



Global Resilience Institute
at Northeastern University

Using The National Water Model As An Educational Tool

Case Location: State of Vermont

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Introduction

The National Water Model (NWM) provides small communities with a helpful and exciting new way of conceptualizing flood risk. As a visual, accessible, and dynamic tool, the NWM gives local practitioners information they need to support their efforts to plan for floods before they happen, so communities can be better prepared to withstand, respond to, and recover from water-related disasters.

The Challenge

In most communities, reactions to and actions to manage flood risk rely on event memory. Rainfall, storm flow, water bodies and water systems are often poorly grasped in terms of choices and decisions. Explanatory data, when available, may only be truly understood by water system experts, to whom most communities lack direct access. The National Water Model, however, enables conversations and engagement about flood resilience that involve the whole community, not just data experts or those who lived through prior flooding events. The NWM is not a floodplain map—it combines precipitation forecasts, the latest USGS topographic data, live input from flow gauges, and decades of historical flow data to tell practitioners where water will be on the ground every day of the year, not just in the worst-case scenarios. These innovative features supercharge local knowledge and empower local experts to better tell the “story” of water and flooding in those communities. Consequently, the NWM allows community members to envision themselves, their homes, their schools, and their workplaces within the ongoing “story” of water and potential flooding in their community.

The Value

This use case offers guidance for practitioners who want to use the NWM to convene and inform conversations about flood risk in their communities. Using insights gained by Vermont practitioners in convening flood-resilience discussions with small communities, this use case outlines the features that make the NWM a powerful educational tool for a wide variety of community stakeholders. By encouraging communities to approach flooding as one aspect of the water systems they live alongside year-round, rather than as a stand-alone event, the NWM helps combat disaster amnesia and promotes a living understanding of water and its relationship to the locations where people live, work, and play.

Partner Community Overview

Vermont, a small state in both geography and population, faces a number of challenges common to rural areas across the United States. Nearly two-thirds of Vermont’s approximately 650,000 inhabitants live in rural areas, the highest share of any state. However, unlike most heavily rural states, Vermont has no county governments. Instead, Vermont’s Regional Planning Commissions (RPCs) provide some support services to officials from member towns, but provide few public

services directly to local residents. Consequently, many public services, from road maintenance to land use planning, are provided by the state's 254 municipalities, only 29 of which have a population of more than 5,000 people. Given that most towns have only a small number of staff to carry out the many functions and duties required to successfully manage a town. Vermont's municipal structure makes the convening and support role of the state government essential, especially in the aftermath of disasters such as the severe flooding Vermont experienced in July 2023.

After the July 2023 flood, some Vermont towns asked, "What more can upstream neighboring towns do for their downstream neighboring towns to reduce flood risks?" The VT Agency of Natural Resources (ANR) [Flood Ready Vermont](#) web site answers this question by guiding towns towards greater flood resilience by providing information on post-disaster funding, tools, and data to assess current flood readiness of towns. The many web links provide useful tools communities can use to find resources such as the [Vermont Flood Ready Atlas GIS](#) mapping tool, [community reports](#), [emergency relief and assistance funding](#), the [National Flood Insurance Program](#), as well as [flood training opportunities](#) for the public and municipal officials.

In addition, state officials identified flood amnesia, the tendency of communities to forget about the impacts of flooding over time, as a major impediment to resilience-building. Because infrastructure is perceived to be strong, and floods causing mass devastation are assumed to be rare and usual events, flood amnesia inhibits communities' sustained attention to, and embracement of, the strategies needed for long-term solutions. As a result, communities often do not take the necessary actions to make them less vulnerable to future flooding. The National Water Model can help communities overcome flood amnesia by providing additional tools that will help the State and its communities respond more effectively, manage more proactively, and build greater resilience to potentially damaging flood impacts.

Case Characteristics and Features

Information gaps make flood amnesia difficult to overcome, even in communities eager to address flood risk proactively. The Vermont Agency of Natural Resources (ANR) seeks to fill these gaps by creating opportunities for municipal stakeholders to leverage state-level capacity and expertise. Vermont's [2023 State and Local Municipal Day](#) proactively convened state and local stakeholders around flood resilience to help a variety of community stakeholders who are NOT water experts (e.g., town managers, planning committee members, road superintendents, and emergency managers) better understand flooding and the best practices which can help build greater resilience. In this way, state officials proactively identified the opportunity to combat flood amnesia by encouraging a forward-looking approach to advancing mitigation efforts for unaffected communities while also working to embed resilience measures into the recovery of impacted communities. Such proactive convening with the aid of the NWM helps communities learn to live alongside their waterways by using the model to provide local stakeholders with the data and information needed for forward-

-looking and informed community-level discussions about flood risk.

The NWM's visualization features allow stakeholders without special expertise in water to use hydrological data to better understand potentials for flooding temporally and geospatially and thus engage in collaborative solutions that will bolster flood resilience. In a state with many ungauged waterways, the NWM provides many communities with the first water data that they have ever had access to on a municipally-relevant scale. By combining topographic data, precipitation predictions, and live information existing streamflow gauges, the NWM generates flow predictions for entire watersheds, including waterways upstream of any gauges. Rather than relying on static floodplain maps, communities which previously had no hydrological data at their disposal can now access current, historical, and near-term forecast data on local waterways.

Tool Comparisons and Limitations

The National Water Model differs from other resources in its features and uses. When fully deployed, the NWM's flood inundation mapping ([FIM](#)) feature will display predicted flood extents based on forecasted rainfall over specified time periods, a feature already available in 10% of the continental United States as of May 2024. This experimental feature, which is still under development, does not yet estimate water depth. While the NWM provides short-term guidance out to thirty days and can perform retrospective runs, it is not a global circulation climate model because it is not designed to predict climate conditions years into the future. The [Next Generation framework](#) (NextGen), also under development, is anticipated to further improve the NWM's localized predictions.

A key difference between the NWM and other sources of flood information is that the NWM is not tied to any regulatory authority. This means that the NWM cannot be used to satisfy federal disaster recovery assistance and flood insurance eligibility requirements. However, stakeholders may be more receptive to its use as an education and outreach tool for this same reason. While the NWM's FIM can be used to forecast flood extents for near-term rainfall events, FEMA's Flood Insurance Rate Maps (FIRM) show the probability that flooding will occur in a particular location in a given year, with probabilities in excess of 1% indicating high risk. Unlike the NWM, FEMA FIRMs meet and can be used for flood-related planning and satisfy community regulatory obligations under the National Flood Insurance Program. Although digitization is underway, many of the FEMA FIRM maps are decades-old and are exclusively available as hard copies. Unlike the NWM, which generates live predictions extending out 30 days, the FEMA FIRM maps are static and show 100-year and 500-year flood predictions, as well as Special Flood Hazard Area designations. They are indications of where flooding is a known possibility but do not predict where it is likely to occur during an upcoming weather event. The National Water Model uses 40 years of retrospective flow and inundation data to train its predictive model. This data is available upon request for communities seeking more detailed historical flood data, like information from a known historical flood event.

Lessons for Communities

By providing real-time river forecasting, flood inundation visualizations, and an overview of local water systems, the National Water Model puts a wealth of water data into the hands of community leaders. In Vermont, the NWM enabled forward-looking community engagement and planning about flood risk, even where flooding has not occurred recently. The NWM's live flow forecasting, flood inundation mapping, and available retrospective data help to combat flood amnesia by helping communities understand destructive anomalies in their full historical and geographic contexts. As the National Water Model continues to evolve and improve, its value as a convening and educational aid will only grow, enabling flood-prone communities to prevent flood damage before it happens.



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