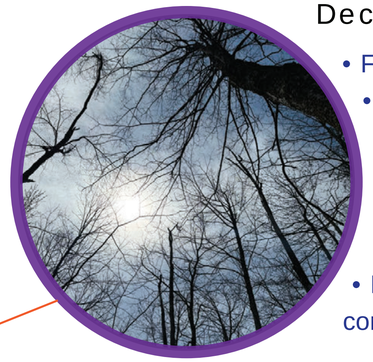
Watershed Uplands - Key Challenges to Flood Resilience

Healthy upland forests, deep spongy soils, slow-moving streams and wetlands provide the first line of defense against flooding in the Mill River. But in much of the watershed, steep slopes, narrow valleys, and underlying bedrock will always tend to send stormwater quickly downhill into streams and rivers. Multiple threats, including extreme weather and temperatures, pests, diseases and erosion place greater pressure on all of these areas. Highly engineered solutions will never go far in a rural town like Williamsburg. Most land management decisions are made by individual land owners, who may encounter technical, financial, or physical challenges to implementing flood resilient land management practices.



Declining Forest Health

- Forests are not as healthy as they could be.
- Widespread tree loss is affecting spruce, beech, hemlock, ash, and other majoy canopy species.
- Invasives, pests and blights are impacting forests and soil.
- Over-browsing by deer is reducing/preventing regeneration of trees.
- Recent land conversion of forests to solar farms has contributed to erosion, soil loss, and flooding.

Soil Health

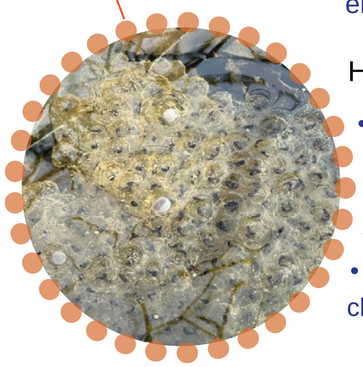
- Soil health is tied to land cover and how the land is managed.
- Forested soil is vulnerable where forests are threatened.
- Reduced soil health risks turning soils from carbon sinks into carbon emitters and increases storm water runoff.
- Landowners face several barriers to implementing healthy soil practices and flood resilient land management.

Riparian Areas: Streams, floodplains, and wetlands

- Healthy riparian areas reduce flooding but many have been damaged by increasingly frequent and intense storms.
- Degraded streambanks have lost the trees, shrubs, and herbaceous plants that are needed to slow flooding, protect water quality, and provide habitat.
- Many streams and rivers are missing riparin buffers due to land management practices that mow up to the water's edge.
- Wetlands retain stormwater and sequester carbon better than forests but have been impacted by land uses.
- Restoring floodplains creates additional flood storage, but most floodplains in town are either constrained by steep valleys or contain existing houses and businesses.

Stormwater Runoff

- Stormwater is a major challenge town wide that damages natural, rural, and urban environments.
- Heavy rain events combined with steep topography and low infiltration lead to large volumes of fast-moving stormwater runoff with the power to blast away roadsides, streambanks, and anything else that stands in the way.
- Stormwater damage is expensive and labor intensive to fix and represents a shared burden for the town and residents.

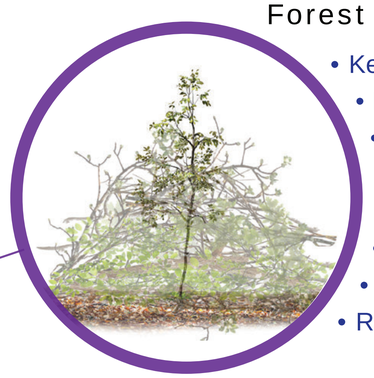


Habitat Fragmentation

- Biodiversity and ecological resilience are degraded or lost by habitat fragmentation.
- Past development along the Mill River corridor, including the downtown villages and Rt.9 impedes habitat connectivity.
- Degraded habitat along tributaries to the Mill River impedes connectivity across town.
- Williamsburg's steep ravines provide rich habitat and sanctuary for wildlife adapting to the changing climate but the soil is highly erosion-prone and vulnerable to heavy precipitation.

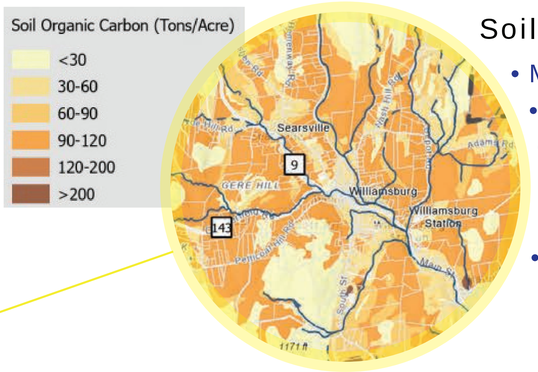
Watershed Uplands - Land Management Strategies to Foster Flood Resilience

Upland land management can reduce flooding by protecting and improving the capacity of forests, soils, riparian and habitat areas to intercept, absorb, and store water. The success of new walls, bridges and other engineered solutions along the main stem depends on runoff not getting much worse. A 5% reduction in runoff from the upper watershed would reduce peak flow rate and volume in the Mill River by about 6% and would lower flood depth in the downtown by 3.6 inches. To achieve this, Williamsburg must work with landowners to expedite land management strategies that foster flood resilience across the Mill River Watershed.



Forest Regeneration

- Keep forests as forests and minimize fragmentation.
- Protect legacy trees.
- Plant climate adapted tree species.
- Use slash walls to protect understory and saplings from deer.
- Protect steep ravines.
- Speed up forest management and regeneration.
- Manage against invasive species.
- Retain snags and leave coarse woody debris to provide habitat.



Soils

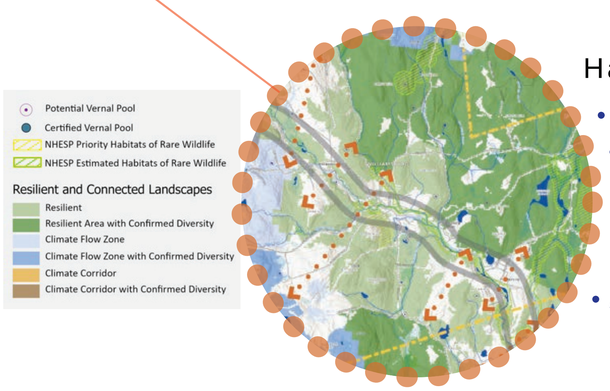
- Maximize soil cover.
- Leave deadwood and slash in place
- Maximize living roots.
- Restore degraded forests.
- Protect land high in soil organic carbon (SOC).
- Regenerate SOC on degraded land.

Riparian Areas: Streams, floodplains, and wetlands

- Plant native riparian trees and shrubs around streams and riverfront areas that are currently lined with lawn, pastures, or hayfields.
- Restore floodplain and conserve lands that are valuable for retaining stormwater.
- Restore damaged or drained wetlands.

Manage stormwater with best practices

- Manage the stormwater along rural dirt roads to reduce the volume and speed of stormwater runoff and the harmful impacts of erosion.
- Expand stormwater management in the downtown villages, rural dirt roads, private properties, and working forests and farmland.

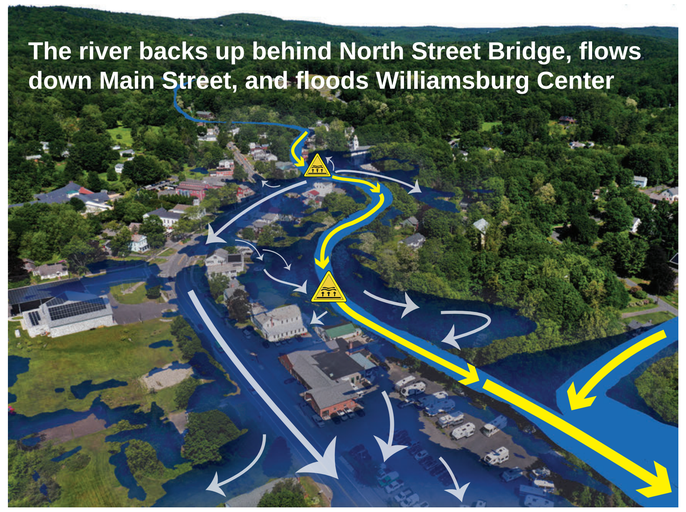


Habitat Connectivity

- Conserve land with priority habitat as indicated by BioMap3.
- Stabilize steep, erosion-prone slopes by removing invasive species and planting native. species.
- Replace turf grass with deep-rooted perennial grasses, wildflowers, shrubs, or trees.
- Aim for at least 25% tree cover.

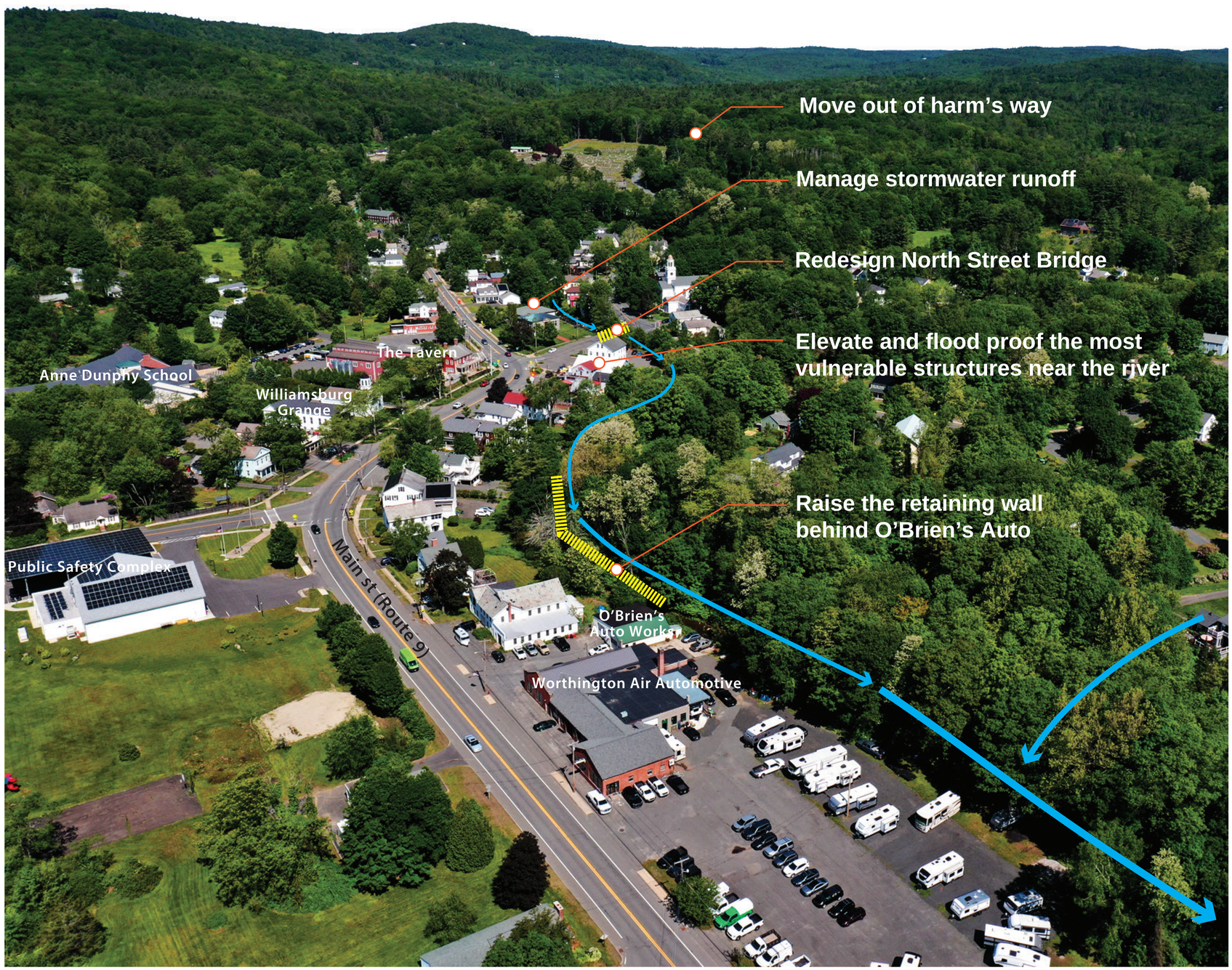
Williamsburg Center - Key Challenges with Flooding Downtown

This poster illustrates the Hydraulic & Hydrologic model of flooding in the Mill River Watershed, which shows that 11 inches of rain will cause the Mill River to back up behind the North Street Bridge, overtop its channel, and inundate Williamsburg Center with over two feet of water. More than 40 structures in downtown Williamsburg would be impacted. By 2070, such a rain event will have a 1% chance of occurring in any given year. In reality though, this storm or one even worse could happen any time, impacting critical infrastructure, business and homes, and citizens located in harm's way.



Williamsburg Center - Key Flood Resilience Strategies Downtown

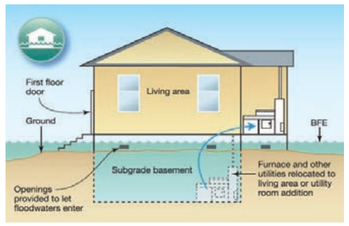
Reducing flood impacts will require a combination of infrastructure upgrades, improvements to homes and businesses, and rethinking about how Williamsburg Center grows in the future. Raising the North Street bridge and installing a floodwall will help guide floodwaters safely away from Main Street. Improved stormwater management can reduce the frequency of flooding. Floodproofing of buildings and critical infrastructure can help reduce impacts should floods occur. Over time, it may make sense to move some structures entirely out of harm's way, and encourage new construction in areas of the downtown that are less likely to flood.

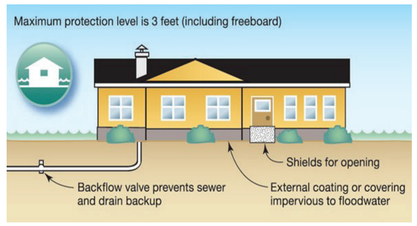


VHB's engineered flood solutions would eliminate flooding in Williamsburg Center that would result from an 11" rain event (the 100-year-storm in 2070) under current conditions.

Elevate buildings and utilities and flood proof structures

- Modify town bylaws to support this.
- Educate residents and businesses about what they can do.





FEMA recommends elevating buildings and utilities in flood-prone areas to protect against flood damage. This involves raising the lowest floor of a building to or above the Base Flood Elevation (BFE) and also elevating or floodproofing utilities like electrical systems and mechanical equipment.

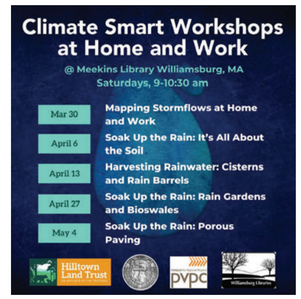
Manage stormwater in the village

- Expand the raingarden at Meekins Library to capture runoff from the roof *AND* the parking lot.
- Install a bioretention basin along North Main Street to capture road runoff.

The existing raingarden at Meekins Library receives stormwater runoff from the roof of the building and could be expanded to capture runoff from the parking lot as well.

Hold public engagement events

- Continue to generate community dialogues that increase awareness of flood risk, as well as understanding about stormwater management, flood proofing, and flood response.



This MVP project engaged residenst in learning what they can do about flooding. The Town can expand the community-wide dialogue to address flood-proofing and flood response.

Ridge to River - Key Challenges to Flood Resilience in the Mill River Watershed

The Mill River Watershed is made up of all of the land, from ridgeline to river, where runoff from rain and snow flows eventually flows into the main stem of the river. Long before flooding is visible along Route 9 in the villages, the scope of that flooding is determined by the size and intensity of storms and the ability of the land to absorb what falls upon it. While some areas with spongy soils and thick forest cover keep water in place, both the speed and volume of runoff increases dramatically in areas with steep slopes, poor soils, shallow bedrock and thin forest cover. As storms become more intense due to climate change, flooding will only get worse unless we take action across the watershed.

Imutable watershed characteristics

Much of the upper Mill River Watershed consists of steep slopes and narrow river valleys. Abundant, shallow bedrock underlies much of the landscape. Stormwater infiltration is limited and runoff from upland areas remains very high resulting in "flashy" streams and rivers that rise quickly during heavy rain events.

The West Branch Mill River flows through a bedrock channel in a beautiful area of Williamsburg known as Devil's Den.

Historic watershed transformation

By 1830 the uplands were almost completely cleared of forests, and much of the soil was washed away which previously served as the first line of defense against flooding by intercepting, slowing, and absorbing stormwater before it could enter streams. Allowing the forests to regrow and the soils to deepen since this historic low point is best for restoring watershed health but takes the longest.

Near-total deforestation by European settlers destabilized the hydrologic cycle, incurring a low point in watershed health. Illustration by Harvard Forest

A legacy of flooding

Historic development along the river, including mill dams, retaining walls, and whole neighborhoods, put homes and businesses in Williamsburg directly in the path of flooding. Encroachment upon stream banks impaired the ability of riparian buffers and floodplains to absorb flood flows. The combination of steep slopes, shallow bedrock, land use changes, and historic development patterns set the stage for a legacy of flooding in Williamsburg.

Williamsburg Center after the Great Hurricane of 1938 when the Mill River overtopped its banks and ran down Main Street carving deep gullies along the roadsides. Source: Williamsburg Historical Society

Pressure from climate change

Climate change continues to put increasing pressure on Williamsburg's natural and built environment, exceeding the limits which critical infrastructure where originally designed for. The Town must adapt both its "green" and "grey" infrastructure to prepare for future impacts. Maximum precipitation is projected to increase 31.6% by 2090.

The North Street Bridge was not designed to accommodate current flooding. As a result, the bridge acts like a dam. The river backs up behind the bridge, overtops its banks and floods downtown Williamsburg.

Land use change and stormwater runoff

Solar farms, forest decline, and land conversions weaken Williamsburg's first line of defense against flooding by removing forest cover and creating impervious surfaces that prevent water from infiltrating. The less water infiltrates, the more quickly it moves into streams and rivers.

Runoff from a large ground-mounted solar facility in Williamsburg had devastating impacts to the West Branch Mill River and local wetlands and required extensive remediation.

Barriers to resilient land management

Many landowners in Williamsburg Center are interested in helping to protect the downtown from flooding through beneficial land management. However, they face a number of barriers: classical forestry does not focus on flood resilience, beneficial practices can have additional costs, forestry grants can be difficult to navigate, there aren't enough foresters to meet demand, and other challenges. Helping landowners overcome barriers, regenerate their land, and reduce flooding is a 'win-win' solution, given the importance of thriving forests to flood resilience and the town's vulnerability to flooding.

Landowners gathered to learn about flood resilient land management in Williamsburg. Source: Hilltown Land Trust

Ridge to River – Landscape Scale Strategies to Advance Flood Resilience in the Mill River Watershed

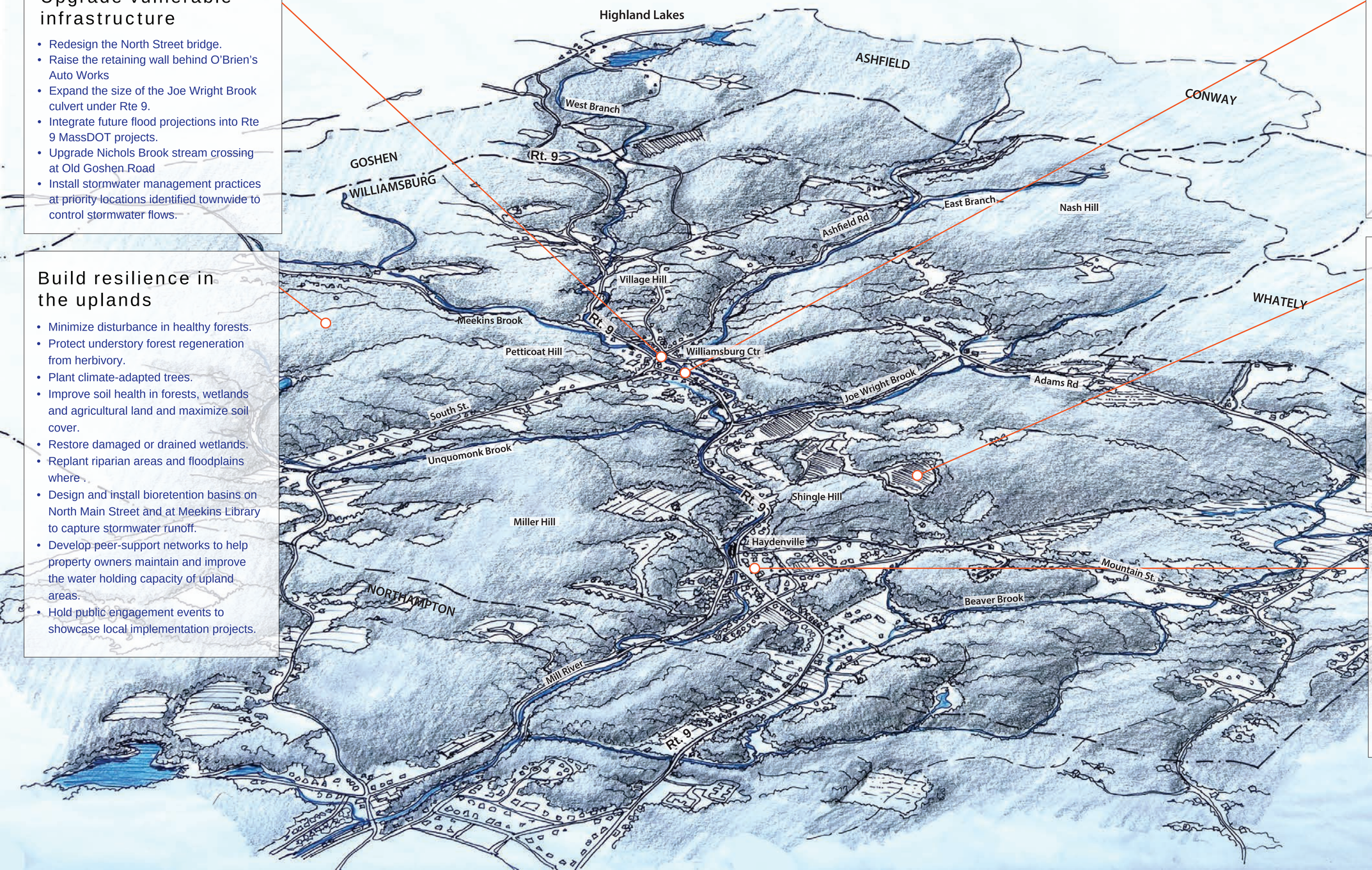
Limiting future flooding will require coordinated action to control and mitigate flooding along the main stem as well as working to reduce runoff close to the source in the uplands. The easiest way to start is by preserving land that is already working hard to absorb runoff, and to manage land use changes like new solar farms in a way that doesn't increase runoff. For areas already disturbed by development or forest decline, there are many ways to restore natural cover and build healthy soils. Along the main stem, roads, bridges, culverts and other infrastructure can be upgraded, both to allow water to pass more quickly and to reduce the amount of damage it causes. Vulnerable uses can be moved in areas where flooding is likely to get worse, and other areas identified where new homes and businesses can thrive outside of the floodplain.

Upgrade vulnerable infrastructure

- Redesign the North Street bridge.
- Raise the retaining wall behind O'Brien's Auto Works
- Expand the size of the Joe Wright Brook culvert under Rte 9.
- Integrate future flood projections into Rte 9 MassDOT projects.
- Upgrade Nichols Brook stream crossing at Old Goshen Road
- Install stormwater management practices at priority locations identified townwide to control stormwater flows.

Build resilience in the uplands

- Minimize disturbance in healthy forests.
- Protect understory forest regeneration from herbivory.
- Plant climate-adapted trees.
- Improve soil health in forests, wetlands and agricultural land and maximize soil cover.
- Restore damaged or drained wetlands.
- Replant riparian areas and floodplains where .
- Design and install bioretention basins on North Main Street and at Meekins Library to capture stormwater runoff.
- Develop peer-support networks to help property owners maintain and improve the water holding capacity of upland areas.
- Hold public engagement events to showcase local implementation projects.



Make room for the river

- Revize zoning to support growth in safe locations.
- Conserve land and include housing.
- Partner on grant applications that support people moving out of harm's way.
- Explore use of property buyouts as a planning tool to make room for the river.
- Consider undertaking a river corridor analysis
- Communicate about key issues, expectations, and individual agency in leading to better outcomes.

Prevent an increase in flood flows

- Adopt a local wetlands protection bylaw.
- Update the Town's floodplain overlay district bylaw.
- Adopt a local stormwater bylaw to control development-related runoff.
- Conserve valuable land for stormwater management and floodplain restoration.
- Utilize new state energy infrastructure reforms as an opportunity to prevent continued watershed degradation due to ground-mounted solar projects in the uplands.

Work together to prepare for flooding

- Update and implement Hazard Mitigation Plan actions.
- Elevate buildings and utilities and flood proof structures.
- Inform residents and coordinate activities on private property.
- Engage and educate the public to increase flood response know-how.