10. NATURAL HAZARDS

In this section we review the most prevalent natural hazards in the NVCOG region and describe hazard mitigation strategies to reduce or eliminate long-term risks to people and property caused by natural hazards. Human activities may enhance the impact of a natural hazard, and they may also eliminate or reduce them through hazard mitigation actions. The hazard mitigation section will cover the development of comprehensive hazard mitigation plans and projects to protect citizens and their property from exposure to natural hazards.

Image: Jonathon Gruenke/The Daily Press via AP

10. NATURAL HAZARDS

10.1 What are Natural Hazards?

Natural hazards are natural events, such as severe weather, that have the potential to threaten lives, property and other assets and tend to occur in the same geographical locations[1]. Natural hazards may cause catastrophic damage to property and critical infrastructure, including power grids, telecommunication systems, transportation networks, and hospitals Such damage often outpaces the governments' ability to address lapses in essential services and poses a direct threat to communities' economic, social, and environmental well-being.

Prospect, CT - property damage from Tropical Storm Isaias, Image: Citizen's News, Elio Gugliotti

The Federal Emergency Management Administration (FEMA) National Risk Index is designed to help communities understand their relative natural hazard risk and the impacts they could expect during or after a disaster. The 18 natural hazards included in the FEMA National Risk Index are:

- Avalanche
- Coastal Flooding
- Cold Wave
- Drought
- Earthquake
- Hail
- Heat Wave
- Hurricane
- Ice Storm
- Landslide
- Lightning
- Riverine Flooding
- Strong Wind
- Tornado
- Tsunami
- Volcanic Activity
- Wildfire
- Winter Weather

The Naugatuck Valley region experiences a range of weather-related events each year, including blizzards, severe thunderstorms, flooding, draught, and tropical cyclones. NVCOG's constituent municipalities are located within Fairfield, Hartford, Litchfield, and New Haven counties. Cumulatively, these counties have been the subject of 33 weather-related Federal Disaster Emergency Declarations since 1954, ranging from hurricanes, severe thunderstorms, blizzards, and flooding.

Natural disasters can and have occurred without federal declarations. Using FEMA's HAZUS-MH software, annualized local loss estimates from natural hazards range from approximately $128,000 per year in Bethlehem to nearly $3.5 million per year in Waterbury. The NVCOG region must prepare for the predicted increase in frequency and magnitude of individual weather events.

NATURAL HAZARD TERMS

NATURAL HAZARD

Environmental phenomena that have the potential to negatively impact societies and the human environment.

NATURAL DISASTER

The **negative impact** following an actual occurrence of a natural hazard in the event that it significantly harms a community.

HAZARD MITIGATION

Efforts to reduce loss of life and property by **lessening the impact of disasters**. In other words, hazard mitigation keeps natural hazards from becoming natural disasters.

Source: FEMA

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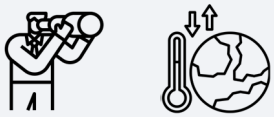
10.2 Climate Change & Sea Level Rise

The region's climate, like the state's, is dominated by a relatively even distribution of precipitation across four seasons, a significant range in temperatures both daily and seasonally, and significant variability in climatic conditions year over year. Generally, the region has a moderate climate with maximum temperatures ranging from 35°F to 40°F in winter to 80°F to 85°F in summer. Average annual precipitation is approximately 86 inches – 46 inches of rain, and 40 inches of snow.

CLIMATE MODELING PREDICTIONS



According to the **Connecticut State Water Plan (2018)** climate models **predict:**

- **Year-round increase in temperature** appearing relatively consistent across calendar months.
- Both **summer and winter temperatures increase by similar amounts**, and a comparable shift is observed for both extremely cold and extremely hot months.
- Shift towards **more pronounced wet seasons,** with **traditionally drier seasons expected to maintain, or slightly increase their precipitation levels.**

Images: Flaticon - aranagraphics, ultimatearm

Climate change is expected to impact temperature, precipitation, and wind patterns and could cause a change in the frequency or intensity of natural hazards. Research suggests that average annual precipitation in Connecticut has increased by 0.95 inches per decade since the end of the 19th century, which also corresponds to an increase in the frequency of severe storms. (Miller et al., 1997; NCDC, 2005).

Given current projections, sea level rise presents a marginal risk to tidally influenced areas of Derby, Shelton, and Ansonia immediately adjacent to the Naugatuck and Housatonic Rivers. It presents a negligible risk to the rest of our region.

10.3 Flood Risk

Due to its geographic location and topographic variability, development in the region particularly impacts the hydrologic systems, i.e. the rivers, streams and brooks that run through and beyond the NVCOG communities.

All 19 NVCOG municipalities are regularly impacted by floods. Flooding impacts vary by the severity of each flood event and may include temporary road closures, minor damage to personal property, failures of dam, septic, and sewer systems, the destruction of homes and businesses and loss of lives.

While populations in floodplains or nuisance flooding areas are directly impacted by flooding, indirect impacts are more widespread. When flooding overtops and closes a roadway or an area is affected by a mudslide, it affects larger traffic patterns. When flooding overwhelms a combined sewer system and the capacity of the downstream wastewater treatment plant, the loss of capacity and potential water quality impacts may affect an entire community.

PREVALENT FLOODING TYPES IN THE NVCOG REGION

RIVERINE - Also known as **overbank flooding**, occurs when channels receive more rain or snowmelt from their watershed than normal, or become blocked by an ice jam or debris. Excess water spills from the channel into its floodplain area.

FLASH - A **rapid rise of water along a water channel or low-lying urban area**, usually results from unusually large amount of rain and/or high velocity of water flow (particularly hilly areas) in a very short period, often with limited warning.

SHALLOW - Occurs in **flat areas** where a lack of a water channel results in **water being unable to drain away easily**. Three types of shallow flooding include: **Sheet Flow**, **Ponding** and **Urban Flooding**.

Source: NVCOG Hazard Mitigation Plan 2022
Image: Flaticon - Freepik

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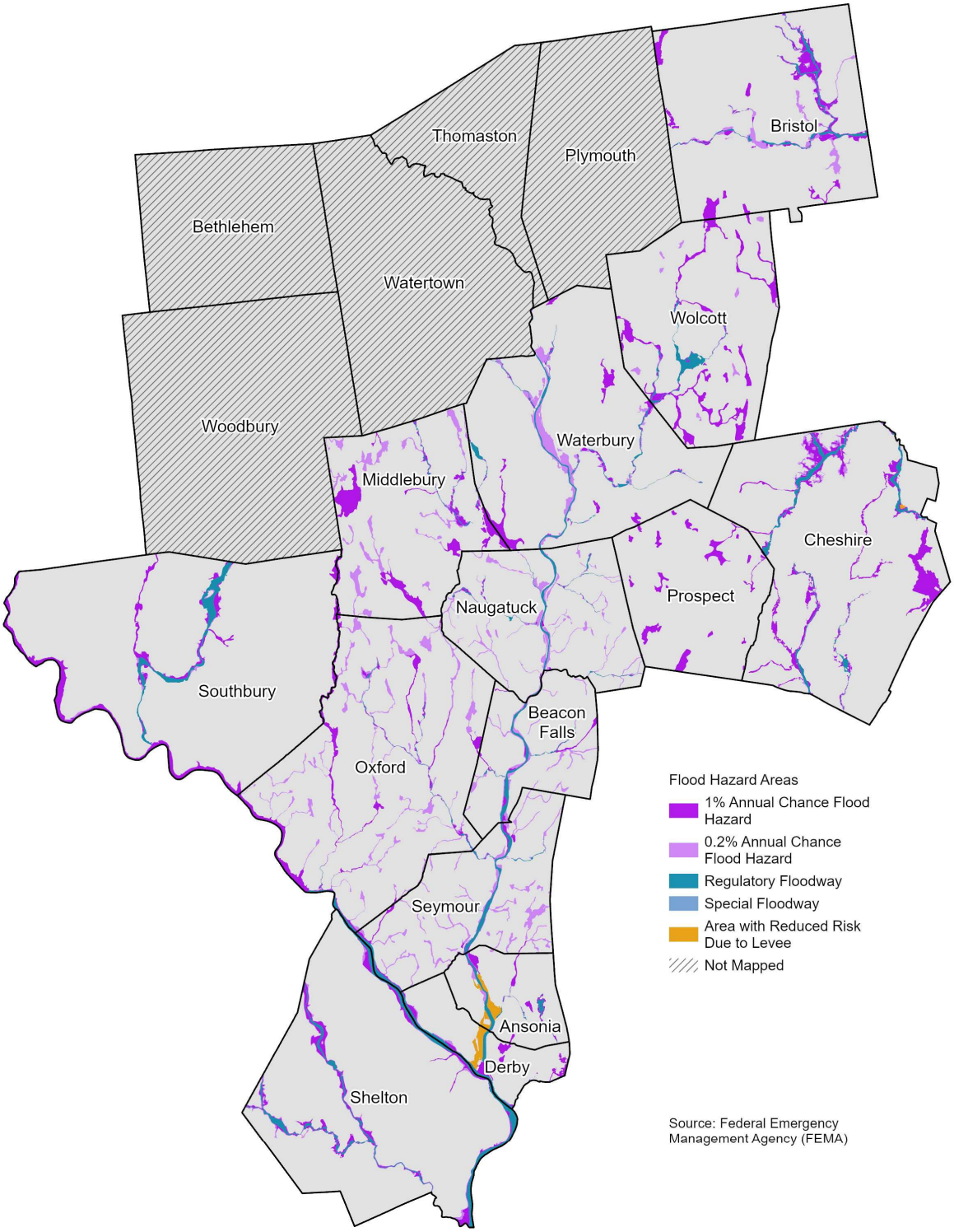
Figure 1 Flood Hazard Areas



10.4 Hurricane-Impacted Areas

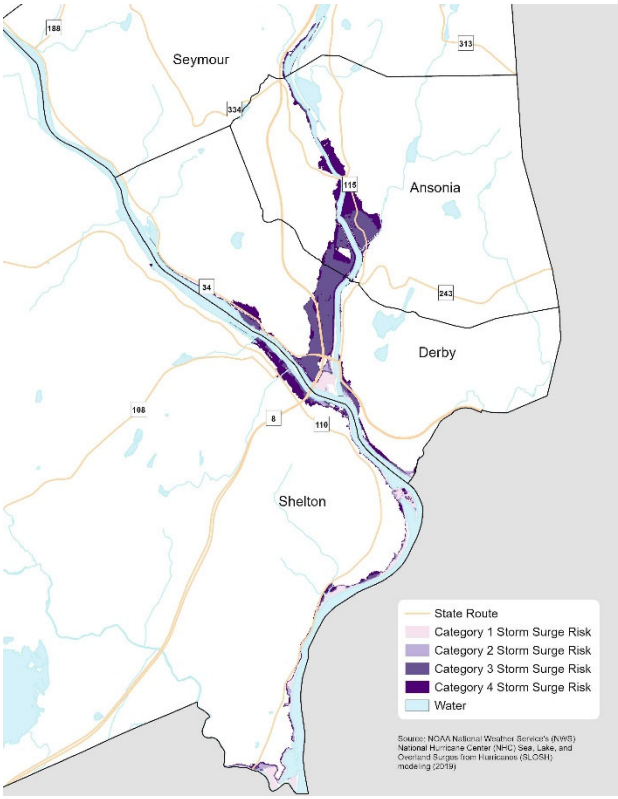
Q: NVCOG REGION'S MOST DESTRUCTIVE NATURAL HAZARD?

A: HURRICANES

Hurricanes are the most destructive natural hazards posed to the entire NVCOG region. Hurricane damage tends to be caused primarily by high winds leading to downed trees, widespread power outages and riverine flooding from intense precipitation.

Storm surge has caused damage as well, with the lower Naugatuck and Housatonic communities marginally impacted by coastal effects. Given the regional impact of hurricanes, the extent of the damage often overwhelms local government's capacity to restore critical infrastructure and essential services. As the climate continues to change, water ocean temperatures are expected to fuel stronger hurricanes, and to enable these storms to retain their strength further northward.

Figure 2 Storm Surge Risk



10.5 Drought-Impacted Areas

All areas of the NVCOG region are susceptible to drought, although the likelihood of crop damage and economic loss is generally greater in rural communities. More developed communities are also susceptible to drought, particularly when the drought impacts the availability of public water supply. In general, NVCOG municipalities are likely to be part of a larger regional area affected by drought as opposed to being individually affected.

PREVALENT DROUGHT TYPES IN CONNECTICUT

HYDROLOGICAL - Characterized by **low streamflow, groundwater, and reservoir levels** resulting from **a lack of precipitation over the course of months**. When the presence of rainfall becomes scarce, streams, rivers, and groundwater can suffer, and water utilities can be forced to set restrictions on usage.

AGRICULTURAL - Occur during the **growing season** due to a **lack of adequate precipitation and soil moisture to sustain crops**. It is determined when the hydration needs of crops are not being sustained by the soil.

MOST RECENT DROUGHTS OCCURRED IN:
1964-1968, 1981, 1987, 2002, 2007-2008, 2012, 2015- 2016, and 2020.

Source: CT Drought Preparedness and Response Plan
Image: Flaticon - Freepik

The entire NVCOG region was abnormally dry as recently as October 2020 after a relatively wet spring season. Litchfield County was designated as a primary natural disaster area in October 2020 by the USDA. Recent water supply incidents in Connecticut occurred in the summer of 2010 and 2015-2016 when local public water utilities needed to declare a water supply emergency. High temperatures combined with spotty rainfall created abnormally dry conditions during these years that persisted into the fall. The dry conditions increased demand for water supply.

Link Between Droughts and Wildfires

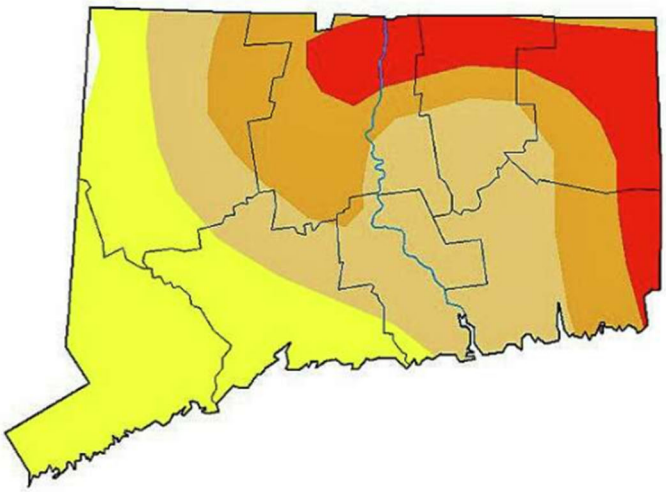
IN CT, FOREST HAS RECLAIMED OVER 500,000 ACRES OF LAND THAT WAS USED FOR AGRICULTURE IN 1914.
Source: CT DEEP
Image: Flaticon - Freepik

During drought conditions, fuels for wildfire, such as grasses and trees, can dry out and become more flammable. Drought can also increase the probability of ignition and the rate at which fire spreads. Drought can be intensified by unusually warm temperatures. When combined with very low precipitation and snowpack, extreme heat can lead to decreased streamflow, dry soils, and large-scale tree deaths. These conditions create increased potential for extreme wildfires that spread rapidly, burn with more severity, and are costly to suppress.

Windham, CT - Burnout operation to mitigate fire intensity at wildfire containment line during drought of 2020, Image- CT DEEP

Drought conditions amplify both the likelihood, and extent of wildfires. Today, most of Connecticut's forested areas are secondary growth forests. According to the Connecticut DEEP, forest has reclaimed over 500,000 acres of land that was used for agriculture in 1914. However, that new forest has been fragmented in recent decades by residential development. The urban/wildland interface is increasing each year as sprawl extends further out from Connecticut's cities. It is at this interface that the most damage to buildings and infrastructure occurs.

Figure 3 Drought Intensity across CT, by county - September 2020



Map released: Thurs. September 24, 2020

Data valid: September 22, 2020 at 8 a.m. EDT

Intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data

Author(s):

Brad Rippey, U.S. Department of Agriculture

10.6 NATURAL HAZARD MITIGATION

Natural hazard mitigation are efforts taken to reduce loss of life and property by lessening the impact of disasters. It is an on-going process that occurs before, during, and after natural disasters and serves to break the cycle of damage and repair in hazardous areas. In other words, hazard mitigation keeps natural hazards from becoming natural disasters.

FOUR GENERAL TYPES OF NATURAL HAZARD MITIGATION ACTIONS:

- Local Planning and Regulations
- Structure and Infrastructure Projects
- Natural Systems Protection
- Education and Awareness Programs

Source: FEMA, 2013, *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*
Image: Flaticon - Freepik

Hazard mitigation actions also have the potential to save money for state and municipal governments; according to the National Institute of Building Sciences findings, every $1 spent on mitigation funding can save $6 in future disaster costs[2]. The following discussion describes some hazard mitigation best practices.

HOW HEALTHY ARE YOUR LOCAL WATER RESOURCES?

Water quality is strongly related to land use. Explore the landscape surrounding the over 4,300 local waterways in CT and test out landscape change scenarios to see what effects they might have, using the UCONN Center for Land Use Education and Research (CLEAR):

LOCAL WATERSHED ASSESSEMENT TOOL

Seymour, CT - Tingue Dam, Image: NVCOG

Retaining Wall, Image: NVCOG

Thomaston Dam, Image: USACE

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Stormwater Mitigation

18.4%

…of NVCOG land cover is classified as **impervious surface**.

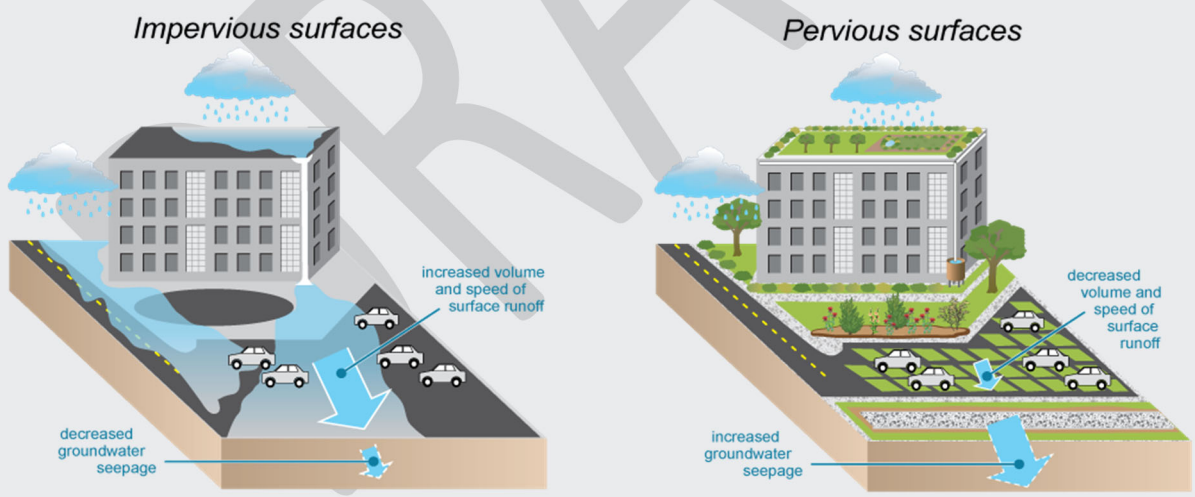
Source: NVCOG GIS, 2016

Strong stormwater mitigation minimizes flooding risks and promotes good surface water quality management. Because watershed boundaries do not coincide with political ones, the actions of municipalities upstream can have a significant impact on the downstream municipality's land and water resources. Stormwater management throughout an entire watershed, with commitment from all municipalities, is critical to protecting the health of the State's resources.

The reduction of land cover that naturally attenuates stormwater flow can result in increased stormwater flows and introduce pollutants to surface waters.

Impervious surfaces, for example, cause rainwater to run off directly into streams, rivers, and wetlands while carrying pollutants like dust, lubricants, tire rubber, animal waste, road salts, invasive seeds, and other surface contaminants. These surfaces may also cause heavier-than-natural peak flows during and after rain events, leading to flash flooding and related damage. As of 2016, impervious surfaces comprise approximately 18.4% of NVCOG regional land cover.

The type of soil present affects the ability of precipitation to infiltrate the ground, which in turn affects the timing and magnitude of flooding. According to the USDA, soils in the region primarily range from well- to excessively drained, with poorly and very poorly drained wetland soils occupying low-lying areas. The ability of soils to encourage infiltration is reduced due to the presence of impervious surfaces that restrict or prevent infiltration.



Impervious 'hard' surfaces (roofs, roads, large areas of pavement, and asphalt parking lots) increase the volume and speed of stormwater runoff. This swift surge of water erodes streambeds, reduces groundwater infiltration, and delivers many pollutants and sediment to downstream waters.

Pervious 'soft' surfaces (green roofs, rain gardens, grass paver parking lots, and infiltration trenches) decrease volume and speed of stormwater runoff. The slowed water seeps into the ground, recharges the water table, and filters out many pollutants and sediment before they arrive in downstream waters.

Conceptual diagram illustrating impervious and pervious surfaces. Impervious surfaces are hard and increase stormwater runoff, causing pollutant and sediment delivery in downstream waters. Pervious surfaces are soft and decrease stromwater runoff, which filters out pollutants and sediments before they arrive in downstream waters.
Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Chesapeake and Atlantic Coastal Bays Trust Fund, 2013. Stormwater Management: Reducing Water Quantity and Improving Water Quality. IAN press, newsletter publication.

Image: Jane Hawkey, Integration and Application Network (ian.umces.edu/media-library)

Figure 4 Major Watershed Basins

Municipal Separate Storm Sewer Systems (MS4)

STORMWATER BEST PRACTICES NOT ONLY PROTECT WATER QUALITY BUT ALSO MINIMIZE FLOODING RISKS.

To promote Low Impact Development (LID) and minimize stormwater runoff, CT state statute mandates compliance with a CT General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4) that went into effect in 2017.[3] The CT MS4 general permit applies to all NVCOG municipalities except for Bethlehem, as it does not fall within an "urbanized area." Compared to the previous permit issued in 2004, this permit represents a drastic increase in municipal responsibility for the management of stormwater and related infrastructure. The six categories of minimum control measures are:

- **Public Education and Outreach**
- **Public Participation**
- **Illicit Discharge Detection and Elimination (IDDE)**
- **Construction Site Stormwater Runoff Control**
- **Post Construction Stormwater Management**
- **Pollution Prevention and Good Housekeeping**

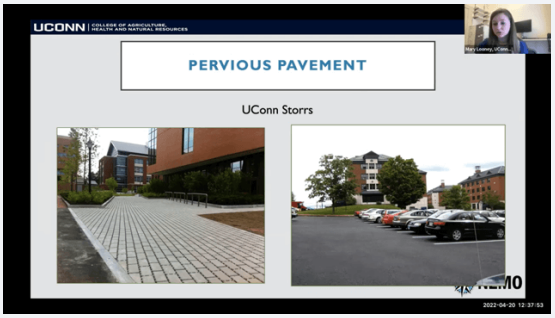
Municipal storm sewer systems refer to municipally owned systems of drains, pipes, outfalls, and other conveyances that discharge runoff to surface waters. Under the MS4 General Permit, Municipalities are required to disconnect 2% of town-owned facilities and roads from directly connected impervious area over the course of the five-year permit. Such disconnection includes ensuring runoff from the impervious surface does not enter the MS4 or that the volume of runoff generated from one inch of rainfall on a site is infiltrated or treated. Municipalities are encouraged to reach compliance with the permit through retrofitting of existing facilities or the design of new ones using green infrastructure tools, especially during road construction.

MS4 COMPLIANCE ASSISTANCE

*Washington, CT - Culvert measurement by Housatonic Valley Association, **Image** - Rory Larson, Steep Rock Association, 2018*

LID Assessment Reports: In 2017, NVCOG developed MS4 and Low Impact Development (LID) assessments for all 19 municipalities to support local efforts to comply with the permitting requirements through amended local regulations for the Illicit Discharge Detection and Elimination, Construction Site Stormwater Runoff Control, and Post-Construction Stormwater Management sections.

Municipal Staff Support: NVCOG hosted an Environmental Sustainability Forum (ESF) event on MS4 compliance in April 2022, with more details available on the NVCOG ESF webpage.



NVCOG Environmental Sustainability Forum - MS4 - 2022, Image: NVCOG

Mapping Stormwater Infrastructure: NVCOG has assisted its municipalities by identifying priority areas for mapping and providing mapping assistance.

Public Outreach: NVCOG has also partnered with the Pomperaug River Watershed Coalition (PRWC) to provide public outreach materials necessary for municipal compliance with the general permit.

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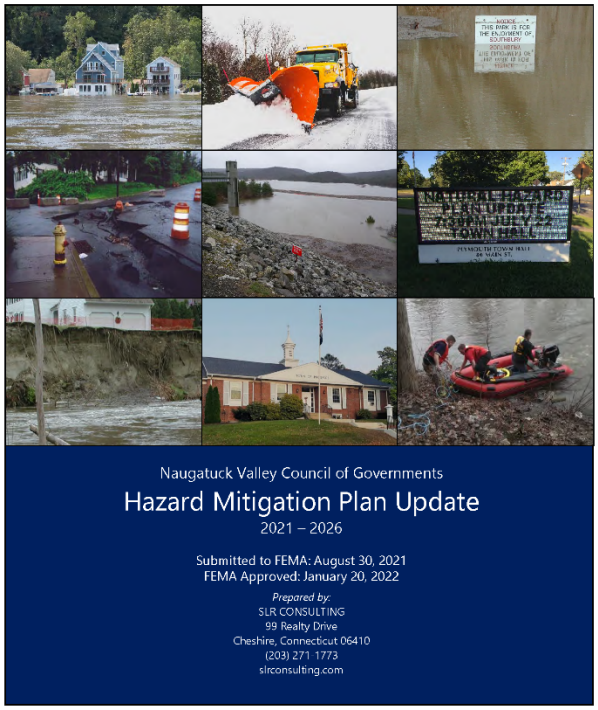
Regional Plan for Multiple Natural Hazards

Municipal Hazard Mitigation Plans (HMPs) identify natural hazards and risks, existing capabilities, and activities that can be undertaken by a community to prevent loss of life and reduce property damage associated with the identified hazards. Public safety and property loss reduction are the driving forces behind these plans, but careful consideration is also to be given to the preservation of history, culture, and the natural environment of the region.



A current Federal Emergency Management Agency (FEMA)-approved HMP is required to qualify a municipality for certain federal hazard mitigation funding. Plans must be updated every 5 years.

In January 2022, the NVCOG Hazard Mitigation Plan Update was published, representing the first multi-jurisdiction hazard mitigation plan to concurrently cover all 19 municipalities in the Naugatuck Valley region served by NVCOG. This hazard mitigation plan uses the "Regional Plan-Municipal Annex" format to provide information pertinent to the entire region in one document, with an annex for each member municipality that provides information specific to that community. With this plan's completion, NVCOG communities may seek funding to complete identified actions included in them through certain FEMA Hazard Mitigation Funding programs. The regional Hazard Mitigation Plan Update and municipal annexes can be reviewed at www.nvcogct.gov/hmp. NVCOG will seek funding for future regional updates.

Natural Hazards Key Takeaways

- **Between 1985 and 2015**, the **NVCOG region increased its developed area by 26%**, to 67,105 acres. The expansion of impervious surfaces increases peak-flood rates and removes land covers that provide natural flood-mitigation.
- There are **5,799 parcels containing 10,816 buildings** that fall within a **100-Year Flood Zone**. 6,849 parcels containing 12,229 buildings fall within a **500-Year Flood Zone**.
- There are **6,509 parcels containing 10,095 buildings** that are at **risk from dam failure**. There are a disproportionately large number of critical facilities (hospitals, power generation, water treatment) located in parcels adjacent to the Naugatuck and Housatonic Rivers.

[1] Source: https://www.maine.gov/mema/hazards/natural-hazards
[2] Source: https://www.maine.gov/mema/hazards/natural-hazard-mitigation
[3] Source: https://nemo.uconn.edu/ms4/permit/