Global Resilience Institute
at Northeastern University

CUAHSI
allied for water science

CIROH

Contextualizing Flood Risk in Ungauged Rivers to Strengthen Local Knowledge and Planning

Location: Windham Region, Vermont

2025

Community Narratives

Narrative Summary

Limited stream gauge coverage and staff capacity have long challenged local flood preparedness and planning in the region. FloodSavvy helps address these gaps by expanding access to streamflow data through an intuitive interface, enabling local decision-makers to visualize historical streamflow patterns, explore flood scenarios, and integrate these insights into hazard mitigation planning.

Contributing Authors

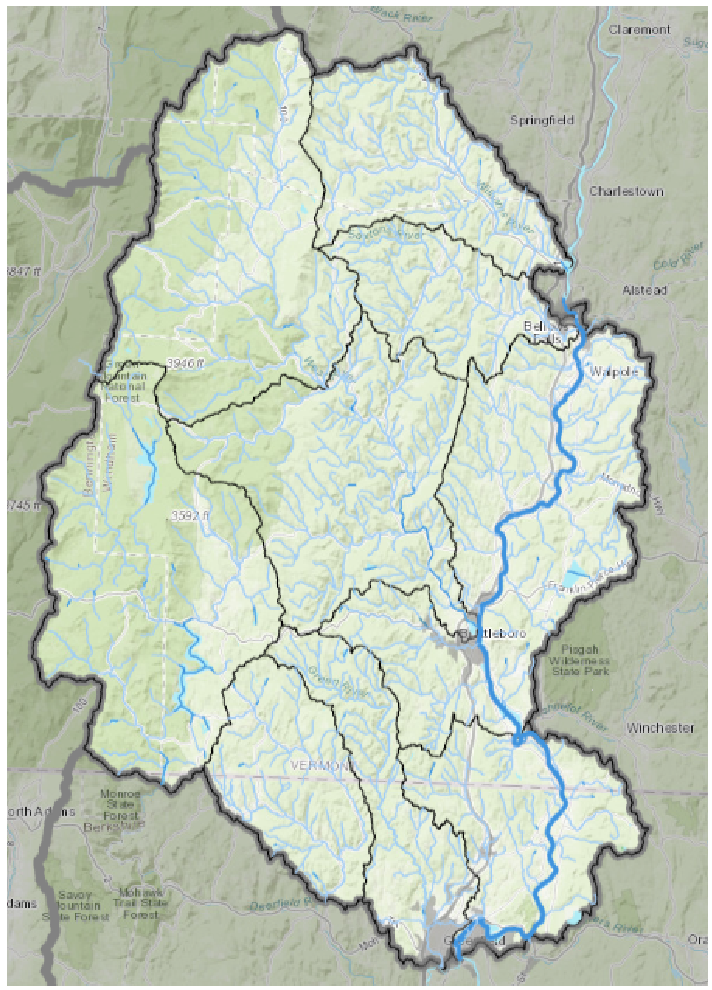
Daniela Rincon-Reyes
Emma Hibbert
Kristin Raub
Robin White
Allison Deese
Shivangi Basu
Members of the Windham Regional Commission

Community Context

The Windham region is located in southeastern Vermont, covering 27 towns, including Brattleboro, the region's largest municipality and economic hub. The terrain rises from the broad Connecticut River valley in the east up into the Green Mountains to the west. The area features a mix of rural villages, forested landscapes, and small urban centers – primarily covered by forests, including spruce, fir, and white pine. Its terrain is mountainous and shaped by a network of rivers and streams, such as the Williams, Deerfield, Saxtons, and West, which connect to the Connecticut River.

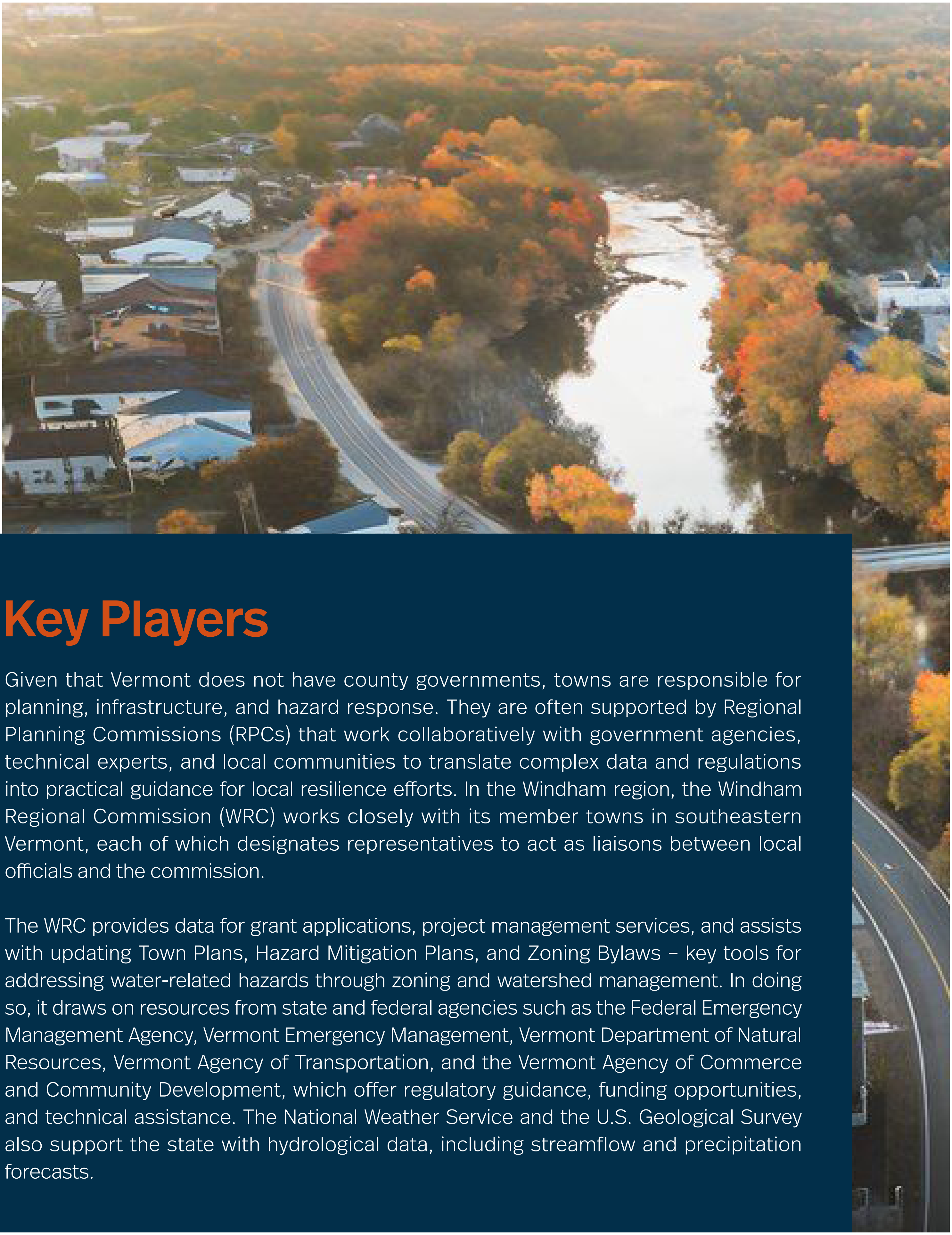
Given the topography and hydrology of the Windham region, water-related challenges include streambank erosion, stormwater runoff, and inundation flooding, particularly in the wake of heavy rainfall events. The region experienced significant flooding during Hurricane Irene in 2011, which devastated infrastructure, washed out roads and bridges, and led to long-term recovery efforts. More recently, heavy rains throughout July 2021 and 2023, as well as December 2020, 2021, and 2023, have led to additional flooding, highlighting the region's continued vulnerability to extreme weather events. Interviewees highlighted that these recent flooding events have elevated conversations in Vermont around preparedness and planning, as many residents have been impacted, including through damaged roadways, washed-out driveways, contaminated wells, and flooded basements.

Overall, residents and local organizations voiced frustration over persistent issues contributing to flood vulnerability in the region. Concerns included historic development in floodplains, outdated or insufficient zoning laws, limited options for relocation without substantial financial support, and undersized road culverts that fail to withstand increasingly intense storms. Fluvial erosion is also shifting river channels, sometimes pushing waterways dangerously close to public infrastructure.



Those experiences [recent floods] certainly gave me a profound immediacy to understanding how important water is.

- Local Committee Member



Key Players

Given that Vermont does not have county governments, towns are responsible for planning, infrastructure, and hazard response. They are often supported by Regional Planning Commissions (RPCs) that work collaboratively with government agencies, technical experts, and local communities to translate complex data and regulations into practical guidance for local resilience efforts. In the Windham region, the Windham Regional Commission (WRC) works closely with its member towns in southeastern Vermont, each of which designates representatives to act as liaisons between local officials and the commission.

The WRC provides data for grant applications, project management services, and assists with updating Town Plans, Hazard Mitigation Plans, and Zoning Bylaws – key tools for addressing water-related hazards through zoning and watershed management. In doing so, it draws on resources from state and federal agencies such as the Federal Emergency Management Agency, Vermont Emergency Management, Vermont Department of Natural Resources, Vermont Agency of Transportation, and the Vermont Agency of Commerce and Community Development, which offer regulatory guidance, funding opportunities, and technical assistance. The National Weather Service and the U.S. Geological Survey also support the state with hydrological data, including streamflow and precipitation forecasts.

Challenges and Information Gaps

Gaps in communication, limited public education on floodplain management, and inconsistent municipal coordination were among the top concerns expressed in interviews with community members, planners, and town officials. They mentioned the need for better on-ground data and forecasting to support flood-related decision-making and emergency planning, including clearer guidance on accessing and using data.

Some residents note lacks of clear communication and engagement from town officials and emergency managers (EMs) around emergency planning efforts – gaps that often widen when key local positions become vacant. At the same time, staffing shortages or the reliance on volunteers in municipal management further restrict the capacity of town officials and organizations to access and act on flood risk data, secure grant funding, or implement best practices in floodplain management. In many towns, a single individual may juggle multiple roles, leaving little room for specialized training or consistent outreach. This lack of capacity is compounded by broader funding constraints to upsize infrastructure like culverts and channelization, and improve public education on floodplains.

In terms of water data needs, a lack of localized stream gauges and historical flood mapping has left many towns relying on incomplete data, making it difficult to understand real-time conditions or predict where the greatest risks lie. For instance, communities in the Saxtons River region relied on a single stream gauge, which was later removed, leaving significant blind spots in flood monitoring and forecasting. Local stakeholders expressed the need for more prescriptive flood risk information that, as one resident described, can help distinguish between "*expecting heavy rains*" or "*getting yourself to a safe place*." There is also a need for understanding what areas are most at risk of fluvial erosion and landslides, and how they interact with steep terrain and river dynamics, to prevent development in those areas. Lastly, interviewees expressed a need for clearer visuals on what could happen during a 50-year or 100-year flood event. Such visuals can support buyout planning, infrastructure protection, and more targeted community outreach.

FloodSavvy: A National Water Model-derived Tool for Accessible Flood Risk Information and Water Decision-Making

NOAA's National Water Model (NWM) simulates streamflow at 18-hour, 10-day, and 30-day intervals, while also storing 40 years of retrospective data for both gauged and ungauged rivers across the U.S. While stakeholders in the Windham region recognized the value of NWM data, they also noted that its technical complexity creates accessibility barriers for first-time users or users without hydrological expertise.

To address this, our team worked together with the Windham Regional Commission to develop FloodSavvy, a web interface that translates complex NWM outputs into clear, actionable flood risk insights for this region. We also created a beginner-friendly NWM Tutorial: A 101 Guide to Understanding and Using the NWM, available in both PDF and video format, to help new users navigate the model. Both resources were shaped with input from Windham stakeholders to ensure they serve as practical, intuitive entry points for applying NWM data to local decision-making. See our project website for more details on FloodSavvy and the co-development process.

After piloting these tools with stakeholders from the Windham region, they identified how NWM data, FloodSavvy, and the NWM Tutorial could help provide an improved understanding of local streamflow patterns, flood risks – especially in ungauged areas, and how these may integrate with Hazard Mitigation Planning.

Applying FloodSavvy's Streamflow and Inundation Maps to Monitor Ungauged Streams and Build Greater Understanding of Local River Patterns

FloodSavvy enables users to select a local river and display historical, modeled streamflow data (2016–present) on a simple hydrograph. Planners saw this as a way to build a greater understanding of local streamflow patterns and monitor ungauged rivers and streams (alongside additional data sources), providing insights that would otherwise be unavailable. WRC staff envisioned using this historical data in hazard mitigation planning to provide an indication of past flood trends and inform development regulations.

Furthermore, *FloodSavvy* provides the capability to view flood maps, or inundation extents, under different streamflow conditions. By combining peak flow values from historical data with flood map visualizations, users can identify locations that could be impacted under potential flood scenarios. While the NWM serves as a critical foundation for streamflow modeling, *FloodSavvy* builds on this by offering an interactive interface that allows users to more easily visualize and contextualize historical data. WRC staff also saw potential for complementing local knowledge of river behavior with historical data and these modeled river projections.

Finally, the ability to screenshot flood maps and download hydrograph data makes it easier to provide flood education to municipal decision makers and to integrate these visuals into official planning documents as well as grant applications for culvert upgrades, wetland conservation, and infrastructure improvements.

> I like being able to see historical streamflow, so that you can see what's high and low. We don't have a lot of gauges in our region, so to have that model is nice.
>
> \- Regional Planner

> Just having that kind of ease of access to show past inundation areas is huge.
>
> \- Regional Planner

What Can You Do If Your Area Is Not Covered by FloodSavvy?

The Windham region users' experience with *FloodSavvy* demonstrates how NOAA's National Water Model (NWM) can be made more accessible and useful for different types of end-users. In the Windham region, for example, *FloodSavvy* provided expanded access to hydrological data that supports mitigation actions. If your community is outside the six currently served by *FloodSavvy*, you can still leverage the NWM in your work. The NWM Tutorial is publicly available and designed for first-time users.

01 Access our NWM Tutorial here.

02 For users interested in Windham's experience, Sections 1–3 walk through how to access streamflow forecasts for both gauged and ungauged rivers via the National Weather Water Service website. Then Section 5 details how to access Flood Inundation Mapping for covered areas experiencing active or forecasted flooding.

03 Other useful resources include:

- National Weather Service Latest Alerts: Active flood warnings across the U.S.
- U.S. Geological Survey Water Data: Comprehensive hydrological data at gauged sites.
- U. S. Geological Survey's Flood Inundation Mapper: Interactive flood maps for select gauged sites.

Funding Acknowledgement: *This research was supported by the Cooperative Institute for Research to Operations in Hydrology (CIROH) with funding under award NA22NWS4320003 from the NOAA Cooperative Institute Program. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the opinions of NOAA.*