRPEDD GRRIP) + River Continuity Surveys (TNC and DER)

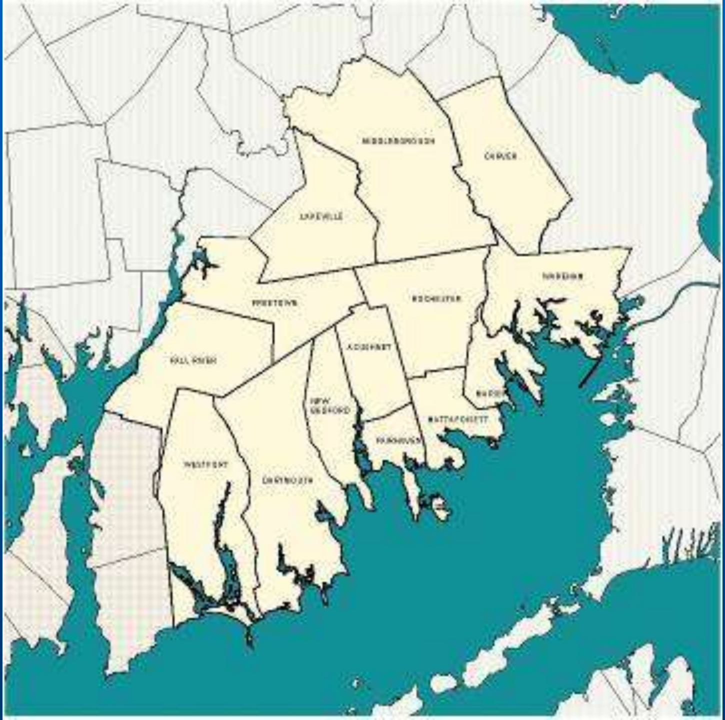
Geographic Roadway Runoff Inventory Program (GRRIP)

Funding for this project was provided under contract with the MassDOT and with the cooperation of the Federal Highway Administration

SRPEDD

What is GRRIP?

- **An analysis of roadway drainage systems and structures intersecting environmentally sensitive areas on local and Federal-Aid Eligible Roads in SRPEDD cities and towns.**



What GRRIP Isn't....

- **GRRIP *is not* a comprehensive inventory of storm drains.**

Comprehensive Environmental Data

- **A total of twenty-two layers of environmental information from coldwater fisheries to rare birds to globally unique habitats.**
- **Data compiled in conjunction with Mass GIS, Coastal Zone Management, USDA, Division of Marine Fisheries, NOAA,TNC, EOEEA and others .**

Purpose of GRRIP

- Assist local highway departments to prioritize roads prior to construction or rehabilitation projects.
- Assist in providing environmental information for individuals dealing with stream continuity and stormwater management.
- Assist town planners and conservation officers by providing comprehensive environmental data for planning decisions.

End Users and Beneficiaries

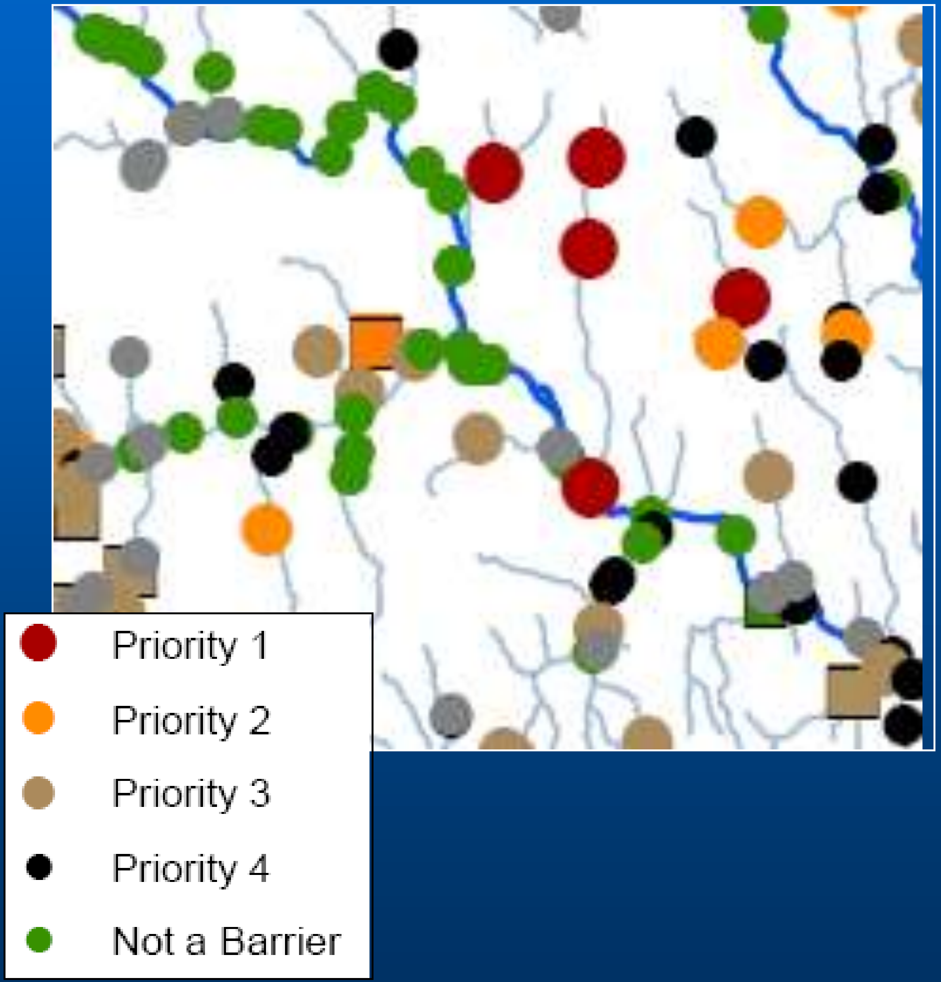
- Town Highway, Planning and Conservation Personnel
- MassDOT Environmental Division & Highway Engineers
- DEP Office of Watershed Management
- EOEEA Departments and Divisions
- DFG Division of Ecological Restoration Program and Fisheries Biologists
- CZM Coastal Nonpoint Source Program
- National Estuary Program Staff
- Regional Planning Agencies
- Watershed Associations

The GRRIP Product

- Adobe Acrobat .pdf format of ArcView G.I.S. Maps
- CD Rom of data, maps, manual and software.
- Hardcopy maps available

Setting Priorities

- Recommend action where there are barriers to organism passage AND stormwater issues in sensitive areas
- We can add in any other spatial data to inform priority rank



Funding Priority Projects

- Municipal Funds
- Chapter 90 Funds
- MassWorks Infrastructure Program if related to economic development and jobs creation programs
- TIP Project listing via TAP or DRIVE (new proposed) funds
- FEMA/MEMA
- Section 319 Grant Program
- Stormwater Utility
- Public – Private Partnership
- MA CZM Coastal Pollution Remediation Grants (CPR)

Some GRRIP Collaborative Projects

- **The GRRIP format can be applied to any other area in the state. Collaborative projects have involved TNC’s Massachusetts impaired stream crossings research; a Mass Riverways/CZM (now DER)/ Save the Bay coastal wetlands restoration project in Somerset, MA; the SRPEDD Route 495 Corridor Study; the Nemasket River (Middleboro) stormwater remediation project; and the Morey’s Bridge/Lake Sabbatia Dam replacement and habitat restoration in Taunton (with MassDOT and the Mill River Restoration Partnership).**

GRRIP Advisors and Partners

- **The Nature Conservancy (TNC), MA Division of Ecological Restoration (DER), USDA, USF&W, NOAA, MA Division of Marine Fisheries (DMF), MassDOT, Mass Audubon, Save the Bay, The Narragansett Bay Project (NBEP), The Taunton River Watershed Alliance (TRWA), Taunton River Stewardship Council, The Three Mile River ACEC Stewardship Committee, Bridgewater State University**

In the end, we hope to go from this . . .

to this!

Stream Crossing Standards

- New crossings must meet the Massachusetts Stream Crossing Standards
- Standards apply to:
  - Restoration 310 CMR 10.11-14;
  - Inland/coastal Limited Projects 310 CMR 10.24/10.53
  - Bank 310 CMR 10.54
  - Land Under Water 310 CMR 10.56
- The bottom of a span structure or the upper surface of an embedded culvert is above the elevation of the top of the bank,
- Channel spans minimum of 1.2 times the bankfull width
- Replacement crossings: to the maximum extent practicable

Stream Crossing Standards: Maximum Extent Practicable

- Balance environmental benefit vs. cost;
- Potential for downstream flooding;
- Upstream and downstream habitat (in-stream habitat, wetlands);
- Erosion potential /stream stability;
- Extent of habitat fragmentation/stream mileage improvements;
- Storm flow conveyance;
- Engineering design/hydrologic constraints;
- Additional impacts to wetlands;
- Potential to affect property and infrastructure;
- Cost of replacement.

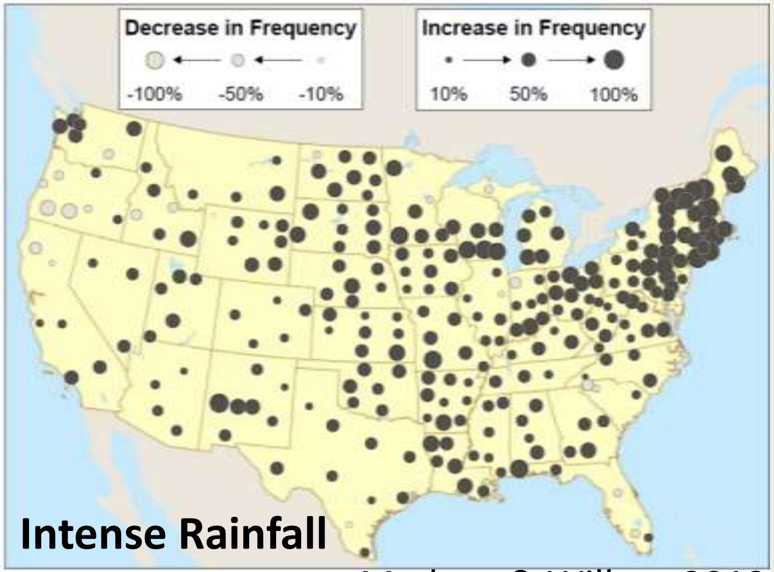
Understanding Obstacles to Improving Road-Stream Crossings in Massachusetts

Timothy Chorey & Kristen Ferry
Massachusetts Division of Ecological Restoration

My Background

- B.S. Watershed Science (Hydrology)
-~5 years Construction Experience
-~5 years Environmental Consulting

The effect of increased storms



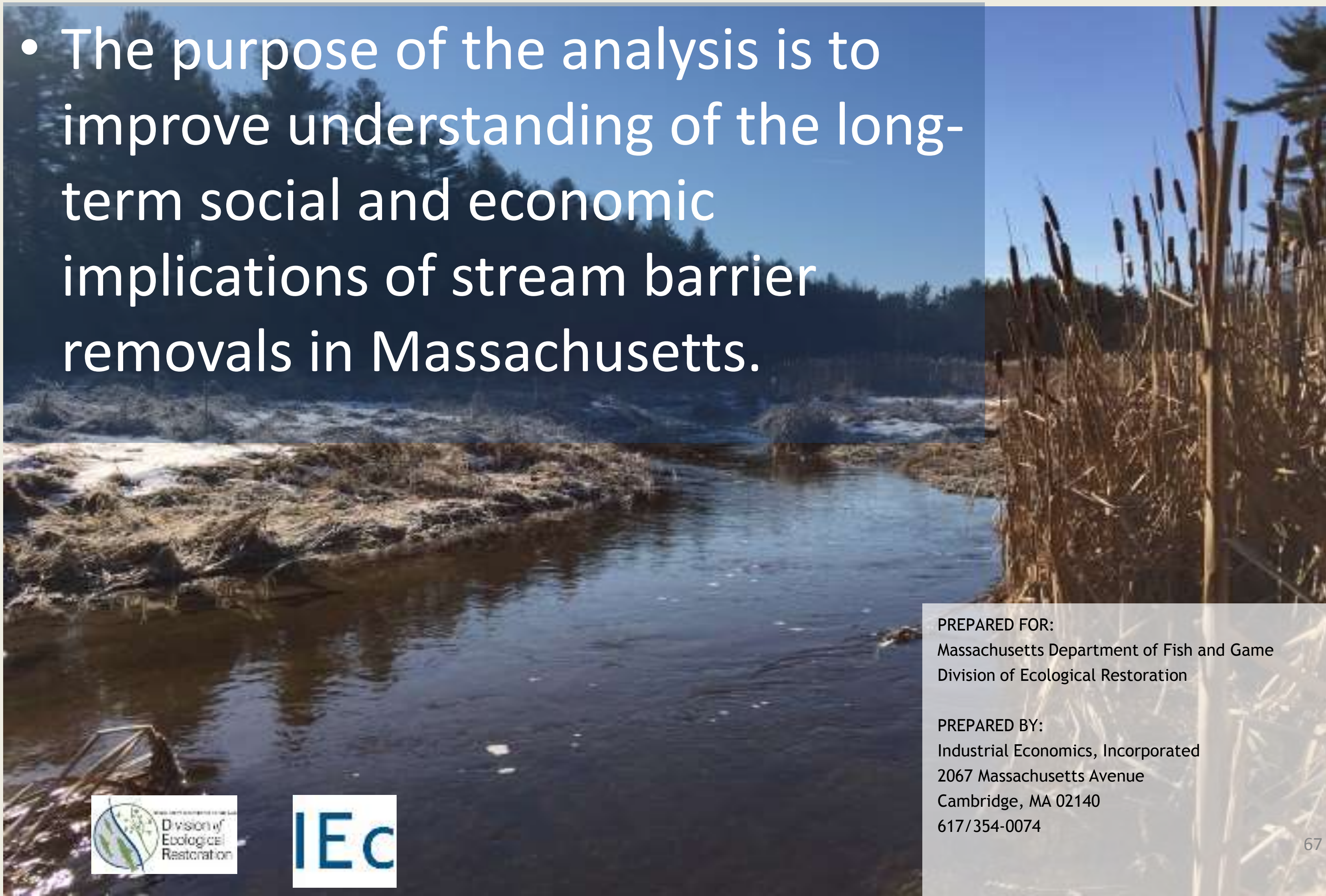
Madsen & Willcox 2012

- Flooding
- Road washout

- Damage
- Loss of business & emergency services
- Travel disruption

Community Benefits of Stream Barrier Removal Projects in Massachusetts: Costs and Benefits at Six Sites

- The purpose of the analysis is to improve understanding of the long-term social and economic implications of stream barrier removals in Massachusetts.



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IEc

Economics

- Short-term: Construction costs 15-200% > traditional hydraulic design culverts

- Long-term: lower maintenance and replacement costs *can* make *cost effective* in 20-50 years

Many design options, costs vary widely

Modified from Bowden and Chorey 2015

Massachusetts Stream Crossing Standards

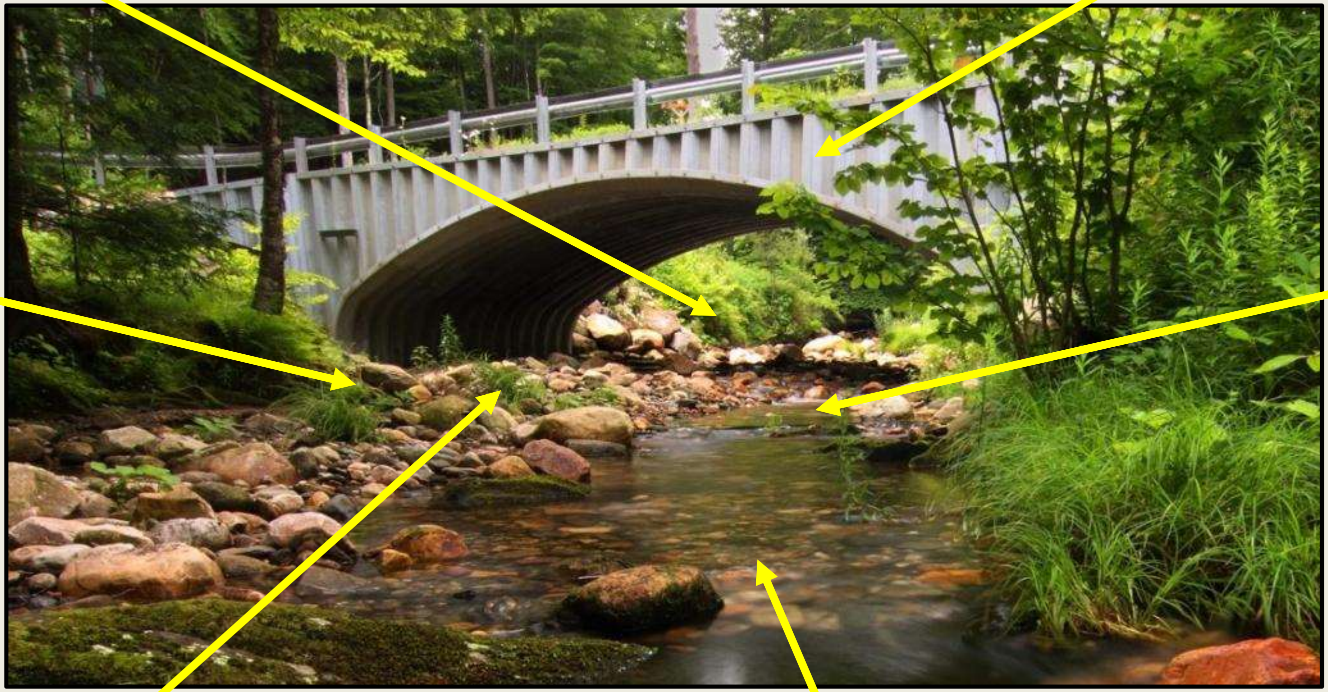
0.82 Openness ratio

Open bottom arch

★ Large span, 1.2x bankfull width

Embedment

Natural substrate



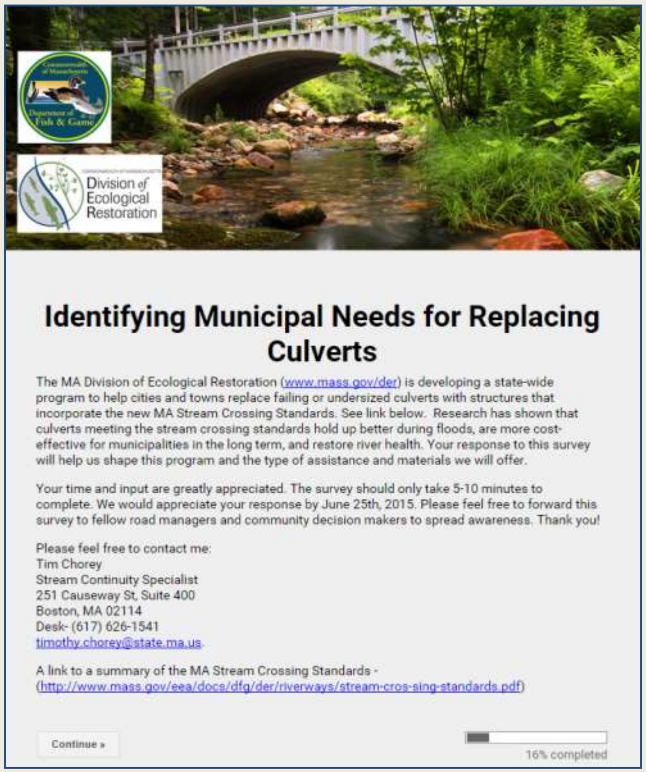
Paul Nguyen

Banks, dry passage

Comparable depth and velocity, up & downstream

Stream Continuity Program Objective

Build municipalities' ability to replace culverts with improved resilient structures.



Identifying Municipal Needs for Replacing Culverts

The MA Division of Ecological Restoration (www.mass.gov/der) is developing a state-wide program to help cities and towns replace failing or undersized culverts with structures that incorporate the new MA Stream Crossing Standards. See link below. Research has shown that culverts meeting the stream crossing standards hold up better during floods, are more cost-effective for municipalities in the long term, and restore river health. Your response to this survey will help us shape this program and the type of assistance and materials we will offer.

Your time and input are greatly appreciated. The survey should only take 5-10 minutes to complete. We would appreciate your response by June 25th, 2015. Please feel free to forward this survey to fellow road managers and community decision makers to spread awareness. Thank you!

Please feel free to contact me:
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A link to a summary of the MA Stream Crossing Standards -
(http://www.mass.gov/eea/docs/dfg/der/riverways/stream-cros-sing-standards.pdf)

Continue »

16% completed

Needs Assessment

Goal:

Identify **Barriers** for replacing culverts that meet Stream Crossing Standards.

2 Parts

Interviews — Qualitative

Online Survey — Quantitative

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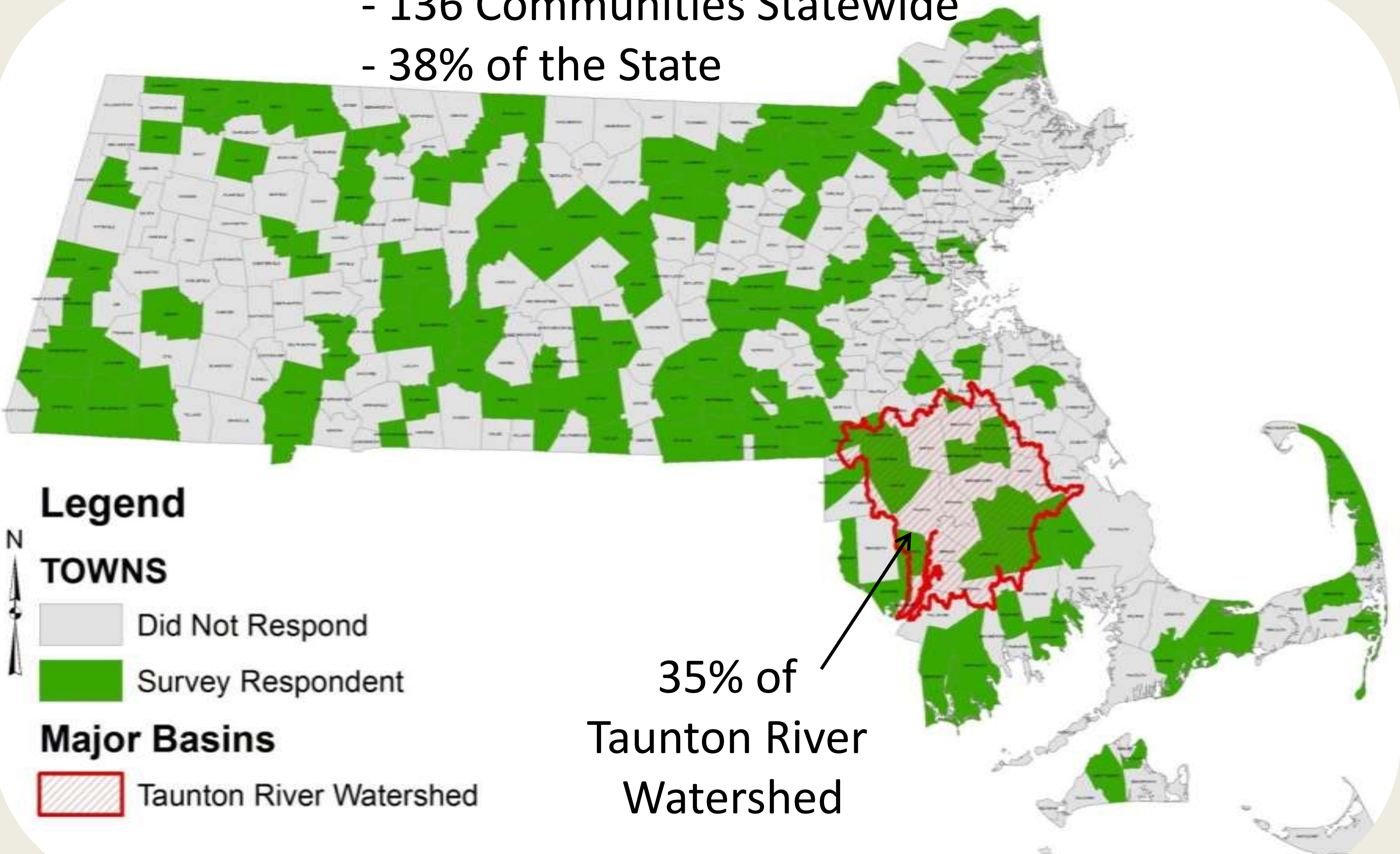
Survey Respondent Map

- 136 Communities Statewide
- 38% of the State



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Barriers

- Coordination among town departments
- Administering contracts
- Selecting an appropriate structure
- Obtaining town approval
- Existing site constraints
- Effecting downstream flooding
- Environmental permitting
- State engineering review (Chapter 85)
- Funding for Engineering and Design
- Funding for Construction
- Traffic disruptions

Help us identify the barriers to culvert projects.

Recent storms (e.g., Tropical Storm Irene in 2011) have demonstrated the potential damages caused by undersized culverts. Damages from flooding and road washout can severely impact emergency response and day-to-day town operations. Replacing culverts with structures that incorporate the MA Stream Crossing Standards will help reduce these hazards. We are interested in understanding the issues and obstacles that prevent municipalities from installing culverts that incorporate MA Stream Crossing Standards.

Based on your experience how would you rank the below steps as obstacles to installing culverts that incorporate the MA Stream Crossing Standards? *

	Unsure	Not an obstacle (1)	(2)	(3)	A major obstacle (4)
Obtaining funding for engineering & design	○	○	○	○	○
Getting town administrative approval for the project	○	○	○	○	○
Environmental permitting	○	○	○	○	○
Coordinating among town departments	○	○	○	○	○
Understanding how to select an appropriate structure (shape & material)	○	○	○	○	○
Concerns regarding increasing downstream flooding	○	○	○	○	○
Existing site constraints such as buildings or utilities	○	○	○	○	○
Engineering review process (e.g. Chapter 85 review)	○	○	○	○	○
Administering engineering and construction contracts	○	○	○	○	○
Obtaining construction funding	○	○	○	○	○
Traffic disruptions caused from construction	○	○	○	○	○

Department of Fish and Game
Division of Ecological Restoration

Survey Results: Largest Barriers

Important Barriers

- Environmental permitting
- State engineering review (Chapter 85)
- Traffic disruptions

Major Barriers- Deal Breakers

- Funding for Engineering and Design
- Funding for Construction

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Additional Findings: The Status Quo

-Culverts are being funded with annual budgets and Chapter 90 funds at the time of failure. This results in:

- -Financial burden
- -Delays other town projects, and
- -Typically results with in-kind replacements or not properly designed or permitted projects

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What does all this mean?

- We identified specific barriers that we can now mitigate!!

- <u>Use findings to:</u>
- Shape our Program to meet your needs.
- Prioritize our focus.
- Make culvert replacement easier.
- Make them less expensive!

How we hope to help you! Early Ideas

- Project Planning Assistance
- Reduce Cost
    - Evaluate current design and construction methods
- Provide Culvert Replacement Training and Assistance
- Identify Multiple Funding Sources

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Stream Continuity Program
– How we are helping NOW!

- Technical Assistance
- Site Visits
- Project Guidance
- Plan Review


To Be Continued…
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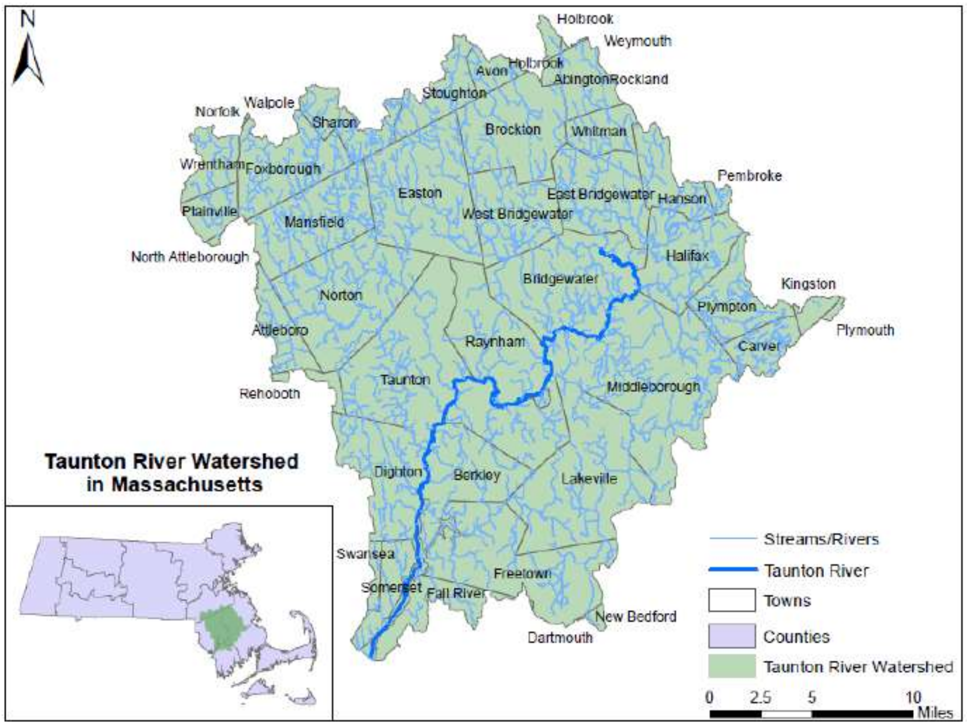
Resilient Taunton Watershed Network

Trish Garrigan, EPA New England
Cathy Bozek, The Nature Conservancy

On behalf of Resilient Taunton Watershed Network

A **resilient watershed** is one that has the capacity to adjust to stresses and disturbances while still able to provide valuable ecosystem services and functions, such as provision of a clean and plentiful water supply and flood protection

Figure 1-1. Taunton River Watershed in Southeastern Massachusetts



Resilient Taunton Watershed Network

Bridgewater State University
Horsley Witten Group
Manomet Center for Conservation Science
MA Department of Environmental Protection
MA Division of Ecological Restoration
MA Executive Office of Environmental Affairs
Mass Audubon
Metropolitan Area Planning Council
Narragansett Bay Estuary Program
National Park Service
The Nature Conservancy (TNC)
Old Colony Planning Council
Save the Bay
Southeastern Regional Planning and Economic Development District (SRPEDD)
Taunton River Watershed Alliance
US Environmental Protection Agency (EPA)
US Geological Survey
Wildlands Trust
…And you!

What is Resilience?

- **Root**
- From the root "resilire" to spring back, rebound

- **Definitions focus on :**
- Absorbing shock
- Responding and recovering quickly
- Adapting to a changing environment
- Avoiding impacts by proactively reducing risks

One Definition

Resilience is the capacity of individuals, communities and systems to survive, adapt, and grow in the face of stress and shocks, and even transform when conditions require it. Building resilience is about making people, communities and systems better prepared to withstand catastrophic events –both natural and manmade- and able to bounce back more quickly and emerge stronger from these shocks and stresses.

The Rockefeller Foundation

Before

After

What does resilience look like?

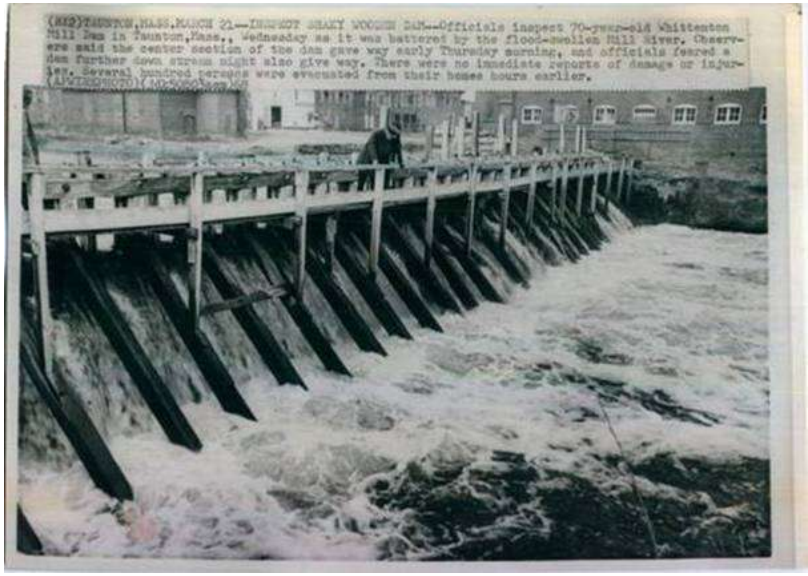
Culverts meet stream crossing standards

before

North Street, Pittsfield, MA

after

before



after

Taunton Mill River before and after removal of Whittenton Dam

Before

Hill Street, Raynham, MA

After

Examples of Actions that Meet Multiple Requirements and Goals

Possible Action	Addresses Stormwater (MS4)	Addresses Water Management Act Mitigation	Helps with Climate Resilience
Revise bylaws to allow for Low Impact Development / infiltration	x	x	x
Require porous pavement in certain situations, and allow for curb cuts to improve drainage to swales	x	x	x
Culvert replacements meeting stream crossing standards		x	x
Acquire/ preserve property for resource protection	x	x	x

Green Infrastructure Benefits and Practices

This section, while not providing a comprehensive list of green infrastructure practices, describes the five GI practices that are the focus of this guide and examines the breadth of benefits this type of infrastructure can offer. The following matrix is an illustrative summary of how these practices can produce different combinations of benefits. Please note that these benefits accrue at varying scales according to local factors such as climate and population.

Benefit	Reduces Stormwater Runoff											Improves Community Livability						
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture	Improves Habitat	Cultivates Public Education Opportunities
Practice										CO_2								
Green Roofs	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Maybe	Maybe	Yes	Yes
Tree Planting	Yes	Yes	Yes	Yes	No	Maybe	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Yes
Bioretention & Infiltration	Yes	Yes	Yes	Yes	Maybe	Maybe	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Maybe	No	Yes	Yes
Permeable Pavement	Yes	Yes	Yes	Yes	No	Maybe	Yes	Maybe	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes
Water Harvesting	Yes	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Maybe	Maybe	No	No	No	No	No	No	No	Yes

Yes Maybe No

- How might your town use the culvert assessment information ?

- What is in the way of your town considering culvert upgrades ?

- What is in the way of your town becoming more resilient ?