riversmart communities

supporting ecologically restorative flood prevention and remediation in New England

Managing Rivers

Floods can cause damage through two main processes, inundation and erosion. Management activities address one or both of these risks.

Inundation occurs when water overtops a channel bank and submerges property. **Erosion** is the removal of material by flowing water, such that it is transported away from its original location. Inundation hazards include property burial by sediment deposition, contamination by pollutants and toxins, growth of mold, and drowning of plants, animals, and people. Erosion hazards include loss of land, structures, and infrastructure due to the undercutting of banks or direct removal by the river.

Flood hazard management addresses either inundation, erosion, or both. Methods can be **intrusive**, directly interfering with natural river processes, or **passive**, avoiding hazards through adaptation of the human environment or implementation of measures designed to facilitate natural processes.

Intrusive	Passive
Hard Bank Stabilization Walls and riprap (large boulders) cover the bank. This deflects, rather than dissipates, energy, increasing erosion on the opposite bank, up- and downstream, and on the foot of the wall.	**Soft Bank Stabilization** A combination of netting and vegetation stabilizes the bank and dissipates, rather than deflects, energy. Also supports ecosystem functions. May include embedded woody debris.
Straightening Cutting-off meanders moves water through an area more rapidly, decreasing inundation risk. Higher velocity also leads to higher stream power and erosion risk, especially downstream of the straightened reach.	**Corridor Easements & Buyouts** Limiting development within an area known to experience frequent flooding and sediment transport limits damage there, while also allowing for floodwater storage, energy dissipation, and habitat access.
Raised Levees and Floodwalls Structures that keep water within the channel extent during floods also increase flood flow velocity, intensifying downstream hazards. Additionally, floodplain habitats and food sources are cut-off.	**Accessible Floodplains, Flood Zone Easements** Giving floodwater access to some floodplain areas, such as conservation- or farmland, allows for water storage and decreases flow velocity during floods. Additionally, floodplain habitats and food sources are accessible.
Flood Control Dams Dams can store large volumes of water during a flood event, eliminating high flows. They also prevent fish passage and ecologically important flood cycles, and trap sediment, increasing erosion downstream.	**Upgrade Crossings** Properly-designed culverts and bridges allow water and debris to flow without clogging, undermining, and washing-out stream crossings during a flood. They also allow for wildlife passage.
Dredging Channel deepening lowers inundation risk, but leads to rapid incision and high risk of bank collapse, and causes headcut-erosion upstream, deposition and increased flood risk downstream, and habitat destruction.	**Elevated Structures** Putting structures on raised-earth or stilts protects them from inundation, though not necessarily from erosion or direct damage from flowing water.
Do Nothing Often, the best management option is to allow the river to bring itself to equilibrium without human intervention.	

Restoration and Remediation

Systems and Risks

Transportation
Roads often wash out during floods, cutting off entire neighborhoods or towns.

Communication
With power and phone lines down, and cellphone service unreliable, preparing alternative communication methods can be key.

Water, Wastewater, Stormwater
High levels of precipitation overwhelm wastewater systems, leading to overflow of pollutants into floodwaters. Stream crossing failures can cut off water distribution and wastewater collection lines.

Energy, Electricity, Gas
Inundation of key infrastructure, washed-out stream-crossings, and overwhelmed power plants can all contribute to failure of energy and gas distribution systems.

Property and Safety
Erosion and inundation, especially with polluted water, can cause permanent damage to buildings, farmland, and other property, as well as loss-of-life.

Upgrade Crossings
Well-designed culverts and bridges allow water and debris to flow without clogging, undermining, and washing-out roads. This protects transport routes, and distribution of water, gas, and sewage.

Use Soft Bank Stabilization
"Soft" methods use vegetation and netting that dissipate, rather than deflect, energy. This prevents aggravation of downstream damage, provides important fish habitat, and preserves aesthetic value.

Change Land-Use Patterns
Limiting types and amounts of development near a river through buyouts, easements, or regulation, decreases direct damage and allows for floodwater storage, energy dissipation, and habitat access.

Adapt
Raising structures in flood zones protects them from inundation, though not erosion. Not rebuilding or performing repairs in high-risk areas prevents repeated money expenditure.

Build a Network
Strong communication networks within and between communities allow for fast response, knowledge exchange, and resource pooling.

Apply for Funding
Securing funding requires knowing the application process ahead of time, having accurate documentation of damages, and (typically) having representatives assess the damage. See funding factsheet for more.

Have a Plan
Having a response and recovery plan, collaborating with experts, and communicating with the public can make a world of difference. It is also required for many funding opportunities.

Case Studies

Worthington, MA
Bronson Brook & Dingle Rd. Double-box culvert replaced with open-bottom culvert.
MassDER, 2012. Stream Crossings Handbook.

South Royalton, VT
Hurricane Flats Farm eroded by Irene. Felled trees, coconut fabric, & willow used to stabilize.
White River Partnership, 2013. whiteriverpartnership.org

Bethel, VT
Hazard-prone land is being converted to public space through FEMA buyout program.
Town of Bethel, VT. 1/13/2015 Public Meeting Townofbethelvt.com


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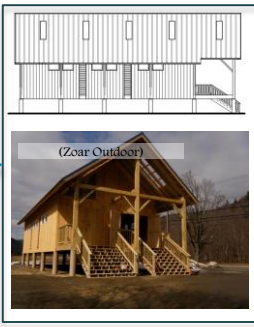

Charlemont, MA
After Irene, Zoar Outdoor rebuilt gear shed on stilts to withstand future floods.
Zoar Outdoor, www.zoaroutdoor.com