A Decade of Climate Resiliency Planning

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Climate Resilience
What does that mean?

✓ The capacity of a community, business, or the natural environment to prevent, withstand, respond to, and recover from a severe storm event.

✓ A climate resilient watershed and climate resilient towns will be able to maintain functions and emerge stronger and better prepared for future storm events and a changing climate.
Climate Variables

Higher temperatures
Increased precipitation
More frequent & intense storms
More frequent droughts

These variables amplify existing risks:
- Community and regional infrastructure & economies
- Public health and well being
- Natural resources and our environment

Goal for Building Resilience to a Changing Climate:
Protect life, property, natural resources and the economy
2005 - TS Tammy dropped 7-10" of rain across Franklin County. Severe inland flooding resulted in $6.5 million in damage.

2008 - FRCOG completed a multi-year assessment project for the Deerfield River watershed, which included detailed work in the larger tributary watersheds – North, Chickley, Green, and South River.

Significant bank erosion identified in these 4 watersheds.
• Scale of the problem was enormous!

• What’s going on?

• One of the healthiest watersheds in the state....

• Outstanding water quality, Cold Water Fisheries Resources, hundreds of acres of intact forests and BioMap2 habitat.
Deerfield River Watershed

- What are the attributes of a healthy and resilient river and watershed?
- How do the health and resiliency of a watershed affect a town?
Lack of Resiliency

Ongoing cycle of storm damages and repairs

Infrastructure, homes, agricultural lands, habitat are damaged or are threatened by the major erosion occurring in these watersheds. Significant amounts of money have been spent to repair damaged infrastructure and in some cases several repairs at the same site have been needed. Ongoing cycle of storm damages and repairs Lack of Resiliency
The Vermont Rivers Program has assessment protocols and model management strategies that help protect and restore natural river and floodplain processes to enhance water quality, ecological health, and flood resilience.
Fluvial geomorphology: the study of the form and function of rivers and the interaction between rivers and the landscape around them.

According to the USGS, “understanding river-channel responses to various human-caused and natural disturbances is important for effective management, conservation, and rehabilitation of rivers and streams to accommodate multiple, often conflicting, needs.”
Fluvial Geomorphic Assessments

goals for South and North River projects

• Determine the causes of channel instability.

• Identify and prioritize potential restoration projects for the watershed that are consistent with river processes and move the system towards equilibrium.

• Address site specific concerns (eroding banks, threatened infrastructure).

• Develop a cost-effective protocol.
findings

Natural Influences:
• Narrow, steep valleys
• Silt & clay-rich glacial sediment

Historic and recent land use:
• Land clearance
• Development
• Riparian buffers

Channel modification:
• Channel straightening
• Mill dams, ponds, and channels
• Encroachments & berming
Fluvial Geomorphic Assessments

findings: impacts to infrastructure and property

End result of channel modifications, encroachments and other development.
Fluvial Geomorphic Assessments

findings: site-specific problems and watershed-scale causes

Severely eroding bank
Fluvial Geomorphic Assessments

findings: site-specific problems and watershed-scale causes
South River

the results of human impacts?

Site experiences repeated erosion and damage. Approach had been to repeatedly armor it, rather than work upstream, holding the floodwater and reducing velocities.
South River Project

- Conceptual designs represent a range of geomorphic needs and treatment types.

- A watershed-based holistic approach where each project is designed to move the river system towards equilibrium by restoring river functions (geomorphic processes).

- Structures that mimic natural conditions and use native materials.
South River
reconnecting the river to its floodplain

Cross section view

New floodplain

OHW (Bankfull)

OLW

V.E. = 1.6x

Excavation / New Floodplain

New floodplain area provides a safety valve which reduces velocities and allows sediment deposition.
South River

bank stabilization and habitat improvement structures

Boulder Deflectors

Woody Materials
South River
boulder deflectors

Because of site constraints, construction was done from the river rather than from the top of bank.
South River

woody material
South River
post construction
October 2017 heavy rain event

South River
Money, money, money, money, money, Money!!!!

- Identified over 40 projects in the South River and North River watersheds.

- Is this achievable?

- What are other strategies that will improve river functions and flood resilience?

http://www.clipartkid.com/money-tree-cliparts/
A more sustainable strategy is:

**Avoidance** of the risks posed by flooding and fluvial erosion by **limiting new development** in the river corridor and **managing the lands** in the river corridor to improve river functions.
Vermont Rivers Program

River Corridor Mapping Protocols

• Based on the science of fluvial geomorphology
• Three phases – field and data intensive
• Includes culverts
• Often larger than 100 year floodplain

River Corridor Management Plan

• Protect river corridor lands
• Plant stream buffers
• Stabilize river banks
• Remove floodplain constraints
• Restoration at the watershed-scale with a goal of moving the stream system towards equilibrium.
River Corridor Mapping

- **River Corridor Mapping Tool**
  - Develop and pilot a cost-effective protocol for watershed towns to identify flood and erosion hazards and the river corridor

- **River Corridor Management Toolkit**
  - River Corridor Management Overlay District
  - River Corridor Easement
Watershed-Based Plan

Deerfield River Watershed

- Comprehensive plan that assessed the health and climate resiliency of the watershed.
- Identifies projects that address multiple problems and have multiple benefits.

- Mitigation
- Restoration
- Preservation
- Avoidance
<table>
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<th>Additional Watershed Resiliency Strategies</th>
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<tr>
<td>Protect and/or restore river corridors</td>
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<td>Protect large blocks of land for multiple benefits</td>
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<td>Manage stormwater with Low Impact Development/Green Infrastructure</td>
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<td>Protect and/or floodproof critical infrastructure</td>
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<td>Conduct public education</td>
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<td>Improve stormwater infrastructure</td>
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<td>Reduce impervious surfaces</td>
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Scenario #1: Moderately developed road along river

CHALLENGES

River constrained by roads on either side
Little to no buffer between farm field and river
Critical facilities and compacted ground sited adjacent to the river
Tributary runs off hill, often carrying debris into river
Possible erosion along riverfront
Critical facilities and compacted ground sited adjacent to the river
Scenario #1: Moderately developed road along river

**POTENTIAL STRATEGIES**

- Increase culvert size
- Protect large blocks of forested land
- Manage stormwater runoff with LID

- Protect land along rivers to provide space for flooding
- Provide incentives to restore floodplains

- Flood-proof critical facilities
- Use LID to slow runoff
- Manage stormwater by planting trees
Scenario #2: Rural farmland along river corridor

CHALLENGES

River constrained by roads on either side and flowing under the bridge, a choke point

Little to no buffer between farm fields and river

It can be difficult to preserve large blocks of intact forest and/or ensure the use of sustainable forestry techniques
Scenario #2: Rural farmland along river corridor

**POTENTIAL STRATEGIES**

- Protect upstream parcels of land that provide flood storage
- Provide incentives for riverfront easement
- Restore buffer along river
- Protect large blocks of land
- Slow and infiltrate rain in upland tributaries
- Manage the land for multiple benefits, including climate resiliency
Recommendations apply to various scales – the Deerfield River Watershed, its ten HUC 12 subwatersheds and the 14 watershed towns in Franklin County.
Watershed Resiliency

Lessons learned

- Much of the cutting-edge river assessment and management work we are doing is modeled on the VT Rivers Program.

- The Deerfield River Watershed is impaired - the major tributaries and smaller headwater streams are adjusting to decades, even centuries, of human manipulation of the river and the watershed lands.

- FRCOG’s cost-effective model fluvial geomorphic and habitat assessment methodology and river corridor mapping protocol can be applied in other similar watersheds.
Watershed Resiliency

Lessons learned

- Fluvial geomorphic-based land conservation and corridor management is a new paradigm in river restoration and protection in Massachusetts.
- These river management tools can address a need that river restoration projects can’t address.
- Corridor mapping represents a landscape-scale framework for identifying a new class of projects and strategies that cross town boundaries.
Looking to the Future

- Incorporating Climate Change Resiliency into Multi-Hazard Mitigation Plan Updates.

- Finalizing a Climate Resilience Plan for the Deerfield River Watershed and its 14 towns that incorporates recent Municipal Vulnerability Preparedness planning (MVP) work and FRCOG’s Watershed-Based Plan.
Looking to the Future

- See an untapped opportunity to incorporate GI into transportation projects.
- Develop a cost-effective and replicable assessment protocol and a set of templates for incorporating Green Infrastructure (GI) stormwater management techniques into transportation projects.
- Once built, these “Green Streets” can help improve water quality and climate resiliency in Franklin County.
Looking to the Future

- Integrating climate resiliency work across programs.
- FRCOG’s Transportation Program is finishing a culvert resiliency project that is based on work recently completed by MassDOT and UMass for the Deerfield River Watershed.

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