



UVLSRPC Regional Plan 2015

Chapter 9

Hazards and Adaptation

TABLE OF CONTENTS

9.1 HAZARD MITIGATION AND EMERGENCY PREPAREDNESS	9-2
Vision	9-2
Emergency Management.....	9-2
Hazard Mitigation Planning	9-2
Local Emergency Operations Planning.....	9-3
National Flood Insurance Program	9-4
Strategies for Hazards and Emergency Preparedness	9-6
9.2 ADDRESSING CLIMATE CHANGE	9-7
Vision	9-7
Climate Change in the Region	9-7
Adapting to Climate Change.....	9-9
Strategies for Climate Adaptation and Mitigation	9-11
APPENDIX I- GLOSSARY OF HAZARDS.....	9-12
APPENDIX II- MUNICIPAL EMERGENCY COORDINATION TABLES	9-17
Municipal Mutual Aid Agreements in the UVLSRPC Region.....	9-17
Municipal Dispatch Coordination in the UVLSRPC Region.....	9-18
Hazard Mitigation Plan Status in the UVLSRPC Region	9-19
APPENDIX III- CLIMATE CHANGE IN SOUTHERN NEW HAMPSHIRE	9-20
APPENDIX IV- RESOURCES	9-108
APPENDIX V- ENDNOTES.....	9-110

9.1 HAZARD MITIGATION AND EMERGENCY PREPAREDNESS

Vision

The region's communities will proactively identify and implement hazard mitigation measures to protect health, safety, and property by eliminating or reducing damages from natural and human-made hazards.

Emergency Management

Governments, whether local, state, or federal, have the responsibility to provide emergency management to protect their citizenry. There are four approaches for a comprehensive emergency management program:

1. Hazard Mitigation –Actions taken to reduce or eliminate the probability of exposure to a hazard.
2. Preparedness –Having a plan so everyone knows what they must do during events, and having plans and facilities to assist in an emergency.
3. Response – When an emergency or disaster happens, response actions include notifying emergency management personnel of the crisis; warning, evacuating, and sheltering people; keeping the public informed; assessing damage; and requesting help from outside agencies.
4. Recovery – Recovery is restoring infrastructure and the social and economic life of the community.

Regional Emergency Response Cooperation

Municipalities have established several regional cooperative agreements and facilities to ensure that there are adequate shared resources available for responding to emergencies while reducing costs to each municipality. There are many different types of formal agreements in place in the region including:

- All municipalities are members of a Fire Mutual Aid organization.
- Approximately two thirds of municipalities belong to the Public Works Highway Mutual Aid Program.
- Emergency dispatch is a cooperative service in many towns to provide emergency communication coverage to every community for fire, police, EMS, ambulance, and highway.
- Some municipalities have contractual agreements with neighboring towns or other entities to provide emergency response and ambulance services as needed.

Tables in Appendix II summarize the mutual aid cooperation and current dispatch service areas for communities in the region.

Hazard Assistance Programs

The Federal Emergency Management Agency (FEMA) provides funding to New Hampshire municipalities through the Homeland Security and Emergency Management (HSEM) office for the purpose of assisting municipalities to develop hazard mitigation plans. For a municipality to be eligible for certain federal grants to mitigate known hazards, there are three requirements:

1. An up-to-date Hazard Mitigation Plan (every five years);
2. An up-to-date Local Emergency Operations Plan (every five years);
3. Participation in the National Flood Insurance Program.

Hazard Mitigation Planning

Flooding and severe winter weather top the list for hazardous events in our region's municipal hazard mitigation plans. If flooding were to occur in all flood plains in the region,

according to municipal plans, the estimated building damage would be close to \$180 million affecting close to 2,000 buildings.

The purpose of hazard mitigation planning is to reduce, avoid or eliminate the risk of loss of life or property likely to be caused by future natural disasters or emergencies; for example, some common hazard mitigation strategies are:

- Replacing a culvert with a larger one on a section of road that consistently floods every spring. This mitigates the risk of future road wash-outs and saves the municipality the expense of fixing road wash-outs every spring and the resulting interruption to travel.
- Installing lightning protection devices in buildings that have a history of being hit by lightning. This reduces the risk of fire and electrical surges damaging electronics including communications equipment and computers.
- Adopting regulations or ordinances to restrict further development in known hazard areas, such as the floodplain or on steep slopes.

Appendix II includes a summary table of the municipal hazard mitigation plan status for each community in the region.

Local Emergency Operations Planning

A Local Emergency Operations Plan (LEOP) is a guide for coordinating emergency response when an emergency or natural disaster occurs. It is often confused with the Hazard Mitigation Plan, but a hazard mitigation plan is intended to reduce or eliminate impacts from hazards before they occur, or before they can happen again. The LEOP process helps the municipality to prepare for responding to an emergency by defining and identifying: 1) Warning contacts and protocols; 2) Issuance and Dissemination of Emergency Public Information; 3)

Evacuation procedures and venues; and 4) Shelter-in-place and public shelter protocols.

Emergency Operations Plans align with the National Incident Management System (NIMS). This system was established after the 2001 terrorist attacks to provide a consistent, nationwide template for Federal, State, tribal and local governments to work with nongovernmental organizations and the private sector to prevent, protect against, respond to, recover from, and mitigate the effects of incidents. NIMS is not a plan itself, but a system to develop a plan that includes the following:

- Assign responsibility to organizations and individuals for carrying out specific actions at projected times and places in an emergency that exceeds the capability or routine responsibility of any one agency, e.g., the fire department.
- Set forth protocols outlining individual and organizational authority, relationships, responsibilities, and coordination of actions.
- Describe how people and property will be protected in emergencies and disasters.
- Identify personnel, equipment, facilities, supplies, and other resources available within the municipality or by agreement with other governmental entities, nonprofit organizations or even private businesses- for use during response and recovery operations.
- Identify steps to address mitigation concerns during response and recovery activities.

One important piece of the Local Emergency Operations Plan is the list of local, regional, and state emergency contacts. Local contacts may include local contractors with a backhoe or other heavy equipment or a local grocery store that could supply emergency food for a shelter. Regional contacts might include the New

Hampshire or Vermont Red Cross (which serves some NH Upper Valley towns), local Medical Emergency Response Corps, and other non-profit organizations.

National Flood Insurance Program

Participating in the National Flood Insurance Program (NFIP) is considered a hazard mitigation strategy because it allows property owners in the floodplain to obtain affordable flood insurance. Recent changes to the NFIP will affect some property owners that in the past received a federal subsidy on their flood insurance premiums; the federal subsidy is in the process of being phased out and premiums will rise substantially.

Eighty-five percent (85%) of the region's municipalities are participants in NFIP. There are only five buildings in the region that are considered "repetitive loss buildings" with a total payout for damages of \$210,000 since the beginning of the program. Repetitive loss simply means that the owners have submitted for damage payment more than once. There were 90 other flood insurance claims in the region at a value of \$1.7 million since the beginning of the program.

The New Hampshire Office of Energy and Planning administers the NFIP, which is a partnership between a community and the federal government to mitigate the risk for loss of lives and property. Communities participate by agreeing to adopt and enforce a floodplain management ordinance designed to reduce future flood risks and in return all residents in those participating communities can purchase flood insurance.

There is no fee to join NFIP. The NFIP regulations do not restrict development in the floodplain, but rather provide minimum regulations for building standards to reduce flood damage. A community has the option to adopt regulations that have more protective building standards than those

required by NFIP. If a community is not a participant in NFIP:

- Property owners will not be able to purchase NFIP flood insurance policies.
- Federal grants or loans for development will not be available in identified flood hazard areas under some federal programs.
- Federal disaster assistance for flood damage will not be provided to repair insurable buildings located in the identifiable flood hazard areas.
- Federal mortgage insurance or loan guarantees will not be provided in identified flood hazard areas.
- Federal insured or regulated institutions are allowed to make conventional loans for insurable buildings in flood hazard areas of non-participating communities—however, the lender must notify applicants that the property is in a flood hazard area and that the property is not eligible for Federal disaster assistance (some lenders voluntarily choose not to make these loans).

Disaster Declaration

In 1988, the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. § 5121-5206, was enacted to support state and local governments and their citizens when disasters overwhelm them. This law, as amended, establishes a process for requesting and obtaining a Presidential Disaster Declaration, defines the type and scope of assistance available from the Federal Government, and sets the conditions for obtaining that assistance. FEMA, now part of the Emergency Preparedness and Response Directorate of the Department of Homeland Security, is tasked with coordinating the response.

The Stafford Act (§401) requires that: "All requests for a declaration by the President

that a major disaster exists shall be made by the Governor of the affected State.” State and Federal officials conduct a preliminary damage assessment (PDA) to estimate the extent of the disaster and its impact on individuals and public facilities. This information is included in the Governor’s request to show that the disaster is of such severity and magnitude that effective response is beyond the capabilities of the State and the local governments and that Federal assistance is necessary.

Based on the Governor’s request, the President may declare that a major disaster or emergency exists, thus activating an array of Federal programs to assist in the response and recovery effort.

Not all programs, however, are activated for every disaster. The determination of which programs are activated is based on the needs found during the damage assessment and

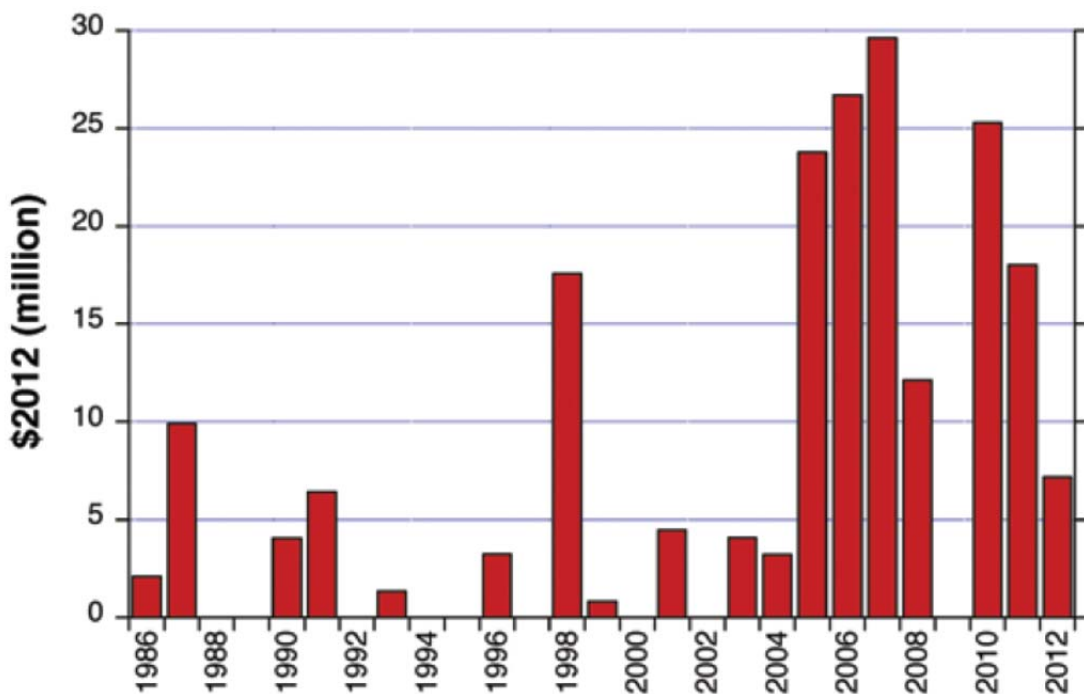
any subsequent information that may be discovered.

FEMA/Emergency Preparedness & Response disaster assistance falls into three general categories:

- Individual Assistance: Aid to individuals and households.
- Public Assistance: Aid to public and certain non-profit entities for certain emergency services and the repair or replacement of disaster damaged public facilities.
- Hazard Mitigation Assistance: Funding for measures designed to reduce future losses to public and private property.

Some declarations will provide only individual assistance or only public assistance. The major Presidentially Declared Disasters and Emergency Declarations for New Hampshire from 1986 to 2012 are summarized in the figure below.

Figure 9.1.1- Federal Expenditures on Presidentially Declared Disasters and Emergency Declarations in New Hampshire from 1986 to 2012 (adjusted to 2012 dollars)¹



Strategies for Hazards and Emergency Preparedness

- Inventory and evaluate critical culverts, bridges, and dams to meet operational standards as determined by the local communities. Bridges should also be evaluated for ice jams. Develop replacement programs.
- Complete fluvial erosion hazard assessments for the Sugar, Mascoma, and Connecticut Rivers. Incorporate fluvial erosion into hazard mitigation plans to evaluate local susceptibility to riverine erosion and to identify homes and infrastructure at greatest risk from eroding or weakening stream banks.
- Evaluate municipal Master Plans, policies and regulations to determine if they assist or deter hazard mitigation efforts. (e.g. minimize further development in flood plains, protect steep slopes from overdevelopment and inappropriate logging operations, protect wetlands for flood absorption, and evaluate building codes for things like lashing of propane/gas tanks)
- Advocate for federal re-evaluation of FEMA floodplain mapping to make them more accurate for planning and development purposes. Consider other methods of accurate floodplain delineation.
- Encourage municipalities to participate in the National Flood Insurance Program and have up-to-date Hazard Mitigation Plans and Emergency Operations Plans.
- Identify priorities from the municipal Hazard Mitigation Plan and add needs for Emergency Management. Incorporate these items into the municipal Capital Improvement Program. Evaluate funding sources through FEMA and NH HSEM.
- Enforce 911 numbering system to assist emergency responders in locating properties.
- Provide ongoing educational opportunities to engage the public in the hazard mitigation and emergency management of the municipality. Teach how individuals, families, schools, and businesses can be prepared for an event.
- Work with schools as a team in emergency preparedness.

9.2 ADDRESSING CLIMATE CHANGE

Vision

The region will anticipate, prepare for, respond to and recover from climate change impacts in a way that minimizes significant disruption to communities including health, safety, built environments, food availability, natural resources, wildlife and financial strength.

Climate Change in the Region

While it is well understood that climate change is a naturally-occurring phenomenon, there is a growing body of scientific evidence indicating human activities are influencing the Earth's climate system.

As part of the Granite State Future project the state's regional planning commissions engaged Climate Solutions New England to prepare two regional studies addressing climate change for northern and southern New Hampshire. These reports describe how the climate of New Hampshire has changed over the past century and how the future climate of the region will be affected by a warmer planet due to human activities. The following information is a brief synopsis of the full report, *Climate Change in Southern New Hampshire*, which is included in Appendix III of this chapter.

Overall, southern New Hampshire has been getting warmer and wetter over the last century, and the rate of change has increased over the last four decades. Detailed analysis of data collected at three U.S. Historical Climatology Network meteorological stations in Keene, Durham, and Hanover reveals the following changes since 1970:

- Average annual maximum temperatures have warmed 1.1 to 2.6°F (depending on the station) with the greatest warming

occurring in winter (1.6 to 3.4°F).

- The number of days with minimum temperatures less than 32°F has decreased, and the coldest winter nights are warming.
- The length of the growing season is two to four weeks longer.
- Annual precipitation has increased 12 to 20 percent.
- Extreme precipitation events have increased across the region, which are evident in the several large floods that have occurred across New Hampshire over the last decade.
- The number of snow-covered days has decreased by twelve days in Hanover.
- More than a century of observations show that spring lake ice-out dates on Lake Sunapee are occurring ten to twenty days earlier today than in the past.

Future climate projections for southern New Hampshire simulated temperature and precipitation from four Global Climate Models and adjusted to New Hampshire using regional historical weather observations. These future climate projections followed two possible scenarios:

- Lower Emission Scenario: Global improvements in energy efficiency and development of renewable energy results in reduced emissions of heat-trapping greenhouse gases below 1990 by the end of the twenty-first century.
- Higher Emissions Scenario: Fossil fuels are assumed to remain a primary energy resource and emissions of heat-trapping greenhouse gases grow to three times those of today by the end of the century.

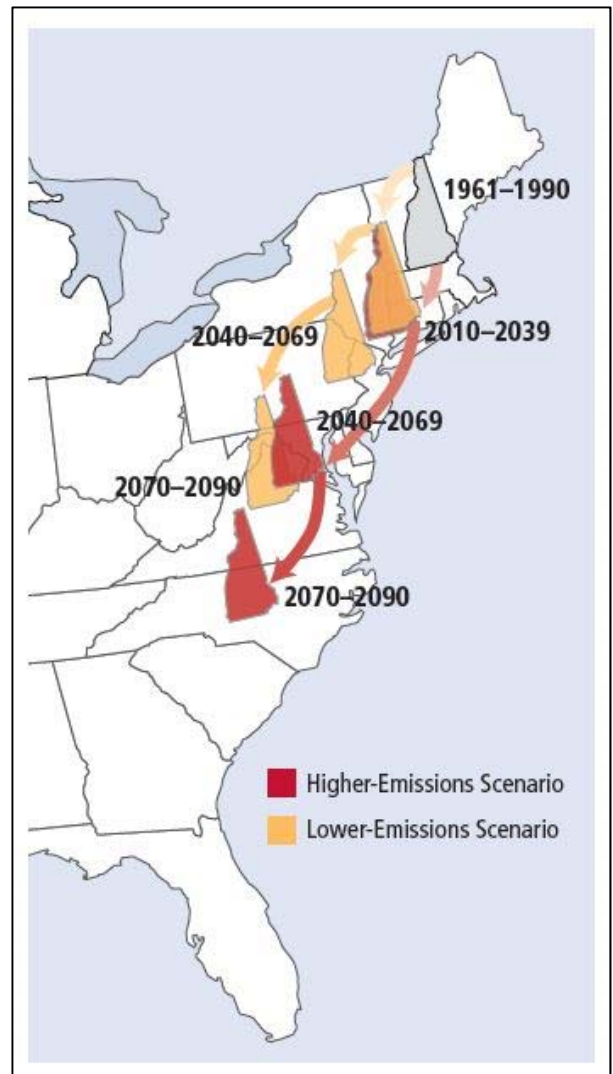
The report provides an overview of the likely climate-related outcomes under both

scenarios. The image to the right visually represents how summers are projected to feel under either scenario. Projected outcomes of the two climate change scenarios include:

- Mid-century annual average temperatures may increase 3 to 5°F, and end-of-century annual average temperatures may increase as much as 4 to 8°F.
- Average summer temperatures may be up to 11°F warmer under the higher emissions scenario (compared to the historical average from 1980 to 2009).
- The frequency of extreme heat days is projected to increase dramatically, and historically hot days will be even hotter.
- Extreme cold temperatures are projected to occur less frequently, and extreme cold days will be warmer than in the past.
- Annual average precipitation is projected to increase 17 to 20 percent by end-of-century.
- The frequency of extreme precipitation events may increase significantly. Under the high emissions scenario, storm events that drop more than four inches of precipitation in forty-eight hours are projected to increase two- to three-fold by the end of the century.

Observed changes in climate have correlated to significant impacts to New Hampshire's environment, ecosystems, economy, and society. The National Climate Assessment, released May 2014,³ identified seven societal and environmental sectors affected by climate change and reflected in this Regional Plan:

- Water resources;
- Human health;
- Energy supply and use;
- Transportation;
- Agriculture;
- Forests, and;
- Ecosystems and biodiversity.



*Above: Projected Summer Climate Shifts 2007
Northeast Climate Impacts Assessment, Union of
Concerned Scientists²*

Observed climate changes over the past several decades are already having a significant impact on New Hampshire.

- The impact of extreme, sustained heat on human health, infrastructure, and the electrical grid.
- Winter warming may reduce heating bills and the risk of cold-related accidents and injury. However, warming winters will reduce opportunities for snow and ice related recreation (and related economic activity).
- Winter warming would also allow some

pests and invasive species to enter the Region that have historically not survived winter temperatures. Winter warming would also affect the habitat and sustainability of New Hampshire's more cold-adapted native flora and fauna.

- The growing season will get longer, which may provide opportunities for farmers to grow new crops. Many existing crops will likely experience yield losses associated with increased frequency of high temperature stress, more frequent extreme weather events (e.g.: erosion from rain or plant damage from hail), inadequate winter chill period, and increased pressure from invasive weeds, insects, or disease.

Communities may respond to climate change by following two different approaches: mitigation or adaptation⁴ or a combination thereof.

Mitigation: The New Hampshire Climate Action Plan calls for the reduction of greenhouse gas emissions and provides an in-depth analysis of actions for local, regional and state agencies to reach the Plan's long-term goals: Reduce greenhouse gas emissions to 20 percent below 1990 emissions by 2025 and to 80 percent below 1990 emissions by 2050.⁶

Adaptation: Communities, businesses, and residents will need to prepare and plan for climate change to minimize the risks associated with natural disasters and extreme weather events. The increasing frequency and cost of damaging natural disasters as illustrated on Figure 9.1.1 on Page 9-5 makes a clear case that adaptation needs to be a regional priority

Adapting to Climate Change

Based on the findings of the climate change study in Appendix III it is not a question of if

climate change is happening, but rather a question of how badly the Region's communities will be affected. Severe weather events can have a significant impact on local and regional transportation, infrastructure, natural resources, and public health and safety. As they become more frequent and severe, communities will find increased pressure to adapt to the conditions, but the process for adaptation may not be the same from community to community.

Various adaption planning and implementation strategies can occur simultaneously as part of a broader process, which includes characterizing vulnerabilities, developing options, implementing actions, monitoring outcomes, and reevaluating strategies. Communities should discuss, analyze, and then determine which adaptation strategies to implement based on their specific vulnerabilities to climate change and local economic, environmental, and social conditions.⁷ While practicing adaptation will benefit a community's capacity to minimize the risk of a natural disaster, there needs to be a balance that considers overall community goals, economic, societal, and environmental needs as well as the benefits of the individual and collective actions.

Vulnerability Analysis: *The Sunapee Watershed Stormwater Infrastructure Project (2012)*⁵ used detailed watershed analyses and climate projections to assess drainage system vulnerability to development pressures and climate change. For the towns in the Lake Sunapee watershed, the study concluded that:

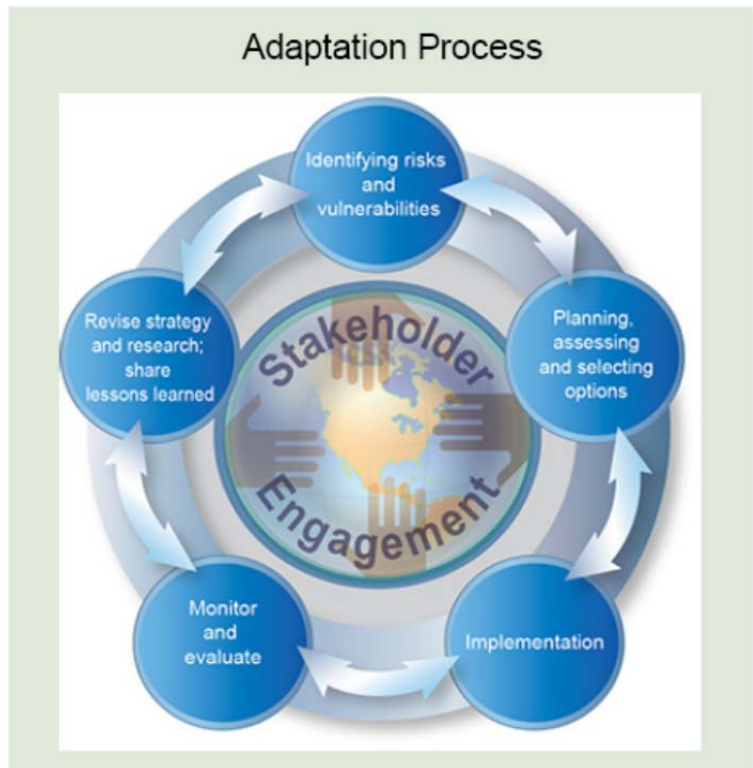
- *Under current conditions, 12% of culverts are undersized for a severe storm event.*
- *35% of culverts are expected to be undersized by mid-21st century for a similar storm event.*

The best effect this process will have is within existing local plans, policies, and practices that have been amended to address the vulnerabilities of the local community. Fortunately for New Hampshire communities, there are opportunities for adaptation available within existing planning and regulatory processes. Specific examples are available for reference in Appendix IV.

Efforts to address climate change should seek input, participation, and support from community members. This may be achieved through specific outreach to neighborhoods or interest groups, municipal meetings, or through larger community events.

As communities adopt various adaptation strategies they are encouraged to monitor their effectiveness. At the time of this Regional Plan there are limited methods of evaluation. Each community should include in its planning and implementation process consideration for measuring the success of the adaptation measure.

At the regional level, the UVLSRPC has strongly supported the continued development of the Upper Valley Adaptation Workgroup (UVAW). The UVAW is a bi-state, multi-stakeholder working group of local leaders, businesses, medical and educational institutions, and advocacy organizations. Started in December of 2011, the workgroup meets regularly focusing on the aim of building climate resilient communities in the



*Above: Generalized Adaptation Process
(Source: National Climate Assessment, 2014)*

Upper Valley Region of Vermont and New Hampshire.

The UVAW has held a series of well-attended local workshops focused on developing community and economic resiliency. UVLSRPC has provided staff and website support to the UVAW, and should continue to remain engaged in developing and growing this important workgroup.

Strategies for Climate Adaptation and Mitigation

- Support the local and regional implementation of mitigation strategies identified in the New Hampshire Climate Action Plan.
- Integrate planning for transportation, land use, human health, natural resources, and ecosystem services.
- Integrate zoning, land use, and resource conservation – environmental and floodplain regulation, conservation subdivision incentives in high-risk areas, village center zoning, transfer of development rights, open space, and land preservation.
- Support the continued development and growth of the Upper Valley Adaptation Workgroup (UVAW).
- Encourage Sustainability and Smart Growth planning- mixed use development and village development, conservation/open space subdivision, alternative transportation access, and preservation of agricultural lands.
- Assist communities in conducting regulatory audits to identify barriers and incentives to implement climate change planning and adaptation at the local level (zoning, regulations, and master plan).
- Encourage integration of climate change into local plans – master plans, hazard mitigation plans, open space/land conservation plans, and regional health assessments.
- Adopt long-range infrastructure investments and improvements into capital improvement plans (CIPs) and maintenance plans.
- Encourage municipal participation in the FEMA Community Rating System to reduce flood insurance premiums
- Encourage cooperative agreements among municipalities (e.g.: water and sewer services, equipment, staff, and integrated transportation, land use, and environmental planning).
- Develop a plan for regional implementation of recommended actions from the NH Climate Action Plan.
- Develop watershed-level plans to evaluate natural and constructed flood storage options upstream of existing areas of concentrated development that are at risk of flooding.
- Consider moving or discontinuing roads when damaged by repeated flood events prior to repairing in place.
- Encourage the Federal Emergency Management Agency (FEMA) to utilize current scientific projections of storm intensity and frequency in revisions to flood maps so that regulations are anticipating climate changes.
- Avoid constructing critical facilities and community assets in the 100-year flood zone unless elevated at least two feet above the base flood elevation and outside of erosion risk areas or hardened to withstand flood forces.

APPENDIX I- GLOSSARY OF HAZARDS

A “hazard” can be defined as a natural or human-caused threat that may result in an emergency or disaster with the potential to cause harm or other undesirable consequences. Natural and human-caused hazards occur in every municipality. In our region, the more common hazards municipalities address in their hazard mitigation planning include the following.

Flooding

Flooding is the inundation of normally dry land. Common impacts of flooding include damage to personal property, buildings, and infrastructure; bridge and road closures; service disruptions; and injuries or even fatalities.

Local Example: In 2005 in Acworth, the Cold River flooded in South Acworth village along Route 123A—the only numbered route in the town and a key east-west corridor for southern Sullivan County. More recently in June 2013, the Federal Emergency Management Agency declared a disaster in Grafton and Sullivan Counties for severe storms, flooding and landslides.

Dam Failures

Dam failures occur when a dam is breached and water flows uncontrolled through or over the dam.

Local Example: A dam does not have to be located in a particular town to affect it. The Moore Dam in Littleton, the Comerford Dam in Monroe, and the Wilder Dam in Wilder, VT impacts any town south of the dams along the Connecticut River. In 1996, the Cold Brook Pond Dam in Lempster had a progressive failure which caused complete erosion of the vegetated

emergency spillway.

Hurricanes and Tropical Storms

Hurricanes and tropical storms are violent storms with intense winds, heavy rain, a storm surge, floods, coastal erosion, landslides, and tornadoes. The season for hurricanes is June through November, with most hurricanes occurring mid-August to late October. The Saffir/Simpson scale is one scale to measure the intensity of the hurricane. While these weather events most significantly threaten coastal communities Tropical Storm Irene demonstrated how inland landscapes and communities can be affected.

Local Example: One of the most notorious hurricanes to occur in our region was the Hurricane of 1938, which hit New England and killed up to 800 people. In contrast, Hurricane Irene (and then Tropical Storm Irene) in 2011 killed 16 people, which is probably in large part due to our more recent warning systems and better preparedness.

Tornadoes and Downbursts

A tornado is a violently rotating column of air that has contact with the ground and is often visible as a funnel cloud. The destruction caused by tornadoes ranges from light to catastrophic depending on the intensity, size and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings and particularly manufactured homes. Tornadoes are more likely to occur during the months of March through May and tend to form in the later afternoon and early evening.

Local Example: In April 2007, a major wind event damaged structures, power lines and trees in Lyme. A portion of the community was without power for several days.

Thunderstorms, Hail, Lightning

Hailstorms are potentially damaging outgrowths of severe thunderstorms, and can cause substantial damage to vehicles, structures, landscaping, and other areas of the built environment. Agriculture is often affected by hailstorms, which cause severe crop damage even during minor events. Lightning is a discharge of electrical energy that results from the buildup of positive and negative charges in a thunderstorm. On average, 55 people are killed and hundreds are injured each year by lightning strikes in the U.S. Lightning can strike communications equipment (e.g. radio or cell towers, antennae, satellite dishes, etc.) and hamper communication and emergency response. Lightning strikes can also cause significant damage to buildings, critical facilities, and infrastructure, often due to an electrical surge or igniting a fire. Lightning can also ignite a wildfire in remote, undeveloped areas.

Local Example: In Sunapee, there have been a few structure fires caused by lightning over the last several years. Lightning has caused damage to the water filtration plant electrical system on several occasions including a storm which caused substantial damage to office equipment. Fuses were installed to prevent future damage, and the fuses must be changed five to six times a year due to lightning. In addition, the nearby town offices received damage to their computer and radio equipment in 2004.

Severe Winter Weather

Severe winter storms may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. Severe winter weather can down trees, cause widespread power outages, damage property, and cause fatalities and injuries.

Local Example: Severe winter weather is common in our region. There was a declared disaster for a severe winter storm as recent as February 2013. In 1998, an ice storm caused over \$3 billion worth of damage in the northeast and millions of people lost power – some for an extended period. This was an historic event because of its prolonged duration and the magnitude of ice accretion and precipitation amounts.

Earthquakes

Earthquakes occur with a sudden release of energy that creates movement in the earth's crust. Most earthquake-related property damage and deaths are caused by the failure and collapse of structures due to the ground shaking. The level of damage depends upon the extent and duration of the shaking. Other damaging earthquake effects include landslides, the down-slope movement of soil and rock (in mountain regions and along hillsides), and soil liquefaction

Local Example: In addition to tremors originating in the state, New Hampshire has experienced stronger earthquakes centered in the St. Lawrence seismic zone and in the northeastern Massachusetts seismic zone. A 1964 earthquake caused fallen plaster in Plainfield and other damage just outside the region. The largest earthquake was in 1940 and centered near Lake Ossipee. Most of the damage was very local although minor damage occurred for

some distance into several states and Quebec.

Landslides

Landslides are the movement of a mass of rock, debris, or earth down a slope by the force of gravity. Landslides occur when the slope or soil becomes unstable, which may be caused by earthquakes, storms, erosion, fire, or human-induced activities. Slopes greater than 10 degrees are more likely to slide, as are slopes where the height from the top of the slope to its toe is greater than 40 feet. Slopes are also more likely to fail if vegetative cover is low or soil water content is high. Potential impacts include environmental disturbance, property and infrastructure damage, and injuries or fatalities.

Local Example: In 1999, during Hurricane Floyd, a travel lane on the river side of the road collapsed leaving a hanging sewer line and unsupported guardrails along Bank Street Extension in Lebanon. More recently, Lebanon has experienced landslides between the north side of U.S. Route 4 and the Mascoma River, from the intersection of U.S. Route 4/NH Route 4A westerly.

Drought

Drought is a period of unusually constant dry weather that persists long enough to cause deficiencies in water supply—surface or underground. Droughts are slow-onset hazards, but over time, they can severely affect crops, municipal water supplies, recreational resources, and wildlife. If drought conditions extend over a number of years, the direct and indirect economic impacts can be significant. This can also make an area more susceptible to wildfire. Human actions and demands for water resources can accelerate drought-related impacts.

Local Example: Following the drought conditions experienced in New Hampshire in the early 2000s, the Hanover Water Company, owned by the town and Dartmouth College, adopted a drought mitigation plan to determine levels of restriction and enforcement in case of a drought.

Extreme Temperatures

Extreme temperatures of hot and cold can both occur in our region. Extreme heat can detrimentally affect people everywhere; the elderly and people who are obese are more likely to be affected by extreme heat than the rest of the population. Fatalities can result from extreme temperatures, as they can push the human body beyond its limits to hyperthermia and hypothermia. The homeless are especially vulnerable.

Local Example: The NH Department of Health and Human Services issues press releases to advise people to take precautions during extreme heat. One of these releases was issued in the summer of 2013. Tragically, local authorities discover individuals, often homeless, who have died from exposure.

Erosion

Erosion is the wearing-away of land, such as loss of riverbank or shoreline due to surface water influences. Periodic natural events cause erosion, such as flooding, but may be intensified by human activities. Long-term erosion is a result of multi-year impacts such as repetitive flooding, wave action, sediment loss, and increased perennial water flow. Death and injury are not typically associated with erosion, but it can damage buildings and infrastructure. Most flood damage in our area is caused by fluvial erosion (from streams and rivers) often affecting the transportation system.

Local Example: In 2005 and 2006, a bridge crossing a stream on Province Road in Dorchester was destroyed by fluvial erosion and flooding. The estimated cost at the time was almost a million dollars for replacement. There are several similar examples of flood damage throughout the region.

Wildfire

Wildfire is any outdoor fire that is not controlled, supervised, or arranged. Wildfire probability depends on local weather conditions; outdoor activities such as camping, debris burning, and construction; and the degree of public cooperation with fire prevention measures. Wildfires can result in widespread damage to property and loss of life.

Local Example: Wildfires are not as prevalent in the northeast due to our climate; however, when there has been a drought causing sufficient fuel for a fire, a careless act can cause a major wildfire. In 2005, Springfield had a fire in the Gile State Forest, which was contained by firefighters and only burned five acres.

Natural Contaminants

Natural contaminants such as radium, radon and uranium are naturally occurring radionuclides. These three particular substances are a health risk only if taken into the body by ingestion or inhalation. Radionuclides are undetectable by taste, odor, or color. Wells drilled into bedrock are more likely to contain elevated levels of radionuclides than shallow or dug wells. Radon gas can be found in the soil and can enter buildings through foundation cracks and penetrations where pipes enter. Testing well water or basement air quality can determine exposure to unsafe levels of radionuclides.

There are many other natural contaminants which can render drinking water unsafe such as arsenic. The Drinking Water and Groundwater Bureau of the NH Department of Environmental Services has several fact sheets available to address natural contaminants.

Local Example: Being the "Granite State," there are many cases of radionuclides contamination in homes and well water. Generally, this information is not shared with the municipality. When I-89 was being constructed, outcroppings of uranium were found which is not surprising since the Ruggles Mine in Grafton is a uranium mine. Uranium and other contaminants are found in our bedrock which can provide particles in our drinking water. NH DES says 40% or more of NH residents get their drinking water from private wells, and many of those wells have unhealthy levels of naturally-occurring arsenic, radon, or other contaminants.

Hazardous Materials

Hazardous materials spills are the release of any substance or material in a quantity or form which may be harmful to humans, animals, crops, water systems, or other elements of the environment. Hazardous materials include: explosives, gases (compressed, liquefied, or dissolved), flammable and combustible liquids, flammable solids or substances, oxidizing substances, poisonous and infectious substances, radioactive materials, and corrosives. The spill can occur from something as common as a home fuel delivery or it could be from a vehicle accident on the road.

Local Example: Hazardous materials spills may happen fairly frequently as they

include overflow spills when home heating fuel is delivered and delivery of gasoline to gas stations as well as transported hazardous materials along our highways.

Public Health

Public Health concerns include contamination to drinking water, infectious diseases like meningitis, and insect-borne diseases. Large gatherings are potential places where diseases could be transferred.

Local Example: This is a concern at colleges, where a diverse international student body lives together and can be easily exposed to and transmit diseases.

Terrorism

Terrorism has been defined in many ways. The word terrorism is derived from the Latin term "terrere" which means to frighten. Under current United States law, set forth in the US Patriot Act, acts of

domestic terrorism are those which: "(A) involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State; (B) appear to be intended— (i) to intimidate or coerce a civilian population; (ii) to influence the policy of a government by intimidation or coercion; or (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping; and (C) occur primarily within the territorial jurisdiction of the United States."

Local Example: In 1993, a disgruntled resident in Newbury opened fire on town employees killing two women. More recently shootings in and around schools have prompted the development of "lockdown" procedures to protect students and staff.

APPENDIX II- MUNICIPAL EMERGENCY COORDINATION TABLES

Municipal Mutual Aid Agreements in the UVLSRPC Region

Municipality	Fire	Public Works		
		Highway	Building Inspection	Waster and Wastewater
Acworth	SW	x		
Canaan	UV	x		
Charlestown	SW	x		
Claremont	SW,UV			
Cornish	UV			
Croydon	K			
Dorchester	UV, LR	x		
Enfield	UV	x	x	
Goshen	SW			
Grafton	UV	x		
Grantham	UV	x		
Hanover	UV	x		x
Lebanon	UV			
Lempster	SW	x		
Lyme	UV	x		
New London	K	x		x
Newbury	K	x		
Newport	K	x		x
Orange	UV			
Orford	UV	x		
Piermont	UV	x		
Plainfield	UV			
Springfield	K, UV	x		
Sunapee	K			x
Unity	SW			
Washington	SW, K	x		
Wilmot	K	x		

Note: There are several intermunicipal agreements for assistance that are not shown here, including agreements related to the acceptance of wastewater between municipalities.

K- Kearsarge Mutual Aid

LR – Lakes Regional Mutual Fire Aid Association

SW – Southwestern NH Mutual Aid & Dispatch

UV – Upper Valley Emergency Services Association

Municipal Dispatch Coordination in the UVLSRPC Region

Municipality	Dispatch			
	Fire	Police	EMS	Hwy
Acworth	SW	CH	SW	Local
Canaan	H	H	H	Local
Charlestown	SW	CH	CH	CH
Claremont	C	C	C	C
Cornish	H	C	H	Local
Croydon	NL	NL	NL	NL
Dorchester	H, LR	SPolice	H, LR	Local
Enfield	H	H	H	H
Goshen	SW	NL	SW	Local
Grafton	H	GCS	H	Local
Grantham	H	NEWP	NL	Local
Hanover	H	H	H	H
Lebanon	L	L	L	L
Lempster	SW	C	SW	Local
Lyme	H	H	H	H
New London	NL	NL	NL	NL
Newbury	NL	NL	NL	NL
Newport	NEWP	NEWP	NEWP	NEWP
Orange	H	GCS, SPolice	H	Local
Orford	H	H	H	H
Piermont	GCS	GCS	GCS	Local
Plainfield	H	H	H	Local
Springfield	H	NEWP	H	Local
Sunapee	NL	NL	NL	NL
Unity	SW	C	SW	Local
Washington	HPD	HPD	HPD	HPD
Wilmot	NL	NL	NL	NL

Note: There are several intermunicipal agreements for assistance that are not shown.

SW- Southwestern NH Mutual Aid & Dispatch

H – Hanover Dispatch

L – Lebanon Dispatch

LR – Lakes Regional Mutual Fire Aid Association

C – Claremont Dispatch

HPD – Hillsborough

CH – Charlestown Dispatch

NL – New London

GCS – Grafton County Sheriff Department

SPolice – State Police

Hazard Mitigation Plan Status in the UVLSRPC Region

Town	NFIP Participant	Fluvial Erosion Element Required	Next Five-year Update Due to FEMA
Acworth	Y		4/1/2018
Canaan	Y		5/24/2016
Charlestown	Y		In process
Claremont	Y	Y	4/13/2016
Cornish	Y	Y	7/13/2016
Croydon	N		Never done
Dorchester	Y		2019
Enfield	Y		In process
Goshen	Y	Y	In process
Grafton	N		Never done
Grantham	Y	Y	In process
Hanover	Y		In process
Lebanon	Y		7/13/2016
Lempster	N		In process
Lyme	Y		2016
New London	Y		2/4/2018
Newbury	Y		5/16/2017
Newport	Y	Y	6/21/2015
Orange	N		5/26/2016
Orford	Y		2015
Piermont	Y		2/3/2017
Plainfield	Y		2015
Springfield	Y		5/18/2018
Sunapee	Y	Y	In process
Unity	Y		10/7/2019
Washington	Y		6/10/2015
Wilmot	Y		2018

APPENDIX III- CLIMATE CHANGE IN SOUTHERN NEW HAMPSHIRE

APPENDIX IV- RESOURCES

Emergency Response and Climate Adaptation Resources

Adaptation Toolkit for New Hampshire Communities provides communities with a path to plan for future extreme weather events.

<http://des.nh.gov/organization/divisions/air/tsb/tps/climate/toolkit/index.htm>

The Climate Adaptation Knowledge Exchange features a vast library of concise case studies of climate adaptation from around the country and the world. It also provides links to funding sources for adaptation.

<http://www.cakex.org/>

Extreme Precipitation in New York and New England provides an updated extreme precipitation analysis via an interactive web tool.

<http://precip.eas.cornell.edu>

The Georgetown Climate Center provides resources to help communities prepare for climate change, including the Adaptation Clearinghouse, Adaptation Tool Kits, lessons learned, and case studies.

www.georgetownclimate.org/adaptation/overview

The Infrastructure and Climate Network (ICNet) is dedicated to accelerating climate science and engineering research in the Northeastern United States. It focuses on climate change and sea level rise impacts and adaptation for sustainable bridges, roads, and transportation networks.

<http://theicnet.org>

New Hampshire's Changing Landscape explores the relationships between population growth, land use change, and the impact of development upon the state's natural resources, including our forest and agricultural lands, critical water supply resources, and biodiversity.

<http://clca.forestsociety.org/nhcl/>

New Hampshire Storm Smart Coast provides a well developed example of a web resource dedicated to helping community decision makers address the challenges of storms, flooding, sea level rise, and climate change. The website also features efforts by the NH Coastal Adaptation Workgroup (NHCAW), a collaboration of nineteen organizations working to help communities in New Hampshire's Seacoast area prepare for the effects of extreme weather events and other effects of long-term climate change. NHCAW provides communities with education, facilitation, and guidance.

<http://nh.stormsmart.org>

Transportation and Climate Change Clearinghouse is the U.S. Department of Transportation

website that provides information on transportation and climate change.
<http://climate.dot.gov/about/index.html>

Upper Valley Adaptation Workgroup is building climate resilient communities in the Upper Valley through research, information sharing, and education.

www.uvlsrpc.org/resources/uvaw/

APPENDIX V- ENDNOTES

¹ *Climate Change in Southern New Hampshire Past, Present, and Future*. 2014. Climate Solutions New England Sustainability Institute

² http://www.ucsusa.org/global_warming/science_and_impacts/impacts/northeast-climate-impacts.html#.VJEpwdLF-Ag

³ *Climate Change Impacts in the United States: The Third National Climate Assessment*. 2014. U.S. Global Change Research Program

⁴ *Climate Change in Southern New Hampshire Past, Present, and Future*. 2014. Climate Solutions New England Sustainability Institute

⁵ *Stormwater Drainage System Vulnerability, Capacity, and Cost Under Population Growth and Climate Change, Lake Sunapee Watershed, New Hampshire*. April 2012. Syntectic International, LLC

⁶ *The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future*. March 2009. NH Department of Environmental Services

⁷ *Climate Change in Southern New Hampshire Past, Present, and Future*. 2014. Climate Solutions New England Sustainability Institute