UVLSRPC Regional Plan 2015

A guide for the future development of the Upper Valley Lake Sunapee Region

Upper Valley Lake Sunapee
Regional Planning Commission
10 Water Street, Suite 225
Lebanon, NH 03766
www.uvlsrpc.org

UVLSRPC REGIONAL PLAN 2015

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Plan Components:

The Upper Valley Lake Sunapee Regional Planning Commission is a regional planning commission organized under the provisions of New Hampshire RSA 36:45-53. The Commission's purpose is to promote the coordinated development of twenty-seven communities in Grafton, Sullivan, and Merrimack County, New Hampshire through the provision of technical planning assistance and the preparation of comprehensive plans and studies for the region.

The work that provided the basis for this publication was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Federal Government.

THIS PLAN WAS ADOPTED BY THE UPPER VALLEY LAKE SUNAPEE REGIONAL PLANNING COMMISSION ON JUNE 17, 2015.

UVLSRPC Regional Plan 2015

Chapter 1

Telling the Story: Introduction, Public Outreach, What We Heard, and Regional Vision

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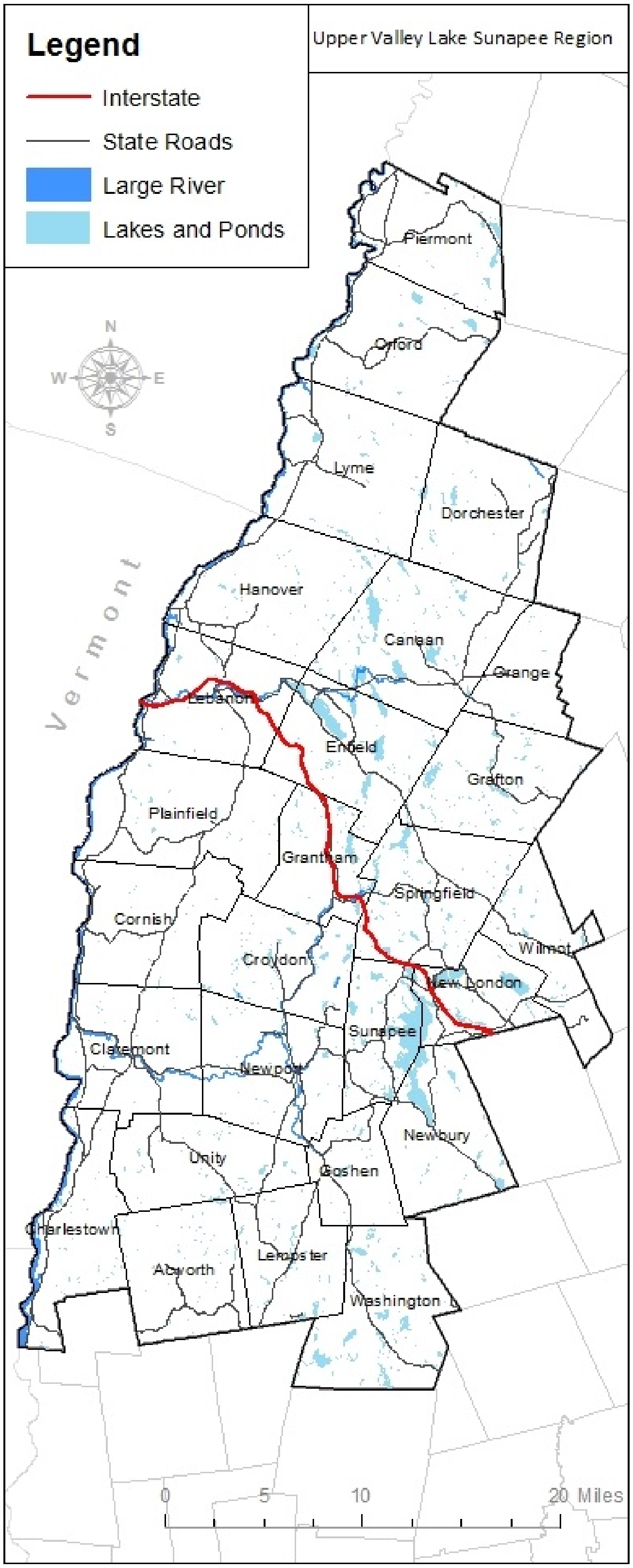
1.1 INTRODUCTION AND PURPOSE



About the Upper Valley Lake Sunapee RPC

The Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) is a voluntary association of 27 cities and towns in western New Hampshire, enabled under Chapter 36 of the New Hampshire Revised Statutes Annotated. The Commission's activities include providing planning-related technical assistance to member communities, coordinating inter-municipal planning projects, and conducting public outreach and education on planning-related matters in the region.

These activities are supported by annual dues from member communities, contracted services for member communities, and state, federal, and private categorical grants. Each community and county in the region has the authority to appoint two Commissioners (three Commissioners for communities with a population higher than 10,000) to represent that community or county's interest in regional affairs, and oversee administrative and fiduciary matters related to the organization.

The Upper Valley Lake Sunapee Regional Planning Commission has been providing professional planning assistance to the region's municipalities since 1963, when the organization was founded as the Upper Valley Development Council. The Commission's areas of expertise include comprehensive land use planning, transportation planning, natural resource planning, community/economic development, public participation, housing, solid waste management, and pre-disaster mitigation planning.

Commissioners of the Upper Valley Lake Sunapee RPC

Chair- Jeffrey Kessler (Town of Newport)
Vice Chair- Nancy Rollins (Town of New London)
Treasurer -Peter Guillette (Town of Grantham)
Assistant Treasurer/Secretary- Katherine Connolly (Town of Hanover)

Acworth
Brian Miller
Laurence Williamson

Charlestown
Vacant

Claremont
Thomas Rock
Richard Wahrlich

Cornish
William Lipfert

Croydon
Vacant

Dorchester
William Trought

Enfield
Dan Kiley
Steven Schneider

Goshen
Vacant

Grafton County
Ken Morley

Grantham
Thain Allan
Peter Guillette

Hanover
Katherine Connolly
Jonathan Edwards
Joanna Whitcomb

Lebanon
Dan Nash

Lempster
Mary Grenier

Lyme
Dan Brand
Sam Greene

New London
Bob Crane
Nancy Rollins

Newbury
Katheryn Holmes

Newport
Jeffrey Kessler
Bill Wilmot

Orange
Judith Lindahl

Orford
Ann Green
Harrison Pease

Piermont
Vacant

Plainfield
James Taylor
John Yacavone

Springfield
Kevin Lee
George McCusker

Sullivan County
Lionel Chute
Jessie Levine

Sunapee
Aaron Simpson
Josh Trow

Unity
William Schroeter
Robert Trabka

Washington
Vacant

Wilmot
Marion Allen
Linda Scofield

Members-At-Large
Peter Gregory
Julie Magnuson
Nancy Merrill
Mark Scarano

About the UVLSRPC Regional Plan

Pursuant to New Hampshire RSA 36:47, the UVLSRPC Regional Plan has been prepared as a guide for regional land use and community development through 2035. The plan incorporates thirty-two individual vision statements among ten major Plan Components. The Vision for the Region compiles the common visionary themes among these Plan Components and articulates the desires for the region shared by residents, community leaders, and business leaders.

The vision, goals, and strategies presented in this plan are the result of substantial input from municipal leaders and the general public. Public input included guidance from the UVLSRPC Regional Plan Advisory Committee, analysis of the 27 municipal master plans from the region's communities, participation at special events around the region, meetings with municipal leaders, an online forum specific to the UVLSRPC region, and a telephone survey of residents of the region.

This plan is advisory in nature, purpose, and effect. Adoption of the plan in no way changes the structure or authority of local governments. Rather, the plan is intended to strengthen the decision-making capacity of local governments by providing information and guidance that can support municipal master plans and policies. The plan recognizes the independent traditions of local government in New Hampshire and seeks to facilitate inter-municipal cooperation. The adoption of this plan means that the UVLSRPC commits its staff and program resources to achieve the plan's goals and recommendations.

1.2 PUBLIC OUTREACH

Regional Advisory Committee

The UVLSRPC Regional Advisory Committee is a subcommittee of the Regional Planning Committee of the Commission. The Committee was created to provide guidance to the staff of the Commission on the development of the UVLSRPC Regional Plan.

The Regional Advisory Committee participated in and conducted public outreach efforts for the UVLSRPC Regional Plan. The Committee assisted staff in reviewing data and public input, and advised staff on the overall goals of the initiative. The Committee also reviewed and amended templates from statewide advisory committees to fit the unique context of the Upper Valley Lake Sunapee Region.

Regional Advisory Committee

William Trought (Town of Dorchester)
Dan Kiley (Town of Enfield)
Steve Schneider (Town of Enfield)
Joanna Whitcomb (Town of Hanover)
Ken Morley (Grafton County)
Dan Brand (Town of Lyme)
Jeff Kessler (Town of Newport)
Aaron Simpson (Town of Sunapee)
Nancy Merrill (City of Claremont)
Shawn Donovan (City of Lebanon)
Tom Rock (City of Claremont)
Jonathan Edwards (Town of Hanover)
Bob Crane (Town of New London)
Nancy Rollins (Town of New London)

The Committee will also present the draft of the UVLSRPC Regional Plan to the full Commission for adoption.

Master Plan Analysis

UVLSRPC staff reviewed the Master Plans of all twenty-seven municipalities within the region as a starting point in the development of the Regional Plan. While 41% of the communities in the region have not updated their Master Plan in the last 10 years, the plans still provide a valid starting point because they serve as policy documents that demanded public participation regarding future decision-making.

The average Master Plan in the region is between eight and ten years old. There are a number of communities that are in the process of updating their Master Plan, or have completed a new update within the last two years. However, in some cases, those plans have not yet been formally adopted. In these cases, the Commission chose to begin with what has been formally adopted by the public and work from that point forward. With the guidance of the Regional Advisory Committee, the Commission reviewed all 27 municipal Master Plans in the region.

Since 2002, municipalities in New Hampshire have been required to create a vision section within their master plan. Ten municipalities within our region have not updated their Master Plan since this time, and thus, do not yet have vision sections within their Master Plans. Determining values and goals and understanding the vision of these communities was more difficult but was completed by drawing conclusions from other parts of the Master Plan.

Special Events

Between June and December 2012, UVLSRPC staff and Commissioners attended twelve outreach events throughout the region. Two activities were available for public input during these sessions, including: 1) A visual preference survey; and 2) An open response to the question: "What is most important to you in your community?" UVLSRPC staff and/or Commissioners participated in the following events:

- Canaan Speedway Races (7/14/2012)
- Dorchester "Going Places" Race (7/22/2012)
- Lebanon Farmers' Market (8/9/2012)
- Newport Farmers' Market (8/10/2012)
- Cornish Fair (8/18/2012)
- Newport Apple Pie Craft Fair (8/25/2012)
- Claremont "Reach the Peak" Race (9/22/2012)
- Claremont Fall Festival (10/6/2012)
- Lebanon-Hanover Football Game (10/12/2012)
- Lempster Christmas Craft Fair (11/17/2012)
- Listen Community Dinner (11/26/2012)
- Wilmot Holiday Craft Fair (12/1/2012)

Members of the public completing a visual preference survey at the Cornish Fair on August 18, 2012.

In total, 507 people completed either the visual preference survey or open response question at the twelve events. Their responses are summarized in the "What We Heard" section.

Meetings with Municipal Leaders

In the fall of 2013, the UVLSRPC convened ten meetings with municipal leaders. The meetings included members of Selectboards, City Councils, Planning Boards, and municipal staff. The purpose of the meetings was to review public feedback received by the Commission and ensure that municipal projects are incorporated into the UVLSRPC Regional Plan. Topics included Housing, Transportation, Economic Development, Natural Resources, Cultural Resources, Utilities and Infrastructure, Public Facilities, Energy Efficiency, and Natural Hazards and Adaptation.

The meetings with municipal leaders were held as follows:

- Town of Croydon (9/23/2013)
- Town of Cornish (9/25/2013)
- Town of Orford (10/1/2013)
- Town of Canaan (10/3/2013)
- Town of Washington (10/8/2013)
- Town of New London (10/10/2013)
- Town of Sunapee (10/17/2013)
- City of Lebanon (10/22/2013)
- City of Claremont (10/24/2013)
- Town of Charlestown (10/28/2013)

Municipal leaders discussing local projects in the City of Claremont on October 24, 2013.

New Hampshire Listens Forum

Through the statewide Granite State Future collaborative, *New Hampshire Listens*, a civic engagement initiative of the Carsey Institute at the University of New Hampshire held ten regional forums around the state to gather regional themes to inform the development of each of the nine regional plans in the state. One *New Hampshire Listens* forum was held in the Upper Valley Lake Sunapee Region on February 26, 2013 in the City of Claremont. Approximately 70 municipal leaders and interested citizens participated in the discussion.

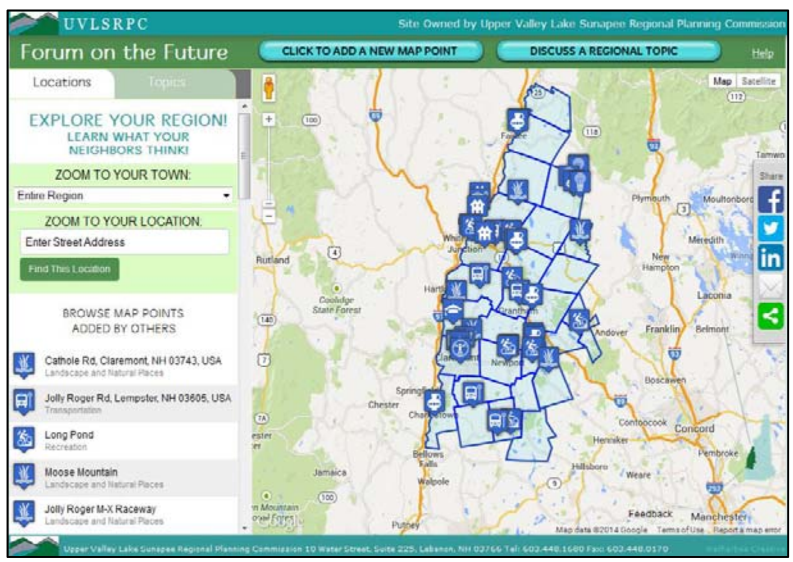
Following the forum, *New Hampshire Listens* published a summary of the evening's discussion, which is available for download on the UVLSRPC's Regional Plan website: regionalplan.uvlsrpc.org.

Online Forum on the Future

Recognizing that some members of the public are unable to participate in public meetings due to work schedules, personal commitments, or other conflicts, UVLSRPC staff established an online "Forum on the Future" to allow public input remotely and electronically.

The Forum on the Future was an interactive mapping framework hosted on the UVLSRPC website. Through the interactive map, users could "pin" comments or suggestions to a specific location of interest. Comments received fell into thirteen categories:

- Arts and Culture
- Education
- Governance
- Health and Wellness
- Housing
- Jobs/Economy
- Landscape/Natural Resources
- Local History
- Public Safety/ Emergency Services
- Recreation
- Social Life
- Transportation
- Utilities/Energy



The Forum on the Future remains active on the UVLSRPC website. To date, comments have been received for nearly sixty unique locations around the region.

Telephone Survey

Through the statewide Granite State Future collaborative, the nine regional planning commissions in New Hampshire pooled funding to hire the University of New Hampshire (UNH) Survey Center to conduct a telephone survey of New Hampshire residents. The UNH Survey Center is an independent, non-partisan academic survey research organization and a division of the UNH College of Liberal Arts.

Between May 9 and July 21, 2013, the UNH Survey center conducted a telephone survey of 2,935 New Hampshire adults. As part of the survey process, the UVLSRPC and Southwest Region Planning Commission pooled funds to allow the UNH survey center to oversample our two regions of the state. This oversampling provided statistical significance for the survey results for our two regions combined, and allowed comparisons between survey results for the two regions versus the statewide results. The overall margin of error for the statewide survey was +/-2.2%.

Survey questions covered transportation and broadband infrastructure, housing, economic development, natural resource management, energy and natural hazard mitigation. A full report detailing the survey results can be found on the UVLSRPC's Regional Plan website: regionalplan.uvlsrpc.org. Some survey responses are highlighted in the "What We Heard" section that follows.

1.3 WHAT WE HEARD

Public input guiding the development of the UVLSRPC Regional Plan was received via many channels as outlined above. In some cases feedback was written, in some cases it was verbal, and in some cases was visual (via preference surveys).

This feedback guides all of the technical components of the UVLSRPC Regional Plan which follow. It also resulted in a series of nine key regional themes which have guided the development of the vision, goals, and implementation strategies detailed in the plan.

Key themes facing the region over the next twenty years include:

- Fostering High-Quality Education and Workforce Training Opportunities;
- Preparing for Slower Population Growth;
- Serving an Aging Population;
- Addressing Deteriorating Infrastructure;
- Encouraging Affordable and Accessible Housing;
- Responding to Non-residential Development Pressure;
- Building upon the Region's Economic Strengths;
- Preserving the Region's Landscape and Natural Resources;
- Adapting our Built Environment for Severe Storm Events.

In the "Word Cloud" (above), the words most often repeated in regional outreach events appear larger.

Fostering High-Quality Education and Workforce Training Opportunities

During the twelve special outreach events, when people were asked the open-ended question "What is most important to you in your community?" the top response was education. Feedback about education took many forms, including:

- Residents of the region value high-quality education and some residents chose their home community because of local school systems.
- Residents of the region value the employment opportunities provided by the grade schools, high schools, and colleges in the region. In some communities, the school system is the largest employer.
- Residents of the region are concerned with the tax burden associated with local school systems. In some schools, enrollments are declining due to broader demographic shifts in the region. There is also concern about the tax burden of school renovation projects, particularly in Claremont and the Mascoma Valley.
- Residents of the region recognize that schools are places of civic engagement, social gatherings, and key life events that build a sense of community.
- Residents of the region want to continue to develop targeted workforce training opportunities, and vocational training. This is an important economic development initiative, and many residents noted that large employers like Sturm Ruger in Newport would benefit from such programs.

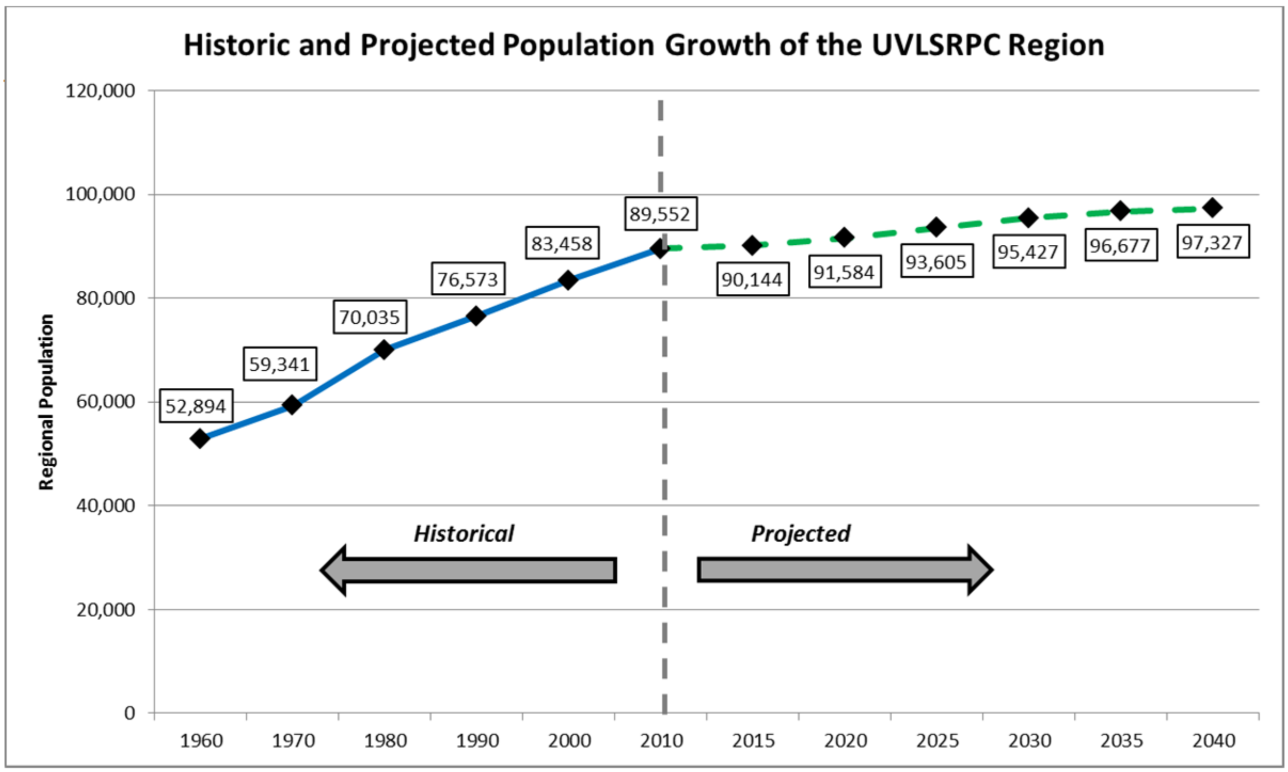
Dartmouth College, the region's most well-known educational institution, provides both educational and employment opportunities to the region's residents.

Preparing for Slower Population Growth

The population of the Upper Valley Lake Sunapee Region, like the State of New Hampshire as a whole, is projected to grow much more slowly over the next twenty-five years than over the past fifty years. In 2013, the state's nine regional planning commissions pooled funds to commission RLS Demographics, Inc. to develop statewide, county-level, and town-level population projections based on a cohort-component analysis.

Looking just at the 27 communities of the Upper Valley Lake Sunapee Region, the population of the region is projected to grow less than 9% between 2010 and 2040. The chart below shows historic and projected population growth in the UVLSRPC Region between 1960 and 2040.

Figure 1.3.1- Historic and Projected Population Growth of the UVLSRPC Region



Serving an Aging Population

The aging of the baby boomer population, called a "Silver Tsunami" by the New Hampshire Center for Public Policy Studies, was a key theme heard in meetings with municipal leaders, special events, the NH Listens Forum in Claremont, and the online Forum on the Future.

In Grafton, Merrimack, and Sullivan County, the population of persons over the age of 65 is projected to nearly double over the next 20 years, growing to approximately one-third of region's population.

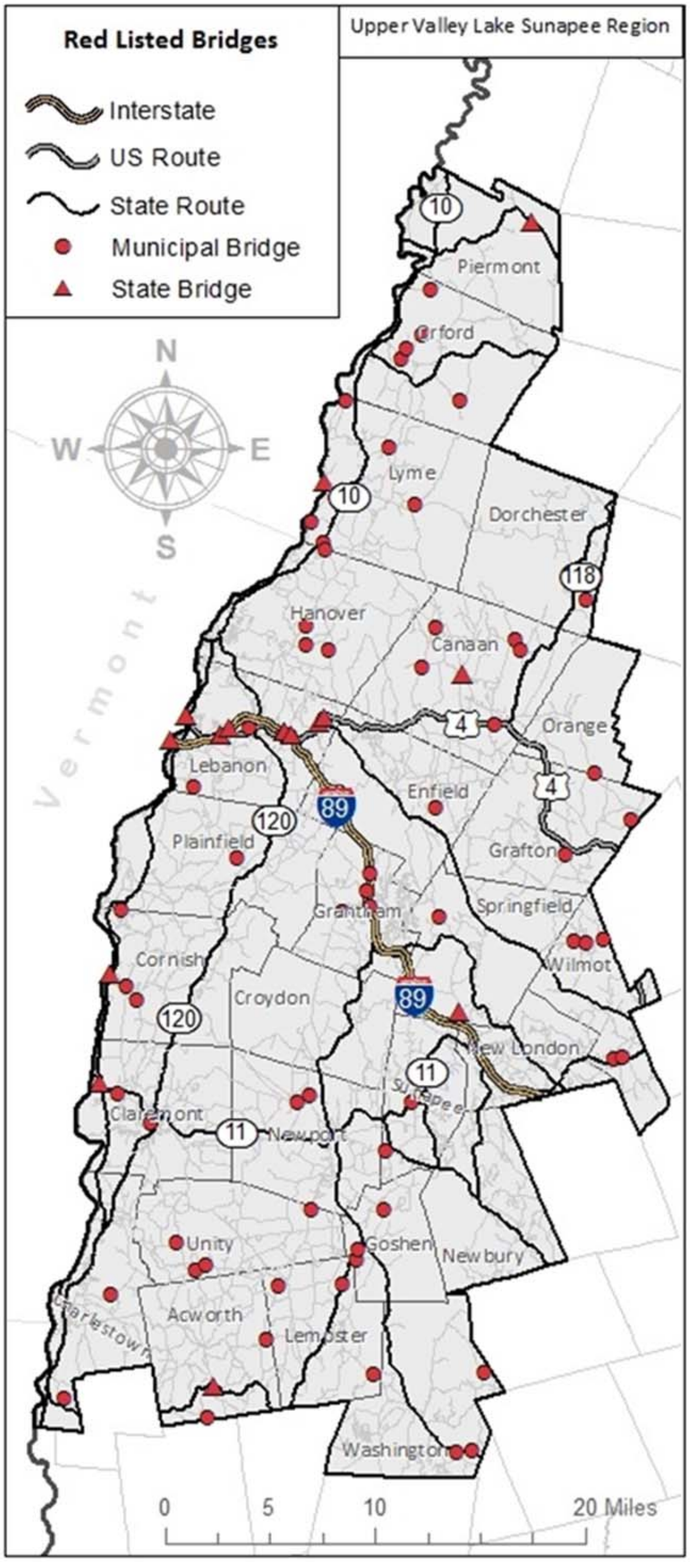
Expanded non-emergency medical transportation and other services will be needed to serve the region's aging population.

With limited state investment in aging services, the region's senior citizens centers are underfunded and will soon be over capacity. While aging in place is a goal of many rural, elderly residents in the region, there are few public transportation options outside of the Lebanon-Hanover and Claremont-Newport employment centers. This makes non-emergency medical transportation a significant challenge in the region.

As a result, many communities in the region rely on persons over 65 years of age to volunteer on town boards and committees, and provide volunteer rides for people in need of non-emergency medical transportation. Without an influx of new volunteers, many communities may face a "volunteer gap" in both the public and private sector.

Addressing Deteriorating Infrastructure

Figure 1.3.2- Red Listed Bridges in the Region



The condition of the region's infrastructure, particularly transportation infrastructure, was a key theme heard in meetings with municipal leaders, special events, the NH Listens Forum in Claremont, and the online Forum on the Future.

In many ways, the region faces more acute issues with infrastructure condition than the State of New Hampshire as a whole. Currently, there are 80 "red listed" bridges in the region (64 municipally-owned and 16 state-owned). Similarly, 46% of the region's road network is in poor pavement condition, compared to 37% statewide.

The condition of the region's transportation infrastructure is fundamental to the movement of people and goods throughout the region, and thus, the region's economic competitiveness.

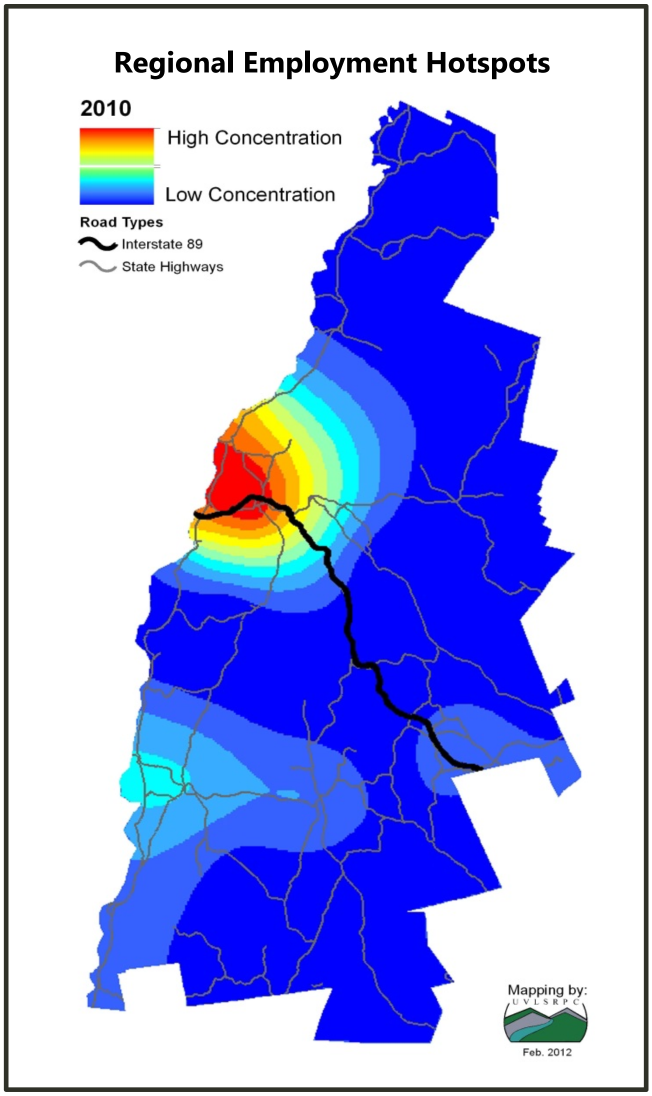
Beyond transportation infrastructure, many public works directors who participated in the ten municipal leaders meetings also pointed out deterioration of the region's water and sewer infrastructure. Many of the region's water and sewer pipelines are more than 100 years old. In water lines, extensive seepage resulting from deteriorated infrastructure can affect water quality and cost municipalities substantial amounts of money.

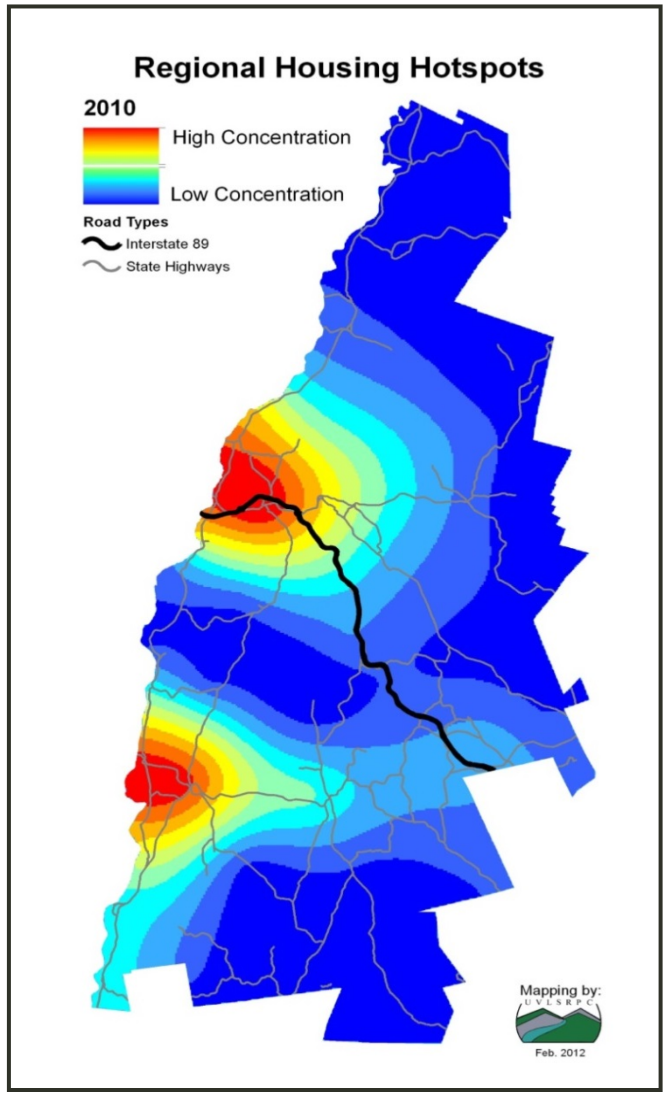
Encouraging Affordable and Accessible Housing

Encouraging affordable and accessible housing was a key theme heard in meetings with municipal leaders, special events, and the NH Listens Forum in Claremont. The region's four largest employment centers of Claremont, Lebanon, Hanover, and Newport have 80% of the region's jobs, but just 50% of the region's housing. For the past thirty years, the region's development pattern has largely been driven by the cost of housing in the Lebanon-Hanover employment center, with much of the new residential development occurring to the east in communities along the U.S. Route 4, Interstate 89, and NH Route 11 corridors. As a result, the average commute for a resident of the UVLSRPC region (one-way) is 15.8 miles, resulting in a substantial transportation cost burden.

The maps below were developed as part of the UVLSRPC Housing Needs Assessment and show employment and housing concentration in the region.

Figure 1.3.3 and 1.3.4- Regional Employment and Housing Hotspots





In 2012, the UVLSRPC developed a Housing Needs Assessment, which included projections that considered housing demand, supply, cost and affordability, regional economic conditions and the distribution of affordable housing. The housing production model projected a need for the UVLSRPC region to add 3,800 to 4,600 total year-round housing units between 2010 and 2020, or approximately 380 to 460 new units per year. Approximately 41% of these units (up to 190 units per year) should ideally be affordable at income levels defined by New Hampshire Workforce Housing Statute (RSA 674:58, IV).While these production estimates would allow for housing supply to keep pace with regional employment and population growth, this remains a considerable challenge for the region.

Responding to Non-Residential Development Pressure

Encouraging affordable and accessible housing was a key theme heard from residents and municipal officials in both Lebanon and Hanover during municipal leaders meetings, special events, and the region's NH Listens Forum.

The City of Lebanon is home to the Dartmouth Hitchcock Medical Center (DHMC), which employs more than 7,000 people. DHMC's position as a national leader in medical research and cancer treatment has led to allied industries (e.g. medical R&D and pharmaceutical companies) wanting the synergy of locating as close to the medical center as possible. This has resulted in substantial non-residential development pressure in the City of Lebanon, as shown in the table below.

Figure 1.3.5- Non-Residential Development Permitted in the City of Lebanon

Non-Residential Development Permitted (Not Yet Built) in the City of Lebanon	
Development Name	**Square Footage (SF)**
Iron Horse Park	667,200 SF
River Park	714,020 SF
Altaria Industrial Planned Unit Development	217,970 SF
Altaria Business Park	240,000 SF
ICV Holdings Phase II	56,364 SF
DHMC- Williamson Center Expansion	162,000 SF
Chaloux Hotel and Conference Center	96,306 SF
TOTAL	**2,153,860 SF**

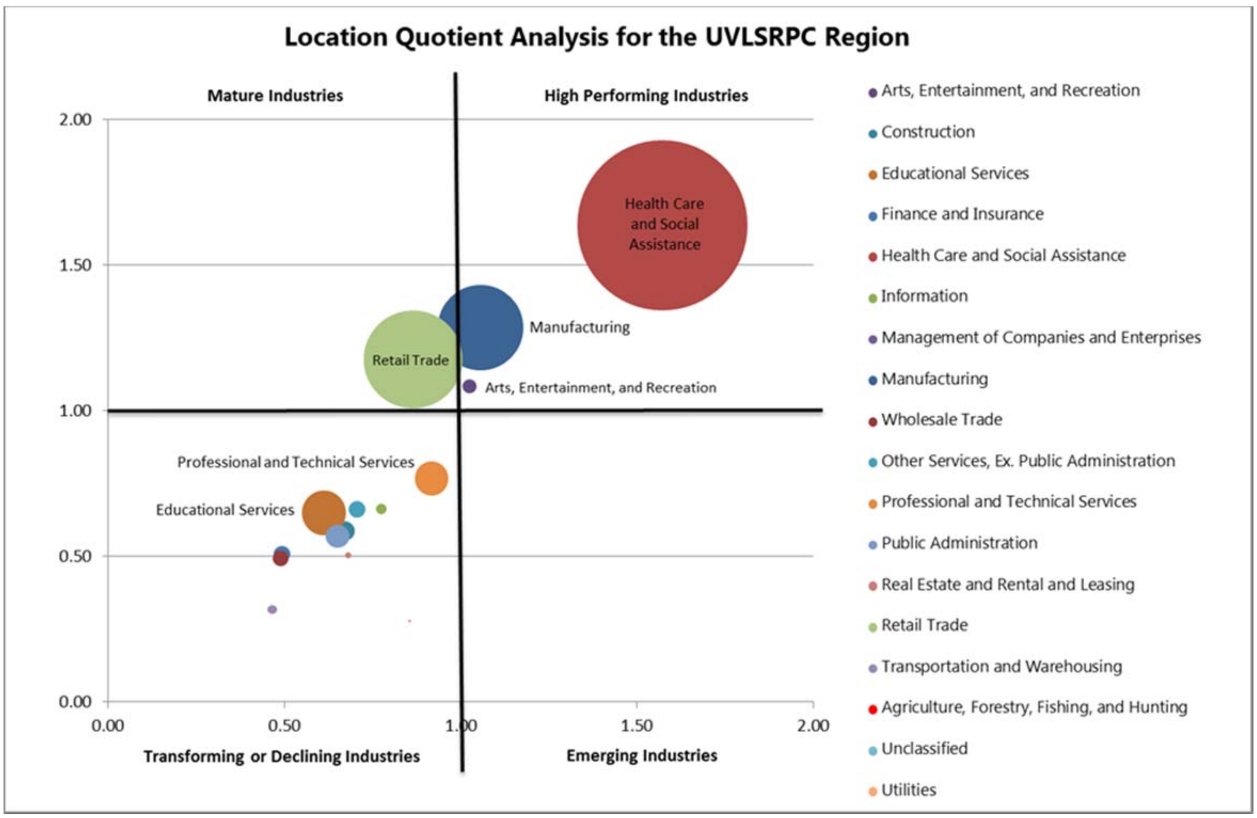
This unprecedented non-residential development pressure has raised concerns in Lebanon (and surrounding communities) about the City's job-housing balance, the potential degradation of high-quality wildlife habitat from additional development, capacity of water and sewer infrastructure, and congestion of key regional transportation corridors (e.g. NH Route 120).

Building Upon our Economic Strengths

While the City of Lebanon faces unprecedented non-residential development pressure, many of the other communities in the region have been significantly impacted by the Great Recession, and have not yet seen an increase in development. Throughout meetings with municipal leaders and special events in Sullivan and Southern Grafton County, UVLSRPC staff heard of the need to spur new economic development by building upon the region's economic strengths.

To determine the region's economic strengths, UVLSRPC staff completed a location quotient analysis. The location quotient is a measure of an industry's concentration in an area relative to the rest of the state or nation. It compares an industry's share of local employment with its share of state or national employment. Although location quotients require several assumptions, including uniform local consumption patterns and labor productivity across the country, they are a quick and useful tool in determining a region's key industries.

Figure 1.3.6- Location Quotient Analysis for the UVLSRPC Region



A location quotient greater than 1.0 means that the industry is producing more goods and services than are used locally. If a location quotient is less than 1.0, it may mean that residents and businesses have to purchase services and retail goods from outside the area. This analysis uses the North American Industry Classification System (NAICS) in determining industry sectors. Those industries that show strength in the UVLSRPC region compared to the nation as a whole include the Health Care and Social Assistance, Manufacturing and Arts, Entertainment and Recreation sectors.

Preserving the Landscape and Natural Resources

A key theme heard in every form of public outreach was the importance of preserving the region's landscape and natural resources. In many ways, the region's identity is tied to its natural resources. Thus, feedback about the region's landscape and natural resources took many forms:

The Connecticut River is a key part of the identity of the region.

- Residents of the region value rural farms and agricultural opportunities. Having farms close by helps people understand where their food comes from, and also contributes to the pastoral setting and "rural character" that is highly valued.
- Residents of the region value the rural "unspoiled" landscapes along the two-lane highways that connect village centers. These landscapes enhance residents' sense of place and provide a unique identity for the region's communities.
- Residents of the region value the outdoor recreational opportunities offered by woods, water, and wildlife. In some cases, Commission staff heard feedback about cases where public access to waterways was perceived to be inhibited or denied, and there was a strong sense of injustice among those residents.
- Residents of the region value the clean water and fishing opportunities provided by the Connecticut River and its tributaries, as well as the region's lakes.
- Residents of the region value forests and wildlife habitat for ecological health, recreation, and rural aesthetics.

The region's natural resources also contribute to a sense of community, as hunting, fishing, and hiking are important social activities in many communities.

Adapting our Built Environment for Severe Storm Events

Following the substantial impacts of both Tropical Storm Irene and the July 2013 rain storms in Lebanon, communities across the UVLSRPC region recognize the need to conduct adaptation planning for severe weather events. This was a key theme heard in meetings with municipal leaders, special events, and the NH Listens Forum in Claremont.

As part of the Granite State Future statewide initiative, New Hampshire's nine regional planning commissions pooled funds to commission the Sustainability Institute at the University of New Hampshire to conduct an assessment of climate change in both northern and southern New Hampshire. The UVLSRPC region is included in the report on southern New Hampshire.

The report found that over the past four decades:

- The climate in southern New Hampshire has warmed between 1.1 and 2.6 degrees Fahrenheit.
- Annual precipitation has increased between 12 and 20 percent.
- The average number of snow covered days in Hanover has decreased by twelve.
- The length of the growing season has increased by two to four weeks.
- Extreme precipitation events have increased across southern New Hampshire.

Above: Slayton Hill Road in the City of Lebanon following a flood event in July 2013.

1.4 REGIONAL VISION

The UVLSRPC Regional Plan has been prepared as a guide for regional land use and community development through 2035. The Plan incorporates thirty-two individual vision statements among ten major Plan Components. The Vision for the Region compiles the common visionary themes among these Plan Components and articulates the desires for the region shared by residents, community leaders, and business leaders.

The capacity of the Upper Valley Lake Sunapee Region to meet the challenges and take advantage of opportunities over the next 20 years relies on many hands committed to making the vision a reality. Common among these themes and critically important to the successful implementation of this Regional Plan is collaboration among individuals, groups, communities, governments, and institutions.

Regardless of the respective Plan Component focus areas, the three common themes of opportunity, resiliency, and resources form the basis for the Vision for the Region. These themes address individual, community, and regional levels of activity.

Opportunity

The region's future success will rely on access to, and a diversity of choice of, services and resources. Personal and community opportunity can be in the form of physical access via transportation systems and networks; the ability to satisfy basic personal needs like housing, health, or education; or encouraging economic development.

Resiliency

A resilient region is prepared to proactively respond to a broad range of events to mitigate negative impacts on residents, economic vitality, and community cohesion. Resiliency requires diverse interests to take advantage of, and expand upon, the region's inherent strengths. Recognizing and celebrating the region's strengths will enhance individual and community sense of identity and encourage development of new strengths to benefit the region.

Resources

The Upper Valley Lake Sunapee Region is rich in natural, economic, and cultural resources. Stewardship of these resources for present and future generations will ensure the most highly valued regional assets will continue to contribute to local and regional vitality. Retaining and utilizing these resources for the next 20 years will be based on traditional and innovative management techniques.

VISION FOR THE REGION

The communities of the Upper Valley Lake Sunapee Region will use their unique strengths and available resources in a collaborative manner to benefit the region's residents, businesses, and institutions. The region's natural, economic, and cultural resources will continue to grow, diversify, and be readily accessible by all.

Land Use

- **Vision**: The region will build upon its historic, traditional settlement patterns by focusing new residential and non-residential development in village and city centers. The region's rural landscape will support traditional uses like housing, farming, forestry, and recreation that strengthen the region's highly valued rural character. To the extent possible, as climate change is likely to accelerate, the most valued natural resources and habitats will be conserved for future generations.

Housing Needs Assessment

- **Vision:** All residents of the region will have access to a variety of diverse and affordable housing options with the opportunity to live in the communities in which they work.

Fair Housing Equity Assessment

- **Vision:** The region will have equal and unrestricted access to housing regardless of factors such as race, color, religion, gender, familial status, disability, economic status, and national origin.

Transportation

- *Highways and Bridges*
  Vision: The region will have no structurally-deficient bridges and all roads will be maintained at good or fair condition.

- *Highway Safety*
  Vision: Eliminate highway fatalities and improve safety for all roadway users in the UVLSRPC Region per the "Toward Zero Deaths" vision in New Hampshire's Strategic Highway Safety Plan.

- *Public Transportation*
  Vision: The region will have affordable transportation options through a coordinated, connected network using a variety of mobility services including local bus, intercity bus, and higher-speed rail systems that accommodate and are accessible to individuals with special needs. The region's system has eliminated duplicative services, filled gaps in service and unmet needs, and makes full use of underutilized capacity.

- *Human Service and Volunteer Transportation*
  Vision: All residents with special needs and mobility challenges will have access to safe, reliable, and affordable transportation options that allow them to remain independent, active, and involved in the life of our communities.

Bicycle and Pedestrian Transportation
Vision: A safe bicycle transportation network connects all the communities in the region and every community center can be accessed by a safe and appropriate pedestrian transportation network.

- *Rail Transportation*
  Vision: The region's two largest employment and population centers have viable, efficient freight and passenger rail access to major markets in the eastern United States and Canada.

- *Air Transportation*
  Vision: The region will have strong, viable, and financially sustainable passenger air connections to major airports in the eastern United States and Canada, and convenient access to general aviation opportunities.

- *Transportation Demand Management*
  Vision: All residents, businesses, and visitors in the UVLSRPC Region can access viable, efficient, and affordable alternatives to single occupant vehicle travel.

Economic Development

Vision: The region will maintain a resilient economy with new employment opportunities, building upon existing strengths in the health care, manufacturing, tourism, and creative sectors. All residents and businesses in the region will have access to viable and effective vocational education opportunities to retain and attract a talented workforce. The region's downtown areas will be prosperous and economically vibrant, anchored by strong locally-owned businesses and access to local agriculture.

Natural Resources

- *Air Resources*
  Vision: The region will have a high quality of air protecting public health, clear skies, and our natural environment.

- *Agriculture*
  Vision: The region will have abundant opportunities to promote sustainable local food production for area markets, preserve rural community character, and foster a sense of community through diverse agricultural businesses and events.

- *Forest Resources*
  Vision: The region's forests will be effectively managed or conserved to ensure unfragmented wildlife habitat, a healthy environment, economic opportunity, recreation, and aesthetic identity.

- *Mining and Extraction*
  Vision: The region will utilize its geologic resources responsibly, with all mining and extraction sites operated according to best management practices and appropriately reclaimed and restored upon closure.

- *Water Resources*
  Vision: All of the region's water resources will be maintained, restored, and/or protected to ensure the quantity and high quality of drinking water and aquatic habitat.

- *Flora and Fauna Resources*
  Vision: The region will protect and enhance our resilient natural communities of flora and fauna by minimizing high value habitat loss and effectively controlling invasive species.

Cultural Resources

- *Historic Resources*
  Vision: The region will respond to growth and change while maintaining its most valued historical and cultural assets through preservation, protection, and adaptive reuse.

- *Arts/Culture*
  Vision: All residents of the region will have access to social and cultural opportunities and community events. The arts will play an important role in the educational, social, and economic life of the region's communities.

- *Recreation*
  Vision: The region will have access to abundant, four-season recreational opportunities anchored by our public lands and waters. Each community in the region will be connected by trail networks that accommodate both motorized and non-motorized recreational travel. Public access to the region's freshwater resources and public lands will be preserved and enhanced where appropriate to support the health of the region's residents, environment, economy, and unique identity and sense of place.

Utilities, Infrastructure, and Public Service

- *Water, Sewer and Stormwater Infrastructure*
  Vision: The region's water, sewer and stormwater infrastructure will be resilient and maintained in a state of good repair to support existing development centers and local economic development initiatives.

- *Broadband Infrastructure*
  Vision: All residents and businesses in the region will have access to fast, reliable, and affordable broadband service through a competitive marketplace.

- *Public Utilities (Electric and Gas)*
  Vision: The region will have access to safe, adequate, and reliable electric and gas service at reasonable rates via resilient infrastructure.

- *Waste Management*
  Vision: All residents and businesses in the region will have access to efficient, environmentally responsible, and affordable waste management. The region's waste generation will be reduced through increased recycling, composting, and purchase of products containing recycled materials, and utilization of products with lower toxicity.

Public Facilities and Energy Efficiency

- *Energy Production and Use*
  Vision: The region will become more energy independent through the use of renewable energy systems by residential, commercial and institutional property owners. Regional energy demand will be reduced through energy conservation and purchase of energy efficient products.

- *Energy Efficient Construction & Green Building*
  Vision: The region's built environment will become increasingly energy efficient through existing building retrofits, energy efficient new construction, and energy-conscious site development practices. Local governments will be leaders in energy efficient building construction practices.

- *Public Facilities*
  Vision: The region's municipalities will provide for current and future needs through well-maintained, safe, accessible facilities that serve as community centers. There will be increasing cooperation among communities to reduce municipal costs and respond to increasing cost burdens from state and federal mandates by sharing facilities and services.

Hazards and Adaptation

- *Hazards*
  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.

- *Climate Change & Adaptation*
  Vision: The region will anticipate, prepare for, respond to and recover from climate change impacts in a way that works to minimize significant disruption to communities including health, safety, built environments, food availability, natural resources, wildlife and financial strength.

- *Emergency Management*
  Vision: The region's communities will be prepared to act effectively and cooperatively when emergencies occur. Residents and businesses will be educated to adequately prepare for and properly respond to public emergencies.

UVLSRPC Regional Plan 2015

Chapter 2

Housing Needs and Fair Housing Equity Assessment

TABLE OF CONTENTS

2.1 INTRODUCTION

Vision

All residents of the region will have access to a variety of diverse and affordable housing options with the opportunity to live in the communities in which they work.

Housing Needs Assessment Overview

The Housing Needs Assessment for the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) has been prepared in accordance with NHRSA 36:47 (II) to assist municipalities with understanding the housing needs of all residents at all levels of income and age. The findings in this report provide municipalities the opportunity to gain an understanding of the demographic and economic ties of housing among communities in the region. The information within the Housing Needs Assessment will provide a valuable resource to community leaders who seek to change policies to enable a more diverse housing stock to accommodate a range of housing needs. Detailed tables, data and methodology explanations are available in the Housing Needs Assessment Technical Report available on the UVLSRPC website at www.uvlsrpc.org.

This Housing Needs Assessment is based on a traditional market analysis approach. While there are a number of Census-based labor market areas within the region, each with unique socio-economic dynamics, the purpose of a housing needs assessment in New Hampshire is to develop an overview of regional needs to which local communities can respond in their master plans.

The geographic focus of the Housing Needs Assessment is the Upper Valley Lake Sunapee Regional Planning Commission (UVLSRPC) region, as defined by the New Hampshire Office of Energy and Planning. Detailed demographic analysis and housing supply projections were prepared for both the UVLSRPC region and for the Lebanon, NH-VT Micropolitan NECTA, which includes the communities listed in the table below:

Lebanon, NH-VT Micropolitan NECTA Communities			
New Hampshire		Vermont	
Lebanon	Cornish	Hartford	Sharon
Hanover	Grafton	Windsor	Strafford
Enfield	Springfield	Norwich	Fairlee
Canaan	Orford	Hartland	Pomfret
Grantham	Piermont	Royalton	Vershire
Plainfield	Orange	Thetford	West Fairlee
Lyme			

Portions of the Needs Assessment also compare, at a less detailed level, the differentials of home price, rental cost, wages and other data for other New Hampshire labor market areas partially within the UVLSRPC region.

Overview of Data Collection and Analysis

Because of the limitations presented by new methods of Census Bureau sampling, it is necessary to develop methods of estimating housing needs that are not exclusively dependent on federal data sources. Data sources for these analyses include:

- US Census population and household information for 1990, 2000 and 2010;
- US Census American Community Survey (ACS) data from the 2006 to 2010 a 5-year sample of the region;
- Detailed housing market and assisted housing information from the New Hampshire and Vermont state housing agencies;
- Building permits history from Census and state databases;
- Employment and wage data from the Economic and Labor Market Information Bureau of New Hampshire Employment Security and Vermont Department of Labor;
- Property tax and assessed valuation data from the NH Department of Revenue Administration.

Additional data sources provided local information specific to the study area to round-out the above sources. These data, collected by the Upper Valley Housing Coalition (UVHC), provide useful quantitative and qualitative information. These sources are:

- *Regional Rent Survey:* The UVHC has been collecting quarterly information since 2010 on listed rentals as part of an effort to track the number, type, location and cost of rental units in the bi-state Upper Valley area.
- *Regional Employee Housing Survey:* UVHC, BCM Planning, LLC and the Commission developed a survey directed at regional employees to obtain an understanding of employee commuting and housing preferences. The survey results in this report will serve as a baseline and UVHC will administer this survey periodically to develop a broader understanding about regional housing trend.

The population of the region served by UVLSRPC is 89,552. Important drivers of housing demand are the traditional first time buyer market (age 25 to 34) and move-up buyer market (age 35 to 44). Both of those population groups were smaller in number in 2010 than in 1990. If historic trends continue, population growth will shift toward an older population. While 13.8% of the region's population was aged 65 or older in 1990, the proportion in 2010 rose to 16.4% and will continue to rise over the next 20 years, reaching an estimated 34% by 2030.

The two most rapidly growing age segments between 2000 and 2010 in both the UVLSRPC region and the nation were in the aging baby boomers 55-64 and age 85+ population groups. New Hampshire and other northern New England states have low birth and fertility rates relative to the United States as a whole. Consequently, the percentage of the regional population that is under age 15 is considerably lower than the national average.

Household income is a principal factor in assessing whether housing is affordable to residents, which in turn provides an assessment of the housing need. Household income is expressed as a percentage of the Area Median Family Income (AMFI) as defined by the U.S. Department of

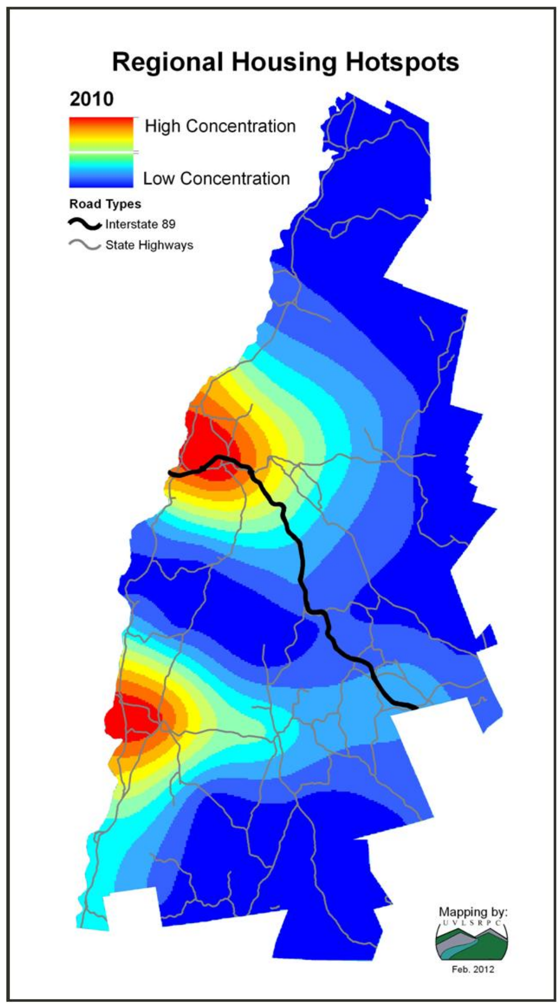
Housing and Urban Development (HUD). HUD defines "very low income household" as households that earn under 50% of AMFI and "low income" as households that earn between 50% and 80% of AMFI.

In New Hampshire, state statute uses a maximum income standard of 100% AMFI for homeowner families of four, and 60% AMFI for a renter family of three to define workforce housing standards. The workforce housing income standard in this study serves as a benchmark for affordability and provides an estimated housing cost burden in order to better understand the impact of incomes on affordability. Approximately 41% of households in the region that are headed by those under 65 years of age have incomes at or below the workforce housing income standards.

2.2 REGIONAL HOUSING NEEDS ASSESSMENT

The Regional Housing Needs Analysis covers the period from 1990 to 2010, providing two decades of information to track housing trends, particularly the rate of ownership, rental housing growth, and the age of heads of households over time.

Demographic Trend Summary



The number of households in the region grew by 13.8% between 1990 and 2000, and by 10.9% between 2000 and 2010. A recent trend in construction of rental housing has provided increased housing diversity and has helped improve housing opportunities and choices for the region's residents. From 1990 to 2010, the average household size in the region declined from 2.51 to 2.31 persons per occupied housing unit. From 2000 to 2010, growth in one and two-person households accounted for 93% of total household growth. Larger households with four or more people make up a relatively small percentage of total households (17.8% in 2010). The total number of these larger households has not increased over the past 20 years.

Demographic analysis shows that the UVLSRPC region has experienced steady population growth since 1990, in part because it has thriving employment opportunities. The region has unemployment rates that are well below state and national averages. The two most significant demographic changes between 1990 and 2010 are the age distribution of the population and household size. Between 2000 and 2010, the most rapidly growing age groups were in the 55-64 year old and 65+ age cohorts. The population growth rate for the 65 and older segment is out-pacing the under 65 group. By 2030, households headed by a person age 65 or older may comprise 48% of all households in the region. Ten-year projections point to a decline in the labor force under 65 if younger workers do not migrate into the area.

Surge in Rental Supply, Ownership Rate Down

The region has had a homeownership rate of about 69% to 70% over the past 30 years. The homeownership rate declined across all age groups between 2000 and 2010, consistent with trends in NH and nationally. The recent increase in multi-family and rental housing developments in the region was a response to market demand for smaller, more affordable units. This supply was badly needed given the very low rental vacancy rate in 2000, following a decade that produced virtually no increase in the rental supply. Rental housing has been and will continue to be a particularly important resource for the UVLSRPC region.

Buyers Seeking Affordability Commute Further

There are major home price differences among the sub-regions of the UVLSRPC region. Home prices are highest close to the job centers of the Lebanon NH-VT NECTA. Many households will opt for housing that is a greater distance from employment centers if these regional price differences persist or if there is limited housing stock or poor quality housing closer to jobs. In the rental market, differences in median rental costs among sub-regions are not as great. Average commuting time of residents has increased by about 25% since 1990. A recent survey of area employees by the Upper Valley Housing Coalition shows that affordability of housing, particularly for homeowners, appears to be a larger concern over commuting distance when choosing a home.

Thousands Have High Housing Cost Burdens

Nearly 13,000 households in the UVLSRPC region (36% of all households - 33% of owners, 42% of renters) have a high housing cost burden - paying 30% or more of their household income on housing costs. Over 5,000 of the Region's households (14% of all households - 13% of owners, 17% of renters) have a severe cost burden - paying 50% or more of their income on housing costs. Housing affordability impacts younger households the most, which comprise the largest portion of the workforce earning entry-level wages.

Employment Does Not Guarantee Affordable Housing

After 2008, the nation's economy has slowed and unemployment has increased substantially. The Region suffered job loss during this period, but not as severely as national trends due to a relatively strong regional economy. Nevertheless, the median sales price of area homes declined along with the number of homes sold while the median market rent continued to increase. Overall, the economy of the UVLSRPC region supports household incomes that compare well to measures of housing affordability based on median market rate home prices and rents. Yet there remain thousands of households, both owners and renters, in the region who are spending excessive portions of their income on housing costs. Those who earn less than the median income, or who have only one wage earner per household, may have difficulty affording the housing.

Housing Production: Accommodate the Aging and Attract the Workforce

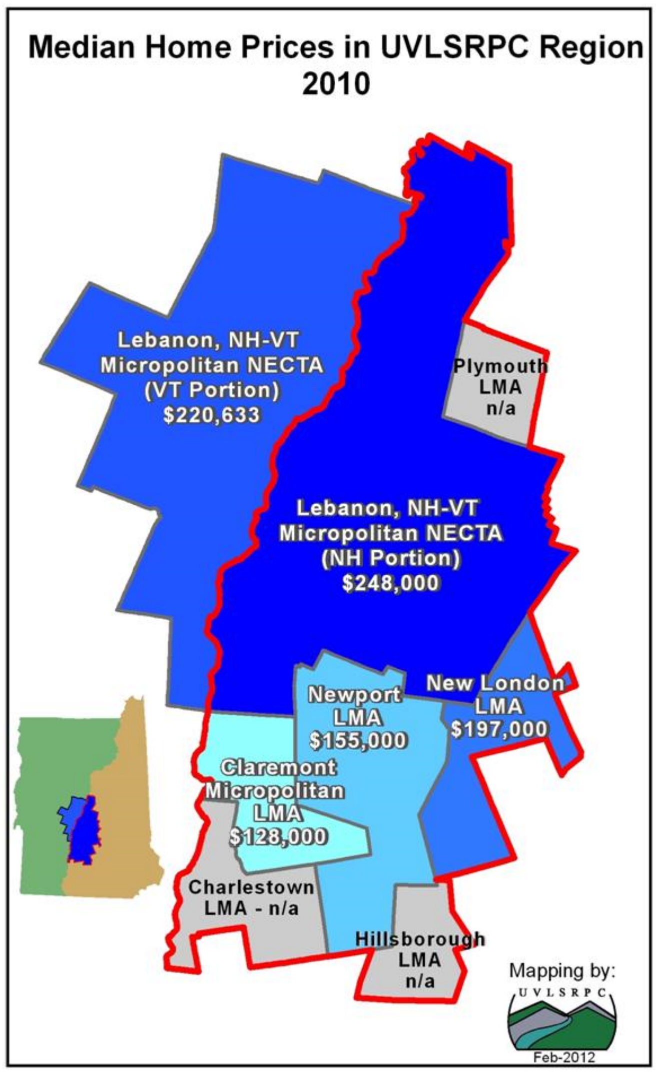
Housing production needs were projected using two independent methods: one utilizing population and age distribution projections and the second utilizing projected regional employment growth rates.

Housing supply projections for 2010 to 2020 identify a need for the UVLSRPC region to increase the number of units to between 3,780 and 4,611. This is year-round housing stock and equates to approximately 378 to 461 units per year. An estimated 41% of those housing units should be in the form of housing affordable to the workforce based on the workforce income standard used in this study, or about 155 to 189 units per year. These estimates would allow for housing supply to keep pace with the expected rate of population and employment growth.

Ownership and Rental Cost Trends

Home Price

Between 2000 and 2008, the median sale price for a primary residence nearly doubled. The increase in median price was realized throughout the region, although considerable differences in price exist between sub-regions. Following 2008, median price dropped sharply throughout the region. The data suggest that an adjustment in pricing relative to economic conditions and actual household incomes has probably improved the overall affordability of primary homes. Current lower mortgage interest rates and home buying incentive programs such as the Federal home purchaser's tax credit in 2010 should have increased the number of qualifying buyers, but tighter credit standards and economic stability have deterred that advantage.



The distribution of primary home sales by price range within the Lebanon, NH-VT NECTA shows that Vermont has a greater share of lower priced homes. When sales in the Vermont portion of the NECTA are compared to sales in Orange and Windsor Counties in VT, another price difference is apparent; sales prices in the Vermont portion of the NECTA are substantially higher than in the outlying areas of each county by about 29%.

Market Rental Costs

Differences in rental costs between geographic sub-areas in the region are not as extreme as the differences in home prices. The distributions of gross rents indicate almost no availability of rental housing under $600 per month. Rents at this level are typically available only in assisted rental housing units which are limited in supply. As of 2010, about 41% of the market rate units in the region would be affordable to workforce households where the gross rent is less than $900 per month. Renters who make the median wage can afford much of the available rental stock, but renters with household incomes below the workforce benchmark will have difficulty affording the median market rent.

Regional Housing Cost Burden

Levels of "housing need" often refer to a housing cost burden level (percentage of income devoted to gross monthly housing costs). Figure 2.3 summarizes the estimated regional levels of housing cost burden based on 2010 housing costs and household income levels.

High Housing Cost Burden (at least 30% of income is used for housing): There are an estimated 12,897 households (36% of all households in the region) that have a high housing cost burden. The most significant cost burden ratios exist for homeowner households with incomes under $50,000 and renter households with annual incomes under $35,000.

Very High Housing Cost Burden (at least 40% of income is used for housing): There are 7,659 households that have a very high cost burden (21% overall, 18% of owner households and 28% of renter households).

Severe Housing Cost Burden (at least 50% of income is used for housing): There are 5,085 households (14% overall, 13% of homeowner households and 17% of renter households) that have a severe cost burden.

- Housing cost burden data for homeowners in the Lebanon NH-VT NECTA (including 12 Vermont communities) is about the same as the UVLSRPC regional average. However, renter households living in the NECTA have proportionately higher rental costs relative to their income.
- Overall, 42% of all renters and 33% of all homeowners in the UVLSRPC region spend 30% or more of their gross income on monthly housing costs. The highest prevalence of high housing cost burden is found among the youngest households.
- There are few homeowners in the under-25 age group, but 70% of those that do own a home have a high housing cost burden.

Rental housing in the region is particularly difficult to afford among households less than 35 years of age. In that age group, 46% have a high housing cost burden.

Economic conditions and regional employment opportunities relate directly to regional housing availability, choice and diversity. The UVLSRPC region enjoys a lower unemployment rate than the other parts of the state or the nation as a whole. Between 2008 and 2010, the region showed the first significant net loss in jobs in 20 years. Relative to the state, the region has a high concentration of jobs in the healthcare and social service sectors with above average concentration of jobs in agriculture, mining, manufacturing and information sectors. The Claremont, Charlestown and Newport labor market areas have a significant portion of the regional manufacturing jobs while healthcare, education and other service jobs are more prominent in the Lebanon NH-VT NECTA.

The average wage paid by industries in the UVLSRPC region in 2010 was $959 per week, or an equivalent annual wage of $49,868. At a 30% housing cost ratio (the % of wages used for housing), this income supports a $1,250 per month housing budget, this could also support the median gross rent in the area but would be insufficient to afford a median priced home without a second household income.

Affordability problems occur more frequently among those who are in lower wage sectors or in entry-level positions. Average entry-level wages in some of the largest occupational sectors range from about $9 to $20 per hour. At $11.50 per hour, a single wage earner could afford a monthly rent of $624 per month. Market-rate rents at this level are generally unavailable in the region.

As the number of jobs in the region continues to grow there will be more demand on the housing market to support the labor force. At the same time, the demographics show a decline in the labor force under 65 years of age. This may make it increasingly difficult for employers to fill their needs. Increasing the availability of affordable housing, particularly rental units, may make it easier to attract the workforce needed in the future.

The Upper Valley Housing Coalition conducted a survey of advertised rents for September 2011. The rent survey indicated that:

- ***66% of the listings were located in NH, 33% in VT.***
- ***Approximately 35% of all the entries are single-family homes.***
- ***The estimated median gross rent was $1,200.***

Regional Housing Supply Projections

The purpose of a housing supply model is to project the number of households and the total year-round housing stock needed to support housing choice within the region. Details of housing supply projection methodologies are documented in the Housing Needs Assessment Technical Report.

The population-based housing production model projects that an additional 4,515 housing units are needed in the region between 2010 and 2020. This averages to an additional 451 units per year. The employment-based housing production model, as discussed on page 2-5, calls for between 3,780 to 4,611 additional units in the region during the same timeframe, 2010 to 2020. Of those additional units, workforce housing need is projected to be between 1,550 and 1,891. These totals, using both population-based and employment-based projections, are comparable to the actual historical building permit data for the years 2000 to 2009 which saw permits issued for 4,673 additional housing units.

Results for the Lebanon NH-VT NECTA

Focusing only on the Lebanon NH-VT NECTA, the population-based housing production model indicates a need for an additional 3,705 units between 2010 and 2020. The employment-based model, using a 1% annual average growth rate in employment, results in a need for 3,346 housing units to be constructed over the next 10 years. However, using the historical 20-year average of 1.66% per year employment growth rate, would require over 5,540 additional units in order to maintain the current housing/jobs ratio in the NECTA. Using the 1% growth rate, between 1,171 and 1,939 of the 3,346 units should be workforce housing in order to accommodate the projected population. A general projection for the NECTA is that between 3,346 and 5,540 housing units should be constructed in the next 10 years. For historical reference, building permit activity from 1990 to 1999 totaled 2,143 units. During the 2000-2009 period the total was 3,539. Inadequate housing production has been a long-term issue for the Lebanon NH-VT NECTA.

Discussion of Production Projections

A strict model of future housing needs based on age and owner/rental tenure relationships would indicate that ownership units will dominate housing production needs in the coming years. This would be true only if 2010 age/tenure relationships remain constant, and if the housing constructed is sufficiently affordable. During the last decade, overall production rates declined. If homeownership rates decline further, a greater portion of production will need to be devoted to rental housing. In addition, an expanded role for rental housing is called for if the region wants to attract and to retain younger workers to meet labor demands.

The assisted rental housing supply is a significant resource for seniors and other renters, but this inventory is relatively old with limited new units being proposed or constructed. Most of the assisted rental housing in the region was built 30 or 40 years ago funded by programs that are no longer available. Affordable housing initiatives should seek to find solutions that integrate both dedicated assisted rental housing facilities and continued use of rental subsidy vouchers to allow low income households the opportunity for affordable housing.

Housing Survey of Employees

A Regional Housing Needs Survey conducted in collaboration with the Upper Valley Housing Coalition (UVHC) was taken by approximately 450 people working in the region. The survey included questions designed to better understand housing needs and the preferences of and the issues experienced by the region’s workforce. Many (77.2%) respondents own the home that they live in, and 19.2% rent their housing.

Respondents for the most part (87%) travel by car to work and 81.1% are alone in their automobile, while 5.9% are carpooling to work. Several people noted that they had either moved or changed jobs to shorten their commute. Three people commented that they chose to live equal distance between their employer and their spouse’s employer. The survey results indicate that while some households may want to live closer to work, their first priority was affordable, quality housing in a good neighborhood, even if that required a sacrifice in convenience to work, shopping or other services. Some respondents indicated that affordable prices closer to work might be desirable but were not available.

Of the total renters participating in the survey, 69% plan to own a home someday but there are some limiting factors involved. The inability to afford the down payment cited by 62% of renters was a very important reason for renting at the present time and 48% said that not being able to find an affordable home close to work was a very important factor. When asked what type of home they would consider owning in the future, 86% said they would definitely consider a single family detached house (only 1% would not consider owning a single family home).

A large number of respondents commented that home ownership in the core of the Upper Valley was too costly; some homeowners had been in their homes for years and said they could not afford to buy today. Others have chosen to rent so that they could be closer to work or other amenities.

"Housing opportunities and choices relative to distance from the workplace will have long term effects on consumer costs for commuting and social consequences such as decreased time with friends and family, difficulty coordinating childcare and other needs and reduced opportunity for community and volunteer involvement." When asked what factors would be "very important" in choosing a new home:

- 85% identified good quality housing
- 80% identified quality of the neighborhood
- 82% chose housing cost

This summary overview emphasizes the factors that have the most critical impact on existing and projected housing demand.

Workforce Housing

The alternative projections indicate that the UVLSRPC region should add between 155 to 189 workforce housing units per year in a combination of ownership and rental housing to keep pace with anticipated growth in households and a modest rate of employment growth.

The Lebanon NH-VT NECTA will need to add 120 to 130 workforce housing units per year, assuming modest employment growth of 1% per year. The NECTA supports a smaller share of workforce households than the total UVLSRPC region. If the goal is to maintain the current housing/jobs ratio in the Lebanon NH-VT NECTA, then more workforce housing will be required within this job growth area. If more workforce units can be produced close to this NECTA job center, it will reduce the need to produce workforce housing in outlying areas of the region, potentially mitigating future commuting issues.

Employment does not guarantee that a person or household can afford the market rate housing. About 23% of new job growth in the UVLSRPC region is projected to occur in sectors that have an average wage that is too low to allow a typical household to afford median housing costs.

Each Community Plays a Role in the Region's Housing Needs

Local responses to these needs will vary as to type and scale, but each community needs to consider whether its local regulations preclude or enable various forms of workforce, affordable and multifamily housing.

Each community is encouraged to evaluate its contribution to the regional housing supply. By comparing the local share of jobs, wages, valuation, total housing units or other factors to an affordable housing supply, each community can begin to evaluate its contribution to the regional housing supply. Communities should consider whether they are supporting sufficient diversity in the housing stock sufficient to enable the creation of affordable workforce housing units, and to appropriately accommodate the impact of an increasingly older population. Guidance for this process is detailed in the Housing Needs Assessment Technical Report.

Housing Improvement Strategies

- *Ensure that Communities in the Region are Educated on New Hampshire's Workforce Housing Statute*

New Hampshire's Workforce Housing Statute (RSA 674:58-61) requires communities to provide a reasonable opportunity for workforce housing alternatives, including multifamily housing with five or more units per structure. Not every community will have the utility infrastructure to support housing at higher densities, nor does the market necessarily support all forms of affordable housing in all locations. State statute requires that communities, through their regulatory framework provide for the opportunity for workforce housing.

- *Develop a Housing Stabilization Program targeted to the Claremont-Newport Labor Market Area*

Rather than affordability, the condition of housing is a primary concern in the Claremont-Newport Labor Market Area. The Commission should work cooperatively with municipalities in the Claremont-Newport Labor Market area to seek funding through the U.S. Department of Housing and Urban Development (HUD), New Hampshire Housing Finance Authority, or other agency to develop a local housing stabilization program that would benefit neighborhoods that have suffered from disproportionate rates of foreclosure and housing abandonment. This could include, but not be limited to, the purchase and redevelopment of foreclosed or abandoned homes.

- *Promote Adaptive Reuse of Existing Housing Stock*

Using existing housing inventory can be less expensive than construction of new homes. Taking advantage of a slower economy can represent a buying opportunity for organizations that have the capacity to purchase, improve and resell the properties to qualifying buyers. Qualified first time buyers may benefit from the lower interest and reduced down payment requirements of New Hampshire Housing Finance Authority (NHHFA) mortgage programs. Under these programs, purchases can include owner-occupancy of properties of up to four units. This might be advantageous in the older urban areas in the region with existing housing.

- *Develop a Strategic Housing Plan to complement the Regional Housing Needs Analysis*

Public comments during the development of this Regional Plan have identified a gap between those who get housing assistance and those who can't afford market-rate housing in the region. The Commission should seek funding from the U.S. Department of Housing and Urban Development (HUD), New Hampshire Housing Finance Authority, or other agency to develop a Strategic Housing Plan that complements the Regional Housing Needs Assessment and identifies strategies that would benefit this portion of the population.

- *Utilize Affordable Housing Covenants*

Without the use of limits on resale price or eligible buyer incomes, the benefit of any affordable ownership program might be enjoyed only by the first generations of owners. Deed covenants are instruments that preserve the value of investments in affordability by:

- Placing limitations on the resale price of real estate;
- Controlling the amount of equity appreciation;
- Limiting improvements to property or dollar value of improvements;
- Providing the covenant holder a right of first refusal to purchase the property;
- Restricting or limiting the types of materials used in construction or improvements

Covenants may be used in the case of inclusionary housing developments or other development agreements with private parties to produce affordable housing development, or used directly by a non-profit developer to create and then sell affordable units.

- *Coordinate with Local Housing Authorities*

Claremont and Lebanon have established local public housing authorities. Historically, housing authorities were formed principally to develop lower-income rental housing and to conduct urban renewal activities with subsidies from the U. S. Department of Housing and Urban Development. Some housing authorities or their subsidiary non-profit corporations have developed other forms of rental housing under the USDA's rural development programs or under the Low Income Housing Tax Credit Program administered by NHHFA.

In New Hampshire, local housing authorities have the capacity to operate up to 6 miles outside the corporate boundaries of the municipality in which they are formed. So it is possible for the housing authorities of Lebanon and Claremont to operate or to develop projects in adjacent towns.

- *Utilize the Low Income Housing Tax Credit (LIHTC) Program [NHHFA]*

This federal tax credit mechanism is today's primary means to develop multi-family rental housing that can serve low income or mixed income markets (general occupancy or elderly housing). Use of the LIHTC requires that a rental project provide a minimum of 20% of its units to households earning 50% of the Area Median Family Income (AMFI) or less, or at least 40% of its units to renters at or below 60% of AMFI. The balance of the units may be rented at prevailing market rents.

- *Participate in the Community Development Block Grant (CDBG) Program [NHCDFA]*

CDBG funds can be combined with other funds to support the creation of housing units, or can be used for related community needs such as encouraging home ownership, developing infrastructure, revitalizing downtowns, rehabilitating rental housing and other uses that have a primary benefit to households earning less than 80% of AMFI.

- *Consider Municipal Contributions to Housing Development*

There are examples such as Gile Hill in Hanover where municipal funding through land donation has made affordable housing possible. Other states have included general obligation (GO) bonds as part of the financing mix for developing affordable housing. The authority of municipalities to use GO bonds for this purpose in New Hampshire would need to be verified prior to use of such a financing tool.

- *Form Local Housing Commissions*

NH RSA 674:44-h enables municipalities to form local housing commissions (The powers of these Commissions differ from those of a local housing authority created under NH RSA 203). The Commission can advise the Planning Board on housing needs assessment, ordinances and regulatory changes and in exploring ways of increasing housing diversity and affordability. It can also receive gifts of money and real or personal property in the name of the city or town for the purpose of maintaining or improving housing affordability. The Commission may also be empowered to manage a non-lapsing affordable housing fund that is similar to the conservation fund administered by a Conservation Commission.

- *Consider Inclusionary and Density Incentives in Zoning Ordinances*

To provide incentives for developers to invest in affordable housing projects, inclusionary zoning provisions must be generous enough (relative to normal development standards) to permit a deep discount on low to moderate income units and to raise the gross profit achieved through construction of more units. In a voluntary program (mandatory inclusionary provisions are not permitted in New Hampshire), the density incentive must be high enough to persuade the developer to choose the inclusionary option. If the incentives are encumbered by more stringent standards for open space or other development requirements, or have less predictable approval procedures than under the baseline standards, inclusionary provisions are less likely to be successful.

- *Consider Jobs-Housing Linkage Contributions*

Linkage fees have been used in other areas of the United States that are experiencing rapid commercial and second home/resort development. Essentially, the fees represent an assessment that is based on the need to mitigate a portion of the low to moderate income housing need created by new job growth. The basis for the fees are usually derived from an analysis that establishes the relationship between local or regional job growth and the associated need for affordable or workforce housing to support the lower wage jobs generated by that development. Based on the results of the linkage study, a pre-determined fee is assessed per square foot of new commercial/industrial development at the time of development, though the pay-in of the fee may be pro-rated over a period of years.

Generally, funds derived from linkage fees flow to a local or regional housing trust or other organization. In New Hampshire, the use of linkage fees would require legislative changes to authorize NH municipalities to use this tool.

- *Require Housing Impact Statements for Large-Scale Non-residential Developments*

Housing developers are frequently asked to produce fiscal impact statements (cost vs. revenue generation of new housing) as part of the development review process.

Large scale commercial developments, however, are rarely asked to describe how and where their employees at different wage levels will find housing that their wage earners can afford. Communities hosting larger scale commercial development could require housing impact statements. This could require developers to furnish an analysis of the wage and salary distribution of the jobs to be created relative to the supply of housing affordable to those wage groups locally and in the region. Such statements could help establish a dialog with the developer about existing housing needs.

- *Promote Employer-Assisted Housing Initiatives*

Employer assisted housing initiatives can include such elements as access to a revolving loan fund to pay back an initial security deposit; providing a match to employee savings for the down payment of a house; leasing rental units for employees; or constructing units for employees. Housing-related cash benefits can provide financial incentives for an employee to stay with the company, live close to work and reduce labor turnover and training costs. Generally, employer assisted benefits are considered taxable income to the employee, but a deductible expense (as with salaries and other compensation) by the employer.

- *Support Affordable Housing Trusts and Community-Based Non-Profits*

A housing trust is simply a way of pooling funds for housing initiatives. An affordable housing trust fund raises funds from both public and private sources and restricts the use of funds to meet specified housing objectives. A dedicated funding stream, whether from taxes, fees and/or an endowment are considered essential for success. Other possible funding sources include: private employers, banks, and foundations that also donate to housing trust funds.

A regional housing trust fund has been established by the Upper Valley Housing Coalition; local housing commissions can also receive contributions.

- *Coordinate Public Education Efforts to Support Affordable and Workforce Housing*

Public objections to housing development in general and affordable housing in particular, are often barriers to achieving balanced development that includes housing diversity. Local housing commissions, the public housing authorities, housing trusts and the Upper Valley Housing Coalition can be active in the educational effort.

- *Consider Inter-municipal Tax Base Sharing and Regionalized Services*

New Hampshire municipalities rely heavily on local property taxes to fund municipal services and public education. This leads to a competition for developments offering high assessed value and low public service costs and less enthusiasm for development that offers lower assessed value relative to its service demands.

NH municipalities are authorized to enter into inter-municipal agreements through RSA Chapter 53-A. The agreement must be approved by the governing body of each participating public agency. The written agreement must address certain points: duration; purpose; financing; method of termination; and a description of any new entity created or joint board responsible to administer the agreement. RSA Chapter 53-A agreements must be approved by the attorney general. In these models, new taxable valuation is shared among all municipalities in the participating region or district, allowing property tax wealth and service costs to be shared within a region.

- *Promote Utilization of the Downtown Tax Incentive, RSA 79-E*

Once this law is adopted by a municipality's legislative body, a property owner who wants to substantially rehabilitate a downtown or village center building may apply to the local governing body for a period of temporary tax relief. The law is structured to encourage both rehabilitation of downtown structures, and housing in the downtown area. The temporary tax relief consists of a finite period during which the property tax on the structure will not increase as a result of its substantial rehabilitation. In exchange for the relief, the property owner grants a covenant ensuring the continuation of the public benefit during the period of the tax relief. To date Concord, Hooksett, Lisbon, Manchester and Pittsfield are using this program.

- *Encourage Additional Utilization of the Housing Futures Fund*

The Housing Futures Fund (HFF) provides grants, through the Tax Credit Program, to assist community-based nonprofit housing organizations. HFF grants are intended to build the capacity of participating nonprofits to investigate opportunities, secure financing, and test innovative new solutions for area residents. The operational grant program enables grantees to focus on housing development and educational outreach to individuals and families in need of quality affordable housing. The technical assistance aspect of the HFF program is implemented by the New Hampshire Community Loan Fund.

- *Consider Creating a Municipal Affordable Housing Revolving fund—RSA 31:95(h).*

In addition to authorizing municipalities to create Housing Commissions, the statute also authorizes the establishment of revolving funds for the purpose of creating affordable housing and facilitating transactions.

2.3 FAIR HOUSING EQUITY ASSESSMENT

What is Fair Housing?

Having equal and unrestricted access to housing regardless of factors such as race, color, religion, sex, familial status, disability, and national origin is the definition of "Fair Housing." Safe, accessible, and healthy housing not only allows residents to live in decent conditions but provides the opportunity to access employment, educational and other services to engage as full, participating and equal members of one's chosen community.

The Fair Housing Act is Title VIII of the Civil Rights Act and became law in 1968. It prohibits discrimination in the sale, rental and financing of dwellings based on race, color, religion, gender, or national origin. Under the federal Fair Housing Act, the following are protected classes: Race, National Origin, Religion, Color, Gender, Familial Status and Disability. The New Hampshire Fair Housing Act includes all of the federally protected classes with the addition of Marital Status, Sexual Orientation, and Age. In 1988, The U.S. Congress amended Title VIII and added protection against discrimination based on disability and familial status (presence of a child under the age of 18) as well as an exemption from familial status discrimination for communities specifically designated for people age 55 and older.

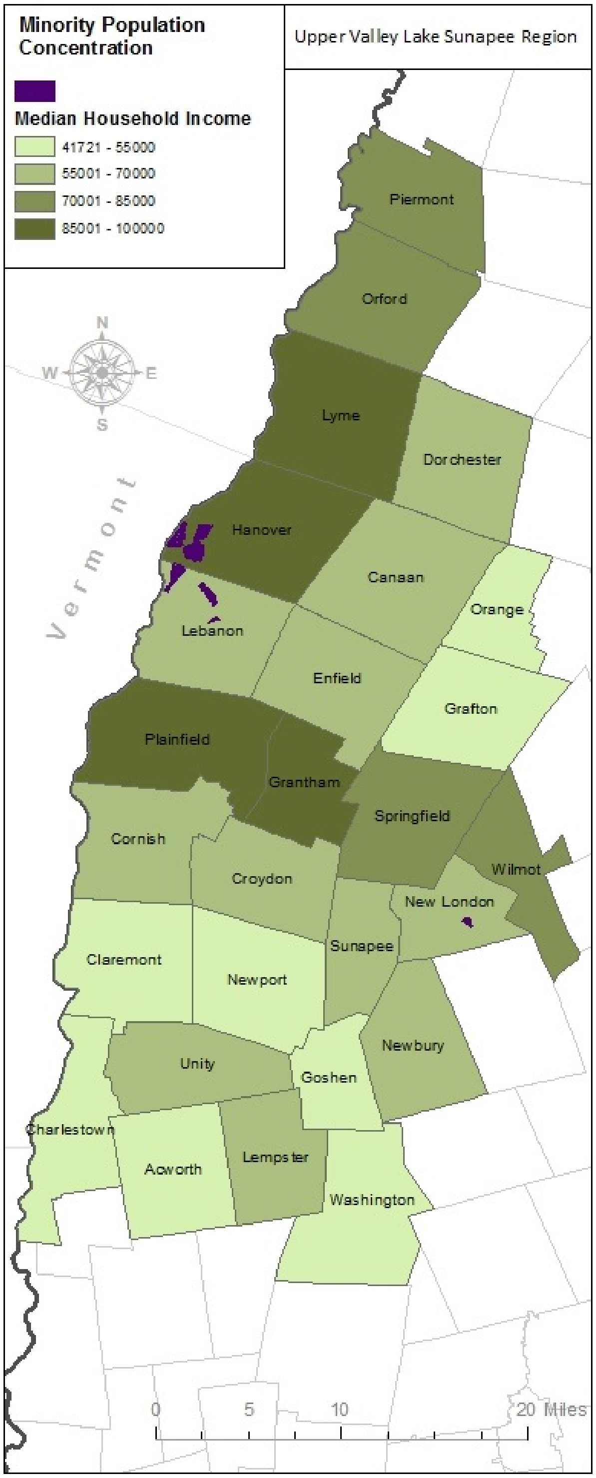
Along with prohibiting discrimination in the sale, rental, and financing of housing, the Fair Housing Act also makes illegal any advertisements or statements that indicate a limitation, preference or exclusion based on one or more the protected classes. Further, any attempt to coerce, intimidate, or interfere with someone exercising a fair housing right is prohibited.

People with disabilities are afforded additional protections. For instance, a landlord may not:

- Refuse to allow a person with a disability to make reasonable modifications to a dwelling or common use area in order to make it accessible;
- Refuse to make reasonable accommodations to rules, policies or practices in order to allow a person with a disability to use the housing.

Protected Categories under Federal and/or State Fair Housing Laws		
• Race	• Color	• Disability
• National Origin	• Marital Status	• Ancestry
• Religion	• Age	• Public Assistance
• Military or Veteran Status	• Sexual Orientation	• Sex
• Housing Subsidies or Rental Assistance	• Gender Identity or Expression	• Families with Children
• Genetic Information		

Fair Housing in the UVLSRPC Region



The UVLSRPC Region is atypical in that the highest percentages of minority populations are residents of the higher-income cities and towns, including Hanover, Lebanon, and New London. This is due to the presence of Dartmouth College, the Dartmouth Hitchcock Medical Center, Colby-Sawyer College, and a number of international high-tech firms established in the surrounding area. These entities attract both students and professionals from around the world. Many students remain in the area upon completing their education because of the excellent quality of life and employment opportunities.

Communities of Interest

The significant factors affecting housing equity in this region relate to socio-economic status, age, and family composition, which are used to identify "communities of interest."

Groups such as elderly persons, minorities, single heads of households, persons without a vehicle, persons in poverty and those with limited proficiency in English have lower incomes and often experience difficulty in securing safe, decent, and affordable housing. UVLSRPC reviewed available information on the presence of residents among these groups in evaluating housing equity.

The region's largest minority groups are: 1) Asian; 2) Two or more races; 3) Hispanic or Latino; 4) Black; 5) Some other race; 6) Native American; and 7) Pacific Islanders. See the Tables in Appendix I of this Chapter for detailed minority population statistics.

Analysis of Households by Age

Analyzing households by age reveals important information about relationships between housing and age cohorts in the region's population:

- There was a steep decline in the number of households within the 25 to 34 year-old age group between 1990 and 2000. A similar decline in households occurred for the 35 to 44 year-old age group from 2000 to 2010.
- These sequential declines in younger households are balanced by increases in the older household age groups.
- The number of households headed by those under 65 years old vs. senior households (age 65+) was about the same from 1990 to 2000. However, between 2000 and 2010, the rate of growth in senior households was double the rate of increase for those households headed by people under 65.
- In 2010, the senior household (age 65+) cohort represented 26% of the heads of households in the UVLSRPC region. Projections prepared for the UVLSRPC Regional Housing Needs Assessment indicated that households headed by seniors will comprise 37% of households by 2020 and 48% of the households by 2030.

Distribution of Workforce and Housing

The terms workforce housing and affordable housing are oftentimes used interchangeably and can be confusing.

Generally, affordable housing is a generic term that refers to housing with covenants, subsidies, or other mechanisms to ensure the availability of such housing for low and moderate-income households at a cost that leaves an adequate amount of household income for other needs. To be considered affordable, the total cost of housing, including principal, interest, taxes and utilities (ownership), or rent and utilities (rental), should be no more than 30% of a person's or family's gross income.

As referenced in NH RSA 674:58, workforce housing includes a variety of housing types (single family, duplex, apartments, and multi-family) affordable to households with low or moderate-income. These individuals include teachers, municipal employees, retail employees, mechanics, young professionals and others with incomes at or below the area median family income of a region. In New Hampshire, workforce housing includes homeownership affordable to households with incomes up to 100% of the area median family income (AMFI) and rental housing up to 60% of the AMFI for a household of three persons.

Prevalent Fair Housing Issues Identified in New Hampshire

A number of issues reoccur in Fair Housing reports filed in New Hampshire, including:

- Discrimination against individuals with a disability;
- Rental discrimination against families with minor children;
- Rental discrimination against families with young children due to the presence or potential presence of lead-based hazards and landlord's lack of understanding of their obligations;
- Predatory Foreclosure Schemes/Predatory Lending;
- Municipalities that have regulations that prohibit multi-family housing;
- Active steering towards certain areas of a community and/or the region based on race/ethnicity, economic characteristics, and familial status.

Source: NHHFA

Fair Housing Impediments and Complaints

Three organizations are the potential recipients of legal complaints alleging violations of the Fair Housing Act:

- NH Commission on Human Rights;
- NH Legal Assistance; and
- U.S. Dept. of Housing & Urban Development, New England Office of Fair Housing and Equal Opportunity.

Information from the three agencies provides sufficient data to determine the nature of issues raised regarding housing discrimination in the Upper Valley Lake Sunapee Region. The information contained in the agencies' files is confidential and can only be shared in a generic manner.

The NH Commission on Human Rights is a state agency established by RSA 354-A for the purpose of eliminating discrimination in employment, public accommodations and the sale or rental of housing or commercial property, because of age, sex, sexual orientation, race, creed, color, marital status, familial status, physical or mental disability or national origin. The commission has the power to receive, investigate and pass judgement upon complaints of illegal discrimination and to engage in research and education designed to promote good will and prevent discrimination.

New Hampshire Legal Assistance (NHLA) is a HUD-funded Fair Housing Initiative that provides private enforcement of the fair housing act through education, outreach, and direct representation of persons facing housing discrimination. In addition, NHLA provides legal services to low-income people, ranging from simple legal information and advice to vigorous and thorough representation in all of New Hampshire's courts and before many of the local, state and federal agencies which play roles in the lives of low-income people.

Town	# of Intakes	Protected Class
Acworth	0	
Canaan	1	*Gender: 1*
Charlestown	4	*Disability: 2, Familial Status: 2*
Claremont	28	*Disability: 22, Familial Status: 4, Gender: 1, Age: 1*
Cornish	0	
Croydon	0	
Dorchester	0	
Enfield	1	*Familial Status: 1*
Goshen	1	*Familial Status: 1*
Grafton	0	
Grantham	0	
Hanover	0	
Lebanon	9	*Disability: 6, Familial Status: 2 Race: 1*
Lempster	0	
Lyme	0	
New London	0	
Newbury	1	*Disability: 1*
Newport	2	*Disability: 2*
Orange	0	
Orford	0	
Piermont	0	
Plainfield	0	
Springfield	0	
Sunapee	0	
Unity	0	
Washington	0	
Wilmot	0	
TOTAL	**47**	**47**

Above: Fair Housing Complaint Summary for the UVLSRPC Region (2008 to 2013).

During the period from January 1, 2008 through December 31, 2013, 47 complaints were filed in the Upper Valley Lake Sunapee Region. The predominant basis for the complaints was Disability (33) followed by Family Status (10), Gender (2), Age (1), and Race (1).

Complaints relating to familial status generally are those where the landlord will refuse to rent to or advertises to exclude families with children. The data available does not offer the finer details or underlying facts of these cases.

The most frequent fair housing complaint filed in the UVLSRPC region, 33 or 70%, were related to disability. Most of these complaints were identified by HUD data as "Failure to Make Reasonable Accommodation." The prevalence of this complaint, in light of the anticipated demographic shift in the population of the region should heighten the consideration given to providing equitable housing opportunities and accommodations for individuals with a disability, the majority of whom will be among the senior population.

As Figure 2.3.1 shows, 42.1% of senior households in the region have at least one disability.

Figure 2.3.1- Senior Households in the Region with at Least One Disability

Senior Households with At Least One Disability		
	# of Households	*% of Households*
Vision Difficulty	3,570	8.0%
Hearing Difficulty	9,818	22.0%
Physical Difficulty	11,380	25.5%
Cognitive Difficulty	4,4630	10.0%
Self-Care Difficulty	3,302	7.4%
Independent Living Difficulty	7,006	15.7%
With At Least One Disability	44,626	42.1%
Total Households Age 65+	106,000	
Source: ACS, 2011 Cited in AARP State Housing Profiles, 2011		

Fair Housing Improvement Needs

Local Land Use Controls

Most municipalities in the region have a full compliment of local land use regulations – Zoning Ordinance, Subdivision Regulations, and Site Plan Review Regulations. Local land use regulations require an approach that accommodates growth in an orderly and planned fashion. In some cases, local land use regulations that are overly stringent increase the cost of housing.

Some municipalities are considering a reduction in lot size for workforce housing. On a regular basis, communities should review and update their local land use regulations to make sure they accommodate local needs and are justifiable.

Senior and Supported Housing

There are 1,539 assisted rental housing units within the UVLSRPC region, serving about 14% of the region's renter households. Sixty percent (60%) of these units are restricted to occupancy by elderly and disabled residents and many others are occupied by senior households. Only 7% of renters under 65 live in an assisted housing development, as compared to 43% of all renters age 65 or older.

The primary concentrations of assisted rental housing units are located in Lebanon, Claremont and Newport, New Hampshire. Within the Vermont portion of the NECTA, assisted rental developments are concentrated principally in Hartford and Windsor, Vermont. Most of the assisted rental inventory was constructed 30 to 40 years ago under federal funding programs that are no longer available. This lack of financial resources makes it increasingly difficult to assist the lowest-income renter households, leading to a greater gap in affordability.

Transportation

Low-income persons have transportation needs due to the high cost of housing. Through community outreach effort, participants identified additional public transit services as a need. Public transit services in the Upper Valley Lake Sunapee Region currently exist in only nine of the region's 27 communities.

Community and Economic Development

New opportunities for job creation should be located in or close to the built area of a community. Housing and community development are interrelated.

Planning for Fair Housing: A Municipal Primer

A Municipal Response to Regional Needs

The local response to regional needs can help to reduce the housing affordability gap. Most communities should review their development regulations and consider whether changes are needed to address the new workforce legislation. Some communities will go beyond basic statutory compliance to provide incentives or actively participate in affordable housing creation. A few communities may find that their current housing stock and development standards already enable them to support a fair share of the region's workforce housing needs. Municipal officials working on housing issues could start their analysis by asking a few central questions:

- If you were new to the workforce and earned an entry level wage in the UVLSRPC Region, where could you afford to live, and what housing options are there in your community?
- How far would you need to commute to find a house or apartment you could afford along with your other household and transportation costs?
- How can we build our jobs and economic base if we don't have enough affordable housing to attract and retain a qualified workforce?
- Where will your aging parents live when they can no longer handle the physical demands and costs of running a single family house?

Factors that Affect Housing Development

- Growth limits
- Open space and agricultural zones that limit residential development densities
- Lengthy review process for new residential developments (special permit processes)
- Parking requirements (number of spaces, on-site parking)
- Local board of health requirements that impose more restrictive wastewater disposal requirements
- Local wetlands regulations
- Local building code requirements that add additional conditions above and beyond the state's building code requirements
- Local historic district regulations

Meeting Basic Statutory Workforce Housing Requirements

Under NH RSA 58 to 61, each municipality should examine whether land use regulations need to be modified to enable workforce housing creation. Small changes that produce even modest gains in workforce housing can help address regional supply and affordability needs:

- Enable accessory dwelling units and duplexes within single family zoning districts.
- Allow multifamily housing units within commercial mixed use sites.
- Re-examine zoning limits on street frontage per unit, the maximum number of housing units per structure and maximum structures per lot to create more flexibility to accommodate development other than single family detached homes.
- Consider a workforce housing overlay district is an option. Such provisions might allow density to be defined using site-specific soil-based development capacity measures subject to performance in creating and preserving affordable housing units.

Providing Access and Equity

Developing Incentives and Linkages

To go beyond basic compliance with the workforce statute and encourage permanent affordable housing will require more sophisticated approaches that create and preserve affordable housing. The best efforts to increase density to leverage affordable housing can be overwhelmed by market pressure to pursue more profitable development.

Market prices and rents will rise to whatever level the market will bear. Therefore, home prices or rent levels of affordable housing units in a development are limited by the conditions of financing programs or the specific affordability covenants attached to the property deed. Recent declines in home prices may present an opportunity to acquire homes at a low cost and preserve them as affordable units.

Affordability covenants used in association with new inclusionary housing developments may also be applied to less expensive housing purchased from the existing stock.

Lasting affordability could be created within an inventory of protected affordable homes in scattered locations. A non-profit organization could acquire and improve selected properties and attach affordability covenants prior to resale to workforce buyers.

In some states, mandatory inclusionary housing provisions may be applied to new residential development or linkage ordinances may require commercial developments to provide or contribute to the workforce housing demand it generates. This approach has worked in resort-oriented communities, but its success is owed to a mandated process.

In New Hampshire, inclusionary housing provisions must provide voluntary incentives. There is no specific legislation allowing mandatory inclusion or linkage approaches, but voluntary incentives based on similar principles could be explored.

APPENDIX I – POPULATION BY RACE AND ETHNICITY IN THE UVLSRPC REGION

Population by Race and Ethnicity – Sullivan County Towns Within the UVLSRPC Region									
Geographic Area	Total population	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Race	Two or More Races	Hispanic or Latino (of any race)
Acworth	891	859	1	6	13	0	1	11	7
Charlestown	5,114	5,002	20	12	21	0	6	53	41
Claremont	13,355	12,808	85	44	126	4	53	235	171
Cornish	1,640	1,590	6	9	6	0	4	25	15
Croydon	764	731	4	5	4	0	2	18	5
Goshen	810	793	4	1	0	0	0	12	1
Grantham	2,985	2,898	13	1	29	0	18	26	53
Langdon	688	679	1	3	2	0	1	2	11
Lempster	1,154	1,132	2	3	0	0	2	15	14
Newport	6,507	6,324	18	15	26	0	18	106	71
Plainfield	2,364	2,316	11	2	12	0	1	22	27
Springfield	1,311	1,286	2	5	2	0	0	16	22
Sunapee	3,365	3,283	7	11	19	1	9	35	26
Unity	1,671	1,628	7	3	5	0	1	27	14
Washington	1,123	1,092	4	9	6	0	1	11	15
County Total	43,742	42,421	185	129	271	5	117	614	493
Percentage of Population		97%	0.40%	0.30%	0.60%	0.01%	0.30%	1.40%	1.10%

Source: U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171) Summary File Tables P1 and P2
Hispanic/Latino not included in Total by Race to Avoid Double Counting

Population by Race and Ethnicity - Grafton County Towns Within the UVLSRPC Region									
Geographic Area	Total Population	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Race	Two or More Races	Hispanic or Latino (of any race)
Canaan	3,909	3,797	5	6	40	0	9	52	32
Dorchester	355	343	1	3	1	0	0	7	0
Enfield	4,582	4,437	18	12	42	0	7	66	56
Grafton	1,340	1,296	4	3	5	0	2	30	20
Hanover	11,260	9,122	386	88	1,220	3	77	364	438
Lebanon	13,151	11,622	213	36	900	1	103	276	376
Lyme	1,716	1,663	5	5	19	0	6	18	41
Orange	331	324	1	0	1	0	1	4	9
Orford	1,237	1,202	5	0	9	0	1	20	8
Piermont	790	768	1	3	7	0	0	11	6
County Total	89,118	83386	828	329	2633	16	366	1560	1600
Percentage of Population		93.6%	1.0%	0.4%	3.0%	0.0%	0.4%	1.8%	1.8%

Source: U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171) Summary File Tables P1 and P2
Hispanic/Latino not included in Total by Race to Avoid Double Counting

Population by Race and Ethnicity - Merrimack County Towns Within the UVLSRPC Region									
Geographic Area	Total population	White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Race	Two or More Races	Hispanic or Latino (of any race)
Newbury	2,072	2,020	4	3	6	4	6	29	25
New London	4,397	4,241	49	2	47	2	4	52	64
Wilmot	1,358	1,332	1	2	6	0	2	15	9
County Total	146,445	139,609	1,530	391	2325	41	484	2,065	2,339
Percentage of Population		95.33%	0.04%	0.00%	1.588%	0.03%	0.33%	1.41%	1.60%

<u>Source:</u> U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171) Summary File Tables P1 and P2
Hispanic/Latino not included in Total by Race to Avoid Double Counting

APPENDIX II- HOUSING DEFINITIONS AND TERMINOLOGY

Affordable Housing: The term affordable housing is typically used to refer to housing with covenants, subsidies, or other mechanisms to ensure availability to low and moderate-income households at a cost that leaves an adequate amount of household income for other necessities. New Hampshire RSA 674:58 contains a specific definition of "affordable" with respect to workforce housing for a specific range of household incomes by tenure.

Area Median Family Income (AMFI): The area median family income divides the distribution of area incomes for a group of two or more people who reside together and who are related by birth, marriage, or adoption into two equal parts: one-half of the family households falling below the median value and one-half above the median.

Assisted Rental Housing Units: Assisted housing developments are housing facilities that provide subsidized or below-market rental housing units for low and very low income households. Assisted housing units are generally classified in three groups: special needs, elderly, and general occupancy or "family" units.

Barrier Free Housing: A general term for housing that is fully accessible (both the building and the housing unit) by a person using a wheelchair.

Equalized Assessed Valuation (EAV): An estimate of the full value or market value of taxable real estate, based on adjustments to municipal property valuation adjustments, made by the NH Department of Revenue Administration. Property values by community must be equalized for the purpose of equivalent assessments of county taxes to each municipality.

Fair Market Rent (FMR): Fair market rents are gross rent estimates established by the US Department of Housing and Urban Development. Fair market rents are established based on the dollar amount below which 40 percent of the standard-quality rental housing units are rented within a 15 month period. Public housing units and units less than two years old are not included in fair market rent distributions.

Fair Share: Municipal accommodation of a reasonable proportion of the low to moderate income housing needs of a market area or region. In some states, fair share is a numerical quantity, goal or quota defined by state or regional housing allocation plans. This quantity may be defined by various proportionate distribution factors relative to the community's share of property tax base, income, total housing units, population, employment or other factors. In New Hampshire, fair share is used in the context of either hosting a supply of workforce housing units, or providing reasonable opportunities for the creation of such housing, without a specific numerical formula for its measurement.

Gross Rent: The cost of rental housing to a tenant including rent paid to the landlord plus any additional cost paid by the tenant for water, sewer, heat, hot water, cooking fuel, and domestic electricity.

Headship: Refers to the ratio of households by age of the head of household to the total population within the same adult age groups. Headship ratios may be used to convert population estimates by age to estimates of the number of households by age using these relationships.

Housing Cost Burden: The percentage of total household income that is spent on gross monthly housing costs. For renters, this includes rent plus any additional utility or fuel costs for heat, hot water, cooking fuel, and electricity. For homeowners, the costs include mortgage principal and interest, property taxes, hazard insurance, and utilities, plus any applicable condominium association fees or site rent within a manufactured housing park. An affordable housing cost burden is generally considered to be not more than 30 percent of a household's gross income. A high housing cost burden is one that exceeds 30 percent of a household's income.

Linkage: Linkage refers to the relationship between commercial development and job creation and the workforce housing demand it generates. In some parts of the United States, development policies and ordinances can require commercial developments to provide a certain number of affordable units to help meet the workforce housing demand generated by expected employment, or to pay linkage fees based on the relationship between jobs, wage levels of related service workers, and local development costs.

Low Income Housing Tax Credit (LIHTC): A program used to leverage the development or rehabilitation of rental housing serving low income households. In New Hampshire, the New Hampshire Housing Finance Authority administers this program, which awards a share of federal income tax credits to qualifying projects or investors. At least 20% of the units in a LIHTC project must be occupied by households earning less than 50% of the area median family income (AMFI); or at least 40% must be occupied by households earning not more than 60% of the AMFI. The remaining units in a development need not be subject to restrictions on income.

Market Rate: Refers to prices or rents that are not subsidized by government programs, and where there are no restrictions on the property that would limit the price or rent from rising or falling according to market demand.

Median Household Income: The median household income divides the distribution of incomes for the occupants of a housing unit that is their usual place of residence into two equal parts: one-half of the households falling below the median value and one-half above the median.

New England City and Town Area (NECTA): Effective in 2003, the federal Office of Management and Budget (OMB) designated certain core based statistical areas in New England as metropolitan or micropolitan NECTAs. One of the seven New England micropolitan NECTAs is in our region. These are core based statistical areas with at least one urban cluster that has a population of at least 10,000, but less than 50,000. Each Micropolitan NECTA must also have adjacent cities and towns or groups of cities and towns that have a high degree of social and economic integration with the “core” as measured through commuting ties. In New Hampshire, the

NECTAs comprise the statistical labor market geographies for those locations. The US Bureau of Labor Statistics, with input from the Economic and Labor Market Information Bureau of New Hampshire Employment Security, divides the remainder of the state that is not within a metropolitan or micropolitan NECTA into small Labor Market Areas.

Moderate, Low, and Very Low-Incomes: The US Department of Housing and Urban Development (HUD) provides income limits based on US Census data. Estimates are based on percent of median family income and calculated at three income levels; Moderate-Income (80 percent), Low-Income (50 percent), and Very Low-Income (30 percent). These benchmarks are published annually and are frequently used as income limits applicable to various regions within each state for affordable housing programs.

Private Covered Employment: Non-government employment that is subject to employment compensation insurance payments by the employer. Covered employment generally excludes self-employed persons and fully commissioned salespersons.

Tenure: In the context of housing analysis, a classification of households into two groups: ownership versus rental occupancy.

Universal Design: A broad range of efforts to produce buildings, products and environments that are usable by everyone, not limited to specialized designs for specific age groups or people with disabilities. With increased life expectancy, there is a growing interest in universal design to deal with the adaptation of design to serve an aging population, various disability levels, as well as general needs. Curb cuts or sidewalk ramps, essential for people in wheelchairs but used by all, are a common example. Additional examples include cabinets with pull-out shelves, or kitchen counters at several heights to accommodate different tasks and postures.

Workforce Housing: Workforce housing includes a variety of housing types affordable to households deriving their income from local or area employment, most typically referring to working residents and households with incomes at or below the area median family income of a region. In New Hampshire, workforce housing has been more specifically defined in RSA 674:58 to include ownership housing affordable to households with incomes up to 100% of the HUD area median family income (AMFI), and for rental housing up to 60% of the AMFI for a household of three persons. Workforce housing options available in the community must include allowances for multifamily structures with five or more units.

APPENDIX III- HOUSING ASSISTANCE ORGANIZATIONS

Claremont Housing Authority: The Claremont Housing Authority manages 96 units of senior housing and assists another 140 households with rent subsidy vouchers.

COVER Home Repair: COVER Home Repair operates the ReCover Store and offers home repair, weatherization and educational programs to residents.

Habitat for Humanity: A community driven organization which has built 26 homes in the region, plus one "house in a box" for Hurricane Katrina Relief.

Hanover Affordable Housing Commission: Coordinates with town agencies and boards to promote the provision of affordable housing in Hanover.

Housing Action New Hampshire: A collaboration of over 40 organizations and individuals, they coordinate alliances to advocate for federal and state investment in the preservation and development of affordable housing, rental subsidies and prevention of homelessness.

Lebanon Housing Authority: Owns and manages over 200 units of rental housing and assists another 163 households with rent subsidy vouchers.

New Hampshire Housing Finance Authority: A public benefit corporation., this agency offers fixed rate mortgages to low and moderate-income home buyers, provides rental assistance to low-income families/individuals and finances the development of quality, affordable rental housing in NH.

Twin Pines Housing Trust: A not-for-profit organization dedicated to "perpetually affordable housing," Twin Pines offers apartments, single family homes and a mobile home park in the Upper Valley.

United Valley Interfaith Project: The United Valley Interfaith Project (UVIP) is a federation of congregations, faith organizations and community organizations. Its Housing Issue Team has conducted extensive research and developed relationships to increase stable funding of weatherization programs for low income people.

The Upper Valley Haven: They provide temporary shelter and education for homeless families and adults as well as food and clothing to anyone in need.

The Upper Valley Housing Coalition: The Upper Valley Housing Coalition is a partnership of business, community, municipal and nonprofit groups which aims to promote an adequate supply of housing for the region's workforce.

Upper Valley Strong: Its mission is to create, strengthen, expand and coordinate Tropical Storm Irene disaster recovery efforts in Vermont communities in the greater Upper Valley area.

Vermont Affordable Housing Coalition: With nearly 70 members, Vermont Affordable Housing Coalition has played a central role in most of the important developments affecting housing policy in Vermont.

APPENDIX IV- FAIR HOUSING LAWS, AND RESOURCES

FEDERAL LAWS

Fair Housing Act and HUD's regulations contain more detail and technical information. If you need a copy of the law or regulations, contact the **HUD Office** nearest you.

Title VI of the Civil Rights Act of 1964
Title VI prohibits discrimination on the basis of race, color, or national origin in programs and activities receiving federal financial assistance.

Section 504 of the Rehabilitation Act of 1973
Section 504 prohibits discrimination based on disability in any program or activity receiving federal financial assistance.

Section 109 of Title I of the Housing and Community Development Act of 1974
Section 109 prohibits discrimination on the basis of race, color, national origin, sex or religion in programs and activities receiving financial assistance from HUD's Community Development and Block Grant Program.

Title II of the Americans with Disabilities Act of 1990
Title II prohibits discrimination based on disability in programs, services, and activities provided or made available by public entities. HUD enforces Title II when it relates to state and local public housing, housing assistance and housing referrals.

Architectural Barriers Act of 1968
The Architectural Barriers Act requires that buildings and facilities designed, constructed, altered, or leased with certain federal funds after September 1969 must be accessible to and useable by handicapped persons.

Age Discrimination Act of 1975
The Age Discrimination Act prohibits discrimination on the basis of age in programs or activities receiving federal financial assistance.

Title IX of the Education Amendments Act of 1972
Title IX prohibits discrimination on the basis of sex in education programs or activities that receive federal financial assistance.

STATE LAWS

Tenancy Protections for Victims of Domestic Violence, Sexual Assault, or Stalking

New tenancy protections for certain victims of violence were signed into law on October 6, 2010. RSA 540:2 has been amended to include certain restrictions on the landlord's ability to terminate the tenancy of a victim of domestic violence, sexual assault, or stalking solely on that basis as long as the victim provides verification of the existence of a protective order against the perpetrator. It also allows landlords to evict only the perpetrator of the violence. (NHHFA)

Same Sex Marriage

Legislation making same-sex marriage legal in New Hampshire became effective January 1, 2010. The legislation also recognizes out-of state marriages not prohibited by New Hampshire law; recognizes foreign civil unions as marriages under NH law; and allows for the conversion of existing civil unions into marriages. Protections against discrimination on the basis of familial status would include these relationships.

Workforce Housing Law

The New Hampshire legislature enacted a Workforce Housing Law in 2008. The legislation reflects court rulings in the case of Britton v. Town of Chester, 134 NH.434 (1991) that require all " New Hampshire municipalities have an obligation to afford reasonable opportunities for the development of housing for low and moderate income families, including fair share of the regional need for such housing." The Workforce Housing section of Chapter 674 (Local Land Use Planning and Regulatory Powers) mandate that local governments provide meaningful opportunities for the development of Workforce Housing, including rental units. By definition, Workforce Housing refers to affordable homes and rental units for low and moderate income families. (NHHFA)

Amendments to the Law Against Discrimination

RSA 354-A was amended in several ways in 2006 clarifying the definition of "employer" to include non-profit, charitable, and educational employees; "a qualified individual with a disability," "reasonable accommodation," and "undue hardship." The law now provides the possibility of compensatory damages for cases removed to state court, and requires the Human Rights Commission pay the costs of transcription for indigent persons in cases appealed to Superior Court. Housing discrimination cases may now include access to or membership or participation in any multiple-listing service, real estate brokers' organization or other service, organization or facility relating to the business of selling or renting dwellings. (NHHFA)

FAIR HOUSING RESOURCES

U.S. Department of Housing and Urban Development (HUD) www.hud.gov

U.S. Department of Justice, Civil Rights Division (D0J)
www.justice.gov/crt/housing/fairhousing

U.S Federal District Court, District of New Hampshire www.nhd.uscourts.gov

New Hampshire Commission for Human Rights (HRC) www.nh.gov/hrc

State of New Hampshire, Office of the Attorney General
http://doj.nh.gov/site-map/consumers.htm

State of New Hampshire Courts http://www.courts.state.nh.us/

New Hampshire Legal Assistance (NHLA) www.nhla.org

Disabilities Rights Center (DRC) www.drcnh.org

UVLSRPC Regional Plan 2015

Chapter 3

Transportation

TABLE OF CONTENTS

3.1 INTRODUCTION

The Regional Transportation Plan presents a bold vision for the future of all components of the region's transportation system based on extensive input from the general public, municipal officials, employers, and partner agencies in the 27 communities of the Upper Valley Lake Sunapee Region.

What does this transportation vision look like?

- A region with no structurally-deficient bridges and all roads maintained in good or fair pavement condition.
- A region where no motorist, motorcyclist, bicyclist, or pedestrian is fatally injured while traveling.
- A region where all residents, businesses, and visitors can access viable, efficient, and affordable transportation options.
- A region where every elderly and disabled resident can access medical appointments and other essential services.
- A region where there are safe bicycling routes to our village and city centers, and safe walking routes within our village and city centers.
- A region where both passenger and freight rail transportation enhance the movement of goods and people from our communities to the major metropolitan areas of Boston, New York City, and Montreal.
- A region with robust airline access to the world with connections in Boston and New York City; and General Aviation access to the northeast, United States, and the world.
- A region where businesses, municipalities, and state agencies work together to reduce the prevalence of single-occupant vehicle travel, and realize the health and environmental benefits of active transportation.

This vision will not happen overnight. In fact, it will take many years of hard work. It will require political will and new partnerships between all levels of government, the business community, advocacy groups, regional institutions, and of course, the general public.

The plan presents short, medium, and long-term improvement needs and strategies for how to implement those improvements. But, perhaps most importantly, the plan establishes a series of performance measures for the region to track its progress towards the vision over time.

The plan will serve as a policy document for the UVLSRPC Transportation Advisory Committee (TAC), and will inform the TAC's criteria for prioritizing projects for inclusion in New Hampshire's Ten-Year Transportation Improvement Plan. Adoption of this plan also means that the Commission will commit its staff and available program resources toward achieving the region's transportation vision and implementing the plan's recommendations.

Each section of the plan addresses a specific component of the region's transportation system. Five key elements are included in each section. The first element outlines the vision for that component of the transportation system. The second element provides an overview of existing conditions and trends. The third element presents the performance measures that will be used to track progress towards the vision. The fourth element details the short, medium, and long-term improvement needs. Last, the fifth element presents strategies for implementing the needed improvement.

3.2 REGIONAL TRANSPORTATION SCORECARD

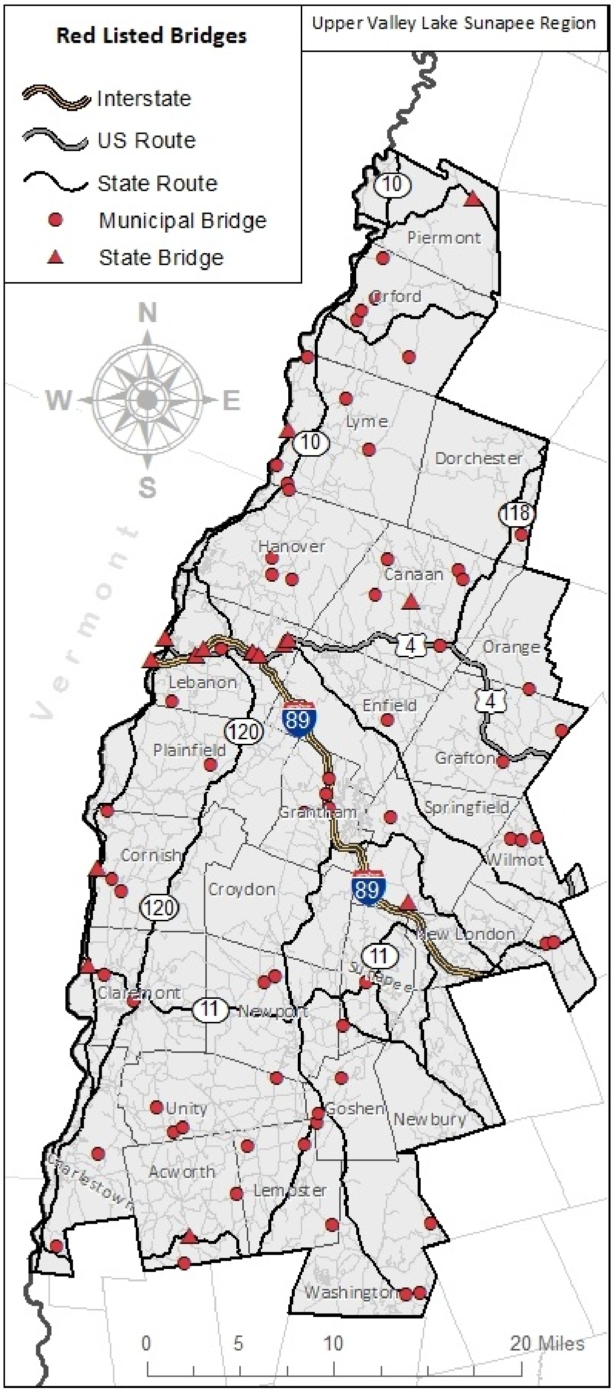
Goal	Measure	Units	Statewide (2012)	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)
Asset Condition	State Highway in Good Condition	Miles	828 (19% of State Network)	81 (18% of Regional Network)	**105 Miles** (23% of Regional Network)
	State Highway in Fair Condition	Miles	1,867 (44% of State Network)	165 (36% of Regional Network)	**215 Miles** (47% of Regional Network)
	State Highway in Poor Condition	Miles	1,565 (37% of State Network)	207 (46% of Regional Network)	**133 Miles** (30% of Regional Network)
	Red Listed Bridges (State-owned)	Number	140 (7% of State-owned Bridges)	16 (6% of State-owned Bridges in Region)	**11** (4% of State-owned Bridges in Region)
	Red Listed Bridges (Municipally-owned)	Number	349 (21% of Municipal Bridges in State)	64 (23% of Municipal Bridges in Region)	**45** (16% of Municipal Bridges in Region)
	Rail Lines Capable of Speeds of 40 MPH	Miles	104	23.3	**23.3**
	Airport Runway Condition	FAA Runway Condition	Good (4.11)	Good (4.10)	**Good** (4.25)
	Remaining Useful Life of Public Transit Fleet	Vehicle Life Remaining	43.8%	37.8%	**50%**
Mode Share	Commute to Work (Driving Alone)	% of Commuters	81.3%	75.7%	**70%**
	Commute to Work (Carpool)	% of Commuters	8.2%	9.4%	**11%**
	Commute to Work (Public Transportation)	% of Commuters	0.8%	1.1%	**2.0%**
	Commute to Work (Motorcycle)	% of Commuters	0.2%	0.3%	**0.3%**
	Commute to Work (Bicycle)	% of Commuters	0.3%	0.4%	**1.0%**
	Commute to Work (Walking)	% of Commuters	3.1%	6.1%	**7%**
	Commute to Work (Telecommute)	% of Commuters	5.4%	5.4%	**7%**
	Commute to Work (Other)	% of Commuters	0.7%	1.7%	**1.7%**
Mobility	Congestion/Operational Level of Service on Key Corridors	Level of Service	C (0.68 Volume/Capacity Ratio)	A (0.26 Volume/Capacity Ratio)	**A** (0.26 Volume/Capacity Ratio)
	Local Transit Ridership (Fixed-Route)	# of Rides Provided	N/A	601,024	**1,000,000**
	ADA Transit Ridership	# of Riders Provided	N/A	10,192	**13,250**
	Elderly/Disabled Transportation Ridership	# of Rides Provided	234,500	47,548	**61,800**
	Volunteer Driver Program Ridership	# of Rides Provided	38,052	5,255	**6,800**
	Percentage of Population With Access to Public Transportation	Percent of Population	26.1%	30.5%	**40%**
	Intercity Transit Ridership	# of Riders	N/A	215,000 (Approx.)	**N/A**
	Passenger Rail Ridership	# of Boardings and Alightings	199,645	17,069	**22,315**
	Passenger Air Ridership	# of Enplanements and Deplanements	2,607,103	19,990	**27,076**
	Bicycle Level of Service	Level of Service	N/A	D (3.57)	**C** (3.00)
	Pedestrian Level of Service	Level of Service	N/A	D (4.12)	**C** (3.50)
	Freight Movement (total freight shipped by all modes)	Tons	65,640,138	N/A	**N/A**
Safety	Highway Fatalities	# of Fatalities (5-Year Moving Avg.)	114	6	**4**

3.3 HIGHWAYS AND BRIDGES IN THE REGION

Vision

Improve all structurally-deficient bridges and maintain all roads in the UVLSRPC Region at good or fair condition.

Existing Conditions



Red Listed Bridges in the UVLSRPC Region

The New Hampshire Department of Transportation inspects all bridges in the state, whether municipally-owned or state-owned. In total, there are currently 80 Red List bridges in the UVLSRPC Region. Of the 80 bridges, 16 are state-owned and 64 are municipally-owned.

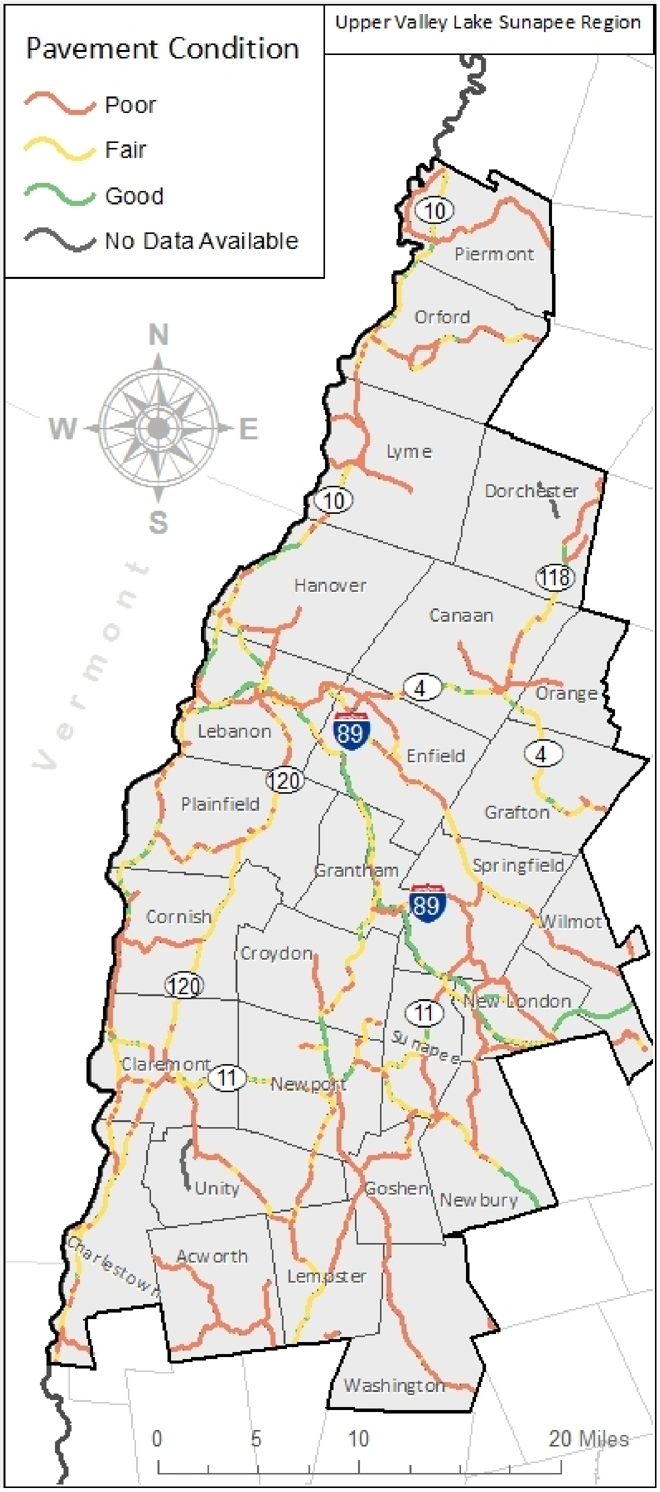
Bridges have three structural components:

- <u>Substructure-</u> The portion of the bridge that supports the superstructure and distributes bridge loads to below-ground bridge footings.
- <u>Superstructure-</u> The portion of the bridge that supports the deck and connects substructure components.
- <u>Deck-</u> The portion of the bridge that carries traffic.

The New Hampshire Department of Transportation inspects each structural element of a bridge and assigns structural sufficiency ratings ranging from "Excellent" to "Imminent Failure." If a bridge is found to be structurally-deficient, it is placed on the state's "Red List" of bridges that need to be repaired or replaced. Due to known deficiencies, red listed bridges are subject to interim inspections, potential weight restrictions, and in serious cases, closure.

What does this map show?

This map displays 2012 New Hampshire Department of Transportation bridge condition data for state and municipally-owned bridges in the Upper Valley Lake Sunapee Region.



Pavement Condition in the UVLSRPC Region

The New Hampshire Department of Transportation has evaluated state-maintained highways throughout New Hampshire to support its Pavement Management System. Pavement condition is determined by evaluating the following indices:

- The Ride Comfort Index (RCI), which represents what motorists feel as they drive down a road. The RCI is determined through measurement of an axle's vertical acceleration averaged between the two rear tires. *The RCI is the primary indicator used to measure, report, and monitor pavement condition in New Hampshire*;
- The Surface Distress Index (SDI), which is an inventory of road surface cracking; and
- The Rut Rate Index (RRI), which measures the frequency distribution of rut depths.

Currently, 18% of state-owned highways in the UVLSRPC Region are in good pavement condition, 36% are in fair condition, and 46% are in poor condition. There remains a high correlation between poor pavement condition and state-maintained highways that are unnumbered or not otherwise eligible for federal-aid funding.

What does this map show?

This map displays 2012 Ride Comfort Index (RCI) data for state-maintained highways in the Upper Valley Lake Sunapee Region. The RCI is reported on a scale of 0 to 5, with 5 representing the best pavement condition.

A segment of roadway with a RCI greater than 3.5 is considered to have "Good" pavement condition. A segment of roadway with a RCI between 2.5 and 3.5 is considered to have "Fair" pavement condition, and a segment of roadway with a RCI less than 2.5 is considered to have "Poor" pavement condition.

Performance Measures

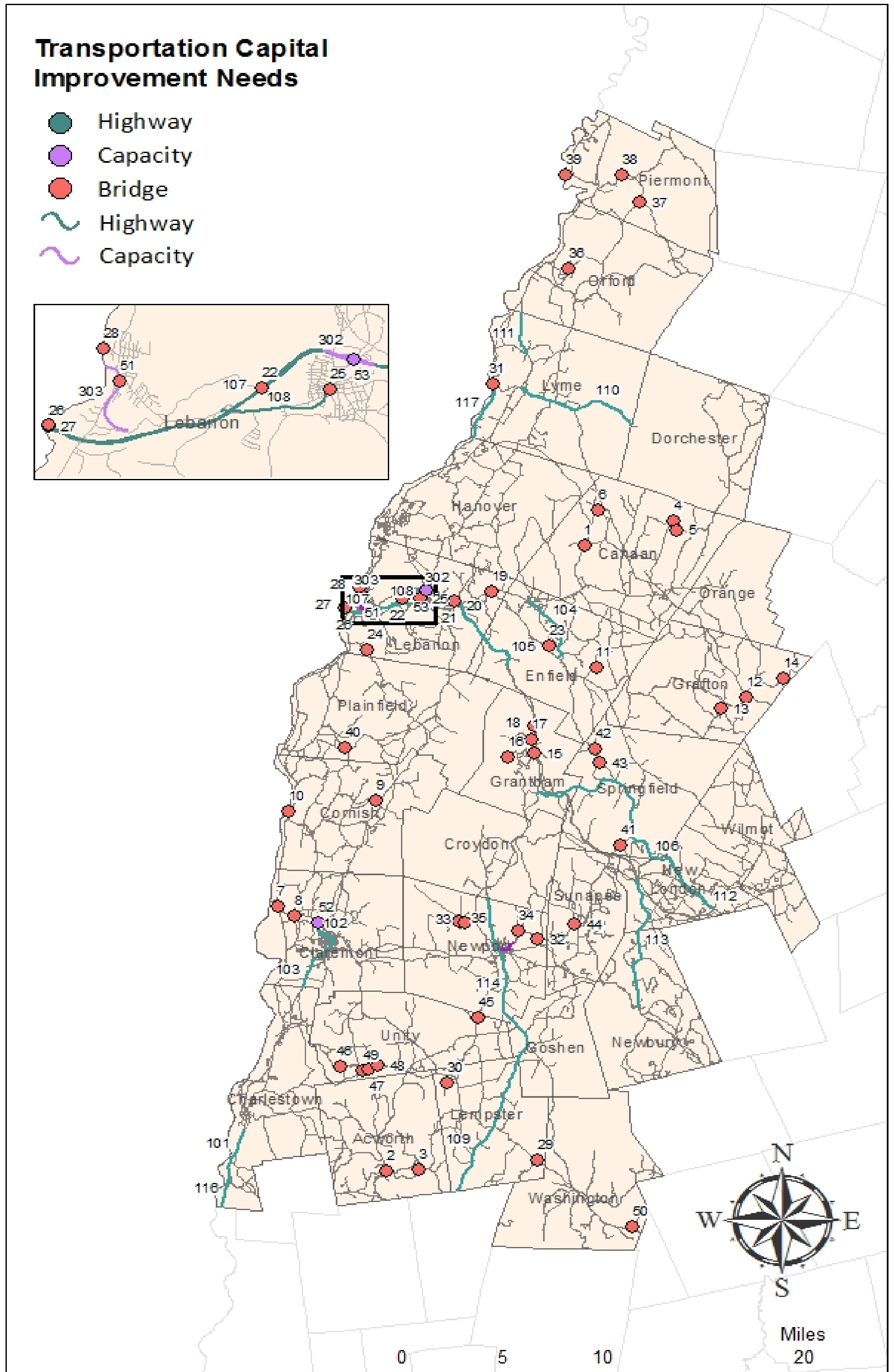
Highway and bridge condition in the UVLSRPC Region shall be measured by the number of state and municipally-owned red listed bridges, and mileage of state highway condition in poor, fair, and good pavement condition.

Performance Targets

- Reduce the number of red listed bridges (both state-owned and municipally-owned) in the UVLSRPC Region by 30% by 2030.
- Increase the number of road miles in the UVLSRPC Region in both good and fair pavement condition by 30% by 2030.

Performance Measures	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Red Listed Bridges (State-owned)	16 (6%)	**11 (4%)**	140 (7%)	N/A
Red Listed Bridges (Municipally-owned)	64 (23%)	**45 (16%)**	349 (21%)	N/A
State Highway in Good Condition	81 Miles (18%)	**105 Miles (23%)**	828 Miles (19%)	N/A
State Highway in Fair Condition	165 Miles (36%)	**215 Miles (47%)**	1,867 Miles (44%)	N/A
State Highway in Poor Condition	207 Miles (46%)	**133 Miles (30%)**	1,565 Miles (37%)	N/A

Improvement Needs



Bridge Improvements			
ID	Type	Community	Project
1	Bridge	Canaan	#087/092)
2	Bridge	Acworth	Replace NH Route 123A Bridge over Bowers Brook
3	Bridge	Acworth	Replace Grout Hill Road Bridge over Cold River (Bridge #147/067)
4	Bridge	Canaan	#156/155)
5	Bridge	Canaan	Replace North Lary Pond Road Bridge over Lary Pond Brook (Bridge #165/146)
6	Bridge	Canaan	Replace Lashua Road Bridge over Mascoma River (Bridge #122/136)
7	Bridge	Claremont	Rehabilitate Bridge on NH Route 12A over Sugar River (Bridge #072/127)
8	Bridge	Claremont	Replace Plains Road Bridge over Sugar River (Bridge #091/118)
9	Bridge	Cornish	Replace Clark Camp Road Bridge over Mill Brook (Bridge #151/122)
10	Bridge	Cornish-Windsor	Provide Scour Protection for the Cornish-Windsor Covered Bridge over the Connecticut River
11	Bridge	Enfield	Replace Boys Camp Road Bridge over Bicknell Brook (#172/112)
12	Bridge	Grafton	Replace Lower Meadow Road Bridge over Mill Brook (Bridge
13	Bridge	Grafton	Rehabilitate Prescott Road Bridge over Smith Brook (Bridge
14	Bridge	Grafton	Rehabilitate Wild Meadows Road Bridge over Brook (#210/107)
15	Bridge	Grantham	Replace Bridge on Olde Farms Road over Skinner Brook (#107/113)
16	Bridge	Grantham	Replace Bridge on Olde Farms Road over Sawyer Brook (#083/108)
17	Bridge	Grantham	Rehabilitate Bridge on Miller Pond Road over Skinner Brook (Bridge #105/128)
18	Bridge	Grantham	Replace Bridge on Frye Lane over Stony Brook (Bridge #108/147)
19	Bridge	Lebanon	Bridge Replacement (U.S. Route 4) over Mascoma River- Adjacent to Intersection of U.S. Route 4/NH Route 4A
20	Bridge	Lebanon	Rehabilitate Interstate 89 Bridges over Hardy Hill Road (Bridges 155/117 and 156/117)
21	Bridge	Lebanon	Rehabilitate Interstate 89 Bridges over Hardy Hill Road (Bridges 155/117 and 156/117)
22	Bridge	Lebanon	Rehabilitate Bridge on Mascoma Street over Interstate 89 (Bridge #103/116)
23	Bridge	Lebanon	Rehabilitate bridge on U.S. Route 4/NH Route 10 over Mascoma River (Bridge #120/115)
24	Bridge	Lebanon	Replace Trues Brook Road Bridge over Bloods Brook (Bridge #066/059)
25	Bridge	Lebanon	Replace NH Route 120 Parking Lot/Pedestrian Bridge over NHRR (Bridge #121/117)
26	Bridge	Lebanon-Hartford	Rehabilitation and Widening of Bridges over Connecticut River (Interstate 89)
27	Bridge	Lebanon-Hartford	Rehabilitation and Widening of Bridges over Connecticut River (Interstate 89)
28	Bridge	Lebanon-Hartford	Replace Bridge over Connecticut River (U.S. Route 4)
29	Bridge	Lempster	Replace Bridge on Mountain Road over Ashuelot River (Bridge #148/067)
30	Bridge	Lempster	Replace Bridge on Keyes Hollow Road over Cold River (Bridge #055/151)
31	Bridge	Lyme-Thetford	Bridge Rehabilitation (East Thetford Road) over the Connecticut River, Remove Lead-based Paint and Recoat
32	Bridge	Newport	Replace Paradise Road Bridge over Sugar River (Bridge #177/117)
33	Bridge	Newport	Rehabilitate Oak Street Bridge over Sugar River (Bridge #103/136)
34	Bridge	Newport	Replace Sand Hill Road Bridge over Brook (Bridge #154/129)
35	Bridge	Newport	Replace Greenwood Road Bridge over Dodge Brook (Bridge #097/139)
36	Bridge	Orford	Replace Archertown Road Bridge over Archertown Brook (Bridge #095/118)
37	Bridge	Piermont	Replace Indian Pond Road Bridge over Bean Brook (Bridge #108/075)
38	Bridge	Piermont	Replace Barton Road Bridge over Eastman Brook (Bridge #092/103)
39	Bridge	Piermont-Bradford	Rehabilitate and Paint NH Route 25 Bridge over the Connecticut River (Bridge #32/103)
40	Bridge	Plainfield	Replace Deck and Repaint Stage Road Bridge over Blow-Me-Down Brook (Bridge #096/079)
41	Bridge	Springfield	Georges Mills Rd- Rehabilitate/Replace Twin 5' Diameter Culverts Carrying Star Lake Outlet at Intersection of Fisher Corner Rd
42	Bridge	Springfield	Rehabilitate Bridge on George Hill Road over Bog Brook (Bridge #064/152)
43	Bridge	Springfield	Replace Bridge on George Hill Road over Gove Brook (Bridge #071/138)
44	Bridge	Sunapee	Replace Lower Main Street Bridge over Sugar River (Bridge #094/100)
45	Bridge	Unity	Replace Old Cheshire County Road Bridge over Spring Brook (Bridge #205/098)
46	Bridge	Unity	Replace Neal Mine Road Bridge over Little Sugar River (Bridge #062/046)
47	Bridge	Unity	Rehabilitate Cold Pond Road Bridge over Little Sugar River (Bridge #092/040)
48	Bridge	Unity	Replace Bridge on South Slack Road over Little Sugar River (Bridge #101/046)
49	Bridge	Unity	Replace Quaker City Road Bridge over Little Sugar River (Bridge #086/039)
50	Bridge	Washington	Replace Smith Pond Road Bridge over Shedd Brook (Bridge #180/046)
51	Bridge	Lebanon	Replace NH Route 12A Bridge over B&M Railroad
52	Capacity	Claremont	North Street Intersection Relocation
53	Capacity	Lebanon	Construct Diverging Diamond Interchange at I-89 Exit 18, Add Northbound Left Turn Lane at NH Route 120/Old Etna Road Intersection, Reconfigure Existing Lanes to Provide a Third Northbound Through Lane on NH Route 120 Through the Heater Road Intersection

Road Segment Improvements			
ID	Type	Community	Project
101	Highway	Charlestown	Reconstruct/Rehabilitate NH Route 12 from NH Route 12A in South Charlestown to Almar Street (Approx. 2.4 Miles)
102	Highway	Claremont	Reconstruction, Improve Drainage, and Improve Sidewalks on Main Street (NH Rt 12) from Opera House Square to Citizens Street
103	Highway	Claremont	Reconstruction, Improve Drainage, and Improve Sidewalks on Charlestown Road (NH Route 12) from Draper's Corners to Urban Compact Boundary
104	Highway	Enfield	Reconstruct/Rehabilitate Shaker Hill Road (Entire Length)
105	Highway	Enfield-Lebanon	Rehabilitate I-89 from Exit 15 to Exit 17, Includes Bridges 156/117, 155/117, 158/114, and 159/114
106	Highway	Grantham-Springfield-New London	Reconstruct/Rehabilitate NH Route 114 from NH Route 10 in Grantham to Homan's Corner in New London (12.3 Miles)
107	Highway	Lebanon	Interstate Rehabilitation (I-89) from Exit 17 to Exit 20, Includes 7 Bridges (#093/109 #094/108, #097/112, #098/111, #140/124, #141/123, and #099/111)
108	Highway	Lebanon	Reconstruction of Mechanic Street (U.S. Route 4) from High Street to I-89 Ramps, Remove Concrete Base, Install Sidewalks, and Improve Drainage
109	Highway	Lempster	Reconstruct/Rehabilitate NH Route 10 from the Goshen/Lempster Town Line to the Lempster/Marlow Town Line (8.3 Miles)
110	Highway	Lyme	Reconstruct/Rehabilitate Dorchester Road (Entire Length)
111	Highway	Lyme	Improve Geometry, Drainage, and Guardrail on NH Route 10 from Post Pond Road to the Orford Town Line, Including Safety Improvements at the Intersection of NH Route 10/North Thetford Road (2.8 Miles)
112	Highway	New London	Reconstruction of Main Street (NH Route 114) from Crockett's Corner to Homan's Corner
113	Highway	New London-Newbury	Reconstruct/Rehabilitate NH Route 103A (Entire Length)
114	Highway	Newport-Goshen	Reconstruct/Rehabilitate NH Route 10 from Newport to the Goshen/Lempster Town Line (6.7 Miles), Improve Safety at the Intersection of NH Route 10/NH Route 31
116	Highway	Walpole-Charlestown	Reconstruction of NH Route 12 from Main Street in Walpole to NH 12A in Charlestown, Remove Concrete Base, Add Shoulders and Improve Drainage
117	Highway	Lyme	Bank Stabilization on Rover Road from East Thetford Road to the Hanover Town Line
302	Capacity	Lebanon	Construct Diverging Diamond Interchange at I-89 Exit 18, Add Northbound Left Turn Lane at NH Route 120/Old Etna Road Intersection, Reconfigure Existing Lanes to Provide a Third Northbound Through Lane on NH Route 120 Through the Heater Road Intersection
303	Capacity	Newport	Capacity Improvements on NH 11/103 between NH 10 and Luxury Drive, Install Westbound Turn Lane to Cross Street, Improve Shoulders, Drainage, and Guardrail (1.0 Miles)

Implementation Strategies

Improving the condition of the region's highways and bridges is almost entirely dependent on funding. For many years, New Hampshire's transportation funding has met only a fraction of infrastructure maintenance needs. Due to deferred maintenance, more bridges have become structurally-deficient and more roads require full-depth reconstruction.

In their July 2010 Long Range Transportation Plan, the New Hampshire Department addressed these issues in detail. The NHDOT presented four distinct funding issues and a series of options for addressing each issue.

<u>Issue #1:</u> Revenue Levels are Inadequate to Meet Needs
- Consider increasing the rates or fees of existing revenue streams (e.g. gas tax, vehicle title fees, or vehicle excise taxes).
- Reduce or eliminate diversions of current revenue streams from direct delivery of transportation facilities or services.
- Fund projects on the Turnpike system exclusively with Turnpike dollars.

<u>Issue #2:</u> Funding Streams must be Reliable, Sustainable, and Diverse
- Indexing the gas tax, tolls, and/or fares to the Consumer Price Index or to a construction cost index.
- Fixing gas taxes as a percentage of gasoline prices so they rise or fall with the price of gas.
- Enhancing local and statewide utilization of creative funding approaches including Tax Increment Finance (TIF), impact fees, and local vehicle registration options fees.

<u>Issue #3</u>: Funding Flexibility Needs to be Improved
- Consider alternatives to adequately fund public transportation operations.
- Seek revision of the restriction of Turnpike tolls to spending on Turnpike related expenditures.

<u>Issue #4:</u> Considering Pricing Policies to Raise Revenue
- Examining strategies such as parking fees, transit fare decreases, peak period toll increases, and fine increases as a means of extending roadway life by managing transportation demand.

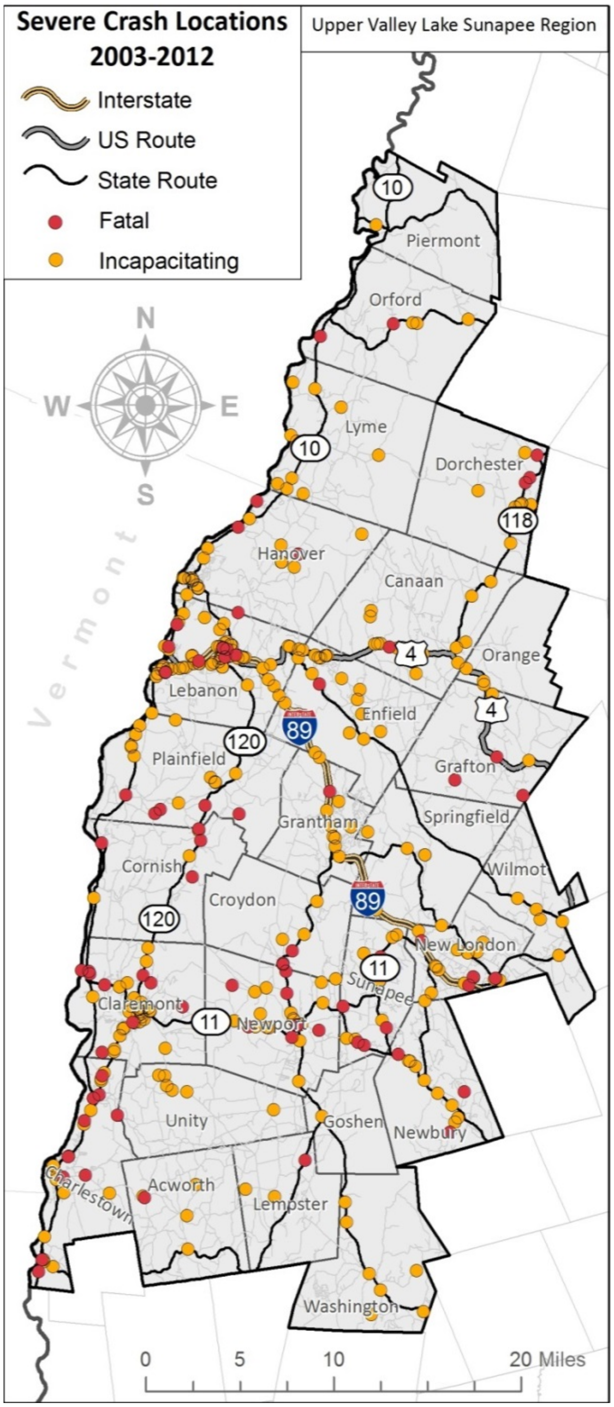
Strategies
• Advocate at the state, local, and federal level for adequate and consistent funding sources for highway and bridge maintenance activities.
• Support an expansion of the NHDOT State Aid Bridge Program.
• Support an expansion of the NHDOT Betterment Program for pavement maintenance efforts administered by NHDOT Maintenance District offices.
• Assist communities in the region in developing Road Surface Management Systems (RSMS).
• Place a higher priority on red list bridge replacement and/or rehabilitation projects during the Ten-Year Transportation Improvement Plan project prioritization process.
• Develop a corridor study for Interstate 89 to determine improvement priorities and concurrence between development and roadway capacity.
• Assist communities in the UVLSRPC Region in developing local Capital Improvement Programs that comprehensively address local highway and bridge infrastructure needs.

3.3 HIGHWAY SAFETY IN THE REGION

Vision

Eliminate highway fatalities and improve safety for all roadway users in the UVLSRPC Region per the "Toward Zero Deaths" vision detailed in New Hampshire's Strategic Highway Safety Plan.

Existing Conditions



Highway Safety in the UVLSRPC Region

For the ten-year period between 2003 and 2012, there were 92 fatal crashes in the UVLSRPC region. Run-off-road crashes accounted for more than 50% of fatalities in the region, and nearly 40% of fatal crashes in the region involved alcohol.

The UVLSRPC Region has an elevated number of bicycle fatalities. Recent bicycle fatalities in Croydon and Newbury have spurred the formation of an advocacy group called the NH PASS (Pass All cyclists Slowly and Safely) Coalition to raise public awareness of NH RSA 265:143-a, which requires that motorists pass cyclists with a minimum of three feet of separation. UVLSRPC staff has worked with NHDOT and the Town of Newport to install signage to advise drivers of this law.

In recent years, infrastructure improvements, public education campaigns, and increased law enforcement have contributed to a statewide decline in fatal crashes across New Hampshire. The NHDOT along with other public and private stakeholders, including UVLSRPC, have formed a statewide partnership called the New Hampshire Driving Toward Zero Coalition. The Coalition's goal is to eliminate all highway fatalities in the state of New Hampshire, starting with a 50% reduction by the year 2030.

What does this map show?

This map displays NHDOT fatal and incapacitating injury crash location data for the UVLSRPC Region for the most recent available ten-year period (2003-2012).

Performance Measures

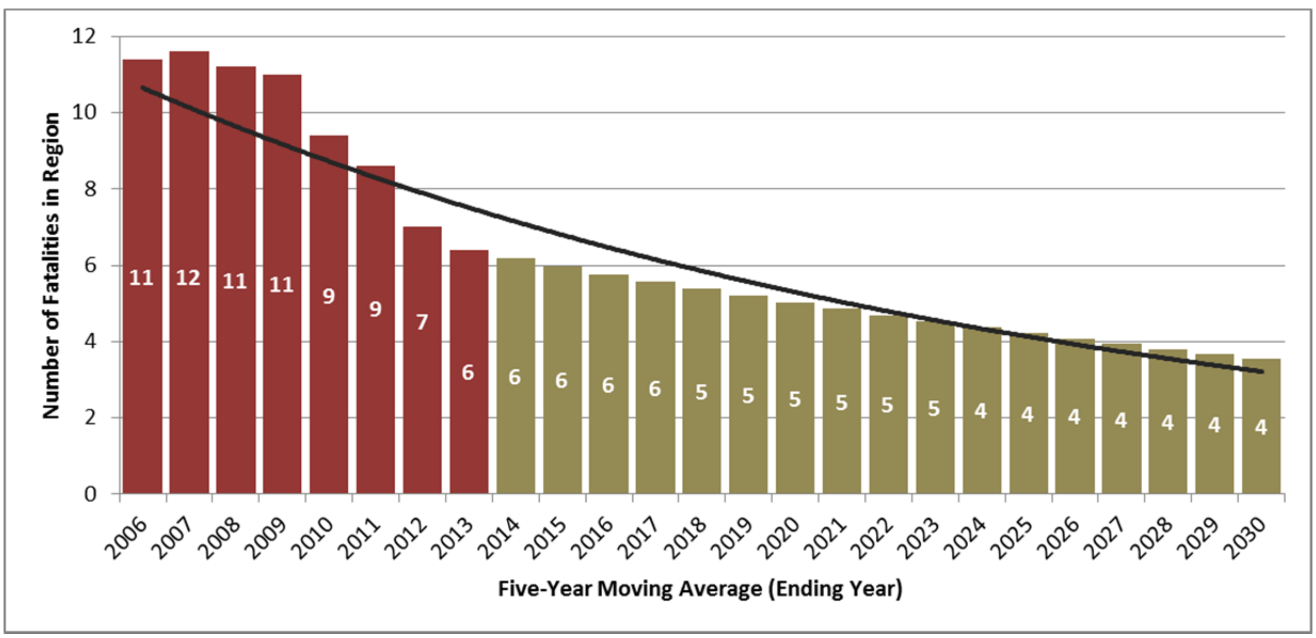
Highway safety performance in the UVLSRPC Region shall be measured by the five (5) year moving average of fatalities in the region. This is also the performance measure used in the New Hampshire Department of Transportation's Balanced Scorecard, which allows for comparison of the state's performance with the Region's performance.

Performance Target

- Reduce the number of fatalities in the UVLSRPC Region for all roadway users by 50% by the year 2030.

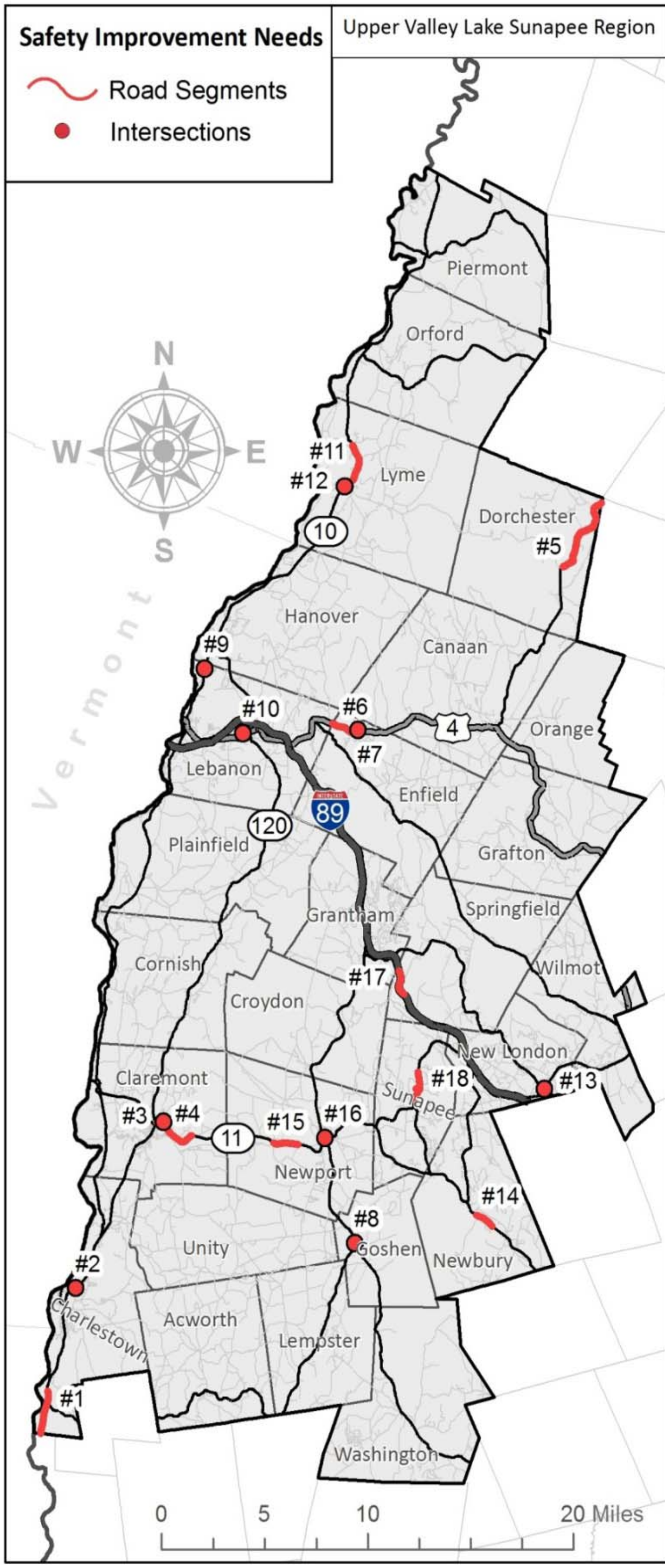
Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Highway Fatalities (5-Year Moving Average)	6	**4**	114	63

Figure 3.3.1- Performance Target for Highway Safety in the UVLSRPC Region



Improvement Needs

Map 3.3.2 – Safety Improvement Needs in the UVLSRPC Region



ID	Community	Safety Need
#1	Charlestown	Reconstruction of NH Route 12 from Main Street in Walpole to NH 12A in Charlestown, Add Shoulders, Add Guardrail, and Improve Drainage
#2	Charlestown	Road Safety Audit at the Intersection of NH Route 12/Lovers Lane
#3	Claremont	Safety and Access Management Improvements at the Intersection of Washington/Bowen Street
#4	Claremont	Implementation of Access Management Measures on Washington Street Between Old Newport Road and North Street
#5	Dorchester	Implementation of Animal-Vehicle Crash Mitigation Measures on NH Route 118 from Townhouse Road to the Groton Town Line
#6	Enfield	Add Shoulders, Improve Horizontal Curves, Remove Clear Zone Obstructions along U.S. Route 4 from Maple/Main Street to the Lebanon City Line
#7	Enfield	Reconfiguration of the Intersection of U.S. Route 4/Maple Street/Main Street
#8	Goshen	Road Safety Audit at the Intersection of NH Route 10/NH Route 31
#9	Lebanon	Pedestrian Safety Improvements at the Intersection of NH Route 10/Gould/Oak Ridge Road
#10	Lebanon	Reconfiguration of the Intersection of U.S. Route 4/High Street/Mascoma Street
#11	Lyme	Road Safety Audit on NH Route 10 from High Street to Whipple Hill Road
#12	Lyme	Post-Construction Evaluation of NH Route 10/East Thetford Road Reconfiguration Project
#13	New London	Post-Construction Evaluation of NH Route 11/NH Route 114 Safety Improvement Project
#14	Newbury	Road Safety Audit on NH Route 103 from Mountain Road to Colburn Farm Road (East Intersection)
#15	Newport	Road Safety Audit on NH Route 11 from Chandlers Mill Road to Whitcher Road
#16	Newport	Reconfiguration of the Intersection of Sunapee Street/Main Street
#17	Springfield	Road Safety Audit on Interstate 89 Northbound Between Milepost 39.4 and 40.6
#18	Sunapee	Road Safety Audit on NH Route 11/Seven Hearths Lane

Note: Safety improvement needs shown above are listed in alphabetical order by community.

Implementation Strategies

Improving the safety of all roadway users requires both infrastructure and behavioral changes. Under MAP-21, New Hampshire receives approximately $9.5 Million per year of federal Highway Safety Improvement Program (HSIP) funding. HSIP funding is used to make safety improvements for both site-specific (i.e. individual locations with fatal and severe crash histories) and systemic (i.e. proactive statewide improvements related to guardrail, curve delineation, or other purpose) projects across New Hampshire.

HSIP funding has recently been utilized to make safety improvements at the intersection of NH Route 10/East Thetford Road in Lyme and the intersection of NH Route 11/NH Route 114 in New London. Many of the safety improvement needs identified in Map 3.3.2 will be eligible for HSIP funding based on crash history. In cases where safety issues require a large-scale reconstruction, those projects will be evaluated and prioritized during the biennial Ten-Year Transportation Improvement Plan process.

Beyond infrastructure issues, there are significant driver behavior issues affecting transportation safety in the region. These behavioral issues, including speeding, impaired driving, distracted driving, teen driving, and seat belt usage are not unique to the region. The same issues are prevalent across the state and the country. New Hampshire's Strategic Highway Safety Plan presents a series of strategies for addressing these behavioral issues. UVLSRPC staff serves on the NH Driving Toward Zero Coalition, a public-private partnership which oversees the development of the Strategic Highway Safety Plan. UVLSRPC should actively participate in current and future educational campaigns developed by the NH Driving Toward Zero Coalition related to speeding, impaired driving, distracted driving, and seat belt usage.

Strategies
• Coordinate Road Safety Audits (RSA) at all locations in the UVLSRPC Region that appear on the statewide "Five Percent" Report of high crash locations developed by the NHDOT.
• Collaborate with state and local partners to ensure that locations with completed RSAs have safety improvements implemented with Highway Safety Improvement Program funding.
• Continue assisting municipalities with the implementation of the NH PASS (Pass All bicyclists Slowly and Safely) safety campaign to promote awareness of NH RSA 265:143-a.
• Continue UVLSRPC participation on the NHDOT Highway Safety Improvement Program Committee and NH Driving Toward Zero Deaths Coalition.
• Oppose discretionary transfers of New Hampshire's Highway Safety Improvement Program funding.
• Support local and statewide campaigns to educate the public about the risks and consequences of impaired driving, and the benefits of wearing seat belts
• Coordinate with NHDOT to develop a statewide training program to ensure that the unique needs of older drivers are considered in the planning, design, construction, and maintenance of the state's highway network.
• Analyze key regional corridors for run-off-road crashes and evaluate the potential to install shoulder and centerline rumble strips on those roads.
• Collect additional speed data as part of the region's traffic data collection program to inform local and statewide speed enforcement efforts.

3.4 PUBLIC TRANSPORTATION IN THE REGION

Vision

All residents, businesses, and visitors in the UVLSRPC Region can access viable, efficient, and affordable transportation options.

Existing Conditions

Figure 3.4.1- Advance Transit Ridership (2000-2012)

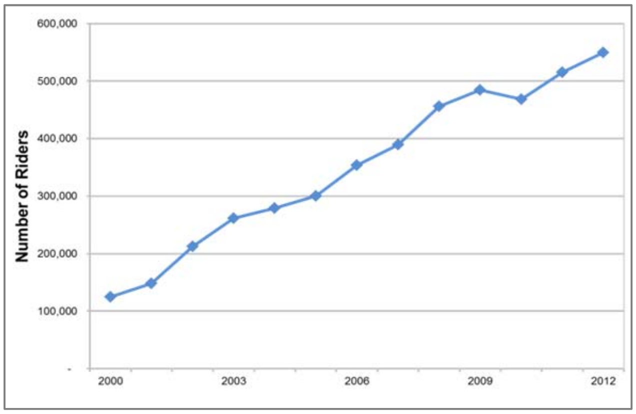
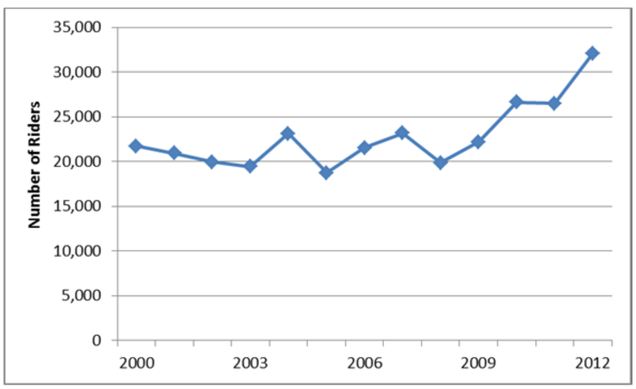


Figure 3.4.2- CATS Ridership (2000-2012)



Public Transit Ridership in the UVLSRPC Region

The UVLSRPC Region is directly served by two local public transportation providers:

- Advance Transit, which provides free-fare, fixed-route public transportation services in Lebanon, Hanover, Enfield, and Canaan, New Hampshire as well as in Hartford and Norwich, Vermont. Advance Transit also provides shuttle transportation services in downtown Hanover and at Dartmouth-Hitchcock Medical Center.
- Community Alliance Transportation Services (CATS), which provides public transportation services in Claremont, Newport, and Charlestown, New Hampshire.

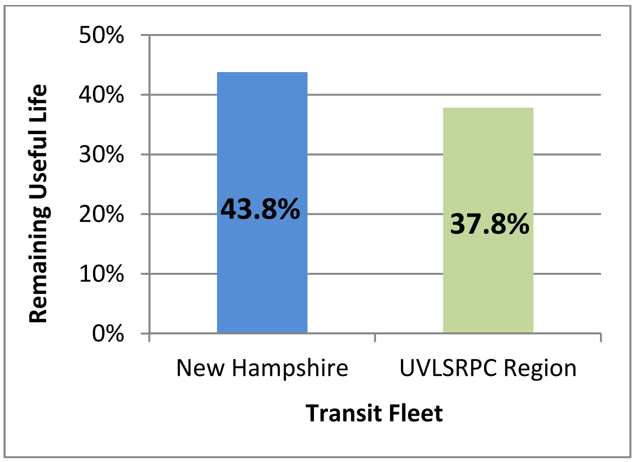
Stagecoach Transportation Services and Connecticut River Transit also provide fixed-route public transportation services connecting Vermont communities to large employers and shopping destinations in the UVLSRPC Region. Public transportation providers in the UVLSRPC region set a new all-time high in fixed-route ridership in 2012, providing (combined) over 600,000 rides. Over the past 10 years, much of the region's transit ridership growth has been driven by three factors:

- A transition to free-fare services by Advance Transit;
- Increased frequency on principal transit routes, including Advance Transit's Red Route;
- The extension of services to additional communities in the region, notably CATS' expansion to the Town of Charlestown.

As a result of these factors, total transit ridership in the UVLSRPC Region exceeds that of many urban areas in New Hampshire.

An Advance Transit bus stops for passengers along the Blue Route in the Town of Enfield.

Figure 3.4- Remaining Useful Life of Transit Fleet



Since 2011, Advance Transit has acquired three Gillig diesel electric hybrid buses (above). These buses are the newest additions to the region's transit fleet, and the first hybrid buses in the region.

Transit Fleet Condition in the UVLSRPC Region

The New Hampshire Department of Transportation evaluates the condition of the state's transit fleet by analyzing the age of active transit buses. The Federal Transit Administration (FTA) has established "useful life" thresholds for transit buses shown in the table below:

Category	Length	Seats	Life
Large, Heavy-duty Bus	35-60 Ft.	27-40	12 Years
Small, Heavy-duty Bus	30 Ft.	26-35	10 Years
Medium-duty Bus	30 Ft.	22-30	7 Years
Light-duty Bus	25-35 Ft.	16-25	5 Years
Cutaways/Modified Vans	16-28 Ft.	10-22	4 Years

Measuring the average remaining useful life of a transit fleet allows for the evaluation of fleet condition over time. Newer buses improve the quality of transit service by reducing maintenance costs, enhancing rider amenities, improving fuel efficiency, and reducing emissions. FTA regulations require that buses reach the end of their useful life before they may be replaced. Thus, the remaining useful life of the region's transit fleet will fluctuate over time depending on bus acquisition cycles and the availability of transit capital funding.

In the UVLSRPC Region, there are a series of pressing transit fleet needs. By the end of 2014, five of the eight buses operated by Community Alliance Transportation Services (CATS) will reach the end of their useful life. Similarly, in 2016, 19 of Advance Transit's 31 buses will reach the end of their useful life. This total includes 11 medium duty buses (purchased in 2009) and 8 large heavy-duty buses (purchased in 2004).

Performance Measures

Public transportation performance in the UVLSRPC Region shall be measured by three key indicators: operational performance; state of good repair of the region's transit fleet; and the region's access to transit options.

Operational performance shall be measured by the total number of annual riders on the region's fixed route public transportation network. This measure differs slightly from the NHDOT Balanced Scorecard, because the Balanced Scorecard counts shuttle ridership for both Advance Transit and the Wildcat Transit service operated by the University of New Hampshire. The UVLSRPC's performance measure focuses solely on fixed-route transit ridership.

The state of good repair of the region's transit assets shall be measured by the remaining useful life of the region's transit fleet according to FTA useful life thresholds. Access to transit options will be measured by the percentage of the region's population with access to multimodal transportation (i.e. living a quarter-mile or less from a transit route, park-and-ride facility, or passenger rail station).

Performance Targets

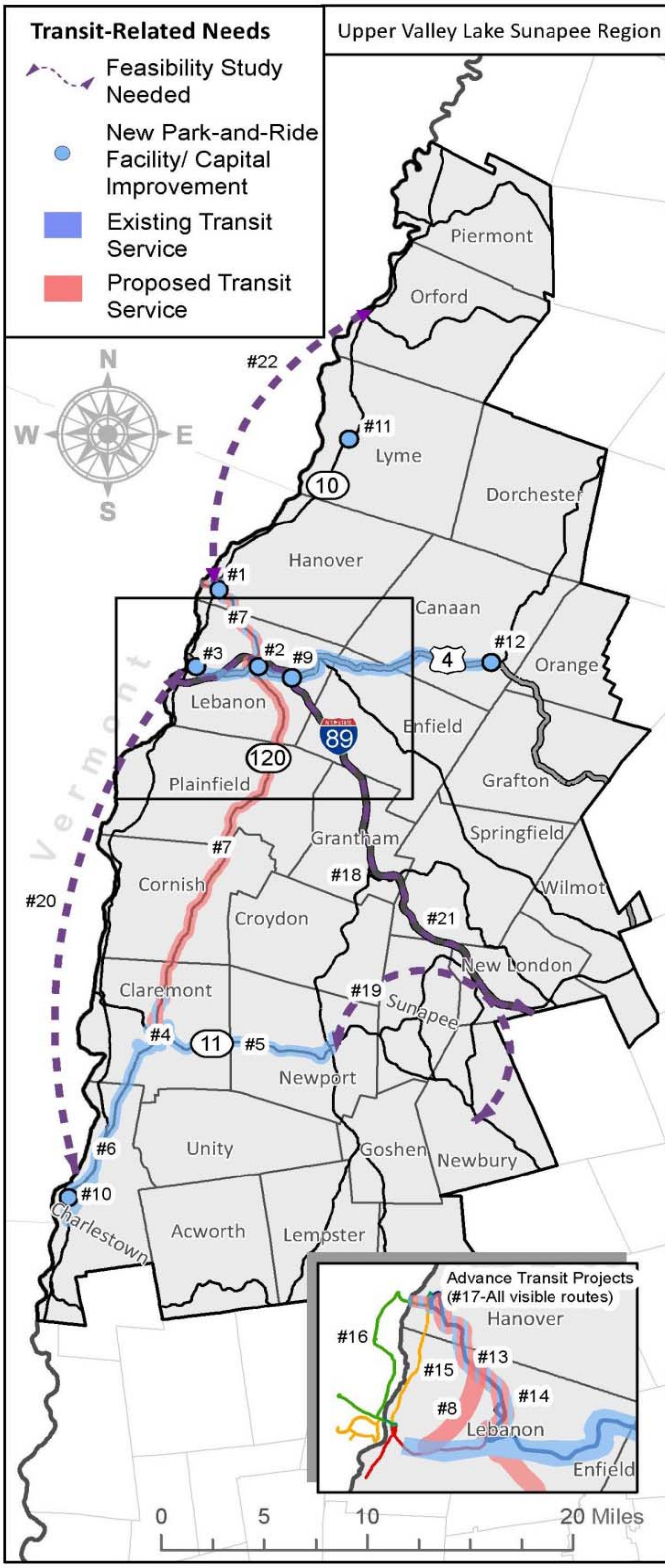
- Reach 1,000,000 annual fixed-route public transportation riders in the region by 2030.
- Increase the remaining useful life of the region's public transportation fleet to 50% by 2030.
- Increase the percentage of the region's population with access to multimodal transportation to 40% by 2030.

Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Local Transit Ridership (Fixed-Route)	601,024	**1,000,000**	N/A	N/A
Remaining Useful Life of Transit Fleet	37.8%	**50%**	43.8%	N/A
Percentage of Population With Access to Multimodal Transportation	30.5%	**40%**	26.1%	N/A
Intercity Transit Ridership	215,000 (Approx.)	**N/A**	N/A	N/A

Intercity transportation services in the UVLSRPC region are privately operated as for-profit businesses, and comprehensive historical ridership data is maintained exclusively by those companies. While it is important to track the performance of intercity transportation in a regional context, this plan does not set a performance target.

Improvement Needs

Figure 3.4.3 – Transit Improvement Needs in the UVLSRPC Region



ID	Type	Project Synopsis
#1	Capital Improvement	Design and Construct the Hanover Mobility Hub (Wheelock Street)
#2	Capital Improvement	Design and Construct a Mobility Hub in Downtown Lebanon
#3	Capital Improvement	Design and Construct a Mobility Hub in West Lebanon Village
#4	Capital Improvement	Bus Stop Improvements along Community Alliance Transportation Services Claremont Route
#5	Capital Improvement	Bus Stop Improvements along Community Alliance Transportation Services Newport Route
#6	Capital Improvement	Bus Stop Improvements along Community Alliance Transportation Services Charlestown Route
#7	New Service	Implement Transit Service on NH Route 120 between Claremont and Lebanon/Hanover per the Recommendation of the NH Route 120 Transit Feasibility Study
#8	New Service	Implement Flex Route or Demand Response Service Connecting Alice Peck Day Hospital with Downtown Lebanon and Centerra Park
#9	Park-and-Ride Facility	Establish a Park-and-Ride Facility in the Vicinity of Interstate 89 Exit 17
#10	Park-and-Ride Facility	Establish a Park-and-Ride Facility in the Vicinity of the NH Route 12/NH Route 11 Intersection in Charlestown
#11	Park-and-Ride Facility	Expand Park-and-Ride Facility Capacity on NH Route 10 in Lyme
#12	Park-and-Ride Facility	Formalize a Park-and-Ride Facility at the Terminus of Advance Transit's Blue Route in Canaan
#13	Service Expansion	Increase Frequency on Advance Transit's Blue Route to All-Day 15-Minute Service on Weekdays between Downtown Lebanon and Downtown Hanover
#14	Service Expansion	Extend Advance Transit's Blue Route Service to 8 PM on Weekdays
#15	Service Expansion	Increase Frequency on Advance Transit's Orange Route to 30 Minutes by adding a Second Bus
#16	Service Expansion	Increase Frequency on Advance Transit's Green Route to 30 Minutes by Adding a Second Bus
#17	Service Expansion	Implement Hourly Saturday Bus Service on Advance Transit's Blue, Red, Orange, and Green Routes
#18	Feasibility Study	Conduct Feasibility Study of Commuter Transportation Route on Interstate 89 Connecting New London and Grantham with the Lebanon/Hanover Employment Center
#19	Feasibility Study	Conduct Feasibility Study of Alternatives for Extending Local Transit Service to the Towns of New London, Newbury, and Sunapee
#20	Feasibility Study	Conduct Feasibility Study of Potential Transit Service on NH Route 12A between Charlestown and West Lebanon
#21	Feasibility Study	Conduct Feasibility Study of Potential Intercity Transit Service Connecting the Upper Valley with Concord, Manchester, and the Manchester-Boston Regional Airport
#22	Feasibility Study	Conduct Feasibility Study of Potential Transit Service between Orford, Lyme, and Hanover

Implementation Strategies

While Figure 3.4.3 presents many public transportation improvement needs, the region’s top public transportation priority remains maintaining the public transportation services we have. New Hampshire’s transit funding structure faces many of the same challenges as the state’s infrastructure funding structure. As a result, revenues to support transit operations are inadequate to meet the region’s needs, and the funding sources that exist are not diverse or sustainable.

Notwithstanding limitations on federal funding and the lack of state funding to support transit operations, the Upper Valley Lake Sunapee Region is regarded as a model for rural public transportation funding. The region’s largest employers, Dartmouth-Hitchcock Medical Center and Dartmouth College, contribute to the operation of Advance Transit’s service. The six communities in Advance Transit’s service area also contribute to the operation of Advance Transit’s service, resulting in a unique and successful public-private funding partnership. Advance Transit has also developed a philanthropy program called the “Keep it Free Fund”, which accepts charitable donations to keep the service free-fare.

As new transit service is developed linking the cities of Claremont and Lebanon, UVLSRPC will work cooperatively with Community Alliance Transportation Services to build a similar public-private funding partnership.

On the capital side of public transportation, the long-standing needs for park-and ride facility development (and expansion) remain difficult to fund. In other parts of the state, park-and-ride facilities are funded by the federal Congestion Mitigation and Air Quality (CMAQ) Program. This funding has historically supported projects in the southern part of the state, in areas that were not in attainment of federal air quality thresholds. Thus, park-and-ride facility development in the Upper Valley Lake Sunapee Region was funded by one-time allocations of NHDOT Betterment Program funding. It will be difficult to achieve the park-and-ride facility improvements outlined in Map 3.2 without statewide eligibility of CMAQ funding or a dedicated funding program for statewide park-and-ride facility development.

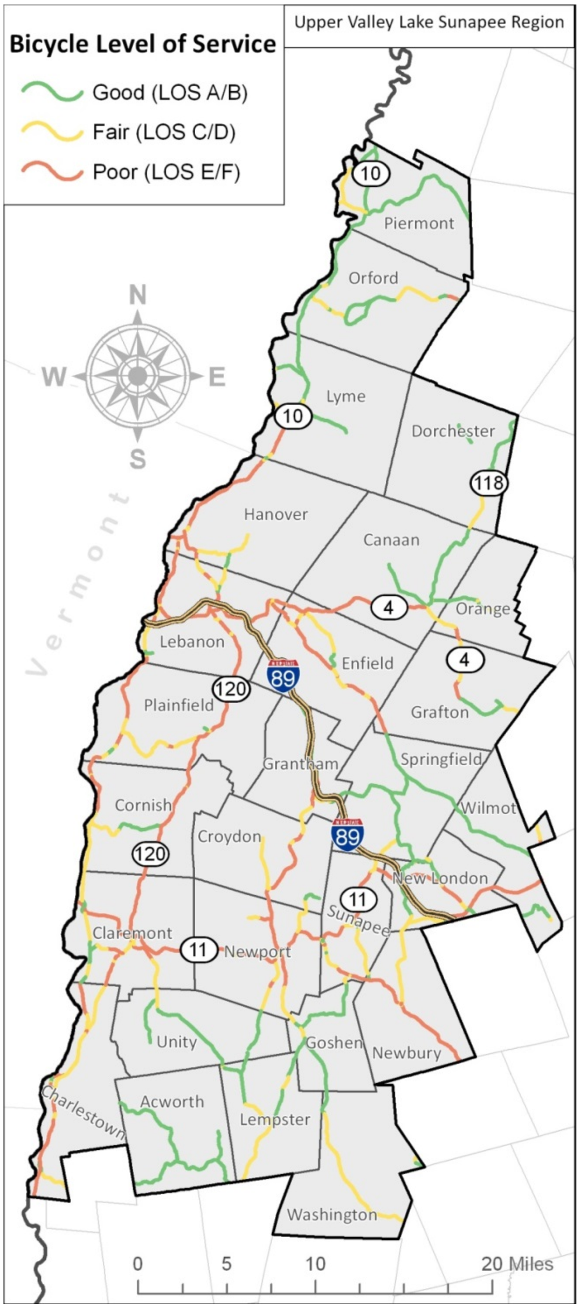
Strategies
• Advocate at the state, local, and federal level for adequate and consistent funding sources for transit operations and capital costs.
• Continue to serve on the Advance Transit Board of Directors and Planning and Operations Committee.
• Continue to serve on the CATS Advisory Committee.
• Provide technical assistance to Advance Transit and CATS in developing applications for FTA Section 5311 capital and operating funding.
• Assist Advance Transit and CATS in applying for FTA Section 5304 funding to update their five-year transit development plans.
• Assist Advance Transit and CATS in updating their air quality impact analyses biennially.
• Apply for and administer transit feasibility studies using FTA Section 5304 planning funds to study new services along the Interstate 89 Corridor, NH Route 12A Corridor, and in the Lake Sunapee communities of Sunapee, New London, and Newbury.
• Advocate for statewide eligibility of Congestion Mitigation and Air Quality (CMAQ) funding in New Hampshire.
• Advocate for the creation of a dedicated, competitive funding program for statewide park-and-ride facility development and expansion.
• Utilize the forthcoming New Hampshire Park-and-Ride Development Toolkit as a means of determining the feasibility of new Park-and-Ride facility development or expansion projects.
• Support the continued development of philanthropic programs to benefit Advance Transit and CATS.
• Pursue federal and state grants to improve the energy efficiency and reduce greenhouse gas emissions of the region's transit fleet.
• Encourage counties and municipalities to budget for matching funds to leverage available federal public transportation grant funding.
• Coordinate with communities to ensure that local zoning ordinances encourage compact, mixed-use, pedestrian-oriented development with local growth centers planned in the context of available public transportation services.

3.5 BICYCLE AND PEDESTRIAN TRANSPORTATION IN THE REGION

Vision

A safe bicycle transportation network connects all the communities in the region and every community center can be accessed by a safe and appropriate pedestrian transportation network.

Existing Conditions



Bicycle Travel in the UVLSRPC Region

To analyze bicycle travel on the region's road network, the Commission conducted a Bicycle Level of Service analysis for all state and urban compact roads in the region.

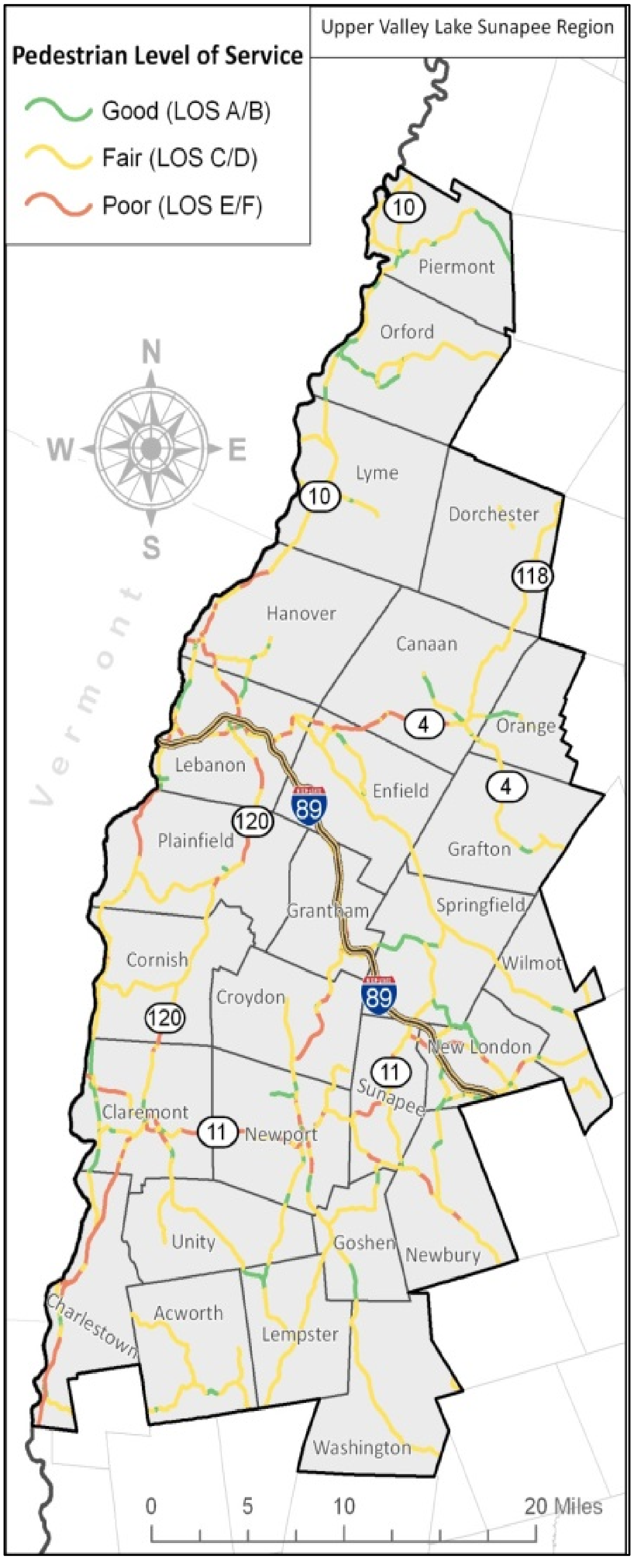
Bicycle Level of Service is a quantitative measure of a roadway's suitability for bicycle traffic. Whereas a roadway's Operational Level of Service is a measure of traveler delay, the Bicycle Level of Service quantifies a cyclist's perceived safety traveling on a roadway.

The National Cooperative Highway Research Program (NCHRP Report 616) has published a methodology for conducting Bicycle Level of Service analysis. The analysis involves a mathematical model that considers vehicle speed, proportion of heavy vehicles, pavement condition, lane width, on-street parking, shoulder width, and traffic volume.

The NCHRP methodology is only used for on-road facilities, not trails or other multi-use off-road paths.

What does this map show?

This map displays Bicycle Level of Service information for state highways in the UVLSRPC region according to the methodology presented in National Cooperative Highway Research Report 616. Level of Service is represented as a letter score, with A and B representing good bicycling conditions, C and D representing fair bicycling conditions, and E and F representing poor bicycling conditions.



Pedestrian Travel in the UVLSRPC Region

To analyze pedestrian travel on the region's road network, the Commission conducted a Pedestrian Level of Service analysis for all state and urban compact roads in the region.

Pedestrian Level of Service is a quantitative measure of a roadway's suitability for pedestrian traffic. Whereas a roadway's Operational Level of Service is a measure of traveler delay, the Pedestrian Level of Service quantifies a pedestrian's perceived safety while walking.

The National Cooperative Highway Research Program (NCHRP Report 616) has published a methodology for conducting Pedestrian Level of Service analysis. The analysis involves a mathematical model that considers traffic volume, shoulder width, on-street parking, sidewalk presence, sidewalk width, and vehicle speed.

The NCHRP methodology is only used for on-road facilities, not trails or other multi-use off-road paths.

What does this map show?

This map displays Pedestrian Level of Service information for state highways in the UVLSRPC region according to the methodology presented in National Cooperative Highway Research Report 616. Level of Service is represented as a letter score, with A and B representing good walking conditions, C and D representing fair walking conditions, and E and F representing poor walking conditions.

Performance Measures

Bicycle and pedestrian transportation performance in the region shall be measured by Bicycle Level of Service (BLOS) and Pedestrian Level of Service (PLOS) respectively. The NHDOT Balanced Scorecard does not currently include any performance measurements related to bicycle and pedestrian transportation. As a result, there is no comparable statewide data to compare the regions performance against.

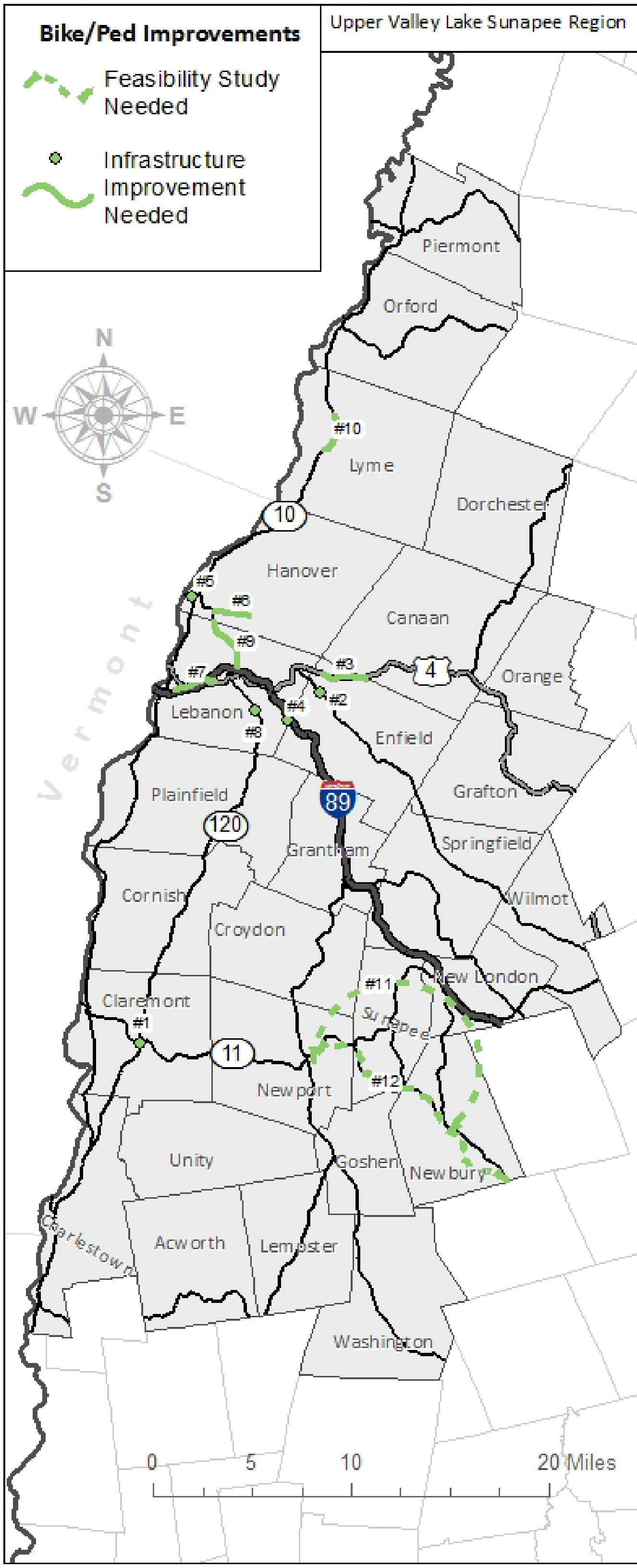
Performance Targets

- Improve the region's average Bicycle Level of Service to C (3.00) by 2030.
- Improve the region's average Pedestrian Level of Service to C (3.50) by 2030.

Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Bicycle Level of Service	D (3.57)	**C** (3.00)	N/A	N/A
Pedestrian Level of Service	D (4.12)	**C** (3.50)	N/A	N/A

Improvement Needs

Figure 3.5.1 – Bicycle/Pedestrian Improvement Needs in the UVLSRPC Region



ID	Community	Project Synopsis
#1	Claremont	Implement the improvements identified in the Bobby Woodman Rail Trail Action Plan
#2	Enfield	Improvements to Rail Trail Crossing (Main Street)
#3	Enfield	Construct Sidewalks Along US Route 4 Between Main Street and Canaan Town Line
#4	Enfield-Lebanon	Expansion of the Bicycle Path along Interstate 89 from Stoney Brook Road to Exit 16
#5	Hanover	Construction of the Hanover Mobility Hub (Wheelock Street)
#6	Hanover	Bicycle/Pedestrian Improvements on Greensboro Road from Great Hollow Road to NH Route 120.
#7	Lebanon	Construction of the Mascoma River Greenway from Lebanon to West Lebanon
#8	Lebanon	Complete Meriden Road Transportation Enhancement Project to Improve Sidewalks and Bicycle Shoulder
#9	Lebanon	Construct Multi-Use Path on East Side of NH Route 120 Between I-89 Exit 18 and Hanover Town Line
#10	Lyme	Shoulder Improvements on NH Route 10 from Lyme Common to Post Pond
#11	Newbury-New London-Sunapee	Feasibility Study for "Wild Goose Loop" Multi-Use Path around Lake Sunapee
#12	Newbury-Newport-Sunapee	Feasibility Study to Form an Inter-Regional Rail Trail Connection by Expanding the Sugar River Rail Trail to Points East
#13	New London	Complete Elkins Village Transportation Enhancement Project to Improve Sidewalks
#14	West Lebanon	Establish an improved pedestrian connection between West Lebanon, NH and White River Junction, VT
#15	Region	Improve Marked Crosswalks to Rectangular Rapid Flashing Beacons (RRFBs) or Pedestrian Hybrid Signals where appropriate (systemic)
#16	Region	Install Countdown Timers at all Signalized Pedestrian Crossings in the Region
#17	Region	Develop Safe Routes to School Plans in all Communities in the Region that Do Not Currently Have Plans
#18	Region	Develop Bicycle and Pedestrian Connections to all Local Bus Stops, Intercity Bus Stations, Passenger Rail Stations, and Park-and-Ride Facilities

Implementation Strategies

State and federal funding sources for local bicycle and pedestrian transportation are very limited. Former standalone funding programs including the Transportation Enhancement Program (TE), Recreational Trails Program (RTP), and Safe Routes to School Program (SRTS) have been consolidated into a single program called the Transportation Alternatives Program (TAP).

At current funding levels, the State of New Hampshire receives approximately $7.5 million in Transportation Alternatives Program funding each biennium. Of that $7.5 million, approximately one-third of it is set aside for Recreational Trail projects administered by the NH Department of Resources and Economic Development. Another portion of the funding is set aside, per federal formula guidelines, to be used exclusively within the Nashua Region. After those set asides, each of the nine regions of the state will likely see one TAP-funded bicycle or pedestrian infrastructure improvement project every two years. Thus, the TAP program, while very popular amongst communities, will remain ultra-competitive and an unreliable source of funding for local projects.

Bicycle and pedestrian improvement projects are also potentially eligible for federal Highway Safety Improvement Program funding, provided that the project location has a history of fatal or severe injury crashes involving bicyclists or pedestrians. Road Safety Audits should be conducted at all locations within the region that have had a fatality involving a bicyclist or pedestrian as a precursor to potential Highway Safety Improvement Program funding.

While the federal Congestion Mitigation and Air Quality Program (CMAQ) can potentially fund bicycle and pedestrian improvement projects, communities in the UVLSRPC region are not currently eligible for that funding because the region remains in attainment of federally-established air quality thresholds.

In the future, developing and improving the region's bicycle and pedestrian transportation infrastructure network will require strong local funding commitments. Projects that are funded through local public-private partnerships will have a higher probability for success. Two recent examples of successful public-private partnerships in the region include the Mascoma River Greenway in Lebanon and the new Riverwalk pedestrian bridge in Sunapee (which was entirely funded through private donations). Additionally, local Planning Boards should ensure through the site plan and/or subdivision review process that developers construct appropriate bicycle and pedestrian infrastructure to connect their developments to the state or local network.

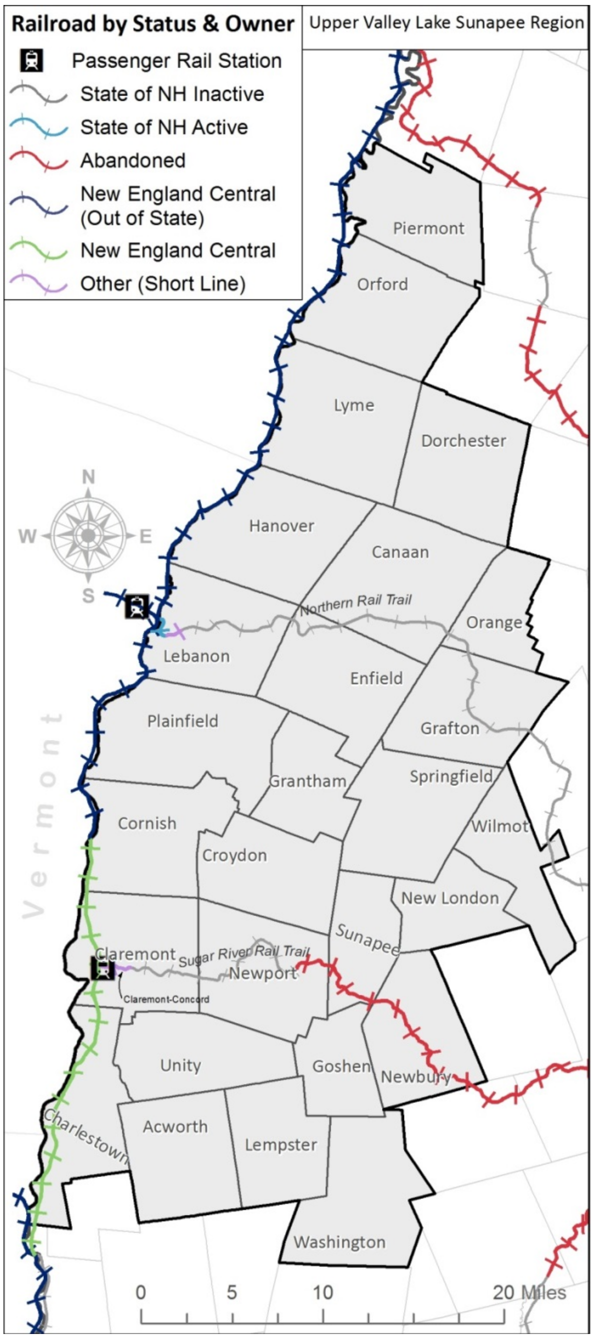
Strategies
• Develop and adopt a regional Complete Streets Policy, and provide technical assistance to communities in the region developing local Complete Streets policies.
• Continue to provide technical assistance to communities in bicycle and pedestrian project planning and implementation.
• Assist communities in conducting Road Safety Audits at all locations within the region that have had a fatality involving a bicyclist or pedestrian.
• Establish a regional bicycle/pedestrian counting program to evaluate existing infrastructure usage and future needs.
• Coordinate with municipalities and state agencies to acquire right-of-way during reconstruction projects to accommodate future bicycle and pedestrian transportation infrastructure needs.
• Coordinate with NHDOT and municipalities to ensure that new developments construct appropriate bicycle and pedestrian infrastructure and integrate that infrastructure into the state or local network.
• Encourage the NHDOT to allow multiple uses on rail corridors where appropriate (e.g. rail with trail).
• Coordinate with NHDOT to evaluate narrowing travel lane widths during resurfacing projects to improve shoulders and/or bicycle lanes.

3.6 RAIL TRANSPORTATION IN THE REGION

Vision

The region's two largest employment and population centers (Lebanon and Claremont) have viable, efficient freight and passenger rail access to major markets in the eastern United States and Canada.

Existing Conditions



Railroad Condition in the UVLSRPC Region

In New Hampshire, active railroads are classified according to a framework developed by the Federal Railroad Administration (FRA). The New Hampshire Department of Transportation measures the overall condition of railroads in the state by evaluating the number of miles of FRA Class 3 track.

FRA Class	Freight Speed	Passenger Speed
1	10 mph	15 mph
2	25 mph	30 mph
3	40 mph	60 mph
4	60 mph	80 mph
5	80 mph	90 mph
6	110 mph	110 mph
7	125 mph	125 mph
8	160 mph	160 mph
9	200 mph	200 mph

In the UVLSRPC region, only the New England Central Railroad (NECRR) meets FRA Class 3 standards. The NECRR runs along the Connecticut River from the Vermont/Quebec border to New London, CT. The NECRR enters the region in Cornish and continues south along the Connecticut River through Claremont and Charlestown before crossing back into Vermont at the Town of Walpole.

The Claremont Concord Railroad (CCRR) operates five miles of short-line railroad that branch from the New England Central Railroad in Claremont (two miles) and West Lebanon (three miles).

Much of the former Northern and Sugar River railroads are currently inactive, owned by the State of New Hampshire, and used as Rail Trail facilities (known as the Sugar River Rail Trail and the Northern Rail Trail).

Passenger Rail Ridership in the UVLSRPC Region

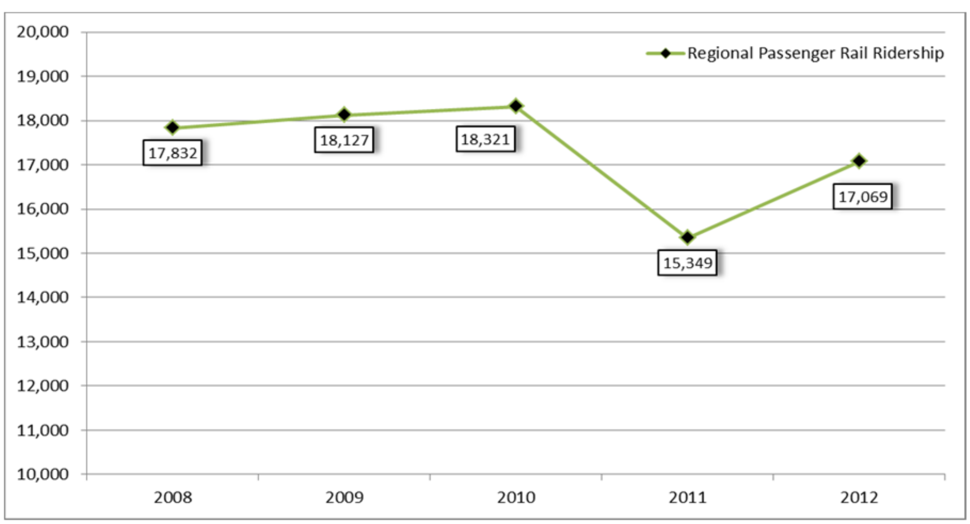
The region's only passenger rail service is Amtrak's Vermonter, which has daily round-trip service between Saint Albans, Vermont and Washington, DC. The Amtrak Vermonter serves the UVLSRPC Region via stops in White River Junction, Vermont and Claremont, New Hampshire.

Between 2003 and 2006, ridership declined significantly on the Vermonter service, due to the elimination of a motorcoach service connecting Saint Albans, Vermont with Montreal, Quebec. However, ridership began to rebound in 2006, and climbed steadily until 2010. In 2011, the New England Central Railroad constructed a $70 million project to increase train speeds along the corridor. While this construction had a short-term impact on Vermonter ridership, sections of the New England Central Railroad between Vernon, Vermont and White River Junction, Vermont are now built to FRA Class 4 standards, and can accommodate passenger rail speeds up to 79 MPH.

The Massachusetts Department of Transportation is also constructing a series of rail improvements, known as the Knowledge Corridor, which would relocate the Vermonter service from the New England Central Railroad to the Pan Am Railroad between East Northfield and Springfield, Massachusetts. The MassDOT estimates that this project will reduce travel times on the Vermonter by 25 minutes, improve on-time performance, and increase ridership.

Amtrak's Vermonter service relies on funding support provided by the State of Vermont. The State of New Hampshire does not currently contribute to the operation of the Vermonter service. Under this funding structure, there is no guarantee that the Vermonter will continue to provide direct service to the City of Claremont. Thus, it will be important advocate locally and regionally for a state-level contribution to Amtrak's Vermonter operation to help ensure continued service to the City of Claremont and the Upper Valley Lake Sunapee Region.

Figure 3.6.1- Passenger Rail Ridership (Claremont, NH and White River Junction, VT Stations)



Note: Passenger rail ridership in 2011 and 2012 was affected by the construction of track improvements and the impacts of Tropical Storm Irene.

Performance Measures

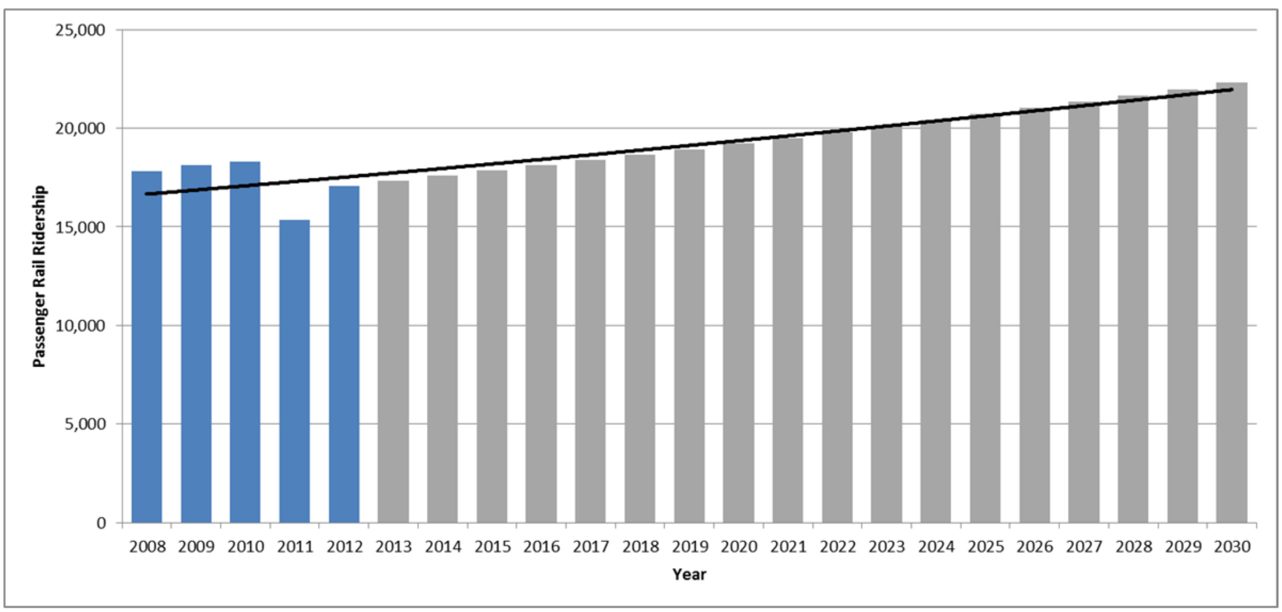
Rail transportation performance in the region shall be measured by passenger rail ridership and the number of miles of rail lines capable of speeds of 40 MPH. Both of these measures are consistent with the NHDOT's Balanced Scorecard. The region's calculation of passenger rail ridership will include the combined boardings and alightings from both the Claremont, New Hampshire and White River Junction, Vermont stations.

Performance Targets

- Increase passenger rail ridership in the region by 1.5% annually, surpassing 22,000 boardings/alightings per year by 2030.
- Maintain the current mileage of railroad in the region capable of speeds of 40 MPH.

Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Passenger Rail Ridership	17,069	**22,315**	199,645	N/A
Rail Lines Capable of Speeds of 40 MPH	23.3	**23.3**	104	N/A

Figure 3.6.2- Passenger Rail Ridership Performance Target in the UVLSRPC Region



Improvement Needs

Needs
• Coordinate with the City of Claremont to plan and implement station improvements, parking improvements, and multi-modal connections at the Claremont Junction passenger rail station.
• Support the infrastructure improvements identified during the Northern New England Intercity Rail Initiative to facilitate higher-speed rail service on the New England Central Railroad line.
• Coordinate with the City of Claremont, City of Lebanon, and short-line rail owners to improve the condition of short-line railroads in the region.
• Coordinate with the NHDOT and applicable railroad operators to ensure that aging railroad bridges are rehabilitated and maintained in a state of good repair.
• Support the City of Lebanon's initiative to redevelop the former Westboro Rail Yard.
• Support safety improvements and/or grade separations for at-grade rail crossings within the UVLSRPC Region.

Implementation Strategies

Projects benefitting the region's rail system are generally developed at the state and federal level. Given the UVLSRPC region's limited rail infrastructure, the most significant effort to improve rail service in the region is the "Boston Montreal High Speed Rail" project.

In 2003, the states of New Hampshire, Vermont, and Massachusetts partnered on the development of a Feasibility Study to evaluate a potential high-speed rail service connecting Boston and Montreal. The alignment evaluated in the study would have utilized the former Northern Railroad line (currently used as the Northern Rail Trail) through downtown Lebanon. However, due to the cost of rebuilding rail infrastructure on the former Northern Railroad, and lack of political support in the State of New Hampshire, this alignment was not considered further.

In 2013, the states of Massachusetts and Vermont (in partnership with the Province of Quebec), began the Northern New England Intercity Rail Initiative (NNEIRI). As part of the NNEIRI, a feasibility study is being developed to evaluate a potential higher-speed rail connection between Boston and Montreal using existing infrastructure. The proposed alignment would begin in Boston, travel west to Springfield, travel north to White River Junction, and then northwest across the United States/Canada border to Montreal.

In the UVLSRPC region, the proposed NNEIRI alignment would utilize the New England Central Railroad, and travel through Cornish, Claremont, and Charlestown. The existing Amtrak Vermonter stop in the City of Claremont is currently proposed to be a stop if the NNEIRI service is implemented. However, it is important to continue to advocate locally and regionally to support the proposed stop in the City of Claremont during the Northern New England Intercity Rail Initiative feasibility study process.

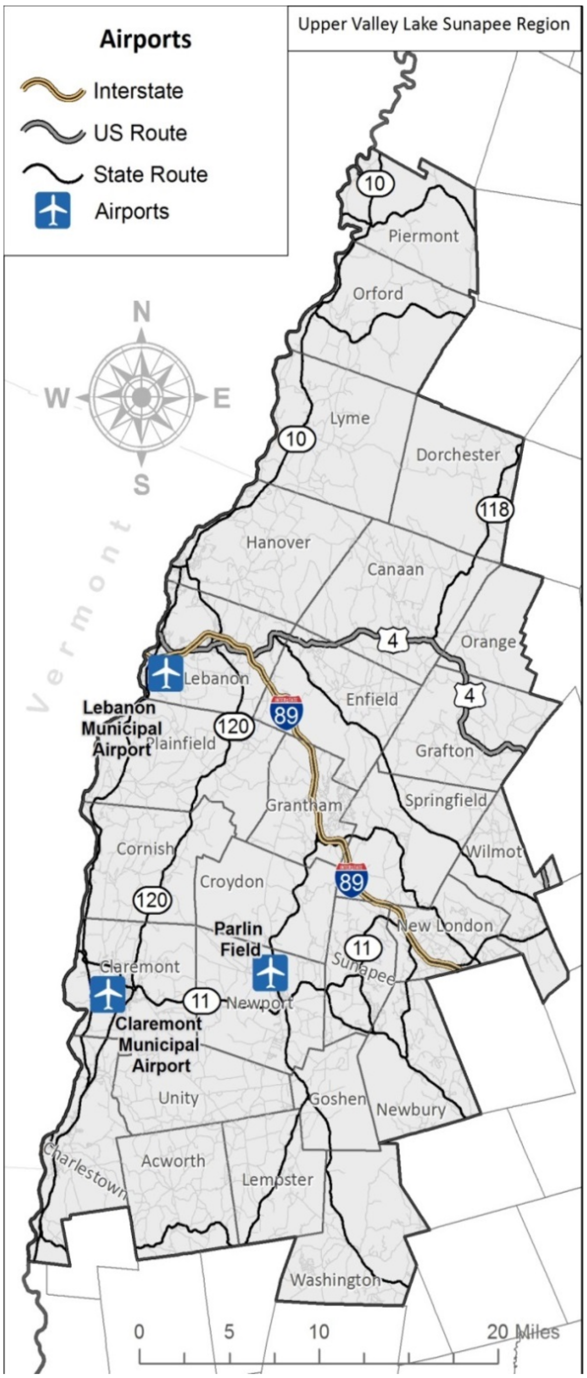
Strategies
• Continue UVLSRPC participation on the NH Rail Transit Authority.
• Continue to serve on the Stakeholders Group for the Northern New England Intercity Rail Initiative Process.
• Continue to support a stop in the City of Claremont during the Northern New England Intercity Rail Initiative feasibility study process.
• Advocate for a state-level contribution to Amtrak's Vermonter operation to help ensure continued service to the City of Claremont and the Upper Valley Lake Sunapee Region.
• Coordinate with NHDOT and municipalities to ensure that rail rights-of-way are available for future railroad use.
• Coordinate with the NHDOT to improve the safety of at-grade rail crossings within the UVLSRPC Region.

3.7 AIR TRANSPORTATION IN THE REGION

Vision

The region will have strong, viable passenger air connections to major airports in the eastern United Stated and Canada, and convenient access to general aviation opportunities.

Existing Conditions



Air Transportation in the Region

The Lebanon Municipal Airport is the region's only commercial service airport. Along with its air service carrier Cape Air, the airport provides the Upper Valley with one-stop service to Boston and White Plains, NY.

Cape Air's Lebanon service is subsidized by the Federal Aviation Administration's Essential Air Service program, as is service at approximately 162 other airports. The subsidy helps ensure good levels of service and good fares for travelers to and from the airport.

Cape Air provides approximately four round trips per day from Lebanon to Boston, and two round trips flights per day to White Plains, NY. From White Plains, Cape Air provides ground transportation to midtown Manhattan. Cape Air flies Cessna 402, nine-seat aircraft to both destinations. Total travel times from Lebanon are: 0:55 to Boston; and 1:20 to White Plains with an additional 1:00 to midtown Manhattan.

From 2008 to 2013, airline ridership at Manchester – Boston Regional and Burlington International airports has decreased 36% and 20% respectively while ridership at Lebanon Municipal and its partner airport in Boston has increased 7% and 10% respectively. The state's third commercial airport, the Portsmouth International Airport at Pease, lost its only airline in 2008, and recently secured a new airline to serve the airport with service to Orlando, Florida.

The Upper Valley has good general aviation access as business aircraft routinely fly non-stop from Lebanon Municipal throughout the country and to Canada, Mexico, Central and South America, and Western Europe. Claremont Municipal Airport and Parlin Field in Newport provide access throughout the northeast.

The Lebanon Municipal Airport's two runways (Runway 07/25 and Runway 18/36), as seen from above.

Figure 3.7.1- Airport Runway Condition

Airport	Runway	Surface	Area	Rating
Lebanon	07/25	Asphalt	5496 x 100	Good (4)
Lebanon	18/36	Asphalt	5200 x 100	Good (4)
Claremont	11/29	Asphalt	3098 x 100	Good (4)
Newport	12/30	Turf	2140 x 80	Good (4)
Newport	18/36	Asphalt	3448 x 50	Exc. (5)

Runway Condition in the Region

The New Hampshire Department of Transportation and Federal Aviation Administration evaluate the runway surface condition at all public-use airports in the state in accordance with Federal Aviation Administration (FAA) rating standards ranging from "Excellent (5)" to "Failed (1)."

To compute the overall average condition for the region, each runway is weighted using the runway's condition rating and total square footage.

There are three airports in the UVLSRPC Region, with a total of five runways:

- Lebanon Municipal Airport (Lebanon)- Commercial and General Aviation.
- Claremont Municipal Airport (Claremont)- General Aviation.
- Parlin Field (Newport)- General Aviation.

The current runway condition in the UVLSRPC region is summarized in Figure 3.7.1.

Performance Measures

Air transportation performance in the UVLSRPC Region shall be measured by the number of annual enplanements and deplanements at the Lebanon Municipal Airport, and the condition of runways at the region's three airports.

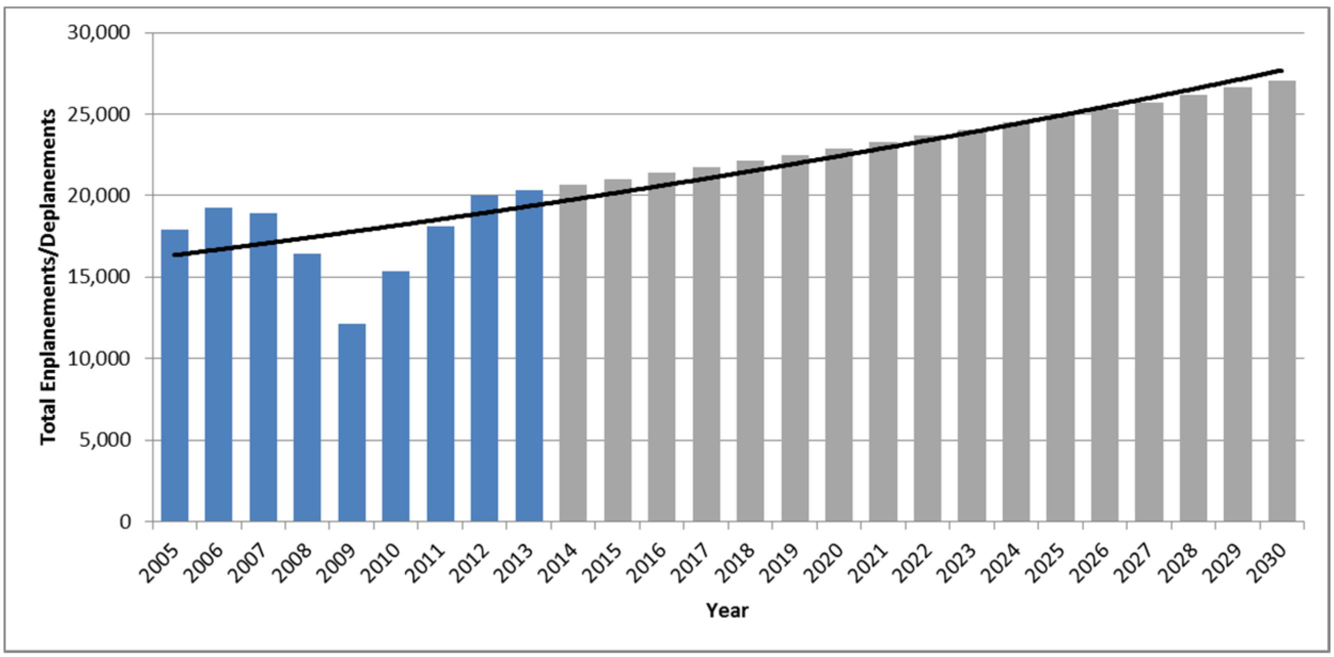
These are also the performance measure used in the New Hampshire Department of Transportation's Balanced Scorecard, which will allow for comparison of the state's performance with the Region's performance.

Performance Targets

- Increase the number of total annual enplanements and deplanements at the Lebanon Municipal Airport by 1.7% per year, surpassing 27,000 by 2030.
- Increase the average FAA airport runway condition rating in the region to Good (4.25) by 2030.

Performance Measure	**UVLSRPC Region (2012)**	**UVLSRPC Region (2030 Target)**	**Statewide (2012)**	**Statewide (2030 Target)**
Passenger Air Ridership	19,990	**27,076**	2,607,103	N/A
Airport Runway Condition	Good (4.10)	**Good (4.25)**	Good (4.11)	N/A

Figure 3.7.2- Performance Target for Passenger Air Ridership in the UVLSRPC Region



Improvement Needs

Many of the improvement needs listed below are included in the current New Hampshire Airport Improvement Program (AIP) as part of the National Plan of Integrated Airport Systems (NPIAS). These projects are subject to change based on the outcomes of local planning and Airport Master Plan processes happening in Lebanon, Claremont, and Newport.

Needs
• Complete runway, taxiway, and apron improvements at the Lebanon Municipal Airport.
• Remove obstructions at the Lebanon Municipal Airport.

• Complete runway and apron improvements at the Claremont Municipal Airport.
• Rehabilitate hangars at the Claremont Municipal Airport
• Remove obstructions at the Claremont Municipal Airport.
• Develop an updated Master Plan for the Claremont Municipal Airport.
• Acquire and install a Visual Guide Slope Indicator (VGSI) at Parlin Field.
• Construct an equipment storage building at Parlin Field.
• Design and construct a parallel taxiway at Parlin Field.
• Design and construct infield drainage improvements at Parlin Field.
• Acquire and install an Automated Weather Observation System at Parlin Field.

Implementation Strategies

The region is reliant on Federal Aviation Administration (FAA) Essential Air Service subsidies to maintain passenger air service connections to Boston and Montreal. Beyond the capital improvement needs identified above, local and regional marketing efforts to increase passenger air enplanements/deplanements at the Lebanon Municipal Airport will be critical to maintain Essential Air Service status.

Strategies
• Advocate for, and contribute to the development of, a feasibility study to determine the viability of the Lebanon Airport becoming a regional facility that is financially supported by the City of Lebanon in partnership with neighboring communities in Vermont and New Hampshire.
• Support the "Fly Lebanon" marketing partnership between the City of Lebanon and the Greater Lebanon Area Chamber of Commerce.
• Support the development of a marketing program for general aviation services at the Claremont Municipal Airport.
• Engage in the Master Planning efforts for the Lebanon Municipal Airport, Claremont Municipal Airport, and Parlin Field.
• Support the continuation of FAA Essential Air Service funding for passenger service linking Lebanon to Boston and New York City.

3.8 TRANSPORTATION DEMAND MANAGEMENT IN THE REGION

Vision

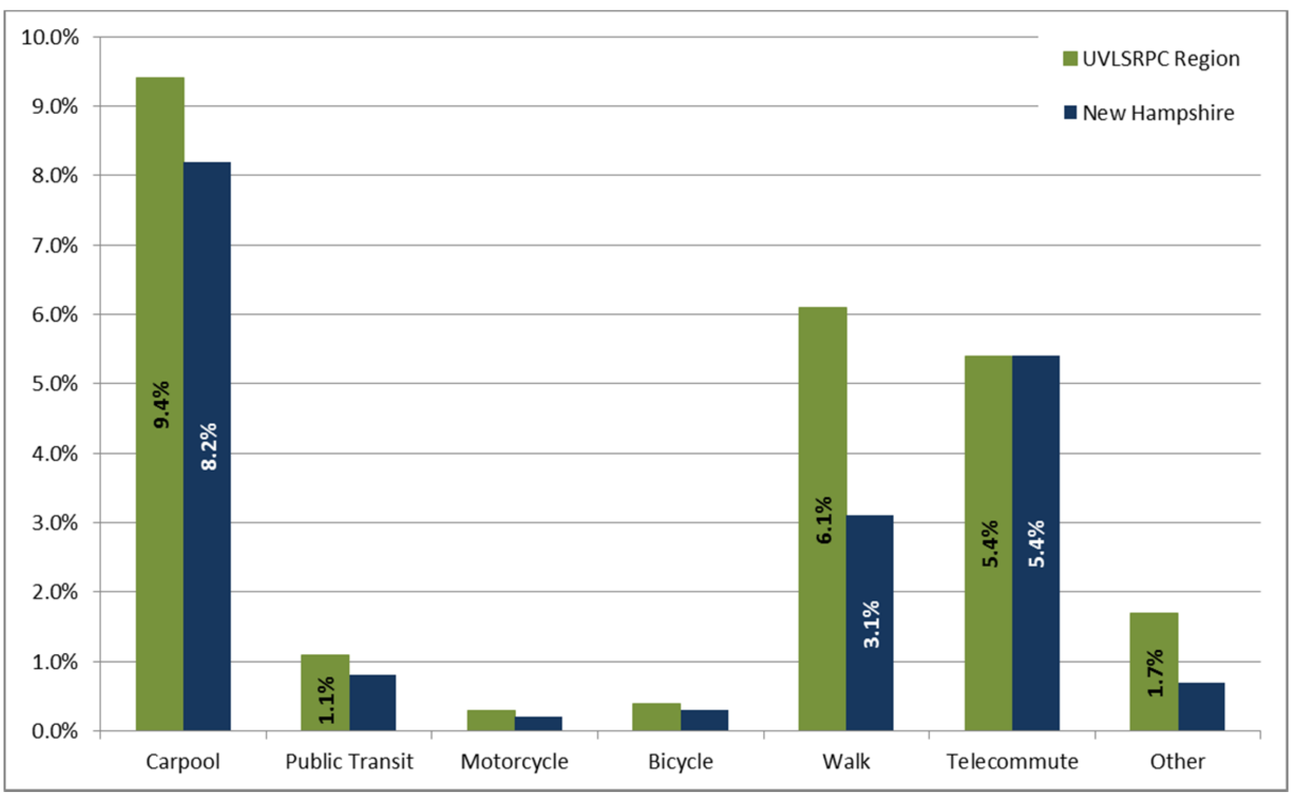
All residents, businesses, and visitors in the UVLSRPC Region can access viable, efficient, and affordable alternatives to single occupant vehicle travel.

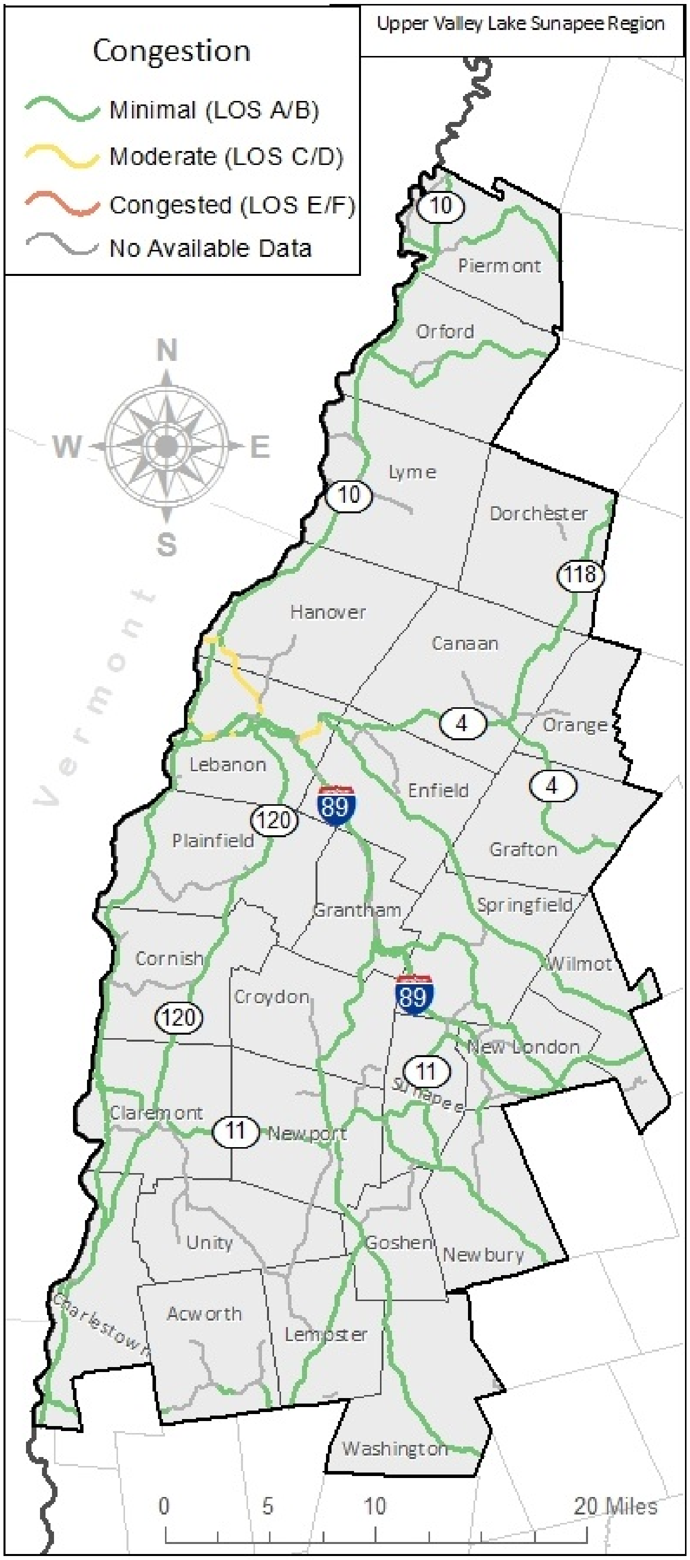
Existing Conditions

Travel demand management initiatives in the UVLSRPC Region have been historically focused on reducing single occupant vehicle traffic by increasing the mode share of carpooling, using public transportation, walking, bicycling, and telecommuting.

The UVLSRPC wrote the 1977 Transit Development Plan that led to the formation of Advance Transit in 1981, was instrumental in the formation of the Upper Valley Rideshare Program in the 1990s, and has participated on the Upper Valley Transportation Management Association since its inception more than ten years ago. As Figure 3.9 shows, these efforts have paid dividends. The region's single occupant commuting rate is currently 75.7% compared to the statewide rate of 81.3%, and the region's mode share for carpooling, public transportation, walking, and bicycling are all significantly higher than the state average.

Figure 3.8.1- Travel Mode Shares in the UVLSRPC Region (2012)





Congestion in the UVLSRPC Region

To analyze congestion on the region's road network, the Commission evaluated Volume/Capacity ratio data (Operational Level of Service) for all state and urban compact roads in the region.

Volume/Capacity ratios are typically represented by a measure called Operational Level of Service (LOS). Operational LOS is represented as a "grade" of A to F using the following criteria:

LOS	V/C Ratio	Description
A	0.00-0.30	No Congestion
B	0.31-0.50	No Congestion
C	0.51-0.70	Moderate Congestion
D	0.71-0.90	Moderate Congestion
E	0.91-1.00	Congestion
F	>1.00	Congestion

Overall, the region has few areas of congestion. However, as the data shows, the following roads do experience significant peak hour delays:

- Interstate 89 Exit 18 and the NH Route 120 Corridor between Lebanon and Hanover;
- Main Street in Hanover;
- NH Route 10A (West Wheelock Street) between Main Street in Hanover and the Vermont State Line.

Also, notably, since the completion of construction on the NH Route 12A/I-89 Exit 20 capacity improvements in West Lebanon, Operational Level of Service on the NH Route 12A Corridor has improved substantially and the data no longer indicates a significant congestion concern.

Performance Measures

Transportation demand management performance in the UVLSRPC region shall be measured by: 1) Mode share for single-occupant commuting, carpooling, public transportation utilization, motorcycling, biking, walking, and telecommuting; and 2) Operational Level of Service on key regional corridors.

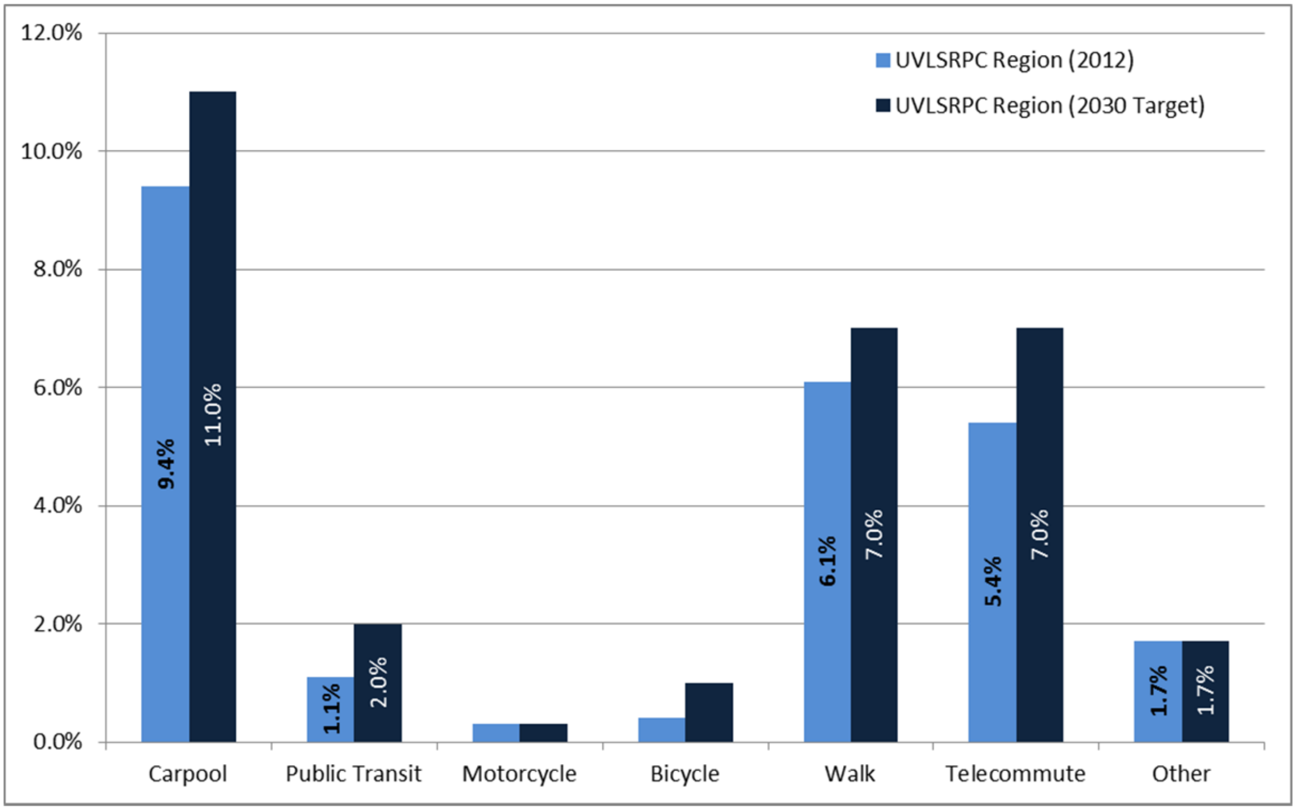
Mode share is not a performance measure in the NHDOT Balanced Scorecard. However, statewide mode share data is available for comparative purposes. Operational Level of Service on key corridors is a measure included in the NHDOT Balanced Scorecard. Whereas the statewide measure is based on five key corridors (I-93, FE Everett Turnpike, NH 101, I-95, and the Spaulding Turnpike), the regional Operational Level of Service reported below focuses on the four most heavily traveled commuter corridors in the region: Interstate 89, U.S. Route 4, NH Route 120, and NH Route 11.

Performance Targets

- Reduce the regional single-occupant commuting rate to 70% by 2030 by increasing the mode share for carpooling (11%), public transportation (2%), bicycling (1%), walking (7%), and telecommuting (7%).
- Maintain Operational Level of Service on key regional corridors at current volume/capacity levels through 2030.

Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
Commute to Work (Driving Alone)	75.7%	**70%**	81.3%	N/A
Commute to Work (Carpool)	9.4%	**11%**	8.2%	N/A
Commute to Work (Public Transportation)	1.1%	**2.0%**	0.8%	N/A
Commute to Work (Motorcycle)	0.3%	**0.3%**	0.2%	N/A
Commute to Work (Bicycle)	0.4%	**1.0%**	0.3%	N/A
Commute to Work (Walking)	6.1%	**7%**	3.1%	N/A
Commute to Work (Telecommute)	5.4%	**7%**	5.4%	N/A
Commute to Work (Other)	1.7%	**1.7%**	0.7%	N/A
Congestion/Operational Level of Service on Key Corridors	A (0.26 Volume/Capacity Ratio)	**A (0.26 Volume/Capacity Ratio)**	C (0.68 Volume/Capacity Ratio)	N/A

Figure 3.8.2- Performance Targets for Travel Mode Share in the UVLSRPC Region



Improvement Needs

Needs
• Implement the statewide Commute Green New Hampshire framework for transportation demand management.
• Continue the Upper Valley Rideshare Program and development of an online regional ridesharing portal that connects with municipal and institutional programs.
• Implement a transit signal priority system across Advance Transit's service area.
• Expand of broadband infrastructure across the region to support telecommuting as outlined in the UVLSRPC Regional Broadband Plan.
• Ensure that other sections of this plan are implemented including, but not limited to: 1) Development of new park-and-ride facilities; 2) Bicycle/pedestrian infrastructure improvements.

Implementation Strategies

Many organizations have taken initiative in developing services and programs that promote transportation demand management, including the UVLSRPC, Advance Transit, Upper Valley Transportation Management Association, and several employers. These programs seek to reduce single-occupant vehicle travel in four different ways:

- Improving Alternative Transportation Modes;
- Providing Incentives and Disincentives to Encourage Alternative Transportation Use;
- Promoting Alternative Work Arrangements;
- Promoting Land Use and Development Strategies that Complement Transportation Demand Management.

Strategies
• Continue UVLSRPC participation in the Upper Valley Transportation Management Association.
• Support the development of employer-based (e.g. financial incentives and preferred parking spaces), retail-based (e.g. discounts at local stores/restaurants), and community-based (e.g. free parking for carpoolers) incentives to carpooling.
• Support the development of a marketing/outreach program targeted to small and medium-sized employers relaying the employer-related benefits of carpooling.
• Support the development of a marketing/outreach program targeted toward commuters in the Upper Valley Lake Sunapee region relaying the commuter-related benefits of carpooling.
• Encourage the development of local land use ordinances that facilitate compact, mixed-use, pedestrian-oriented, and handicap-accessible communities.

3.9 HUMAN SERVICE & VOLUNTEER TRANSPORTATION IN THE REGION

Vision

All residents with special needs and mobility challenges will have access to safe, reliable, and affordable transportation options that allow them to remain independent, active, and involved in the life of our communities.

Existing Conditions

Advance Transit – ACCESS AT

Advance Transit is a fare-free transportation system serving the City of Lebanon and the Towns of Hanover, Enfield, and Canaan, NH and Hartford and Norwich, VT. It provides free complementary paratransit service as required by the Americans with Disabilities Act (ADA) through a program called ACCESS AT. ACCESS AT offers curb-to-curb service to persons with disabilities that prevent them from using Advance Transit's fixed-route service. Eligibility is determined by the criteria in the Americans with Disabilities Act. To be eligible for the service, an application, in-person interview, and possibly, a functional assessment must be completed. The ACCESS AT service is provided to any area within ¾ mile of any of Advance Transit's fixed-route service network, except a commuter segment of the Blue Route. Recently, the downtown Hanover shuttle has been expanded to provide route deviation service to any person within ½ mile of the route. In 2012, ACCESS AT provided 10,192 ADA paratransit rides throughout its system.

Grafton County Senior Citizens Council

The Grafton County Senior Citizens Council (GCSCC) is an organization that works throughout Grafton County to ensure that senior citizens "receive services that help them remain independent in their own homes for as long as possible." The GCSCC manages eight program centers throughout the county, and four program centers in Southern Grafton County: Upper Valley (Lebanon), Mascoma (Canaan), Orford, and Bristol. In addition, some Southern Grafton County residents may receive services from GCSCC's Haverhill or Plymouth program centers.

Grafton County Senior Citizens Council provides transportation to Senior Citizens in in Lebanon.

The Grafton County Senior Citizens Council provides door-to-door transportation to medical appointments, shopping centers, senior centers, and other human services. In 2012, the GCSCC provided 43,693 rides to 1,087 passengers. Of those rides, 41,965 were on agency mini-buses and 1,728 in private vehicles, driven through a network of mostly volunteer drivers.

In many rural communities in southern Grafton County, the GCSCC is the only available transportation service. Thus, GCSCC services have become a vital link between rural communities in southern Grafton County and the service centers of Lebanon and Hanover. Because GCSCC is the only service provider for southern Grafton County's rural communities, they have experienced demand not only from senior citizens, but low-income households throughout Grafton County and northern Sullivan County as well. In response, GCSCC has adapted its service to provide trips to anyone in need to the extent that resources allow. The organization's ability to provide additional services is, however, constrained by available financial resources.

Community Alliance Transportation Services

Community Alliance of Human Services Transportation (CATS) based in Newport, NH operates bus services for communities in Sullivan County. Deviated route service is provided in Charlestown, Claremont, and Newport. Buses operate between 6:25 a.m. and 5:00 p.m., Monday through Friday (except holidays), and the three communities are linked through a system of transfer points along the routes.

All schedules allow for deviation up to ¼ of one mile. Patrons within the ¼ mile service area may call to schedule a pick up. Approximately one-half of CATS' ridership is estimated to be general public, the other half are social service agency clientele.

Kearsarge Valley Council on Aging

The Kearsarge Valley Council on Aging (COA Chapin Senior Center) serves the residents in Andover, Danbury, Grantham, Newbury, New London, Springfield, Sunapee, Sutton and Wilmot. In addition to over 27 seasonal programs and services, COA partners with area organizations for the use of some larger facilities to accommodate events and activities. The transportation program's volunteer driver corps drive an average of 60,000 miles annually to assist eligible seniors in the communities it serves.

Human Service Transportation

Beyond the services described above, there are few transportation options available to residents of the region. This is common for a rural area. Many social service agencies do not provide transportation. Their focus is on a range of other primary services. Human service providers cite transportation as one of the most prominent limitations among clients. The reasons vary but include: financial (i.e. cannot afford to purchase or maintain a private vehicle) and disability (i.e. not able to operate a private vehicle due to one or more physical limitations or age related disability).

When transportation services are available through specific programs, the resulting system is complex. Different providers are frequently needed to address specific needs. For example, the Veterans Administration could provide a veteran with transportation to one of the Administration's hospitals for medical needs; however, the same person would need to seek other means of transportation for shopping and recreational trips.

The ServiceLink (Aging and Disability Resource Center – ADRS) has provided people with a means of navigating through this complex network of human service transportation providers by directing people to the existing human service or transportation resources that best meets their individual needs. There is a ServiceLink Resource Center in southern Grafton County at the Center for Elder Services in Lebanon, NH.

Volunteer Driver Services

A door-to-door volunteer driver service was established in July 2010 to serve individuals of all ages throughout Sullivan County. It has also expanded services to seniors over age 60 and individuals of all ages with a disability. The program is administered by Community Alliance Transportation Services. The GCSCC also facilitates long-distance transportation to residents of Grafton County via volunteer drivers.

Paratransit bus services are available to those who cannot be accommodated in private autos. Services provided to seniors and individuals with a disability are funded through a Purchase of Service Agreement under the Federal Transit Administration (FTA) Section 5310 program. During FY 2012, CATS volunteer drivers provided more than 2,300 one-way trips. The most popular destination was Dartmouth-Hitchcock Medical Center and Fresenius Medical Care, a dialysis center in Lebanon, NH.

As successful as the region's volunteer programs have been to date, it is important to note that although volunteers are an important part of the overall transportation system, they cannot be relied upon to alleviate all heavy or complex travel demands in the region. The current volunteer driver pool is comprised of many individuals who are at or beyond retirement age. The region's pool of volunteer drivers is aging and may become unable to continue their community service.

Performance Measures

Human service and volunteer transportation performance in the UVLSRPC region shall be measured in three ways: 1) ADA Transit Ridership; 2) Elderly/Disabled Transportation Ridership; and 3) Volunteer Program Ridership.

Currently, none of these measures are included in the NHDOT Balanced Scorecard. However, statewide data is available for comparative purposes.

Performance Measure	UVLSRPC Region (2012)	UVLSRPC Region (2030 Target)	Statewide (2012)	Statewide (2030 Target)
ADA Transit Ridership	10,192	**13,250**	N/A	N/A
Elderly/Disabled Transportation Ridership	47,548	**61,800**	N/A	N/A
Volunteer Driver Program Ridership	5,255	**6,800**	38,052	N/A

Improvement Needs

Needs
• Maintain existing elderly and disabled transportation services at the Mascoma Senior Center in Canaan and the Upper Valley Senior Center in Lebanon, and procure replacement buses as necessary.
• Enhance the capacity of Transport Central, an emerging transportation program based in Plymouth, New Hampshire, to increase volunteer driver services in the Town of Dorchester.
• Implement a deviated route transit service ("Flex Route") linking Alice Peck Day Hospital, downtown Lebanon, and Centerra Park.
• Install Global Positioning Systems (GPS) and/or Automatic Vehicle Locating (AVL) systems to assist providers in optimizing route timing and scheduling.
• Update the Community Alliance Transportation Services Five-year Transit Development Plan.
• Acquire a supplementary paratransit bus to provide non-emergency medical transportation shuttle services between Sullivan County communities and Valley Regional Hospital, New London Hospital, and Dartmouth Hitchcock Medical Center.

Implementation Strategies

The Southern Grafton County and Sullivan County Public Transit and Human Service Transportation Coordination Plans describe, in detail, the region's identified implementation strategies. Those plans can be found on the UVLSRPC website at www.uvlsrpc.org.

Strategies
• Continue to support the Grafton/Coos County Regional Coordinating Council and the Sullivan County Regional Coordinating Council to cooperatively develop local service designs, implement coordination policies, and provide feedback to the Statewide Coordinating Council relative to state and federal policies.
• Work with the New Hampshire State Coordinating Council for Community Transportation to improve insurance options for volunteer drivers.
• Develop a coordinated regional marketing campaign to raise public awareness of human service and volunteer transportation options, and reduce confusion amongst the public about existing services.
• Explore opportunities to increase shared dispatch capacity between Advance Transit and GCSCC, including a web based trip reservations system at multiple locations.
• Explore joint vehicle procurement and delivery between Advance Transit and GCSCC.
• Explore joint maintenance agreements between Advance Transit and other service providers in Southern Grafton County. Advance Transit has maintenance tools, equipment, personnel, and expertise in-house. Smaller providers may be able to maximize existing resources by using Advance Transit's maintenance facility and personnel on an at cost basis.
• Conduct a regional Health Impact Analysis to determine the health-related impacts of expanding public transportation in the UVLSRPC region.
• Coordinate with municipalities to ensure that the spectrum of long-term-care support services, including accessible transportation that will help the population age-in-place is considered in local Master Plans.

UVLSRPC Regional Plan 2015

Chapter 4

Economic Development

TABLE OF CONTENTS

4.1 INTRODUCTION

What is economic development and why does it matter to our region? Economic development generally refers to efforts that either increase or maintain a preferred standard of living within communities. Policy changes, educational opportunities, and investment in public infrastructure are often supported to promote opportunities for individuals to raise their income and/or employment opportunities. It is important to understand how the Upper Valley Lake Sunapee region compares to other areas of the country and the State of New Hampshire in order to be competitive in attracting a talented workforce and ensuring business ventures are successful. The following information is intended to provide an overview of the regional economic picture and outline strategies for enhancing the future development of the region's economy.

Vision

The region will maintain a resilient economy with new employment opportunities, building upon existing strengths in the health care, manufacturing, tourism, and creative sectors. All residents and businesses in the region will have access to viable and effective vocational education opportunities to retain and attract a talented workforce. The region's downtown areas will be prosperous and economically vibrant, anchored by strong locally-owned businesses and access to local agriculture.

4.2 DEMOGRAPHIC TRENDS AFFECTING OUR ECONOMY

Historic Population Growth

The 2010 U.S. Census reports the State of New Hampshire's population as 1,316,470. The Upper Valley Lake Sunapee (UVLSRPC) region population was reported as 89,552, comprising 6.8% of the state's population. Between 2000 and 2010, the region's population increased by 6,094 persons. Population change is driven both by natural increase (excess of births over deaths in the resident population) and by people moving in from outside the region, or in-migration. The 45-54 and 55-64 year old age groups show the most increase over the past 20 years, reflecting the maturation of the Baby Boom population. While 13.8% of the region's population was age 65 or older in 1990, the proportion in 2010 was 16.4%. This percentage will continue to rise over the next 20 years, with persons 65 or older reaching an estimated 34% of the region's total population by 2030.

With the exception of a slight dip in population between 1850 and 1890; the Upper Valley Lake Sunapee Region's population has steadily increased since the first U.S. Census was conducted in 1790. However, a different pattern emerges when historic population growth in the region's four most populous communities- Claremont, Hanover, Lebanon, and Newport- is analyzed separately from the more rural communities in the region. In rural communities, there was a consistent population decrease between 1840 and 1930, a period of almost 100 years (see Figure 4.2.1). In the region's four largest communities, where infrastructure could accommodate growth, there was a consistent increase in population even during the period when the rest of the region saw mass migration of farmers moving to the Midwest in the late 1800's (see Figure 4.2.2).

Figure 4.2.1- Historic Population Changes in UVLSRPC Rural Communities

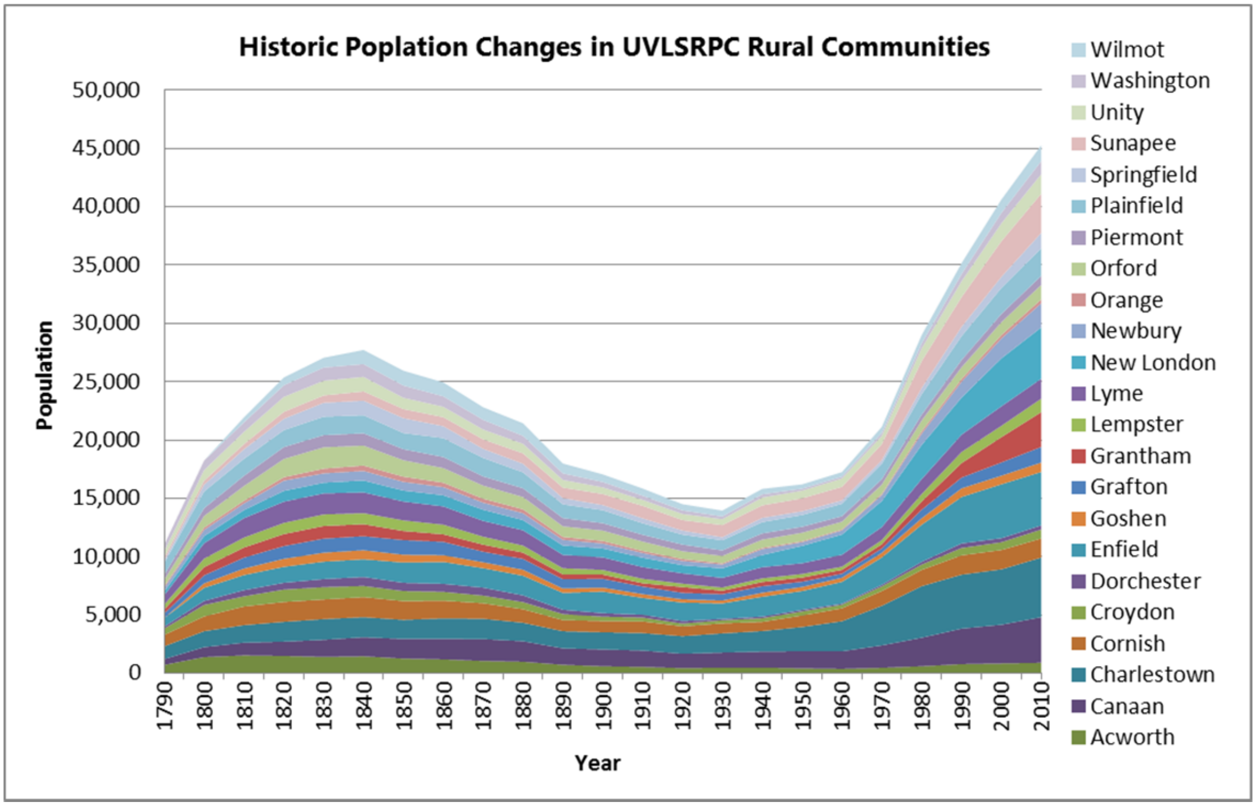
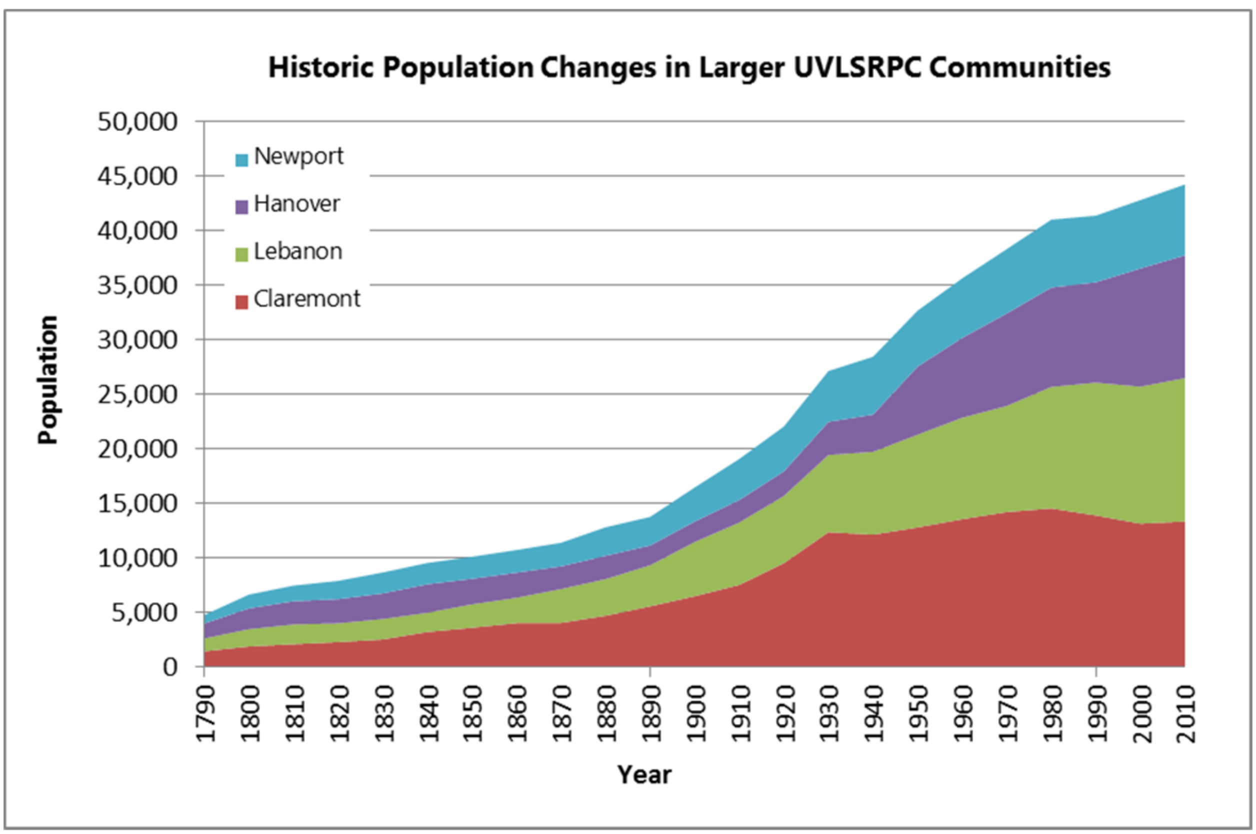


Figure 4.2.2- Historic Population Changes in Larger UVLSRPC Communities



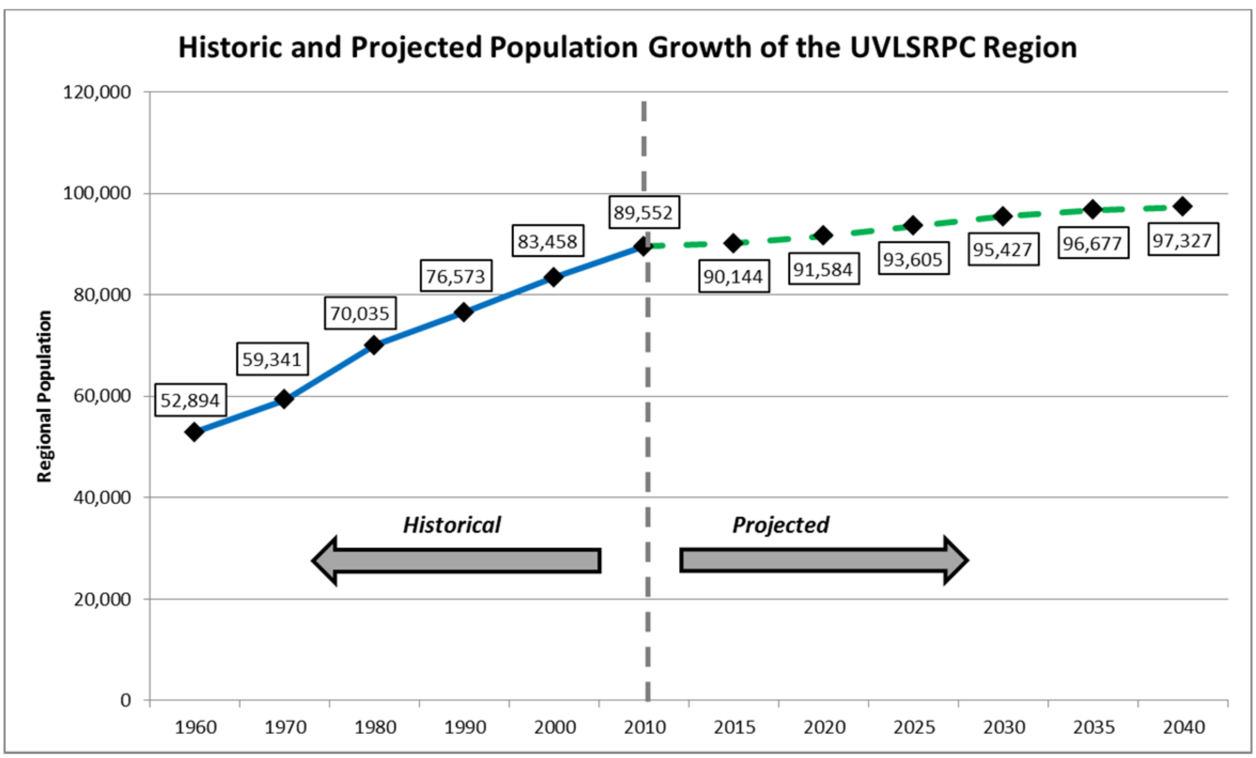
The ebbs and flows of population in the region are a result of a number of factors. New Hampshire continues to have one of the lowest birth rates in the nation, and for many decades, natural increase has not been the primary driver of population increases. Historically, New Hampshire's increase in population has come from in-migration, predominantly from Massachusetts. More recently, in-migration has slowed considerably and New Hampshire has even seen some net out-migration in the past few years.[1] Much of the decline in in-migration was a result of the economic recession in 2008. Even if opportunities may be available for people to move, the uncertainty of the economy has proven to keep many people stationary.

Future Population Growth

The population of the Upper Valley Lake Sunapee Region, like the State of New Hampshire as a whole, is projected to grow much more slowly over the next twenty-five years than over the past fifty years. In 2013, the state's nine regional planning commissions pooled funds to commission RLS Demographics, Inc. to develop statewide, county-level, and town-level population projections based on a cohort-component analysis.

Looking just at the 27 communities of the Upper Valley Lake Sunapee Region, the population of the region is projected to grow less than 9% between 2010 and 2040. Figure 4.2.3 below shows historic and projected population growth in the UVLSRPC Region between 1960 and 2040.

Figure 4.2.3- Historic and Projected Population Growth of the UVLSRPC Region



[1] What is NH? NH Center for Public Policy September 2013.

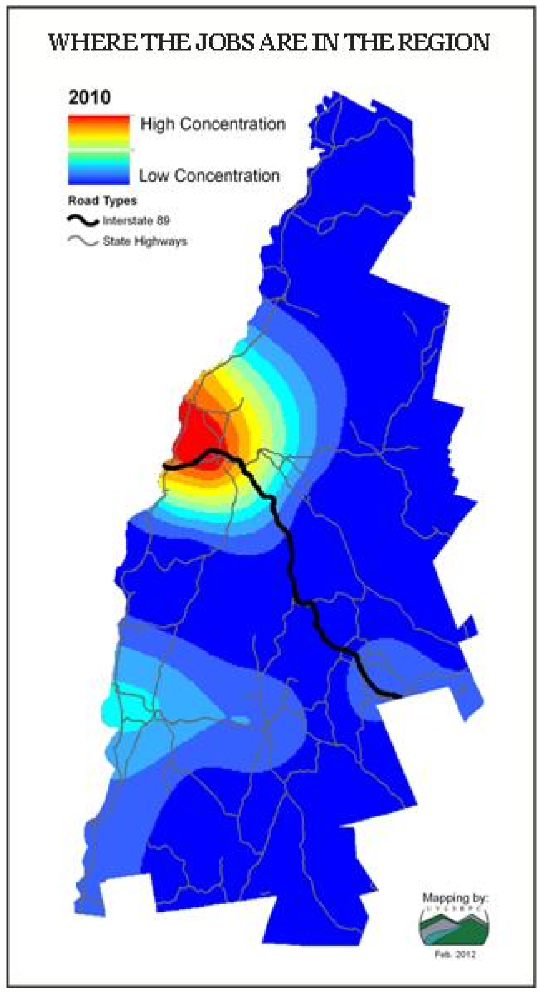
The cohort-component analysis projects that the region will see substantially lower population growth as a result of the aging and natural decline of the Baby Boom population. Every age cohort below 30 in Sullivan County is anticipated to lose population between 2010 and 2020, and between 2020 and 2030. Additionally, Sullivan County may see a slight increase in population of those 30-39 years of age between 2010 and 2020. Contrary to the statewide trends, in Grafton County, the age cohort from 15-19 may see an increase in population between 2020 and 2030. As many rural communities in the region struggle with declining school enrollment, population projections for this age cohort should be updated regularly.

The economy of the region will be greatly influenced by the proportion of working-aged residents to the total population. Worker ages vary throughout the towns in the UVLSRPC region. The region has approximately three percent fewer workers aged 29 and younger, than either New Hampshire or Vermont as a whole. The higher percentage of older workers in the Upper Valley is a reflection of the fact that fewer young workers are in the labor market. At 43.3 years, the median age in the Upper Valley is older than the median age for both New Hampshire and Vermont.[2]

Employment

Job growth in the region was over 20% from 1990 to 2000, but only 3% from 2000 to 2010. The region's long term (20 year) average annual job growth was about 1.2% per year. The most recent projection of regional and employment issued by the New Hampshire Department of Employment Security, forecasts employment growth of 10.2 percent between 2012 and 2022.[3]

While the Educational Services sector in the region is the most concentrated in the state, it is the Healthcare and Social Assistance sector that is projected to grow the most over the next ten years. The Healthcare and Social Assistance sector is projected to add 2,200 jobs between 2012 and 2022 in the region. Additionally, the Construction and Extraction Operations sector in the region is projected to have the highest growth rate in the state during this period at 24.8%. However, this sector has a small employment base in the region and only 65 additional jobs are expected in the sector annually (whereas the Healthcare and Social Assistance sector is expected to add more than 200 jobs in the region annually).



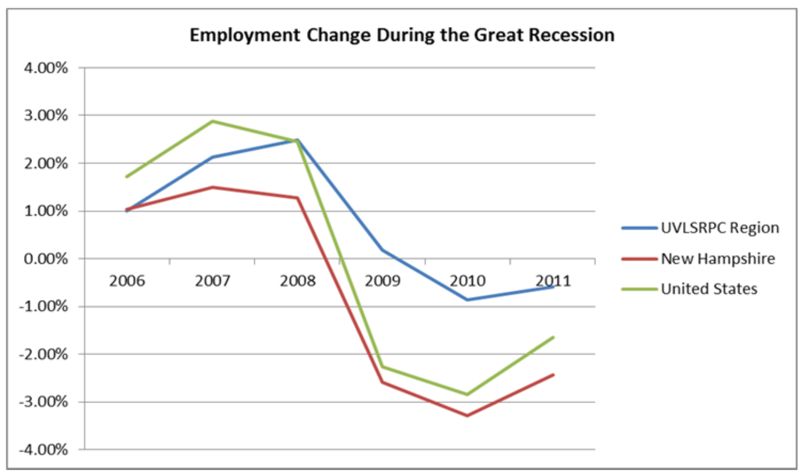
[2] The Upper Valley – On the Map, A profile of the Lebanon NH-VT Micropolitan NECTA, NH Employment Security, ELMI, November 2012.
[3] Planning Regions- Looking Ahead to 2022. NH Employment Security, ELMI.

Approximately 74% of all the businesses found within both the Claremont and Lebanon Micropolitan Statistical Areas (MSA) are small businesses with less than 20 employees. These small businesses make up about 28% of the employment base in the Claremont labor market and 18% in the Lebanon labor market. Larger employers (those over 500 employees) dominate the Lebanon MSA. While making up only 9% of the employer base, large employers generate 53% of the total jobs within the area (SBA 2010)[4]. Relative to the state, the UVLSRPC region has a high concentration of jobs in agriculture, mining, manufacturing, information, and an especially high reliance on the healthcare and social assistance sector. The region also has comparatively low concentrations of federal and state government employment.

Grafton and Sullivan County contain 8% and 3% of New Hampshire's employers, respectively. However, the two counties are home to 22% of the agricultural employers. Grafton County makes up 10% of the state's employment base, as large employers like the Dartmouth-Hitchcock Medical Center and Dartmouth College are located in the County. In 2010, Sullivan County made up 2% of NH's employment base, but 4% of the State's manufacturing base. The Sullivan County Comprehensive Economic Development Strategy (CEDS) reported that, in 2002, manufacturing made up 26% of the employment base of Sullivan County, the highest level of any County in NH. The bulk of this employment continues to be comprised of machinery and fabricated metal production. While the total number of jobs is not large, the potential for these skills to be used in newly emerging businesses should not be overlooked, as a long-term strategy.

Between 2008 and 2010, the region had the first significant net loss in total jobs in 20 years. During this time period, lob losses were experienced around the country as a result of The Great Recession. However, as shown in Figure 4.2.4, the region's reliance on Health Care and Social Assistance employment has provided a means of economic resilience, as demographic shifts (i.e. aging population) continue to drive demand for health care services.

Figure 4.2.4- Employment Change During the Great Recession



The region has benefited significantly from the strong local economy and unemployment rates below state and national averages. Over the past 20 years (1990-2010), the New Hampshire portion of the Lebanon NH-VT NECTA gained 8,695 jobs (principally service industry jobs), while other regional employment centers sustained losses[5]. The City of Lebanon was the center of the region's employment growth over this period. The higher wages prevalent in the Lebanon-Hanover area attract workers from areas of Vermont and New Hampshire outside the Lebanon NH-VT NECTA.

[4] SOURCE: 1989-2010 Business Information Tracking Series.

[5] 2012 Housing Needs Assessment, UVLSRPC

Income and Poverty

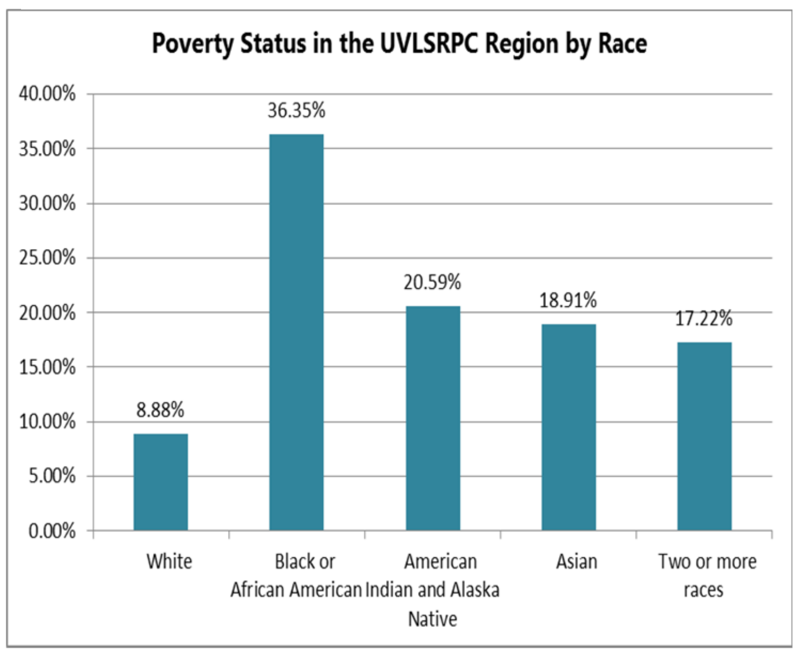
Average wage levels in the UVLSRPC region in most major sectors exceed that of New Hampshire state averages. The average wage paid by industries of the UVLSRPC region in 2010 was $959 per week, or an equivalent annual wage of $49,868. At a 30% housing cost ratio, this income supports a $1,250 per month housing cost budget, which is more than sufficient to support the median gross rent in the area but not sufficient to afford a median priced home without a second household member who works.

The region, like all of New Hampshire, has maintained low poverty rates in comparison to the rest of the country. In 2012, the percent of people living below the poverty line in New Hampshire was 10%, whereas 15.9% of people were living below the poverty line nationwide. While poverty rates are currently lower in New Hampshire than the rest of the nation, they are growing at a faster rate. There was a 30% increase in the percent of people with income below the poverty line nationwide between 2000 and 2012, but there was an 89% increase in New Hampshire during that same time period. This may indicate a loss in economic competitiveness for the state of New Hampshire.

According to the American Community Survey[6] five-year estimates for 2006 through 2010, approximately 9.4% of the UVLSRPC region's population lives below the poverty line. In Sullivan and Grafton County, single-parent households with children under 18 years of age have poverty rates of 48.5% and 30.2% respectively. In Sullivan County this is almost half of the estimated 1,200 single-parent families with children under 18 living in poverty.

Inequality is a weakness that undermines regional economic performance. Disparity in income data according to race or gender can signal underlying social problems that limit the productivity potential of a region's entire workforce.[7] The disparity of poverty within our region is large. While Black or African Americans make up only 2.6 % of the population, more than 36% of that population lives below the poverty line. Other races within the region also have higher levels of poverty than those that reported their race as white. Figure 4.2.5 demonstrates that, while the number of minorities in the region is low, the percent of minorities living below the poverty line is much higher within those populations than for white populations.

Figure 4.2.5- Poverty Status in the UVLSRPC Region by Race



Note: Since the 2010 U.S. Census, Hispanic or Latino ethnicity has not been considered a race.

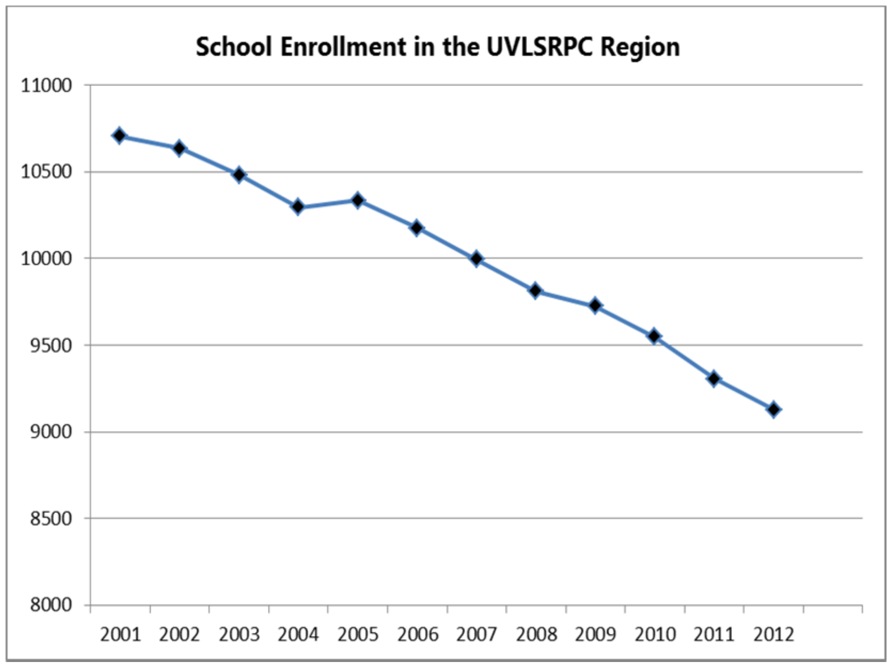
[6] American Community Survey uses a 5 year average.
[7] October 2005 Council on Competiveness, Measuring Regional Innovation

Schools and Education

One of the most consistent topics that came up at UVLSRPC regional plan outreach events during the summer of 2012 was education. It is clearly valued within the region and many people have personal connections, whether through employment or their children, grandchildren or neighbors, to the local school. The schools are seen as public investments and centers that unite the community.

The UVLSRPC region is home to 15 School Administrative Units (SAU), five of which are single municipalities. Unique to this region, there are two interstate SAUs with Vermont communities. The two largest SAUs in the region, Mascoma Valley and Kearsarge, have clearly established regional identities.

Figure 4.2.6- School Enrollment in the Region (2001-2012)



School populations have declined throughout the state and the region in recent years. In New Hampshire, there was an overall decline in school enrollment between 2001 and 2012 of 8%. However, during that same time period the UVLSRPC region saw more than a 15% decline. While overall enrollment numbers have declined, each community in the region faces its own unique situation. The Town of Lyme, for example, saw an enrollment increase of more than 20% for the same time period. Each community will need to assess their individual situation when determining the future of school-related public investments and policymaking.

In research completed by the NH Center for Public Policy in 2013[8] it was reported that, "while minorities represented only 4.9 percent of New Hampshire's population in 2000, they produced 50 percent of the population gain between 2000 and 2010. Minorities make up a small percentage of the school age population within the region, but the trends demonstrating a change in this are significant. Between 2002 and 2012, there was a 51% increase in the percentage of minorities enrolled in New Hampshire's public school system. In the UVLSRPC region during this same time period, there was a 57% increase in the percentage of minorities enrolled in local schools. Consistent with the NH Center for Public Policy study, the largest percent of minorities seem to be in those schools that are seeing an increase in enrollment. Lyme has the highest percent (16.75%) of minority students in the region. Minority enrollment is predominately Asian and Hispanic. The region lost enrollment between 2002 and 2012 among black and Native American populations.

[8] Health and Equity in New Hampshire 2013 Report Card, NH Center for Public Policy, January 2013

The results of the fall 2013 New England Common Assessment Program (NECAP) for grades three through eight and high school students in New Hampshire demonstrated 77 percent of students tested were proficient or above proficient in reading, compared to 79 percent the year before. In math, 65 percent of students were proficient or above proficient compared to 68 percent the year prior.[9] However, these percentages have increased by almost 10% over the past ten years.

STEM (science, technology, engineering, and math) education continues to be a high priority within the region's schools, and the school districts within the region have varying degrees of test proficiencies in STEM disciplines. In the statewide (May 2011) Elementary and Middle School District rankings for improvement in testing, Washington (3), Lyme (10) and Newport (14) ranked in the top 15 in mathematics. Cornish (1), Washington (6) and Sunapee (9) ranked in the top 10 in science. At the High School level, rankings on improvement included Mascoma Valley (8), Fall Mountain (12) and Claremont (14) in science. Three district High Schools in the region (Lebanon, Kearsarge, and Dresden) were ranked higher than the state average in math assessments. Five district High Schools in the region (Dresden, Sunapee, Fall Mountain, Lebanon, and Newport) were ranked higher than the state average in science assessments.

Workforce Development

As evidenced by the public outreach conducted during the drafting of this plan (see Chapter 1), residents of the region want to continue to develop targeted workforce and vocational training opportunities.

Lebanon College closed in 2014, underscoring the need for workforce development to be better tied with employer needs.

In a January 2015 speech, New York Governor Andrew Cuomo noted that "There is no generic skills package anymore" during a discussion of the community college system. Thus, it is imperative that vocational training be linked to realistic job opportunities at large regional employers like Sturm Ruger, Hypertherm, and Timken. The closure of Lebanon College in 2014 further underscored this need.

River Valley Community College (RVCC) has adapted well to this new reality, and now offers targeted programs in Advanced Manufacturing, Sales, Project Management, and Computer applications. The Commission should advocate for the continued expansion of River Valley Community College's targeted workforce development programs, and support the adaptive re-use of the former Lebanon College facility for new or expanded workforce development programs.

[9] NH Department of Education http://www.education.nh.gov

4.3 ECONOMIC CHALLENGES IN THE REGION

Home Affordability

While Chapter 2 of this plan discusses home affordability in detail, economic conditions and regional employment opportunities relate directly to regional housing availability, choice, diversity, and affordability. Levels of "housing need" often refer to a housing cost burden level (percentage of income devoted to gross monthly housing costs). Below is a summary of the estimated regional levels of housing cost burden based on 2010 housing costs and household income levels.

High Housing Cost Burden (at least 30% of income is used for housing): There are an estimated 12,897 households (36% of all households in the region) that have a high housing cost burden. The most significant cost burden ratios exist for homeowner households with incomes under $50,000 and renter households with annual incomes under $35,000.

Very High Housing Cost Burden (at least 40% of income is used for housing): There are 7,659 households that have a very high cost burden (21% overall, 18% of owner households and 28% of renter households).

Severe Housing Cost Burden (at least 50% of income is used for housing): There are 5,085 households (14% overall, 13% of homeowner households and 17% of renter households) that have a severe cost burden.

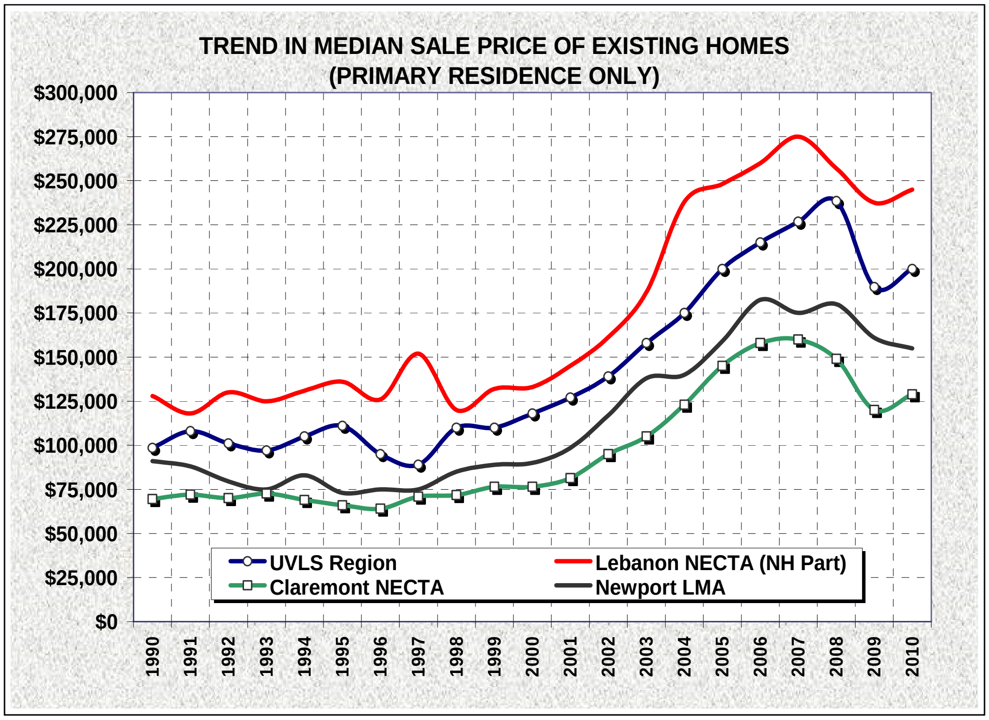
- Housing cost burden data for homeowners in the Lebanon NH-VT NECTA (including 12 Vermont communities) is about the same as the UVLSRPC regional average. However, renter households living in the NECTA have proportionately higher rental costs relative to their income.
- Overall, 42% of all renters and 33% of all homeowners in the UVLSRPC region spend 30% or more of their gross income on monthly housing costs. The highest prevalence of high housing cost burden is found among the youngest households.
- There are few homeowners in the under-25 age group, but 70% of those that do own a home have a high housing cost burden.

Rental housing in the region is particularly difficult to afford among households less than 35 years of age. In that age group, 46% have a high housing cost burden.

As mentioned in Section 4.2 above, the average wage paid by industries in the UVLSRPC region in 2010 was $959 per week, or an equivalent annual wage of $49,868. At a 30% housing cost ratio (the % of wages used for housing), this income supports a $1,250 per month housing budget. This income level could support the median gross rent in the area but would be insufficient to afford a median priced home without a second household income.

Affordability problems occur more frequently among those who are in lower wage sectors or in entry-level positions. Average entry-level wages in some of the largest occupational sectors range from about $9 to $20 per hour. At $11.50 per hour, a single wage earner could afford a monthly rent of $624 per month. Market-rate rents at this level are generally unavailable in the region.

As the number of jobs in the region continues to grow there will be more demand on the housing market to support the labor force. At the same time, the demographics show a decline in the labor force under 65 years of age. This may make it increasingly difficult for employers to fill their needs. Increasing the availability of affordable housing, particularly rental units, may make it easier to attract the workforce needed in the future.



Source: UVLSRPC Housing Needs Assessment

Brownfields

The U.S. Environmental Protection Agency defines a brownfields as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.” Brownfields are often, but not always, former industrial or commercial properties.

According to New Hampshire Department of Environmental Services (NHDES) data shown in the table below, the UVLSRPC Region is home to more than 1,100 identified remedial sites. Within the region, Claremont, Hanover, Lebanon, and Newport are home to higher concentrations of brownfields sites. These sites include those that were known to be contaminated, or have the potential to be contaminated based on the past or present use of the site. Every community in the Upper Valley Lake Sunapee region is home to at least one NHDES-designated remedial site.

The presence of brownfield sites hinders the redevelopment potential of the region's former industrial centers, and correlates to public health, welfare, and economic impacts in the region's communities.

Currently, there is no coordinated brownfields assessment program in the region to assist communities and landowners in evaluating site-specific contamination and planning for the reuse of brownfields sites.

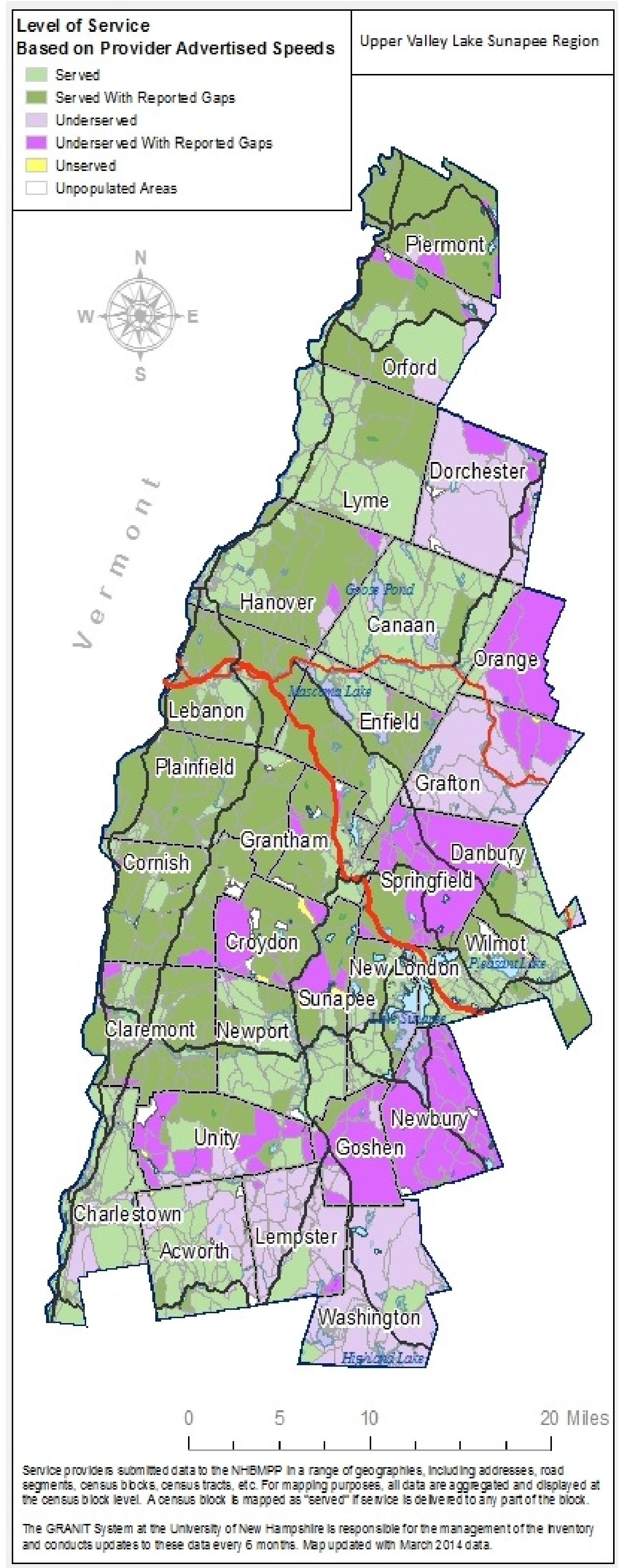
The UVLSRPC should apply for U.S. Environmental Protection Agency Brownfields Assessment funding that would accomplish the following:

- Establish a regional Brownfields Advisory Committee to identify, solicit, and prioritize brownfields sites for assessment;
- Conduct community outreach to landowners and the general public in municipalities affected by the presence of brownfields;
- Conduct Phase I and Phase II environmental assessment work that leads to the development of site-specific reuse plans.

The establishment and success of a regional brownfields assessment program will rely on strong partnerships with the U.S. Environmental Protection Agency, New Hampshire Department of Environmental Services, municipalities, chambers of commerce, local economic development councils, environmental advocacy groups, and landowners.

Community	Number of Remedial Sites
Acworth	5
Canaan	42
Charlestown	50
Claremont	156
Cornish	19
Croydon	6
Dorchester	5
Enfield	63
Goshen	10
Grafton	18
Grantham	28
Hanover	108
Lebanon	192
Lempster	22
Lyme	26
New London	61
Newbury	32
Newport	100
Orange	2
Orford	14
Piermont	9
Plainfield	36
Springfield	25
Sunapee	57
Unity	18
Washington	6
Wilmot	13
Total Region	**1,123**

Lack of Broadband Communication Infrastructure



While Chapter 7 of this plan discusses regional broadband availability in detail, the importance of broadband for the region's economic development cannot be understated.

As part of the New Hampshire Broadband Mapping and Planning Program broadband needs by economic sector were determined through telephone surveys, public forums, and sector-specific interviews.

Three major themes cross-cut all economic sectors and are evidence of how quickly "online business" has become mainstream and is transforming how business is conducted:

- *Telework/Tele-education:* Employees are increasingly working beyond the four walls of their employers' headquarters, e.g. at home, satellite locations, and travelling for business locally and globally. Both employers and employees face challenges to achieving a connected workforce because there is limited high-capacity broadband service in residential and rural neighborhoods. Educational institutions also seek tele-education opportunities, either online learning as a supplement to the classroom or curricula delivered fully online.

- *Doing More Business Online:* All businesses and organizations interviewed reported that they have a growing dependence on online interaction with external companies or organizations. It is essential to have sufficient broadband service to conduct online business with suppliers, customers, accounting/billing services, electronic medical records firms, off-site IT/security back-ups and partnering organizations, such as Inter-Library Loan, Code Red reverse 911 system and state agencies.

- *Online Training and Professional Development:* Access to training and professional development online, including keeping up to date with training on ever-changing technology is imperative. There is a particular need for training in sectors that rely on volunteers, such as local government, social services and public safety.

The Upper Valley Lake Sunapee Regional Planning Commission, advised by a group of broadband stakeholders representing multiple interests from 19 communities in the region, developed a Regional Broadband Plan to better understand current broadband (or high-speed Internet service) availability in the region, to identify the challenges and barriers to universal access, and to plan for increased broadband adoption and utilization over the next six years.

This plan establishes four performance-based goals to achieve the regional vision of "fast, reliable and affordable broadband service through a competitive marketplace throughout all parts of the Upper Valley Lake Sunapee Region" and "a future with rural regions having the opportunity to access broadband services equal to that in metropolitan areas."

The regional broadband plan is intended to serve as a comprehensive document that describes broadband availability in the Upper Valley Lake Sunapee region and identifies ways to increase broadband adoption and utilization. The plan serves as a guidance document for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for and utility of broadband now and into the future.

Looking ahead to future needs, the Federal Communications Commission's National Broadband Plan calls for gigabit service (1 Gbps or higher down/up) to all community anchor institutions by 2020. Currently, this speed is only available in a few locations in the region – one census block in Hanover, three census blocks in Claremont, four census blocks in Washington and eleven census blocks in Lebanon. Again, the southeastern and northeastern parts of the region, as well as parts of Croydon and Grantham, have the lowest speeds of broadband available.

2020 Broadband Goals for our Region

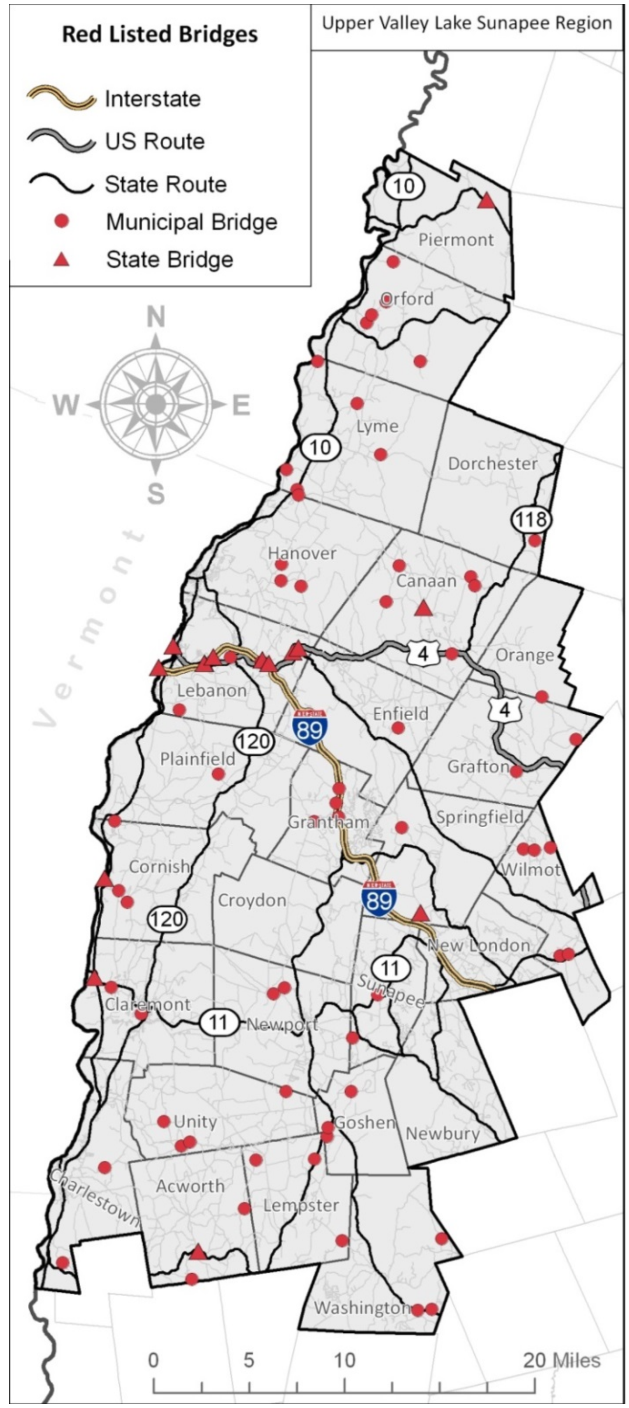
1. Provide affordable broadband service that would support telework and tele-education (20 Mbps download, 10 Mbps upload) in all areas of the region.

2. Build "Gigabit Communities" – expand "big broadband" (1 Gbps download, 1 Gbps upload) to all community anchor institutions and city/town centers, with extensions to residential and outlying areas.

3. Encourage marketplace entry of competitive, innovative service providers.

4. Work towards parity in broadband service availability across the rural areas of our region, the downtowns and village centers of our region, and metropolitan areas in the Northeast.

Deteriorating Transportation Infrastructure



The flow of goods and people over well-maintained transportation infrastructure is fundamental to any economy. As Chapter 3 of this plan details, the UVLSRPC Region faces acute transportation infrastructure deficiencies.

The region's 27 communities are home to 80 "red listed" (i.e. structurally deficient) bridges, and nearly 50% of the region's state highway network is in poor pavement condition. Recent closures of the U.S. Route 4 Bridge over the Connecticut River in Lebanon and the Shaker Bridge over Mascoma Lake in Enfield highlight the economic importance of our region's transportation infrastructure.

Transportation infrastructure funding at the state and federal level has remained essentially stagnant over the past decade while the costs of infrastructure components like liquid asphalt have increased exponentially over the same time period. Without a substantial change in this funding structure, the region's transportation infrastructure will continue to deteriorate and act as a headwind to our economy.

In addition to road and bridge infrastructure needs, improved rail connectivity is needed to line the region to Boston and other large markets on the eastern seaboard. Similarly, maintaining infrastructure at the region's three airports (Lebanon Municipal, Claremont Municipal, and Parlin Field in Newport) is essential to maintaining the passenger air and general aviation operations that form an important part of our economy.

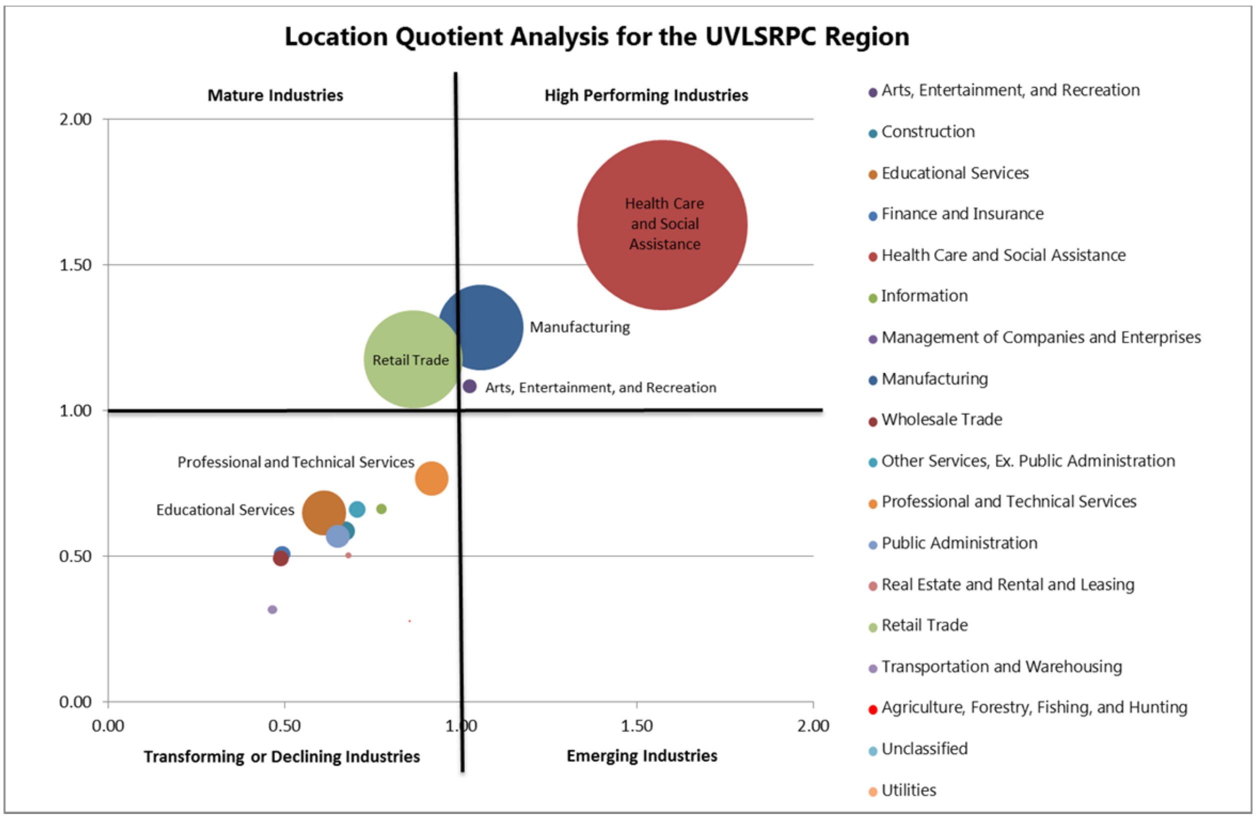
The region's major employers increasingly benefit from and rely on the public transportation services provided by Advance Transit and Community Alliance Transportation Services. These agencies are providing more than 600,000 rides annually in our region. It is important that the region's transit fleet be considered an essential component of our transportation infrastructure. Compared to the statewide average, our region's public transportation fleet is aging (37.8% of remaining useful life) and in need of substantial new investment.

5.4 ECONOMIC STRENGTHS IN THE REGION

Location Quotient Analysis

A location quotient is a measure of an industry's concentration in an area relative to the rest of the state or nation. It compares an industry's share of local employment with its share of state or national employment. Although determining a location quotient requires several assumptions, including uniform local consumption patterns and labor productivity across the country, it is a useful tool in determining a region's key industries.

Figure 5.4.1- Location Quotient Analysis for the UVLSRPC Region



A location quotient greater than one indicates that the industry is producing more goods and services than are used locally. The X axis provides a comparison of the relative concentration of an industry in the region versus the national concentration of that industry. The Y axis shows the relative concentration of an industry in the region versus the statewide concentration of that industry. The size of the circle on the chart indicates the relative size of the industry. Each quadrant in a location quotient chart tells a different story, as detailed below:

Upper Right-Hand Quadrant: Industries in this quadrant are fundamental to the regional economy and are steadily growing. Large industries in this quadrant will increase workforce demand, while small industries are emerging high exporters and should be developed.

Lower Right-Hand Quadrant: Industries in this quadrant are growing, but are less concentrated than the statewide average. If trends continue, their Location Quotient will eventually be in the upper right-hand quadrant.

Upper Left-Hand Quadrant: Industries in this quadrant are more concentrated regionally than nationally, but are mature and declining regionally. If a large industry is in this quadrant, the region may lose a substantial portion of its export base.

Lower Left-Hand Quadrant: Industries in this quadrant are less competitive nationally and statewide, and are declining or transforming.

The location quotient analysis indicates the following about the region's economy:

- The Health Care and Social Assistance sector forms the foundation of the region's economy, and provides the region with a statewide and national competitive advantage. The presence of the Dartmouth-Hitchcock Medical Center and related medical research and development companies has also spurred innovation in this sector. Between 2001 and 2014, the UVLSRPC region produced more than 16% of the patents filed in New Hampshire, with many of those patent applications emerging from the Health Care sector.

- The Manufacturing sector remains the third most important sector in the region's economy. However, additional business development is needed in this sector to ensure that it remains a high-performing industry in the future. Looking specifically at Sullivan County, the Manufacturing sector is the largest and most high-performing industry in the county.

- The Arts, Entertainment, and Recreation Sector has emerged as an industry that provides the region with a statewide and national competitive advantage. However, this industry is still small in the region, and additional business development is needed in this sector.

- The Retail Trade sector remains concentrated in the region, but is weakening. A renewed focus should be placed on the development of this sector to minimize future job losses. Looking specifically at Sullivan County, the Retail Trade sector is the second largest and second most high-performing sector in the county.

- The Educational Services sector, while the fourth largest employment sector in the region, is located in the lower left-hand quadrant, indicating that the sector is declining or transforming.

While more than 20% of the New Hampshire's Agriculture and Forestry sector employers are located in Grafton and Sullivan County, the location quotient analysis demonstrates that this sector does not yet provide the region with a statewide or national competitive advantage. If the Agriculture and Forestry sector is to be included as part of the region's economic development strategy, there would need to be changes that have local impacts via job creation or the development of value-added agricultural product industries.

Shift-Share Analysis

Shift-Share Analysis can provide economic development leaders in the region with basic information on the growth of industries and the local economic base compared to larger economies. It demonstrates which industries are most competitive locally, meaning that they are likely exporters and could bring wealth and investment into the local economy. It will also reveal which industries might require assistance to sustain their performance if they are valued by the region. The employment data presented in this analysis were obtained from the U.S. Bureau of Labor Statistics' (BLS) Census of Employment and Wages.

The number of jobs in an area is a primary indicator of local economic health and vitality. Between 1990 and 2012, employment in Grafton and Sullivan Counties averaged 61,552, with a high of 66,700 in 2008 and a low of 52,059 in 1991.

Figure 5.4.2- Employment Changes in Grafton and Sullivan Counties (2002-2012)

Sector	Employment (2002)	Employment (2012)	Employment Change	Percent Growth (2002-2012)
Education and Health Services	19,952	22,879	2,927	14.7
Trade, Transportation, and Utilities	12,000	12,151	151	1.3
Manufacturing	9,458	8,065	-1,393	-14.7
Leisure and Hospitality	6,835	7,270	435	6.4
Professional and Business Services	3,300	4,556	1,256	38.1
Public Administration	2,641	2,081	-560	-21.2
Construction	2,304	1,911	-393	-17.1
Financial Activities	2,102	1,899	-203	-9.7
Other Services	1,644	1,540	-104	-6.3
Information	1,244	765	-479	-38.5
Natural Resources and Mining	453	421	-32	-7.1
	61,933	63,538	1,605	

Figure 5.4.2 shows sector-level employment statistics for the region's 11 largest industries. The sectors are ordered according to how many people they employed in 2012. During the period from 2002 to 2012, employment in Sullivan and Grafton Counties increased by 1,605 jobs. In terms of employment growth, the most important industry was Education and Health Services (2,927 jobs) followed by Professional and Business Services (1,256 jobs), and Leisure and Hospitality (435 jobs). Manufacturing employment declined by 1,393 jobs, which is partially the result of plant closings (e.g. Customized Structures in Claremont in 2008).

Figure 5.4.3- Shift-Share Analysis for Grafton and Sullivan Counties (2002-2012)

Sector	National Growth Component (Percent)	National Growth Component (Jobs)	Industrial Mix Component (Percent)	Industrial Mix Component (Jobs)	Competitive Share Component (Percent)	Competitive Share Component (Jobs)
Professional and Business Services	2.7	90	9.3	306	26.0	859
Manufacturing	2.7	258	-24.4	-2,310	7.0	659
Trade, Transportation, and Utilities	2.7	328	-3.5	-420	2.0	244
Construction	2.7	63	-19.0	-438	-0.8	-18
Natural Resources and Mining	2.7	12	16.7	76	-26.5	-120
Financial Activities	2.7	57	-5.4	-113	-7.0	-148
Other Services	2.7	45	3.9	64	-13.0	-213
Information	2.7	34	-22.4	-278	-18.9	-235
Education and Health Services	2.7	545	14.5	2,883	-2.5	-501
Leisure and Hospitality	2.7	187	11.9	816	-8.3	-567
Public Administration	2.7	72	-0.9	-22	-23.1	-610
		1,691		564		-650

The purpose of a shift-share analysis is to evaluate the change in employment for an area through the consideration of the three components of employment change: 1) The National Growth Component; 2) The Industrial Mix Component; and 3) the Competitive Share Component.

The National Growth Component

The National Growth Component is the growth or contraction in the United States economy over a given time period. From 2002 to 2012, the nation's employment grew by 2.7 percent (i.e., America's employment in 2002 and 2012 was 128.2 million and 131.7 million, respectively. The effect of the national growth component is felt most acutely during the peaks and valleys of the business cycle, (i.e. during recessions and boom times). For instance, the largest employment sector in Grafton and Sullivan Counties is the Education and Health Services sector. The 2.7 percent national growth component led to this sector's employment growing by 545 jobs (i.e., 2.7 percent times the sector's base employment, 19,952, equals 545 jobs). Overall, the national growth component was responsible for a total of 1,691 jobs in Grafton and Sullivan Counties during this time period.

The Industrial Mix Component

The Industrial Mix Component is determined by calculating the growth rate for an economic sector at the regional level and subtracting from it the national growth component. Thus, the Industrial Mix Component measures how well an industry has grown, net of effects from the business cycle. The highest industrial mix component was 16.7 percent in the Natural Resources and Mining sector, and it was responsible for 76 jobs in Grafton and Sullivan Counties. If the counties' employment were concentrated in sectors with higher industrial mix components, then the area could expect more employment growth. In total, the Industrial Mix Component was responsible for increasing employment in Grafton and Sullivan Counties by 564 jobs between 2002 and 2012. The majority of these jobs can be attributed to growth in the Education and Health Services sector. Shift-share analysis does not explain why an economic sector has slower or faster growth. Rather, the local leaders must use knowledge about the local business conditions facing particular industries to understand these dynamics.

For instance, the region's growth in the Education and Health Services sector is largely attributable to the presence of the Dartmouth Hitchcock Medical Center (DHMC) which employs more than 7,000 people in the City of Lebanon. DHMC's position as a national leader in medical research and cancer treatment has led to allied industries (e.g. medical R&D and pharmaceutical companies) wanting the synergy of locating as close to the medical center as possible. This has resulted in substantial non-residential development pressure in the City of Lebanon, as shown in Figure 5.4.4 below.

Figure 5.4.4- Non-Residential Development Permitted in the City of Lebanon

Non-Residential Development Permitted (Not Yet Built) in the City of Lebanon	
Development Name	**Square Footage (SF)**
Iron Horse Park	667,200 SF
River Park	714,020 SF
Altaria Industrial Planned Unit Development	217,970 SF
Altaria Business Park	240,000 SF
ICV Holdings Phase II	56,364 SF
DHMC- Williamson Center Expansion	162,000 SF
Chaloux Hotel and Conference Center	96,306 SF
TOTAL	**2,153,860 SF**

The Competitive Share Component

The third component of shift-share analysis is called the Competitive Share Component. It is the remaining employment change that is left over after accounting for the national and industrial mix components. If a sector's competitive share is positive, then the sector has a local advantage in promoting employment growth. The top three sectors in competitive share were Professional and Business Services, Manufacturing, and the Trade, Transportation, and Utilities sector. Across all sectors, the Competitive Share Component totals -650 jobs between 2002 and 2012 in Grafton and Sullivan Counties. This indicates that Grafton and Sullivan Counties were not competitive in securing additional employment between 2002 and 2012 through local advantages.

The information above provides an overview of both Sullivan and Grafton Counties between 2002 and 2012. Assessing each county individually between 2010 and 2012, Sullivan County appears to have a competitive edge driven by a local productive advantage. Sullivan County was the only county in New Hampshire to gain total employment between 2010 and 2012 due to competitive share, with an increase of 503 jobs during this period. This represents a 4% increase in Sullivan County's employment. During that same time period Grafton County had a 1% increase in employment and the state of New Hampshire had a 2% increase in employment. Shift-share analysis indicates that, of the 4% increase in employment in Sullivan County, 25% of that increase was derived from a local competitive advantage. At both the state level and within all other counties in NH there was a negative contribution from competitive share to the total employment.

5.5 ECONOMIC SCENARIO ANALYSIS

As a component of the UVLSRPC Regional Plan, the New Hampshire Employment Security's (NHES) Economic and Labor Market Information Bureau analyzed two separate economic impact scenarios in coordination with Commission staff. The impact analysis was conducted using the Economic and Labor Market Information Bureau's New Hampshire Econometric Model, which is a REMI Policy Insight® Model. The following information summarizes the findings of this study, while the full report detailing these economic scenario analyses can be found in Appendix A of this chapter.

The UVLSRPC would like to acknowledge the contributions of NHES staff members Katrina Evans, Annette Nielsen, and Elisabeth Richardson, who were instrumental in developing these analyses.

To understand the employment impacts of these scenarios, the following terms are defined:

- Direct Jobs- Jobs that have been entered or removed from the regional economy in the REMI model.
- Indirect Jobs- Jobs that are created from the "ripple effect" of the direct jobs from inter-industry purchases (i.e. business-to-business services).
- Induced Jobs- Jobs created from an increase in consumer spending and from population increase.

Indirect and Induced jobs are collectively referred to as "secondary jobs."

Scenario #1: The Economic Impact of a Large Manufacturer in Sullivan County

Scenario #1 considers the economic value of a large manufacturer located in Sullivan County, Sturm, Ruger and Co., which is located in the Town of Newport. The scenario evaluates the economic impact of the estimated 823 manufacturing jobs supported by Sturm, Ruger and Co. The following results are based on the REMI Policy Insight® Model analysis developed by staff at New Hampshire Employment Security's Economic and Labor Market Information Bureau.

Employment Impacts

- In 2014, the total impact on Sullivan County of 823 manufacturing jobs would be 1,380 direct, indirect, and induced jobs. Over the simulation period of 2014 to 2035, the total average employment impact on the county is estimated to be 1,460 jobs.
- In 2014, the distribution of secondary jobs impacted would be spread across 12 employment sectors. The largest secondary job impacts would be in the State and Local Government (202 jobs), Construction (94 jobs), and Retail Trade (68 jobs) sectors.

Gross Domestic Product

- In 2014, the total value of the 823 manufacturing jobs to the local economy in terms of Gross Domestic Product (GDP) would be $115.2 million (in 2005 dollars). This impact would grow over time. By 2035, GDP in the region would be impacted by $159.1 million (in 2005 dollars).
- The economic activity created by the 823 manufacturing jobs would account for 9.4% of total GDP in Sullivan County in 2014. Over time, as other sectors in the economy recover, the value of these manufacturing jobs is reduced. In 2035, the value of the 823 manufacturing jobs would be reduced to 7.7 percent of Sullivan County's GDP.

Personal Income

- The impact of the 823 jobs on total real personal income would be $54.6 million (in 2005 dollars) in 2014. By 2035, the impact on real personal income would grow to $137.2 million (in 2005 dollars).

Population

- In 2014, 823 manufacturing jobs sustained 424 persons to Sullivan County's population. Over time, the impact of these manufacturing jobs on the county's population increases to about 3,600 persons. This represents 7.1 percent of the projected population baseline for the county.

Job Multiplier

- The multiplier effect on Sullivan County of each manufacturing job in this scenario is between 1.7 and 1.8 jobs annually over the simulation period.

Scenario #2: Development of Claremont Industrial Parks

Scenario #2 considers the economic benefits of the development of the Claremont Industrial District (e.g. Syd Clarke Industrial Park). This scenario assumes that building-out the industrial park between 2014 and 2035 would have construction costs totaling $104 million. The following results are based on the REMI Policy Insight® Model analysis developed by staff at New Hampshire Employment Security's Economic and Labor Market Information Bureau.

Employment Impacts

- By 2035, at the anticipated full implementation of development of the Claremont Industrial District, the total impact on jobs is estimated to be 2,394 direct, indirect, and induced jobs.
- By 2035, the distribution of secondary jobs impacted would be spread across 13 employment sectors. The largest secondary job impacts would be in the Construction (354 jobs), State and Local Government (253 jobs), and Retail Trade (118 jobs) sectors.

Gross Domestic Product

- In 2014, the first year of the expansion of the Claremont Industrial Park, the Gross Domestic Product (GDP) in Sullivan County would increase by $14.0 million (in 2005 dollars). By build-out in 2035, GDP in the region would grow by $221.6 million.
- The economic activity created from the expansion of the Claremont Industrial District would account for 10.7 percent of total GDP in Sullivan County by 2035.

Personal Income

- Total real personal income would increase by $8.1 million (in 2005 dollars) in 2014. By 2015, the increase in real personal income would grow by $172.9 million (in 2005 dollars) above the baseline.

Population

- Sullivan County's population would gain 42 persons above the baseline in 2014. By 2035, the population of Sullivan County would gain close to 3,400 persons above the projected population baseline (a 6.7 percent increase above the forecasted baseline).

Job Multiplier

- The multiplier effect on Sullivan County of each job created in the Claremont Industrial District is between 1.6 and 1.7 jobs annually over the simulation period. The impact of construction costs on the region is excluded.

5.6 REGIONAL ECONOMIC DEVELOPMENT STRATEGIES

Regional Economic Development Strategies
• Reconvene the Sullivan County Comprehensive Economic Development Strategy (CEDS) Committee and develop an updated CEDS for the County through the inclusion of diverse public and private stakeholders.
• Investigate the feasibility of adding Sullivan County to the Northern New Hampshire Economic Development District.
• Engage in CEDS planning in both East Central Vermont and Northern New Hampshire to ensure that both the UVLSRPC region's interests and inter-regional projects are considered.
• Develop a Regional Brownfields Assessment Program.
• Develop specialized regional business incubators focused on value-added products in the *Agriculture* and *Arts, Entertainment, and Recreation* and *Manufacturing* sectors.
• Coordinate with local and statewide partners to implement the recommendations of the UVLSRPC Regional Broadband Plan.
• Complete an inventory of existing providers of workforce training within the UVLSRPC region (and in neighboring communities in Vermont) to identify training gaps.
• Coordinate with local and statewide partners to develop targeted workforce/vocational training opportunities specific to the unique needs of the region's large employers (e.g. Sturm Ruger).
• Ensure that the strategies identified in Chapter 2 (Housing) of this plan to promote and encourage the construction of an affordable housing stock in the region are implemented.
• Develop and maintain a "Regional Dashboard" of key economic indicators to guide the formation of local and regional economic development policies.
• Provide technical assistance to UVLSRPC communities in streamlining local land use permitting processes to ensure that the local regulatory environment is equitable and efficient for all applicants.
• Provide technical assistance to rural UVLSRPC communities wishing to expand their economic base through cottage industries and home-based businesses.
• Ensure that infrastructure programs prioritized at the regional level (e.g. Ten-Year Transportation Improvement Plan) place priority on infrastructure projects at direct growth towards the region's existing village and city centers.
• Promote the tourism economy within the region and provide technical assistance to the Connecticut River Scenic Byway and Lake Sunapee Scenic Byway councils.

APPENDIX A- NHES ECONOMIC SCENARIO ANALYSIS REPORT

Economic Impact of Current and Future Industrial Developments in Sullivan County

prepared by

Economic and Labor Market Information Bureau
New Hampshire Employment Security

for

Upper Valley-Lake Sunapee Regional Planning Commission

Granite State Future

November 2014

Acknowledgments

The following New Hampshire Employment Security staff members were instrumental in producing this publication:

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This report was funded by the Granite State Future – a Housing and Urban Development Sustainable Communities Initiative. The report was created by New Hampshire Employment Security's Economic and Labor Market Information Bureau under contract with the Nashua Regional Planning Commission.

For more information about Granite State Future, go to www.granitestatefuture.org.

The economic impact of current and future industrial developments in Sullivan County

Two separate scenarios were developed for the Upper Valley/Lake Sunapee Regional Commission. The inputs used were provided by Mike McCrory, Senior Planner at the Upper Valley Lake Sunapee Regional Planning Commission, in consultation with Nancy Merrill, Director of Planning & Development for the City of Claremont. With the first scenario, the regional planning commission wanted to assess the economic value of Sturm, Ruger & Co., a large manufacturer, being located within the region. According to the New Hampshire Business Review's 2014 Book of Lists, Sturm, Ruger & Co. was listed with 823 employees at their New Hampshire locations. The planning commission agreed to using this number as a proxy for the company's employment in the region. The second scenario was an attempt at assessing the economic impact on the region from expanding job creation in the Claremont Industrial District. Mike McCrory and Nancy Merrill provided employment by industry data and construction costs for proposed economic development in the Claremont Industrial District over a 22-year period. The employment data for the development of the city's industrial district was translated into the REMI model's NAICS-based industries. [2]

This impact analysis was conducted using the Economic and Labor Market Information Bureau's New Hampshire Econometric Model – a REMI Policy Insight + ® model. [1]

By using this econometric model, we are able to estimate both the number of direct jobs added in Sullivan County as well as the indirect and induced jobs gained in the region.

For each of the scenarios, inputs and assumptions will be described, followed by the anticipated implications that each of the scenario would have on Sullivan County. Each scenario result will include the direct jobs generated at the company location or industrial park, as well as the secondary (in-direct and induced) jobs added in Sullivan County. The results include impacts on the region in terms of added gross domestic product, personal income, and population.

Scenario 1: The economic value of a large manufacturer being located within the region

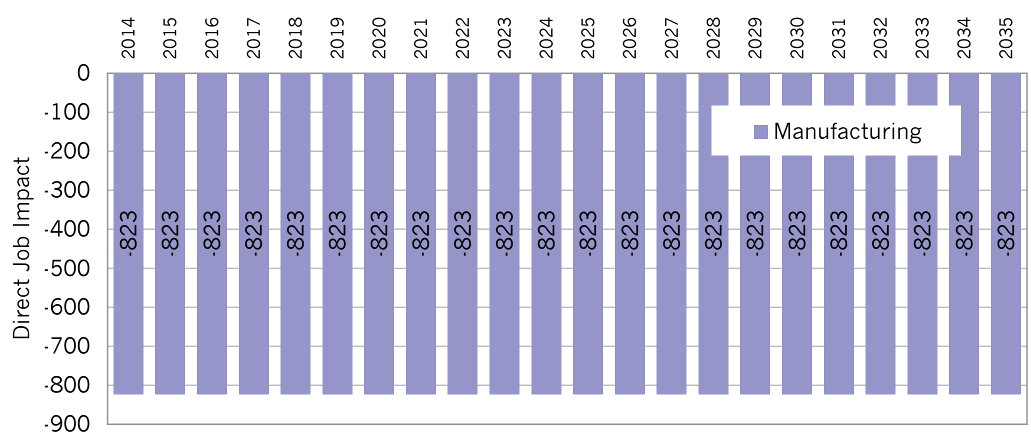
Inputs and assumptions

According to *2014 Book of Lists*, [3] Sturm, Ruger & Co. employed 823 workers in New Hampshire and according to the New Hampshire Community profile, [4] Sturm, Ruger & Co. had 818 employees located

1. Product of Regional Economic Models, Inc. of Amherst, MA.
2. NAICS is the North American Industry Classification System, used to classify business establishments according to type of economic activity (process of production) in Canada, Mexico and the United States. An establishment is typically a single physical location, though administratively distinct operations at a single location may be treated as distinct establishments. Each establishment is classified to an industry according to the primary business activity taking place there.
3. New Hampshire Business Review, 150 Dow Street, Manchester NH. Copyright 2014 McLean Communications.
4. Economic & Labor Market Information Bureau, NH Employment Security, February 2014. Based on a Community Response from the town of Newport that was received on July 11, 2013.

in the town of Newport, a town located in Sullivan County. To evaluate the impact of these manufacturing jobs to the county, 823 manufacturing jobs were removed from the baseline Sullivan County manufacturing employment in the REMI Model. These manufacturing jobs were removed from the REMI model as a constant number over the entire simulation period from 2014 to 2035. The method of removing baseline employment in order to measure the value of a specific job type and/or event is called a counterfactual scenario.

Removal of manufacturing jobs from Sullivan County projected employment baseline to measure the value of these jobs



Scenario Results: Economic value of 823 manufacturing jobs in Sullivan County

The following results are an assessment of the value of these manufacturing jobs. The results include both direct jobs currently located in the region as well as the secondary (indirect and induced) jobs depending on the presence of these 823 manufacturing jobs in Sullivan County. [Despite the current manufacturing jobs being removed from the REMI model baseline employment, the results are expressed in terms of value added to the region.]

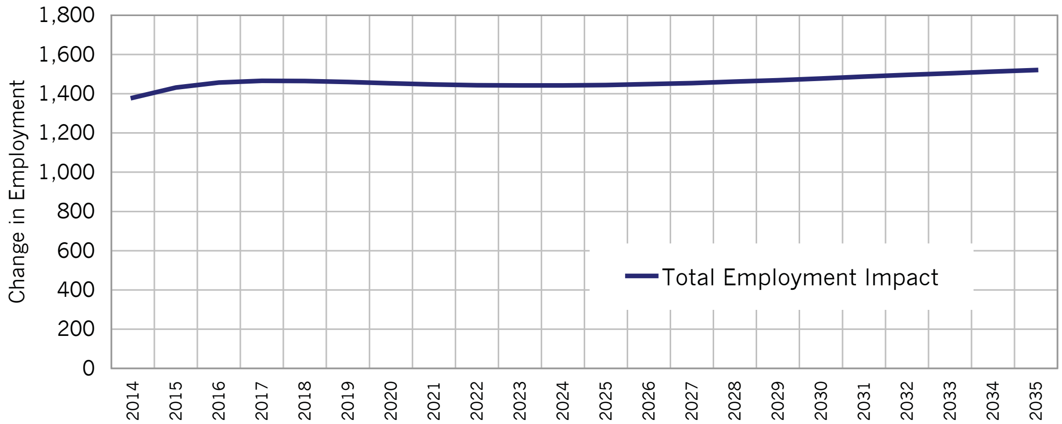
Employment Impacts

- In 2014, total impact on Sullivan County of 823 manufacturing jobs would be 1,380 direct, indirect and induced jobs. [5] On average, over the entire simulation period, total impact on the county is about 1,460 direct, indirect and induced jobs. The REMI model is dynamic in the sense that migration responds to economic opportunities over time. If there are more economic opportunities, in-migration occurs and

5. The direct jobs are jobs that have been entered or removed from the regional economy in the REMI Model. The indirect jobs are those created from the ripple effect of the direct jobs from inter-industry purchases (business-to-business services). The induced jobs are those generated from an increase in consumer spending and from the increase in population. Indirect and induced jobs, combined are also referred to as secondary jobs. Jobs in the REMI model are based on Bureau of Economic Analysis (BEA) definition of employment. The BEA estimates of employment and wages differ from covered employment data because BEA makes adjustments to account for self-employment. So the employment count in the REMI model is larger than what is reported by the Economic and Labor Market Information Bureau (ELMIB), New Hampshire Employment Security. The REMI model does not distinguish between full-time and part-time jobs.

similarly, if economic opportunities decline, out-migration occurs. This explains why more jobs are generated and/or lost over time.

Total employment Impact on Sullivan County due to 823 jobs in Manufacturing



- In 2014, the distribution of the secondary jobs[6] impacted would be as follows: 94 jobs would be impacted in *Construction*, 68 jobs would be impacted in *Retail trade*, and 33 jobs would be impacted in *Health care and social assistance*. Another 202 *State and local government* jobs would be impacted.[7]

Table 1. Direct and Secondary Jobs Impacted	2014	
	Direct Jobs	Total jobs Impacted
Manufacturing	823	848
Construction		94
Retail Trade		68
Health Care and Social Assistance		33
Wholesale Trade		28
Administrative and Waste Management Services		26
Accommodation and Food Services		25
Other Services, except Public Administration		22
Real Estate and Rental and Leasing		16
Professional, Scientific, and Technical Services		10
Arts, Entertainment, and Recreation		5
State and Local Government		202

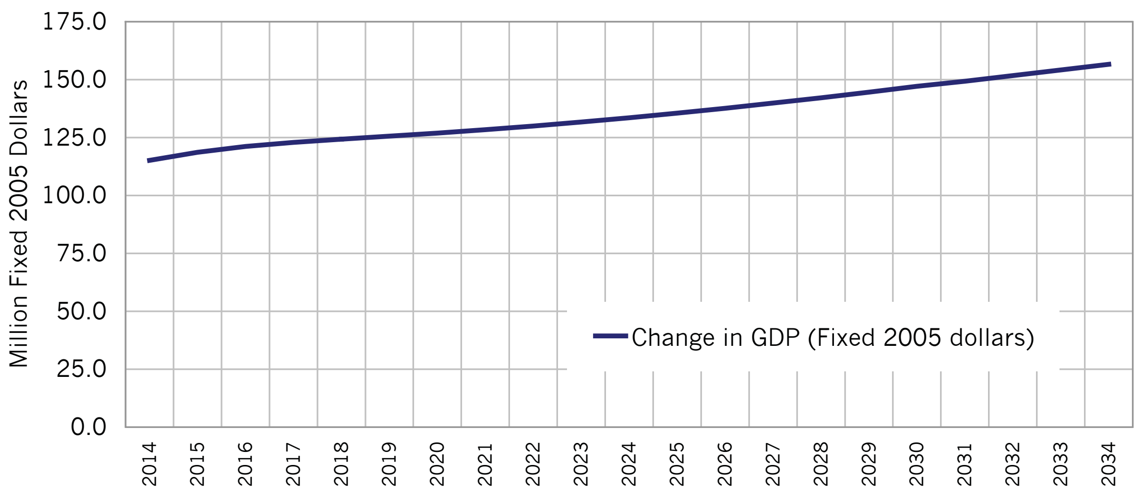
6. The difference between total jobs created and the direct jobs added to the local economy.

7. The impact on *State and local government* jobs would best be interpreted as employment that would be required in order to provide for the overall increase in the demand for shared government services. Shared services could include education, public safety, water and sewage treatment, road construction and maintenance, and other services related to an increase in business activity and resident population.

Gross Domestic Product

- In 2014, the total value of the 823 manufacturing jobs to the local economy expressed in terms of Gross Domestic Product (GDP) would be $115.2 million (in fixed 2005 dollars). This impact would grow over time and by 2035, GDP in the region would be impacted by $159.1 million (in fixed 2005 dollars).
- The economic activity created by the 823 manufacturing jobs would account for 9.4 percent of total GDP in Sullivan County in 2014. Over time, as other sectors in the economy recover, the value of these manufacturing jobs is reduced. In 2035, the value of the 823 manufacturing jobs would be reduced to 7.7 percent of the county's GDP.

The impact on GDP in Sullivan County due to 823 manufacturing jobs



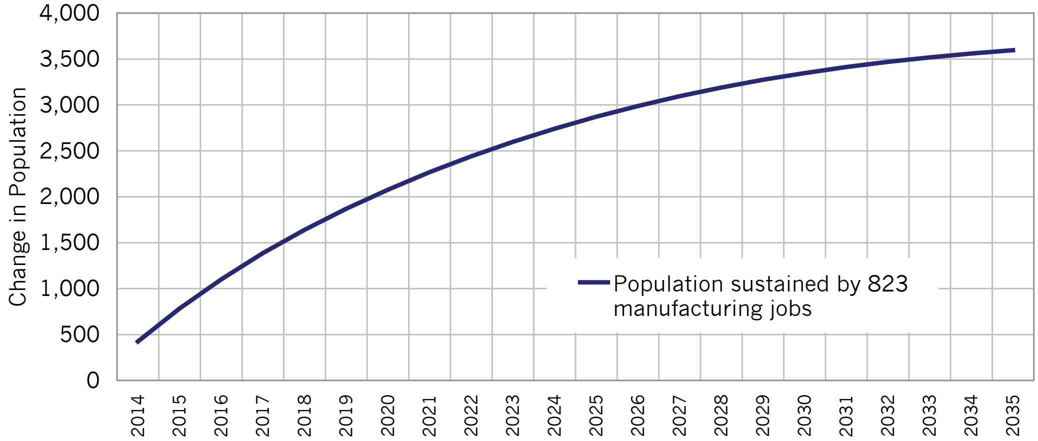
Personal Income

- The impact of the 823 jobs on total real personal income would be $54.6 million (in fixed 2005 dollars) in 2014. By 2035, the impact on real personal income would grow to $137.2 million (in fixed 2005 dollars).

Population

- In 2014, 823 manufacturing jobs sustained 424 persons to Sullivan County's population. Over time, the impact of these manufacturing jobs on the county's population increase to about 3,600 persons. This represents 7.1 percent of the projected population baseline for the county.

The impact on population in Sullivan County due to 823 manufacturing jobs



Job Multiplier

- The multiplier effect on Sullivan County of each *Manufacturing* job in this current scenario is between 1.7 and 1.8 jobs[8] — including the direct job created — annually over the entire simulation period.

Scenario 2: Development of the industrial parks in Claremont

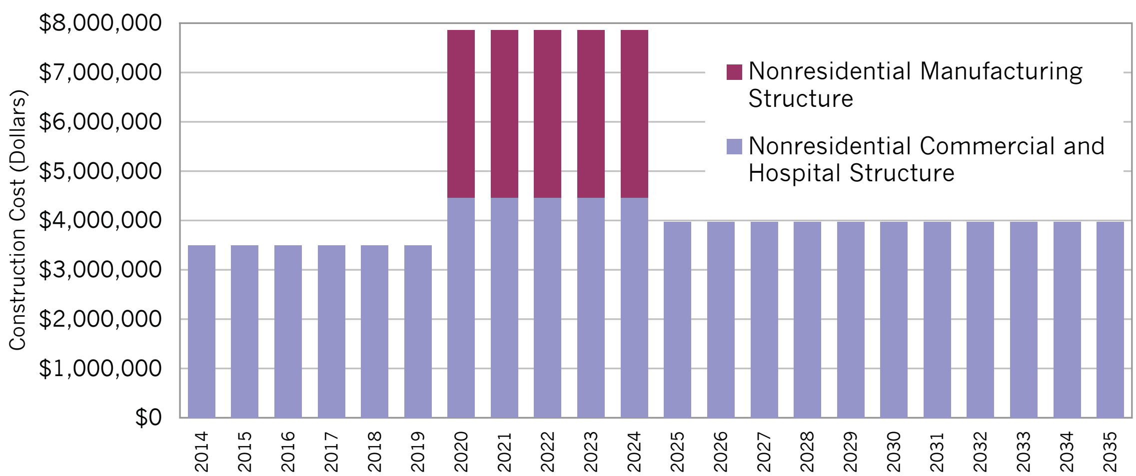
Inputs and assumptions

Construction Costs. It was assumed that construction costs would total $104 million, spread out over the entire time period. About 84 percent of the construction cost was modeled as *Nonresidential commercial and hospital structure* and the remaining half was added to the REMI model as Nonresidential manufacturing construction. The costs for *Nonresidential commercial and hospital structure* were added to the model annually over the entire period, whereas costs for *Nonresidential manufacturing construction* were spread over the years 2020 to 2024.

8. A job multiplier of more than one indicates that the new job created in the local economy have a ripple effect that generates more employment in the region. A multiplier of less than one indicates that some of the current employment in the region would be eliminated due to the competition from the expanding businesses.

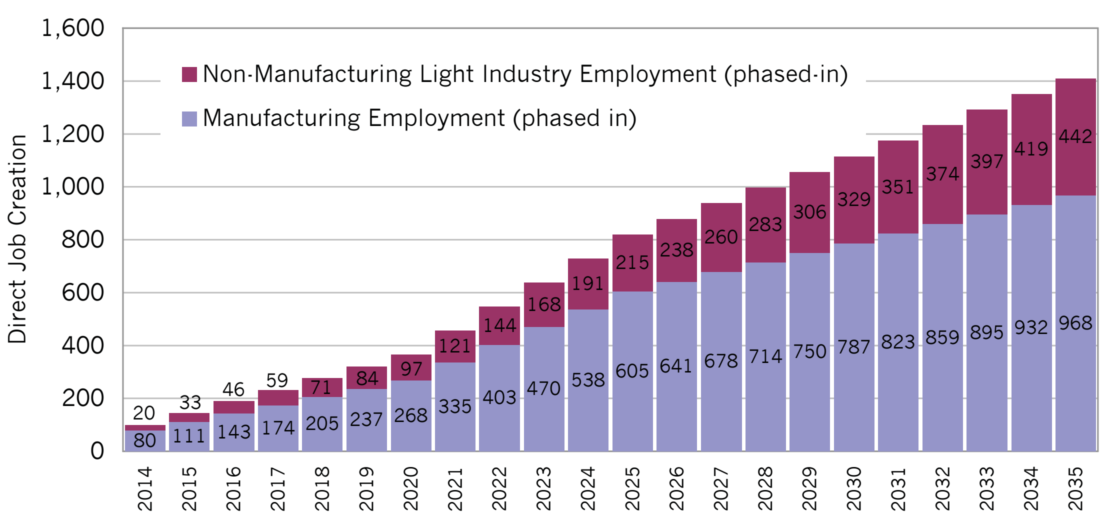
Table 2. Claremont Industrial District Construction Costs	2014-2019	2020-2024	2025-2035
Nonresidential Commercial and Hospital Structure	$20,960,000	$22,325,000	$43,720,000
Nonresidential Manufacturing		$17,000,000	

Distribution of construction costs for the expansion of Claremont Industrial District



Direct Jobs. In this scenario, it was assumed that 1,410 direct jobs would be created in Sullivan County over the period 2014-2035. About two-thirds of these jobs are expected to be in manufacturing with the remaining jobs created in non-manufacturing light industries.

Distribution of Jobs Created due to the expansion of Claremont Industrial District



In the REMI model, the manufacturing sector is comprised of 75 detailed industries. In Sullivan County, 45 those detailed industries contained employment. Employment added to the Manufacturing sector were proportioned over ten targeted detailed industries in the REMI model, using the 2035 projected employment for Sullivan County as the basis for the proportions.

Table 3: Selected manufacturing industries	2035 Employment Share
Machine shops; turned product; and screw, nut, and bolt manufacturing	23.2%
Plastics product manufacturing	13.5%
Electric lighting equipment manufacturing	12.9%
Household and institutional furniture and kitchen cabinet manufacturing	12.4%
Cement and concrete product manufacturing	10.5%
Other wood product manufacturing	9.1%
Sawmills and wood preservation	8.2%
Medical equipment and supplies manufacturing	3.5%
Hardware manufacturing	3.4%
Aerospace product and parts manufacturing	3.3%

The non-manufacturing light industry employment was spread between two non-manufacturing targeted REMI industries using the 2035 projected employment for Sullivan County for those two industries as the basis for the proportions.

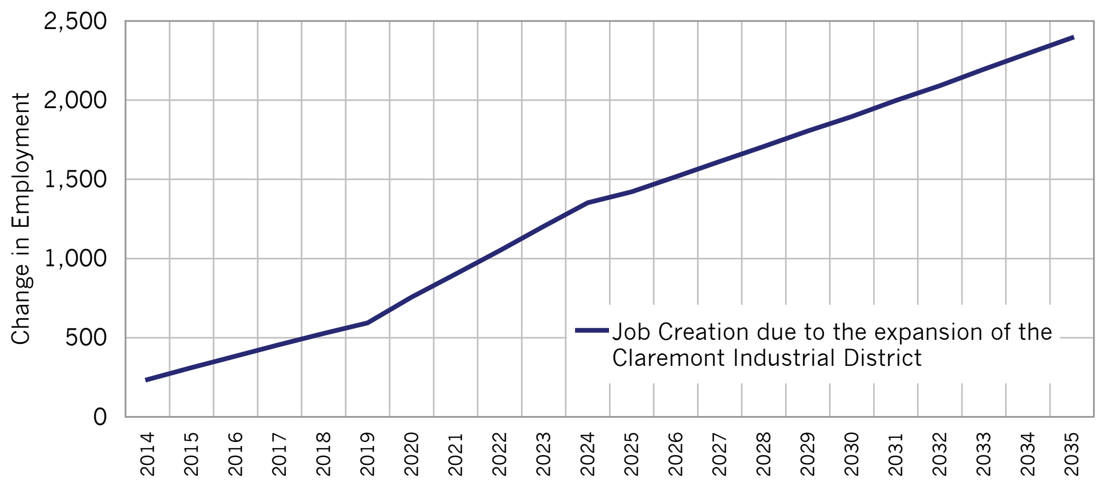
Table 4: Selected non-manufacturing light industries	2035 Employment Share
Management, scientific, and technical consulting services	38.5%
Other professional, scientific, and technical services	61.5%

In this development scenario, it was assumed that the anticipated job creation would not displace existing employment in the county.

Scenario Results: Impact on Sullivan County of the economic development at the Claremont Industrial District

- In 2014 a total of 236 direct, indirect and induced jobs[9] would be created in Sullivan County.
- By 2035, at the anticipated full implementation of development of the Claremont industrial district, the total impact on jobs will have increased to 2,394 direct, indirect and induced jobs.

Change in employment in Sullivan County due the expansion of Claremont Industrial District



- By 2035, the distribution of the secondary jobs[10] created would be as follows: 118 jobs would be created in *Retail trade*; 83 jobs would be created in *Health care and social assistance* and 76 jobs would be created in *Accommodation and food services*. Another 253 jobs would be created in *State and local government* (see footnote 7 on page 5). A total of 354 jobs would be created in *Construction*. Some of these jobs would be created due to input construction cost, while others would be created as secondary jobs, responding to the increase in business activity and increase in population.

9. The direct jobs are defined in footnote 3. The indirect jobs are those created from the ripple effect of the direct jobs from inter-industry purchases (business-to-business services). The induced jobs are those generated from an increase in consumer spending and from the increase in population. Indirect and induced jobs, combined are also referred to as secondary jobs. Jobs in the REMI model are based on Bureau of Economic Analysis (BEA) definition of employment. The BEA estimates of employment and wages differ from covered employment data because BEA makes adjustments to account for self-employment. So the employment count in the REMI model is larger than what is reported by the Economic and Labor Market Information Bureau (ELMIB), New Hampshire Employment Security. The REMI model does not distinguish between full-time and part-time jobs.

10. The difference between total jobs created and the direct jobs added to the local economy.

Table 5. Direct and Secondary Jobs Created	2035	
	Direct Jobs	Total jobs created
Manufacturing	968	957*
Professional, Scientific, and Technical Services	442	433*
Construction**		354
Retail Trade		118
Health Care and Social Assistance		83
Accommodation and Food Services		76
Wholesale Trade		47
Other Services, except Public Administration		29
Administrative and Waste Management Services		28
Arts, Entertainment, and Recreation		14
Real Estate and Rental and Leasing		5
Educational Services		2
Forestry, Fishing, and Related Activities		1
Utilities		1
State and Local Government		253

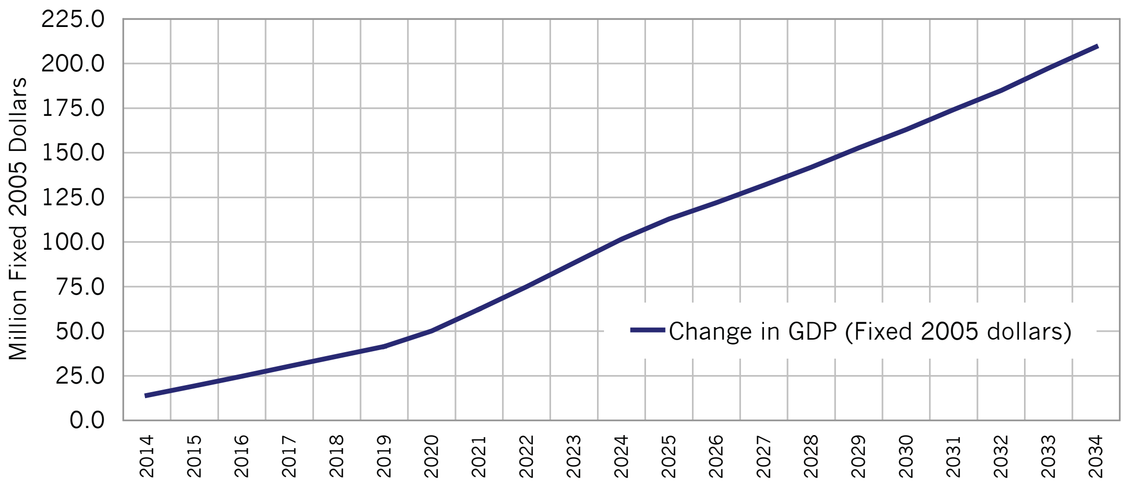
* Due to innovation and agglomeration, efficiency will cause a slight decline in comparison to the direct jobs created

** Includes estimated construction costs

Gross Domestic Product

- In 2014, the first year of the expansion of the Claremont Industrial Park, the Gross Domestic Product (GDP) in Sullivan County would increase by $14.0 million (in fixed 2005 dollars) above the baseline. By 2035, GDP in the region would grow to $221.6million (in fixed 2005 dollars) above the baseline.
- The economic activity created from the expansion of the Claremont Industrial District would account for 10.7 percent of total GDP in Sullivan County by 2035.

The impact on GDP in Sullivan County due to the expansion of Claremont Industrial Park



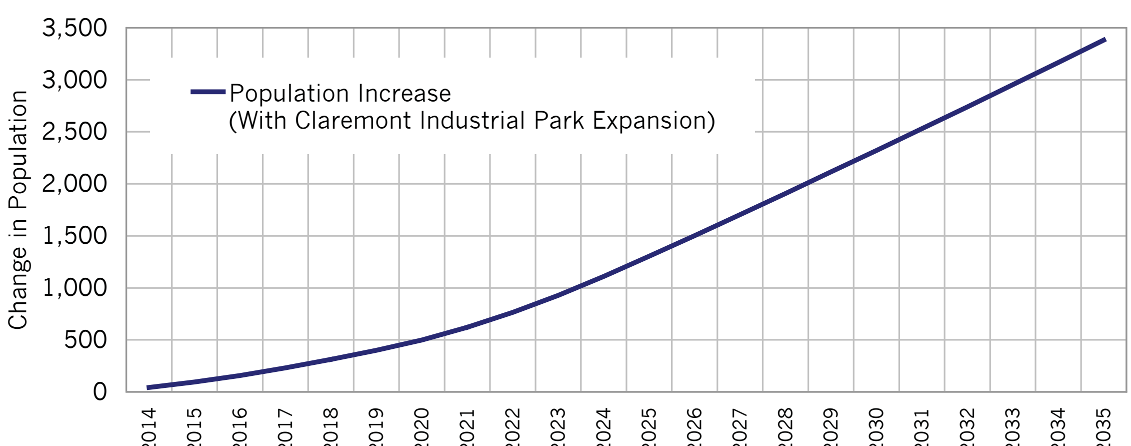
Personal Income

- Total real personal income would increase by $8.1 million (in fixed 2005 dollars) in 2014. By 2035, the increase in real personal income would grow by $172.9 million (in fixed 2005 dollars) above the baseline.

Population

- Sullivan County's population would gain 42 persons above baseline in 2014. By 2035, the population of Sullivan County would gain close to 3,400 persons above the projected population baseline (a 6.7 percent increase above the forecasted baseline).

The impact on population in Sullivan County due to the expansion of Claremont Industrial Park



Job Multiplier

- The multiplier effect on Sullivan County of each job created at the Claremont Industrial District is between 1.6 and 1.7 jobs (see footnote seven on page 6) — including the direct job created — annually over the entire simulation period. (The impact of construction costs on the region is excluded.)

Summary

The impact of these two scenarios to the region are vastly different, as one scenario assesses the current value of existing manufacturing employment versus the other economic development scenario is built-out over a 22-year period.

- The first scenario shows how the county is very dependent on one large employer in the region, accounting for 9.4 percent of total Gross Domestic Product for Sullivan County in 2014.
- The second scenario shows that the potential expansion of the Claremont Industrial District would generate up to $221.6 million (in fixed 2005 dollars) in additional Gross Domestic Product (GDP) to the region by 2035, accounting for 10.7 percent of Sullivan's County GDP in that year.

The explanation below is the economic theory and empirical data behind the REMI model.

The REMI Model

REMI Policy Insight® is a structural model, meaning that it clearly includes cause-and-effect relationships.

The model is based on two key underlying assumptions from mainstream economic theory: households maximize utility and producers maximize profits. Since these assumptions make sense to most people, lay people as well as trained economists can understand the model. The tool is often used by economic developers and planners to gage the potential impact on a regional economy of proposed projects such as transportation infrastructure, office and retail development, relocation or expansion of businesses, etc.

In the model, businesses produce goods and services to sell locally to other firms, investors, governments, and individuals, and to sell as exports to purchasers outside the region. The output is produced using labor, capital, fuel, and intermediate inputs. The demand, per unit of output, for labor, capital, and fuel depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply and demand for labor determine the wage rates in the model. These wage rates, along with other prices and productivity, determine the cost of doing business for each industry in the model. An increase in the cost of doing business causes either an increase in prices or a cut in profits, depending on the market for the product. In either case, an increase in costs would decrease the share of the local and U.S. market supplied by local firms. This market share, combined with the demand described above, determines the amount of local output. Many other feedbacks are incorporated in the model. For example, changes in wages and employment impact income and consumption, while economic expansion changes investment, and population growth impacts government spending.

The effects of a change scenario to the model are determined by comparing the baseline REMI forecast with an alternative forecast that incorporates the assumptions for the change scenario.

UVLSRPC Regional Plan 2015

Chapter 5

Natural Resources in the UVLSRPC Region

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5.1 AIR RESOURCES

Vision

The region will have a high quality of air protecting public health, clear skies, and our natural environment.

Existing Conditions

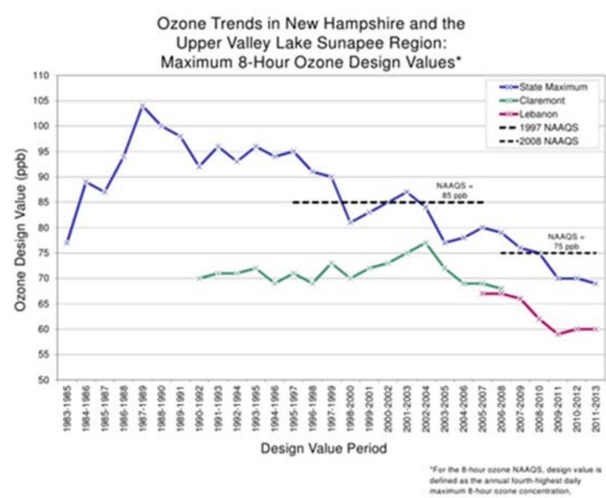
Direct health-related costs to New Hampshire from transported pollution from out-of-state sources were estimated to exceed $1 billion per year in 2004. This figure does not include the economic impacts associated with increased health claims and risks, loss of worker productivity, and higher electricity costs and costs of doing business as well as higher fuel costs due to increased requirements for operation in "dirty air" regions.[1]

In a December 2013 press release, Governor Maggie Hassan announced that "New Hampshire has joined with seven Northeast and Mid-Atlantic states in petitioning the U.S. Environmental Protection Agency (EPA) to require upwind states to reduce air pollution generated within their borders, which causes asthma, respiratory disease, and other public health problems downwind." The purpose of the petition was to require Illinois, Indiana, Kentucky, Michigan, North Carolina, Ohio, Tennessee, Virginia, and West Virginia to reduce the air pollution emissions carried by prevailing winds and contributing to ozone generation in downwind states such as New Hampshire.

The petition further asks that the upwind states join the Ozone Transport Region (OTR). Under the federal Clean Air Act, states within the OTR must take air pollution reduction actions consistent with downwind states. New Hampshire is an OTR state and has aggressively reduced air pollution emissions within the state over the last several years. On days in New Hampshire when the ozone reaches unhealthy levels, over 95% of that ozone originated in upwind states. The petition is based upon a multi-state report by the states of Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, and Vermont. (NH DES, et al, 2013)

Ozone

"Smog" or "ground-level ozone" describes the results of chemical reactions in the atmosphere caused by nitrogen oxides and volatile organic compounds (VOCs) in the presence of strong sunlight. On hot sunny days, these compounds react with oxygen in the air to produce ozone, or smog, at ground level.



These pollutants come from local sources, such as cars, trucks, industrial boilers, power plants, paints, solvents, and other commercial and consumer products. About half of all human-made nitrogen oxide and VOC emissions come from cars and trucks. In addition, ozone and its precursors are transported to NH from sources up to several hundred miles away to our south and west.[2] NH DES has one monitoring station in the Region: the Lebanon monitoring station represents a consolidation of the former stations in Haverhill and Claremont. It is located on a ridge at the Lebanon Airport. The station provides information on ozone and particulate matter. The National Ambient Air Quality Standards exceedence days between 2008 and 2012 at the Lebanon site include one day in 2008 for ozone and none for particulate matter.

In 2008, the US EPA set a National Ambient Air Quality Standard (NAAQS) of 0.075 parts per million (ppm), averaged over 8-hours, for ground-level ozone. All of New Hampshire is meeting this standard.

Small Particle Pollution

Small particles can be emitted directly from burning materials or they can be formed from other gases which react in the atmosphere. Most of the small particles found in the Northeast result from burning coal, diesel, gasoline, wood, and other fuels, with the large coal burning industries and power plants in upwind areas contributing the largest amounts. These particles carry toxic and often carcinogenic materials.

Portions of NH experience elevated levels of small particles, defined as particles that are less than 2.5 micrometers in diameter. For comparison, a human hair is about 70 micrometers in diameter. Small particle pollution results in reduced visibility and hazy views. These microscopic particles can be inhaled deep into the lungs where they can induce or aggravate respiratory illnesses such as asthma, chronic bronchitis or emphysema. They can also cause coughing or wheezing in healthy individuals, complicate cardiovascular disorders, alter the respiratory system's defense against foreign materials; and damage lung tissue.

Although annual concentrations have not yet exceeded the federal standard (NAAQS), the concentrations frequently reach unhealthy levels for people who are sensitive to the effects of particle pollution. This includes the elderly, children, and people with lung or heart conditions. Wood smoke is a particular concern in the winter when cold air and temperature inversions limit air movement. Communities located in valleys are more strongly affected. On cold, clear and calm nights, smoke is unable to rise and disperse. Pollutants are trapped and concentrated near the ground, and the small size of the particles allows them to seep into houses through closed doors and windows. Choosing low-emission units, operating them properly, and using good quality, dry firewood can reduce this health risk.

Given our geography, this phenomenon is a threat to air quality in the Connecticut River Valley of New Hampshire, including the Upper Valley Lake Sunapee Region. The Commission should work collaboratively with New Hampshire Department of Environmental Services, the American Lung Association, and interested partners to develop a wood stove swap program to incentivize owners of inefficient woodstoves to upgrade to more efficient units. A similar program has been utilized in the Southwest region of the state.

Acid Rain and Deposition

Acid rain and deposition are primarily comprised of acids that form when emissions of sulfur dioxide and nitrogen oxides react in the atmosphere with compounds such as water and oxygen. The source of sulfur dioxide and nitrogen oxides is principally from the burning of fossil fuels by electric utilities, industries, and motor vehicles.

Once the acids form in the atmosphere, they can travel long distances and be deposited by precipitation, particles, gas, or vapors—and also by clouds or fog affecting high altitudes and coastal areas. The high elevation mountain-tops in New Hampshire receive the highest acid deposition on an annual basis. Much of the pollution in NH has been transported by the wind from other states.

Deposits of acidic compounds negatively impacts aquatic and terrestrial ecosystems, public health, visibility and materials and structures such as buildings, monuments, and statues. Acid depletes nutrients from the soil, slowing growth of trees and other vegetation. Trees stripped of nutrients become stressed and are more susceptible to insect infestation, drought, freezing, and ozone damage. Many studies have shown the decline of red spruce to be directly linked to the impacts of acid deposition. Acid also leaches aluminum from soils and rocks and carries it to soil water, vegetation, lakes and streams where it can limit trees' ability to absorb water and nutrients. It can also be toxic to organisms such as plants and fish. Acid deposition in lakes and streams impacts the survival of aquatic organisms reducing diversity and abundance of organisms.

Mercury

Mercury is usually emitted as a gas that is absorbed into clouds and deposited by precipitation leading to mercury contamination. Coal burning and medical/municipal solid waste incinerators are the major sources of mercury emissions. Mercury is highly toxic and has been linked to many health effects including neurological and developmental problems, cancer, and endocrine disruption in fish, wildlife, and humans. Once mercury is ingested by humans, it is readily distributed throughout the body, including the brain, and is passed through the placenta to a developing fetus.

Once mercury enters the environment, it can remain as an active toxin for over 10,000 years. Mercury concentrations can be highly variable from year to year depending on weather factors, including wind direction and precipitation. In 2008, the NH DES published a Fish Consumption Advisory.[3] Water bodies with mercury levels above a specified level are considered impaired and recommended to have an advisory about eating the fish. In our region these water bodies include Mascoma Lake in Enfield, Ashuelot Pond and May Pond in Washington. An additional analysis explored mercury concentrations of fish specimens of length-restricted fish species (bass, pickerel and perch) that were greater than 12 inches long and in specific water bodies. These large fish have the highest fish tissue mercury concentrations measured in the State, and fish from Goose Pond in Canaan were included in this category.

Motor Vehicles and Toxic Air Pollutants

Motor vehicle exhaust contains numerous toxic air pollutants (TAPs) such as benzene, formaldehyde, 1, 3-butdiene, and diesel particulate matter. Some additional TAPs emitted by motor vehicles include acrolein, cadmium, chromium and lead. These components have the potential to cause serious adverse health effects in humans ranging from neurological to cardiovascular to respiratory effects.

These toxins are emitted into the air when gasoline evaporates during refueling or when gasoline remains in a hot engine after it is shut off. These same compounds can also be emitted through the tailpipe and crankcase when the fuel is not completely burned in the engine.

Starting in 2006, New Hampshire began its on-board diagnostics test program for all 1996 and newer vehicles. These tests are run on your car during the annual inspection. In 1999, New Hampshire inspectors began checking heavy-duty diesel trucks to ensure their particulate emissions meet specific standards. Since this air quality testing has begun, vehicles emit 90% less hydrocarbons and 50% less toxic air pollutants over than lifetimes than earlier uncontrolled models. .According to EPA's National Emissions Inventory, total emissions of toxic air pollutants from mobile sources in New Hampshire have decreased from over 24 million pounds in 2002 to approximately 18 million pounds in 2008. Despite these improvements, if the number of cars and miles they are driven increase at a rate that offsets the benefits of current mandates, overall emissions of air toxics may again begin to rise.

Air Quality Regulations

The Federal Clean Air Act originated in 1970 and regulates air emissions from stationary and mobile sources. The law required the Environmental Protection Agency to establish its National Ambient Air Quality Standards (NAAQS). In 1985, the New Hampshire Acid Rain Control Act was begun to reduce emissions of sulfur dioxide from stationary sources (power plants and industrial facilities) within the state by 25 percent and to set an annual sulfur dioxide emissions cap on major sources. The NH Clean Power Act passed in 2002, amended in 2006, calls for annual reductions of multiple pollutants including sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury. NH rules (Env-A 2900) were adopted to implement the Act which calls for substantial reductions in sulfur dioxide and nitrogen oxides emissions from the 1999 levels.

In 1997, the Conference of the New England Governors and Eastern Canadian Premiers recognized that acid deposition continues to negatively impact the resources in northeastern U.S. and eastern Canada, in spite of significant reductions of sulfur emissions that have taken place since 1990. In response to the need for further action, representatives of the states and provinces developed an Action Plan finalized in 1998 to further reduce emissions of sulfur dioxide and nitrogen oxides.

Although sulfur deposition has declined, research from Hubbard Brook Experimental Forest in Thornton, NH and other study sites in the Northeast demonstrate that acid deposition is still a problem. While sulfur emissions have decreased, nitrogen emissions have not decreased substantially since the 1980s. Also, the loss of acid-neutralizing minerals from the soil and the long-term accumulation of sulfur and nitrogen in the soil have left many ecosystems more sensitive to additional acids. Greater reduction in polluting emissions are needed to truly address this problem—including in states where much of the pollution originates and is transported to New Hampshire.

Indoor Air Quality

The State of NH Indoor Air Quality Program was discontinued due to a lack of funding. Why care about indoor air quality? Americans, on average, spend more time indoors than outdoors. The indoor concentrations of pollutants can exceed levels typically found outdoors due to the confining space of our homes. Health effects associated with indoor air pollutants include irritation of the eyes, nose, and throat; headaches, dizziness, and fatigue; respiratory diseases; heart disease; and cancer. Some of the indoor contaminants come from outdoor air and building materials; others are produced by indoor activities such as cooking, smoking, and cleaning materials. Natural substances, such as mold and radon, can also affect indoor air quality.[iv]

For indoor air pollution, the Commission has developed a "Healthy Home: Clean Safe and $ave" program to teach people to use less toxic cleaning products than those typically found on the store shelf. There are very few regulations to restrict toxic ingredients in these cleaning products, yet consumers feel if they are on the shelf, the products must be safe. Reading the "small print" on the backs of some of these products is pretty frightening. Simple white vinegar, liquid castile soap, baking soda, and water can deal with most cleaning jobs in a home without releasing toxic emissions

Regional Efforts

Public transit and carpooling opportunities available in the Region can help improve air quality by reducing vehicle emissions. Advance Transit provides free transportation on their buses in the Upper Valley including in Vermont along the Connecticut River. The current primary service areas are for shopping, the hospitals, and Dartmouth College in and around Hanover and Lebanon and Hartford, Vermont. There is also a route out Route 4 to Canaan. The goals of Advance Transit include reducing traffic and parking congestion. Three of their 31 buses are hybrid diesel and electric. Upper Valley Rideshare provides a weekly listing of hundreds of carpool connections to help keep fewer cars on the road.

Improvement Strategies

Air Quality Improvement Strategies
• Work collaboratively with New Hampshire Department of Environmental Services, the American Lung Association, and other interested partners to develop a wood stove swap program that would incentivize owners of inefficient woodstoves to upgrade to more efficient units.
• Expand carpooling and public transportation options in the region (per the recommendations in the Transportation Chapter of this Plan).
• Improve public outreach programs to encourage consumers to buy non-toxic, low VOC products.
• Provide technical assistance to municipalities considering local ordinances to reduce idling.
• Deploy electric vehicle charging stations on arterial roads in the region.
• Support stronger federal fuel economy standards.

5.2 AGRICULTURAL LANDS

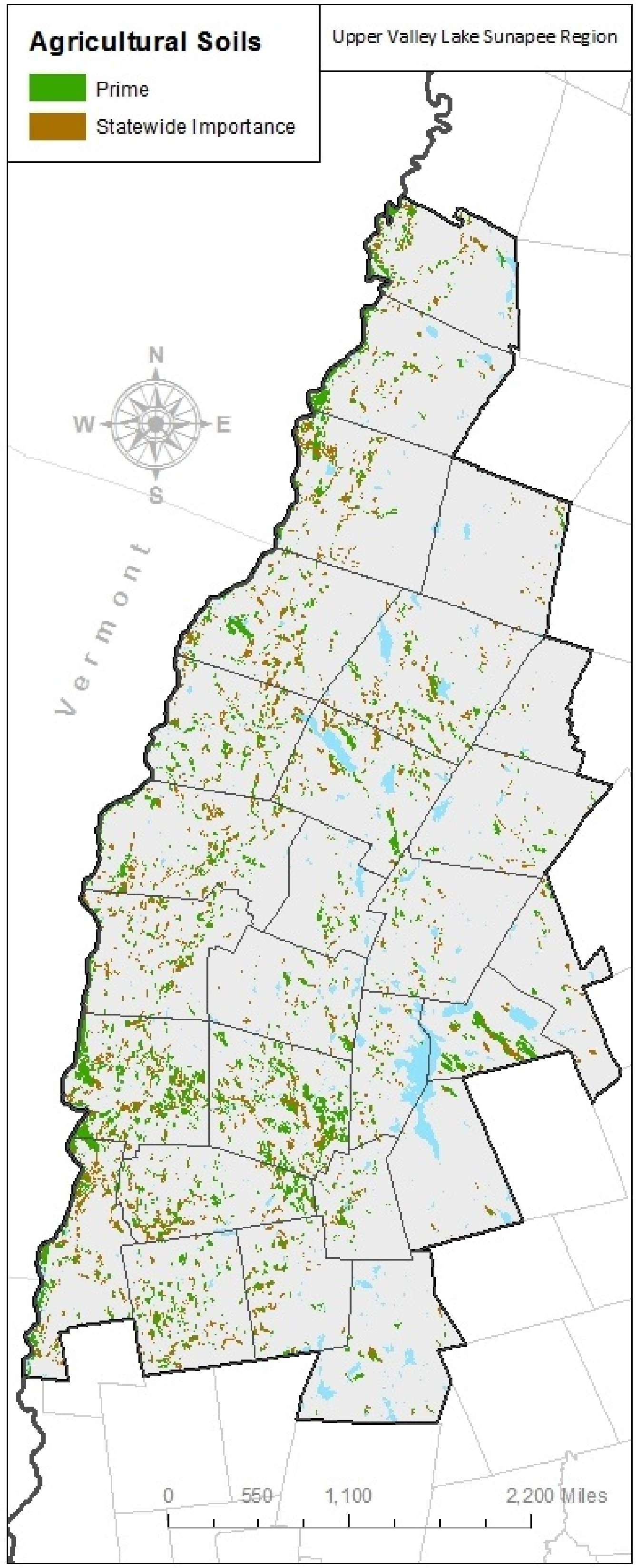
Vision

The region will support abundant agricultural opportunities to promote economic development and production of food and other products for diverse markets, preserve rural community character, and foster a sense of community through agricultural events such as farmers markets, fairs and festivals.

Existing Conditions

The Region is fortunate to have some of the best agricultural soils in the state. This is primarily due to the enriched river valley alluvial soils that make up the floodplain terraces.

Agricultural Soil Classification	Acres in UVLS Region	% of UVLS Region
Prime Agricultural Soil	32,060	4.7%
Statewide Significant Agricutural Soil	25,645	3.7%
Locally Important Agricultural Soil	152,235	22.2%
Total Important Agricultural Soils in the UVLS Region	209,940	30.6%
UVLS Region	686,123	acres
Data based on geographic USDA NRCS soil survey data obtained from NH GRANIT.		



These soils are valuable resources for growing food crops and hay as well as providing scenic qualities for the Region. The US Department of Agriculture's Natural Resources Conservation Service (NRCS) has classified soils by agricultural potential. NRCS classifies agricultural soils according to their comparable value nationally, statewide and locally. Prime agricultural soils are of national significance and are the most productive soils because of the combination of physical and chemical properties. Soils of statewide significance are those that are very important to agriculture in the state. Soils classified as locally important to agricultural are productive soils that have been identified by County Conservation Districts. These soils may be less productive than Prime or Statewide significant soils, but may be historically farmed and known to be productive on a local scale. The USDA's Web Soil Survey, is a good resource for learning about soils in the Region.[5]

Physical characteristics of land that contribute positively to agricultural potential are the zero to low grade slope, moisture, good drainage, depth to bedrock and seasonal high groundwater table. Some land use techniques can increase the productivity of soils such as crop rotation and applying compost before the growing season. Other techniques can be detrimental to productivity and certainly land conversion from farming to residential uses would remove the soils from farming completely.

In 2011, an estimated 1% of the State's GDP was sales and receipts in the agricultural sector.[6] In 2010, an estimated $43 million in sales of harvesting crops was reported. According to the National Crop Insurance Services in March 2014, New Hampshire's agriculture industry contributes more than $239 million to the State's economy. Milk and ornamental horticulture (greenhouse and nursery products) are the largest sectors of the state's agricultural economy, each accounting for roughly one-third of total farm sales. The other chief commercial crops are hay and silage corn, fruit (including apples and berries), livestock, eggs and poultry, maple syrup, Christmas trees, sweet corn and other vegetables. Grafton and Sullivan counties are the two top counties for dairy farming in New Hampshire. The UVLSRP region is also home to agricultural supply and service provider businesses that support farm businesses here and across the two states of New Hampshire and Vermont.

There are about 140 commercial dairy farms in the State. New Hampshire and New England dairy farms produce about 1/3 of the dairy consumed in the state. Growth of the local agricultural and food movement is difficult to measure, but the NH Department of Agriculture, Markets & Food points to the quadrupling of local farmers markets in the state from 2007 to 2014. During the same period, winter farmer's market locations in the state went from two to nearly thirty.

	New Hampshire	Grafton County	Merrimack County	Sullivan County
Number of Farms	4,391 (2012)	500 (2012)	600 (2012)	298 (2012)
	4,166 (2007)	552 (2007	583 (2007)	294 (2007)
Farmland Acres	474,065 (2012)	82,372 (2012)	64,950 (2012)	39,015 (2012)
	471,911 (2007)	99,964 (2007)	64,642 (2007)	43,199 (2007)
Market Value of Products Sold	$190,907K (2012)	$29,831K (2012)	$45,266K (2012)	$17,311K (2012)
	$199,051K (2007)	$34,393K (2007)	$55,286K (2007)	$14,972K (2007)

The Farmland Information Center of the American Farmland Trust (AFT) reported that one-fifth of the farmland in NH has been lost in the last thirty years.[7] A 2014 study completed by the AFT ranked sections of Cheshire, Grafton and Sullivan counties, and part of the Connecticut River Valley, as 19th on the list of the *Top 20 Most Threatened High-Value Farmland Regions in New England*.[8]

Protection of local farmland has many benefits, including:

- Ensures that land remains available farming;
- Provides access to fresh local farm products, while simultaneously reducing "food miles" (i.e. the distance food travels before it is eaten) and reducing the carbon footprint;
- Makes productive use of floodplains;
- Keeps local money in the local economy;
- Provides open space and habitat for wildlife, including deer, turkey, bluebird and woodcock;
- Provides scenic views while making productive use of the land and maintains rural and cultural qualities of the land;
- Continues the visual and land use tradition of the region's working landscape;
- Enhances the Region's economic development potential including agricultural tourism and rural enterprises.

Benefits of the Farm and Ranch Lands Protection Program	
Keeps land available for agriculture	96% of landowners said that at least some of their protected land was in active agricultural use, and nearly 50% said that all of their protected land was in production
	70% of owners are farmers, and the proportion of producers is higher among those who purchased protected farms
Improves agricultural viability	84% of landowners who sold easements invested at least some of the proceeds in their operations or agricultural land
	Easement proceeds spent on agruicultural purposes tend to be spent locally, bolstering the entire agricultural sector of in communities with protcted farms
Encourages on-farm conservation	75% reported the application of at least one conservation practice
	20% used proceeds from the easement sale to install or expand conservation practices
Helps farmers gain access to land	55% of landowners who sold easements spent proceeds repaying loans on farm and ranch land they already owned or buying additional agricultural land
	65% of landowners who had purchased protected land said the price was lower than comparable unprotected land
	69% of the owners with succession plans said the next owner would be a farmer
Adapted from a summary of the American Farmland Trust: http://www.farmlandinfo.org/FRPPImpactsSummary	

Agricultural lands can be protected in a number of ways. The NH Farm Viability Task Force suggests that Current Use (RSA 79-A) taxation—see page 5-36—is the single most important public policy benefit for farmers.[9]

The federal Agricultural Conservation Easement (ACEP) Program was enacted under the 2014 Farm Bill and takes the place of the Farm and Ranch Lands Protection Program (FRPP). This program is administered by the Natural Resources Conservation Service (NRCS) and provides financial and technical assistance for land protection.

There are two components of the ACEP: the Agricultural Easements component; and the Wetland Reserve Easement component. Program benefits include protecting the long-term viability of the nation's food supply by preventing conversion of productive agricultural lands, protecting environmental quality and providing habitat for wildlife, fish, and improving water quality. The program assists state and local governments and NGOs in protecting eligible cropland, grassland, pastureland, nonindustrial private forestland, and wetlands in the state.[10]

The state of NH also has a legacy of contributing to the permanent protection of land through the state's Land and Community Heritage Investment Program (LCHIP) offers grants to assist non-governmental organizations (NGOs) in land protection. For the next two years, beginning in 2015, all of the proceeds from the NH deed recording fee will be dedicated to the LCHIP. This is estimated to be about $8.5 million toward land conservation. Significant portions of these funds had been diverted into other programs in previous years.

A municipality can also implement local land use regulations using a variety of tools such as agricultural zoning and other districts or district overlays which limit or restrict development of agricultural areas. [11]

Threats and Challenges

Agriculture is a cornerstone of the rural character favored by most of the Region's communities, yet farmers struggle with local regulatory pressures and unfriendly attitudes toward farm enterprises. The public yearns for rural quality of life, but may not understand the realities of working farms and woodlots of the productive, resource-based rural economy, as opposed to the consumptive uses of land and natural resources found in a typical suburban community. Working farms and rural character come with both pretty and gritty sides. Farms are businesses that may have some commercial and industrial aspects. Trucks deliver supplies, haul crops from field to barn, and produce to market. Along with peaceful cows or woolly sheep grazing in the meadows, odors may emanate from stored silage feeds, and from storing and applying manure in accordance with environmental standards. County Conservation Districts, the UNH Cooperative Extension, and the USDA Natural Resource Conservation Service offer technical assistance to farmers and communities to assist with educating and funding best management practices. Following agricultural BMPs can also reduce the negative impacts of agriculture applications such as pesticides and fertilizers.

Economic sustainability is the greatest challenge to the sustainability of farms of all types. Farm businesses must be able to adapt and grow. The very small and small farms that predominate New Hampshire's landscape are generally part-time or supplementary-income enterprises. Farms of any size may seek to diversify by adding new enterprises or finding alternative sources of income. The history of agriculture in the region is a story of continual change and evolution.

Municipalities can establish local agricultural commissions (RSA 673:4-b), with the purpose of protecting agricultural lands, preserving rural character, providing a voice for farmers, and encouraging agriculture-based businesses. At this time, no municipalities in the Region have agricultural commissions. Agricultural commissions can provide a voice for agriculture, to help inform municipal boards and authorities, and to enhance understanding of agriculture in the community. A guide to can be found on The UNH Cooperative Extension is a great resource and offers several helpful documents including *Creating a Local Agricultural Commission in Your Hometown*[12] and *Preserving Rural Character through Agriculture: Resource Kit for Planners*.[13]

Nutrient Management

Under RSA 431:33, the Department of Agriculture, Markets & Food is responsible for responding to complaints involving the mismanagement of manure, agricultural compost and chemical fertilizer. The Division of Regulatory Services coordinates inspections to sites where these materials are suspected of causing environmental contamination or nuisance problems. When merited, complaint resolution focuses on corrective measures in accordance with the *Manual of Best Management Practices (BMPs) for Agriculture in New Hampshire*, published by the department in accordance with RSA 431:34.

The division also administers the Agricultural Nutrient Management (ANM) grants program to assist agricultural land and livestock owners with efforts to minimize adverse effects to waters of the state by better managing agricultural nutrients. The ANM grant program provides financial assistance with implementing Best Management Practices that prevent or mitigate water pollution, and often works in tandem with the USDA Natural Resources Conservation Service.

Improvement Strategies

Agricultural Land Improvement Strategies
• Assist communities in developing Local Agriculture Commissions to promote local farming.
• Promote and provide technical assistance to communities wishing to protect productive farmland through local ordinances or overlay districts.
• Prioritize the conservation of agricultural soils of prime and statewide importance, especially those currently in open fields.
• Support agricultural education programs such as those provided by County Conservation Districts, UNH Cooperative Extension, local 4-H clubs, and "*Ag in the Classroom"* school events.
• Support the Valley Food and Farm Program developed and administered by Vital Communities, a local non-profit organization.

5.3 FOREST LANDS

Vision

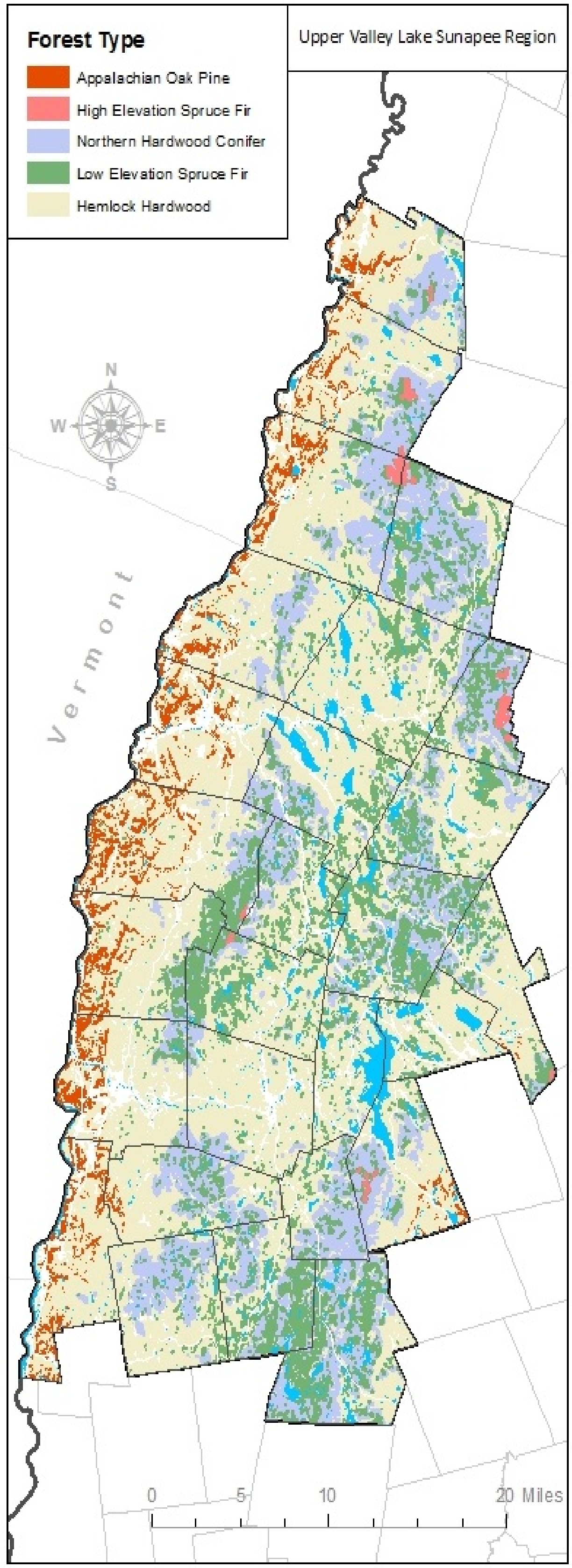
The region's forests will be effectively managed to ensure unfragmented wildlife habitat, a healthy environment, economic opportunity, recreation, and aesthetic identity.

Existing Conditions

A "forest block" is an area of forest that is not fragmented by roads or development. A 500-acre block is generally large enough to support significant wildlife, protect water quality and allow some economic forest management. Sustainable forest management and ecological significance requires blocks of at least 5,000 acres, and these values increase with block size. (Society for the Protection of NH Forests, 2005)

Nearly all of the Region's land is capable of growing repeated forest crops. This represents a significant economic potential. In addition to providing a permanent supply of fuel wood, lumber and other wood products, as well as forest industry jobs, the Region's forests have several functions and associated benefits. These include:

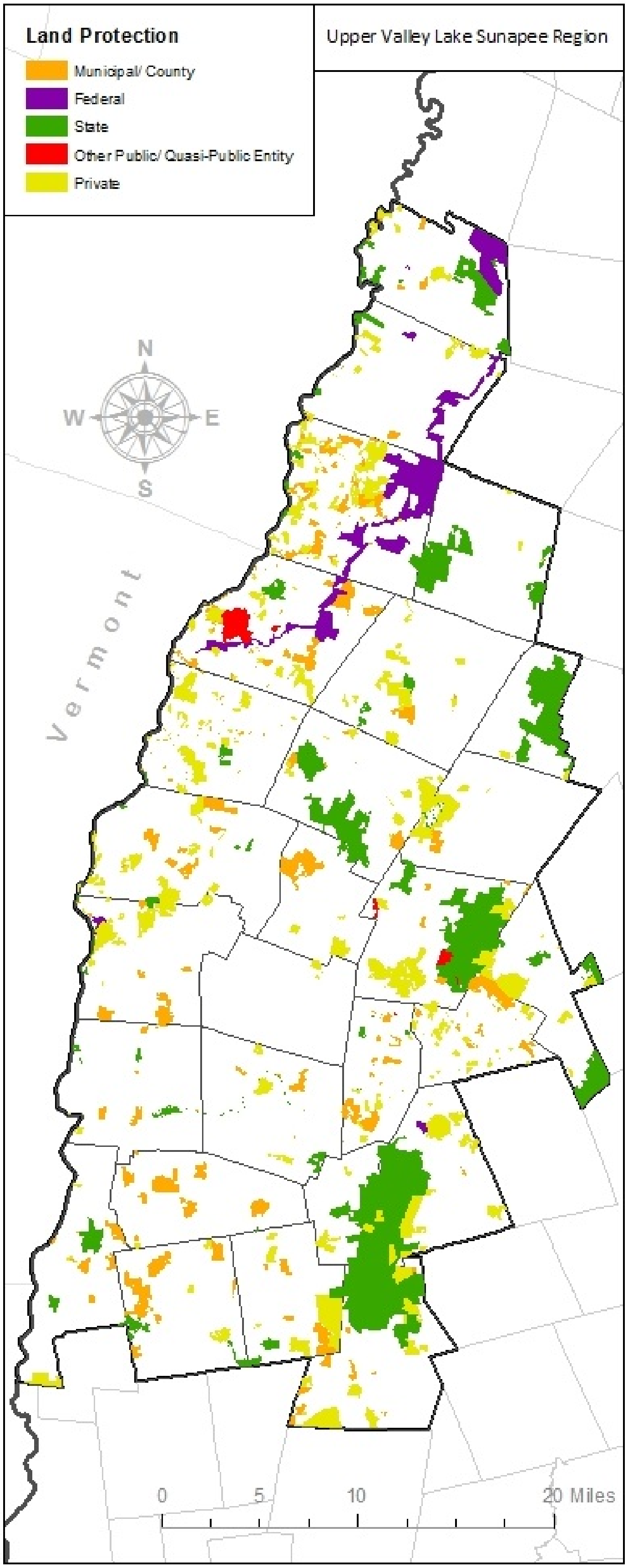
- Stabilizing soils, especially on hillsides. Deforestation diminishes the soil's ability to absorb and hold water resulting in erosion of slopes, sedimentation in waters, and more frequent and severe flooding;
- Providing natural habitat that fosters our native biological diversity;
- Providing carbon storage;
- Offering areas for outdoor recreational opportunities such as hiking, skiing, hunting and camping;
- Acting as a screen or buffer of sights, sounds and the wind; and
- Providing natural beauty and scenic views for both residents and tourists.



Ownership of forested lands in the Region is predominantly private. Many communities have town forestlands. Many town forests are used for recreational and educational purposes, as well as a source of income when timber is harvested. The State of New Hampshire owns over 23,000 acres of State Forest lands in the Region. These tracts, constituting just over 3.45% percent of the Region's land area, contribute to the pattern of open spaces in the Region and are managed with a multiple use philosophy geared toward timber production, recreation, and wildlife habitat.

Figure 5.3.1- State Lands in the Region

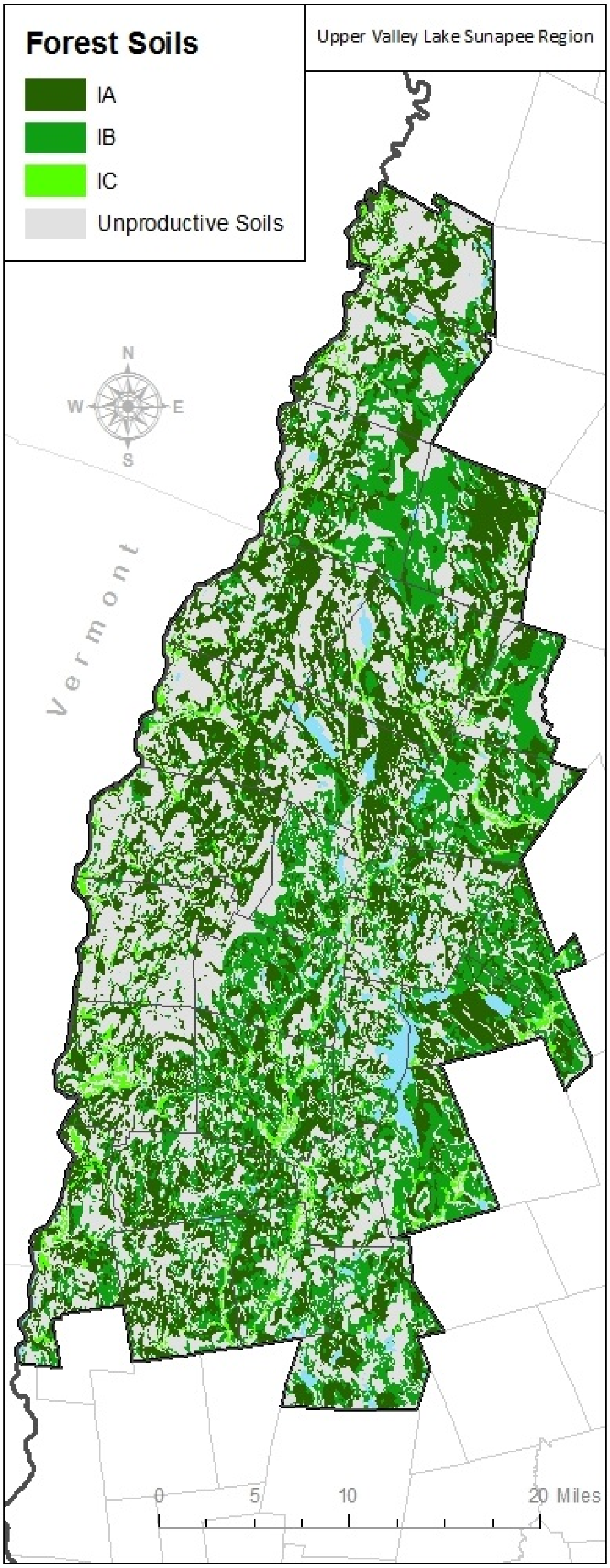
Name	Municipality	Acres in Region
State Forests:		
Annie Duncan State Forest	Plainfield	113
Cardigan Mountain State Forest	Orange	4,742
Connecticut River State Forest	Charlestown	216
Dodge Brook State Forest	Lempster	222
Fall Mountain State Forest	Charlestown	520
Gile State Forest	Springfield, Wilmot	6,675
Hubbard Hill State Forest	Charlestown	759
Lake Tarleton State Park	Piermont	48
Lovewell Mountain State Park	Washington	478
Mascoma State Forest	Canaan	216
Max Israel State Forest	Washington	628
Mount Sunapee State Forest	Goshen Newbury	2,893
Province Road State Forest	Dorchester	1,072
Sentinel Mountain State Forest	Piermont	235
Total Acres in State Forests		*18,817*
State Parks:		
Cardigan State Park	Orange	Part of Cardigan State Forest
Gardner Memorial Wayside Park	Springfield	Part of Gile State Forest
Mount Sunapee State Park	Goshen, Newbury	Part of Mt. Sunapee State Forest
Pillsbury State Park	Washington	4,455
Winslow State Park	Wilmot	Part of Gile State Forest
Total Acres in State Parks		*4,455*
Wildlife Management Areas:		
Cemetery Hill WMA	Sunapee	99
Chase Island WMA	Cornish	13
Gordon WMA	Sunapee	20
Gallop Marsh WMA	Unity/Lempster	19
Henry Laramie WMA	Enfield/Grantham	3,062
Lebanon WMA	Lebanon	28
Lower Shaker WMA	Enfield	1,096
Mascoma River WMA	Canaan	125
McDaniels Marsh WMA	Grafton/Springfield	609
Reeds WMA	Orford	64
Spaulding WMA	Canaan	56
Webster WMA	Canaan	91
Wendell Marsh WMA	Sunapee	9
Wilder WMA	Lyme	60
Total Acres in WMAs		*5,351*
State Conservation Easements on Private Property:		
Piermont Mountain	Piermont	1,650
Pillsbury & Sunapee (2 properties)	Goshen	9,366
Ragged Mountain	Wilmot	695
Yatsevitch	Cornish	973
Total Acres State Easements:		*12,684*
Total State Land (Including Easements)		**41,307**



As with agricultural soils, the US NRCS has identified soils that have the best potential for timber production. Soil productivity is a key factor in the economic value and ecological diversity of our forested landscape. Most of NH's best forest soils are found in the southeastern part of the state. This information is available in soil surveys and at the offices of the NRCS and UVLSRPC.

There are three major types of soils for forest are described below and shown on Group IA: These are deeper, loamy, moderately well-drained and well-drained soils. Generally these soils are more fertile and have the most favorable soil-moisture conditions. The climax forest stands on these soils include shade-tolerant hardwoods such as sugar maple and beech. Early successional stands often include a mix of hardwoods including sugar maple, beech, red maple, yellow, gray and white birch, aspen, white ash, and northern red oak in combinations with red and white spruce, balsam fir, hemlock, and white pine. The soils in this group are well-suited for growing high quality hardwood veneer and saw timber. The less abundant softwoods require intensive management to establish larger stands due to the highly competitive hardwoods.

Group IB: These soils are moderately well-drained and well-drained, sandy or loamy-over-sandy, and slightly less fertile than those in group IA. Soil moisture is adequate for good tree growth but may not be quite as abundant as in group IA. Successional trends and the trees common in early successional stands are similar to those in group IA. However, beech is usually more abundant on group IB soils and is the dominant climax species. Group IB soils are well-suited for growing hardwoods with less nutrient and moisture demands such as white birch and northern red oak. Softwoods generally are scarce to moderately abundant and managed in groups or as a part of a mixed stand.



Group IC: Group IC soils are derived from glacial outwash sand and gravel with coarse texture which is somewhat excessively drained to excessively drained and moderately well drained. Soil moisture and fertility are adequate for good softwood growth but are limiting for hardwoods. Successional trends on these soils include stands of shade tolerant softwoods such as red spruce and hemlock. White pine, northern red oak, red maple, aspen, gray birch, and paper birch are common in early successional stands. These soils are well-suited for high quality softwood saw timber, especially white pine. Less site-demanding hardwoods such as northern red oak and white birch have fair to good growth on sites where soil moisture is more abundant.

Timber harvesting, like any removal of vegetative cover, increases the velocity and volume of stormwater runoff and can result in sedimentation of surface waters. This is a particularly important concern on land areas with steep slopes, where much of the commercially marketable timber in the Region is located.

Much progress has been made regarding the development of best management practices, which, if followed, enable logging to be done with less damage to the land or surface waters.

A number of factors suggest that there is an increased need to develop local and statewide policies that specifically address land use issues relating to the Region's forests, including:

- The Region's growth is placing pressures on forest land for conversion to more intensive uses;
- Housing development on the fringes of large tracts of forested land increases the dangers of forest fires and also increases the threat to life and property should a fire occur as well as the increased likelihood of invasive species penetrating the forest;
- National demand for lumber and finished wood products makes timber harvesting attractive to woodlot owners;
- High energy costs and the uncertainty of energy supplies have spurred a rapidly expanding fuel wood, biomass, and wood pellet market. This places additional reliance on our forests as an energy resource, yet provides new opportunities for the region's landowners, producers, and consumers; and
- Ownership of forestland is increasingly fragmented, complicating efforts directed toward sound forest management and providing critical wildlife habitats.

Forest Health

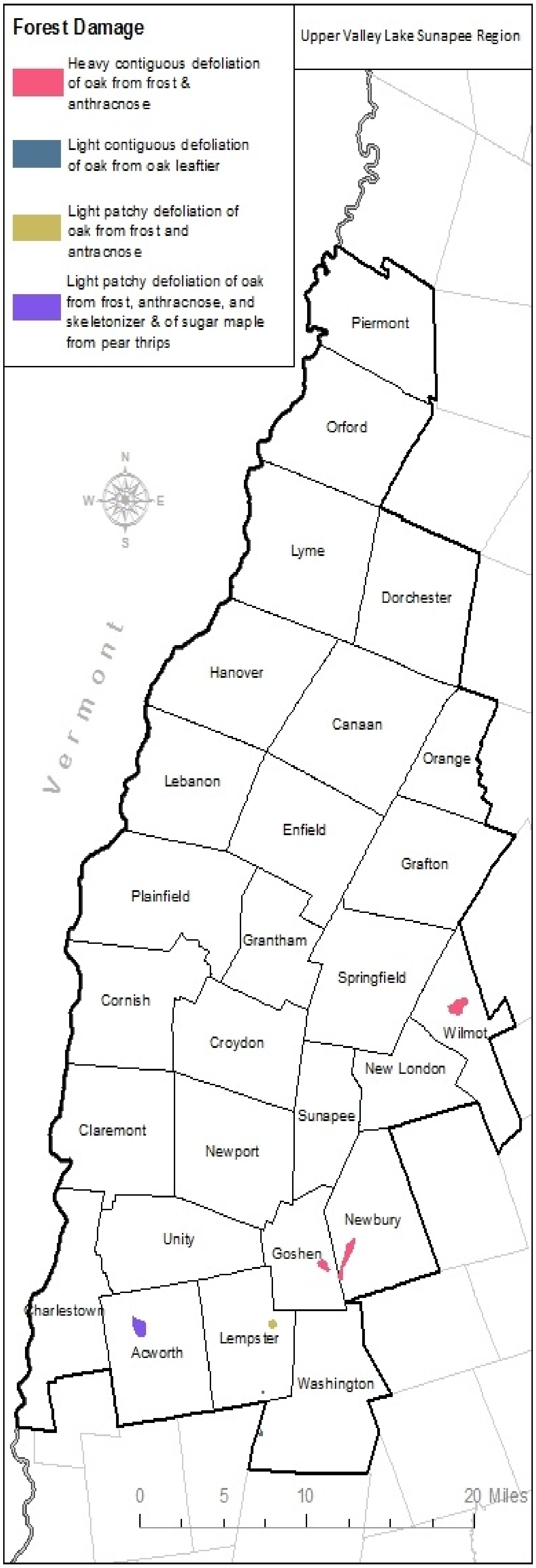
The effects of climate change on the forests of New Hampshire remain uncertain. This phenomenon may even increase forest growth, and we simply do not know enough to suggest long-term effects on the trees directly from climate change.

As we have more international and interstate travel, more invasive species enter our lives and affect the natural environment. Many invasive insects, fungi, and bacteria have been introduced to our forests causing disease and killing various species of trees. In 2011, the State of NH implemented a ban on untreated, out-of-state firewood in NH without a commercial or home heating compliance agreement to prevent the spread of invasive species to our forests. The State also implemented a quarantine of all hardwood firewood, ash wood products and all nursery stock is in effect for Merrimack County.

The three insects of greatest concern today are hemlock woolly adelgid, emerald ash borer and Asian longhorned beetle. At the moment, the Asian longhorned beetle is still in the Worcester, MA area and heroic efforts, at great cost, are attempting to eradicate it. The other two insects are found in New Hampshire, but fortunately, only affect two genera: ash and hemlock. No big losses have occurred yet in New Hampshire, but hemlock wooly adelgid is being found throughout southern NH counties and a recent discovery of emerald ash borer in the Concord area is substantial.

Spruce budworm may show up again which could affect acreage in New Hampshire including ecologically sensitive high elevation zones. The last outbreak was in the late 1970s, and it resulted in the mortality of vast acreages of spruce-fir forests from Maine to New York. Should another outbreak of spruce budworm appear, it could have significant effects in the very spruce-fir forests that regenerated beginning in the late 1970s following the last outbreak.

There are many other invasives in our midst including pine canker, gypsy moths, elongate hemlock scale, red pine scale, white pine blister rust, and the winter moth. Defoliation of trees has been caused by Anthracnose (sugar maple and birch), Oak Leaftier, Pear Thrips (fruit trees and other trees, especially sugar maple), Oak Skeletonizer, and Balsam Wooley Adelgid.



And there are even more invasives which are no longer as well-known since they have killed off certain species of trees and are no longer in the media. However, we should not forget elm trees that lined our main streets and which disappeared due to Dutch Elm Disease, or butternut trees that succumbed to Butternut Canker, or the chestnut tree that used to inhabit the Connecticut River Valley before the Chestnut Blight was brought from Asia in the early 1900s. Research still goes on to find elm, butternut, and chestnut trees that are resistant to these earlier invasive killers.

Lastly, invasive plants, such as autumn olive, buckthorn, Japanese knotweed, bittersweet and garlic mustard all appear to be growing in area and reach. As these invaders become more established, forest trees are being affected and in some cases are crowded out by these invasive plants. Factors impacting the spread of invasive species include soil disturbance, poor land management, and little control of the spread of invasive species by seeds and plant parts.

Economics of Forests

New Hampshire forests cover 84% of the State and have been at this level since the 1980s. Individuals, families, and businesses own over 76% of the forest, the State owns 5%, and the federal government, primarily through the White Mountain National Forests, owns 14%. The annual value of sales or output of NH's forest products industry totals nearly $1.4 billion while the forest-based recreation economy is also worth approximately $1.4 billion. Landowners received approximately $30 million in stumpage payments for timber harvested in 2012. Of that, approximately $3 million was paid in timber tax to NH communities. (North East State Foresters Association, 2013)

There are many reasons for a private owner to hold on to forested land including wildlife habitat protection and viewing; recreation; land protection; and timber production. Although some may enjoy the resources to own land for its own sake, most of us rely on income from the forest to hang onto it. This income can be generated from logging for building materials, pulp, and chips; maple syrup production; and Christmas trees.

The economics of forests is not just about production and sale of wood products or wood fuel. Indirect benefits include employment; purchases such as equipment, parts, fuel, insurance; and taxes such as timber tax. The NH Timberland Owners Association and Plymouth State University have recently begun a study to evaluate direct and indirect economic activity associated with timber harvesting. This will provide information not currently available, and the study should be complete by the beginning of 2015.

Carbon in Our Forests

Carbon dioxide is a naturally occurring greenhouse gas that contributes to global warming and climate change, and has been on the rise from various human activities. The largest amounts of carbon dioxide emissions are from the burning of fossil fuels for electricity, transportation and industry. Many laws and strategies have been put into place to try to regulate and reduce carbon emissions.

Forests help to naturally take carbon dioxide out of the atmosphere and emit the oxygen we breathe. The trees capture and store most of the carbon in the process of terrestrial carbon capture and sequestration. Trees absorb carbon dioxide through photosynthesis and are often referred to as carbon sinks. Most of the carbon is initially stored in the stem, branches, and foliage. The carbon can also travel through the tree and is stored in the roots, soil, and fallen leaves. This process stores a significant amount of carbon. However, some is lost back into the atmosphere through respiration and the decomposition of organic matter.

A recent study by the University of Connecticut's Center for Land Use Education and Research (CLEAR) and the Department of Energy and Environmental Protection (DEEP) researching the loss of carbon sinks (forests and vegetated landscape) due to land use change due to sprawling regional development. The purpose of the study was to find out if "land conservation and strategic land use planning could prove more cost-effective public policy instruments, on a dollar per dollar basis, for states to reduce carbon emissions". The study found that over a 25 year period (1985-2010), through deforestation for development and land use change, the amount of carbon sequestration by carbon sinks in the state of Connecticut has decreased below the amount of carbon emissions of the state per year. The amount of carbon emission has not changed much over the 25-year period. The conclusion was that forests and vegetation provide an important resource to reducing the amount of carbon that gets into the atmosphere affecting global warming and climate change. The results also indicate that avoided deforestation, more compact development, or redevelopment of carbon sinks can reduce carbon levels more cost effectively than many current emissions proposals.

The Upper Valley Lake Sunapee Region has a vast amount of forested land but has also been affected by development and sprawl. Although this particular study has not been done for the Region or the state of New Hampshire, the results of Connecticut's study show the importance of the protection of forests and its effects on climate change.

Improvement Strategies

New Hampshire RSA 79-A:1 states that it is in the public interest to encourage preservation of open space by conserving forest and other natural resources. There are a number of mechanisms to accomplish conserving forest lands which have been used in the region.

A zoning ordinance may be used to protect large forest tracts by requiring large lots in specific areas of the municipality where the goal is to encourage forestry and timber harvesting. For example, the Town of Lyme established a Mountain and Forest District with a minimum lot size of 50 acres. Their master plan supported the larger lot size and the selection of the lot size was not arbitrary as noted in a 1995 NH Supreme Court Case.

According to 1995 court expert testimony, 50 acres is the minimum size for profitable forestry. Smaller lots can create access problems as the timber harvester must gain permission to cross abutting lots, and there is less opportunity for harvesting on smaller lots.

Other methods to maintain large tract forests are voluntary conservation easements by the property owner and purchase of tracts of forest by the municipality and/or conservation organizations.

Forest Improvement Strategies
• Enhance public education programs promoting good forest stewardship and best management practices for the sustainability of private nonindustrial forests.
• Prioritize the conservation of large, connected blocks of unfragmented forests.

5.4 WATER RESOURCES

Vision

All of the region's water resources will be maintained, restored, and/or protected to ensure the quantity and high quality of drinking water and aquatic habitat.

Existing Conditions

Watersheds

Watersheds are the catch basins for all precipitation. Rain or snow falling on the area of land within the confines of a watershed's interconnected ridge crests or high points eventually becomes surface water and groundwater. A watershed is usually associated with the particular river or stream it feeds. For example, the Connecticut River drains a watershed including parts of Canada, New Hampshire, Vermont, Massachusetts and Connecticut. Each tributary to the Connecticut River has its own watershed area that ultimately feeds into the Connecticut River and is a sub-watershed of the larger watershed. The Sugar River is a tributary river feeding into the Connecticut River. Surface water in one watershed will not enter another watershed on the opposite side of the ridge because higher elevation ridges divide one watershed from another. Groundwater can move between watersheds.

The area contained within a watershed is a very important consideration in community planning efforts. Quite often, a particular small watershed lies entirely within a single community, while larger watersheds usually do not. Water resources management and protection in a community may have a substantial impact on the water resources of a neighboring town at a lower elevation with connecting watersheds. Therefore, it is very important for communities to work together in order to plan effectively to protect water resources.

For more than 40 years, policy makers have been working to reduce acid rain, a serious environmental problem that can devastate lakes, streams, and forests and the plants and animals that live in these ecosystems. Now new research funded by the NH Agricultural Experiment Station (NHAES) at the University of New Hampshire College of Life Sciences and Agriculture indicates that lakes in New England and the Adirondack Mountains are recovering rapidly from the effects of acid rain.

Researchers found that sulfate concentration in rain and snow declined by more than 40 percent in the 2000s, and sulfate concentration in lakes declined at a greater rate from 2002 to 2010 than during the 1980s or 1990s. During the 2000s, nitrate concentration in rain and snow declined by more than 50 percent and nitrate concentration declined in lakes.

"This is really good news for New England. Lakes are accelerating in their recovery from the past effects of acid rain. Our data clearly demonstrate that cleaning up air pollution continues to have the desired effect of improving water quality for our region's lakes," said NHAES researcher William McDowell, professor of environmental science and director of the NH Water Resources Research Center.

In addition to McDowell, the research team included Kristin Strock, assistant professor at Dickinson College; Sarah Nelson, assistant research professor with the Senator George J. Mitchell Center and cooperating assistant research professor in Watershed Biogeochemistry in the UMaine School of Forest Resources; Jasmine Saros, associate director of the Climate Change Institute at UMaine and professor in UMaine's School of Biology & Ecology; Jeffrey Kahl, then-director of environmental and energy strategies at James Sewall Company.

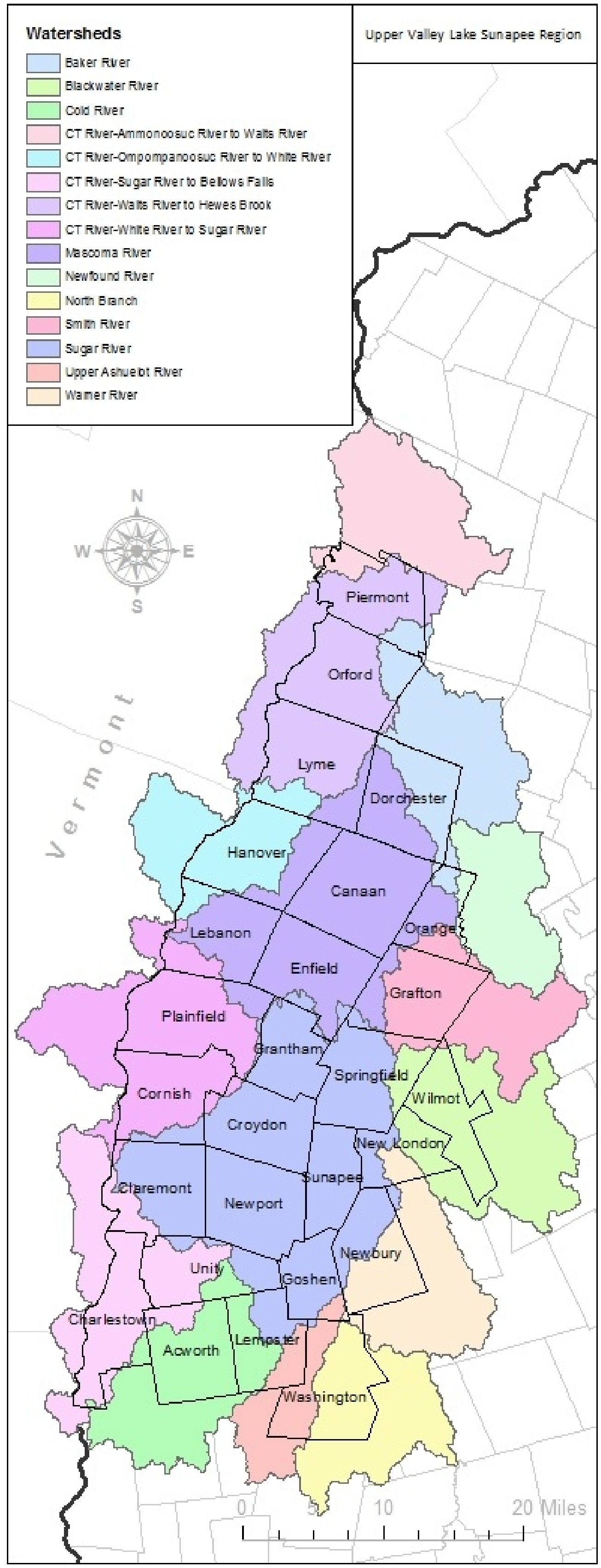
Researchers analyzed data collected since 1991 at 31 sites in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and southern New York and 43 sites in the Adirondack Mountains of New York. The results are presented in "Decadal Trends Reveal Recent Acceleration in the Rate of Recovery from Acidification in the Northeastern U.S." in the journal Environmental Science & Technology.

According to the U.S. EPA, acid rain refers to a mix of wet and dry materials from the atmosphere containing higher-than-normal amounts of nitric and sulfuric acids. The precursors of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur dioxide and nitrogen oxide resulting from fossil fuel combustion.

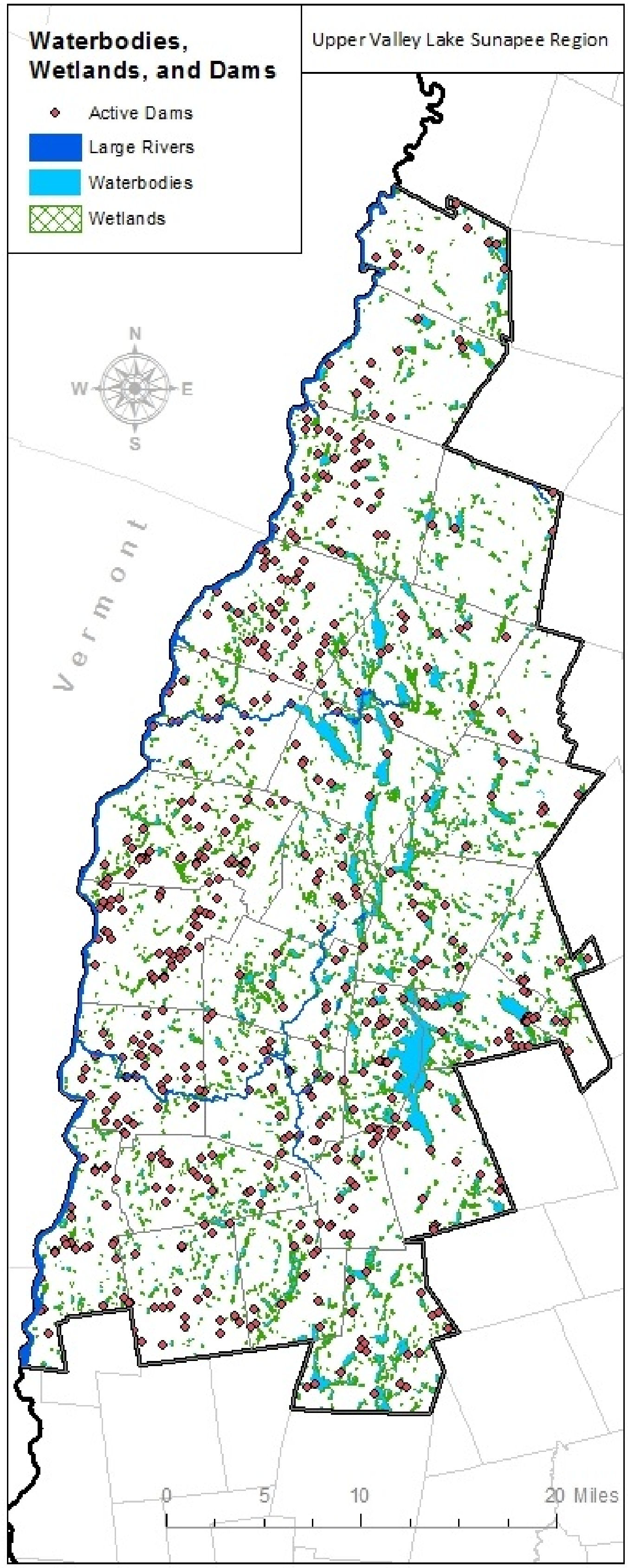
In the United States, roughly two-thirds of all sulfur dioxide and a quarter of all nitrogen oxide come from electric power generation that relies on burning fossil fuels, such as coal. Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. The result is a mild solution of sulfuric acid and nitric acid. When sulfur dioxide and nitrogen oxides are released from power plants and other sources, prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.

The watershed approach to water resources planning makes sense because watersheds are the main units of surface water and groundwater recharge. The size and physical characteristics of the watershed have a large influence on the amount of water that, ultimately, will end up as surface water and groundwater. In addition, the land uses located within a watershed have a direct impact on the water quality and flow.

Watersheds with a large proportion of forested land are more likely to provide high water quality. Forests are living filters that protect our aquatic ecosystems, drinking water supplies, and human health. Forests protect soils and moderate stream flow, and support healthy aquatic systems thus creating better water quality. Conversion of forest to other land use leads to reduced water quality due to an increase in runoff, soil erosion, downstream flooding, and pollutants entering rivers and streams. These contaminants in surface water can directly affect the quality of groundwater. Surface water and groundwater can be connected by the stream feeding the groundwater, the groundwater feeding the stream, or a system where they both feed each other. It is all the same water and can carry contaminants from one to the other. This is especially significant in the northeastern U.S. and our region due to the use of many private wells—60% of NH residents rely on groundwater for drinking water.



The largest watershed in our Region is the Connecticut River Watershed. The Connecticut River Watershed is broken up into sections beginning and ending with tributaries. Two of the major tributaries of the Connecticut River that have large watersheds in our Region are the Mascoma River and the Sugar River.[14] These two tributaries as well as the other HUC 10 watersheds in our Region can be seen on the Watershed Map.[15]



Surface Water

The Region has a large number of rivers and streams including the Connecticut, Mascoma, and Sugar Rivers that carry water resources throughout the region. Water bodies, such as lakes and ponds, constitute nearly 25855 acres, or 3.9%, of the area of the Region not including wetlands.[16] Aside from their recreation, wildlife habitat and scenic values, surface waters directly or indirectly contribute to our drinking water supplies. Depending on prevailing hydrologic conditions and their setting, surface waters often recharge groundwater during times of excess precipitation; likewise, groundwater discharges into surface water maintaining the base flow which becomes especially important during times of little or no precipitation or melting.

Wetlands and Buffers

Wetlands occur in every community in the Region as you can see on the Waterbodies, Wetlands, and Dams Map.[17] Wetlands and adjacent upland buffers are important in maintaining wildlife habitat and adequate water supply and quality.

Wetlands support almost two-thirds of New Hampshire's wildlife in greatest need of conservation.[18] Wetland conservation is important to wildlife habitat connectivity. Wetlands and natural, vegetated buffers serve as protection, homes, breeding grounds, and food sources to many diverse species of plants and animals. Buffers help maintain microclimate, protect the wetland habitat, maintain diversity, and reduce human impacts on the natural habitat.

Wetlands are important to maintaining water supply and quality. In times of flooding, wetlands can help store water and slow down the velocity of the water coming from the uplands to help prevent flash flooding. In times of drought, wetlands can release water to stream from stored water and groundwater that drains into the wetland. Wetlands remove excess nitrogen and trap sediment and contaminants, such as phosphorus, metals, solids, toxic waste, and stormwater runoff. Vegetated buffers of at least 100 feet can protect water quality by filtering most nutrients and contaminants. Buffers also help to stabilize soils and prevent erosion.[19]

Water Resource Protection

Under the Rivers Management and Protection Act (RSA 483), a Designated River is managed and protected for its outstanding natural and cultural resources. In the Upper Valley, the Connecticut River and the Mascoma River are Designated Rivers. The NH DES has developed management and protection plans for these rivers to keep the water quality and resources at their best.[20]

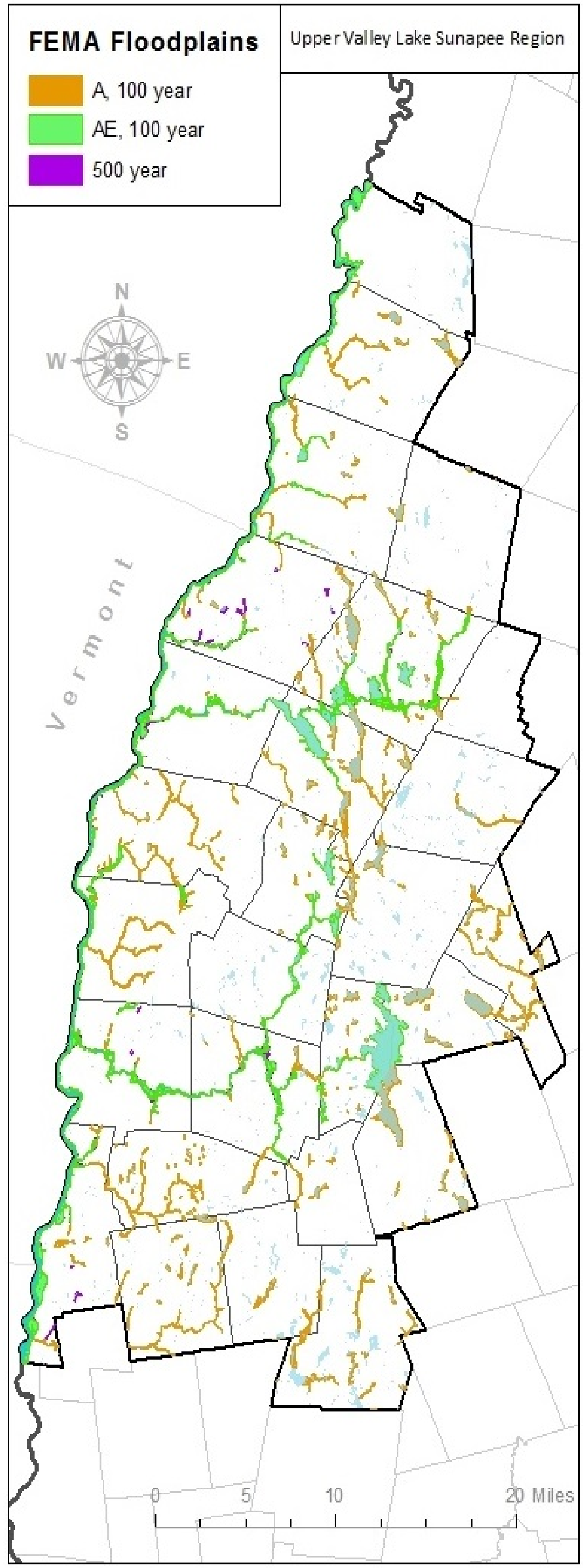
A water body is classified as impaired if it does not meet NH DES standards of water quality under the Water Pollution Control Act (RSA 485-A: 12) and is in need of a clean-up. If a water body is on the impaired list, no additional pollution loading that could contribute to impairment is allowed. The Water Quality Certification Program addresses these impaired waters and has various designations for protecting water quality and aquatic life, and for supporting recreational uses such as swimming and boating (NH DES WQC Program). Some notable impaired water bodies in the UVLS Region are Lake Sunapee, the Connecticut River in Plainfield and Lebanon, Mascoma Lake, the Mascoma River from Mascoma Lake to the Connecticut River, and the Sugar River in parts of Claremont, Newport, Goshen, and Croydon.[21]

Lake and watershed associations, including private non-profit organizations such as the Lake Sunapee Protective Association (LSPA) and the Connecticut River Watershed Council (CRWC) oversee water quality and related concerns.. These groups can also work with publicly supported broader-based entities such as Connecticut River Joint Commissions (CRJC), to coordinate protection efforts when water bodies straddle municipal and state boundaries. The Upper Valley Lake Sunapee Regional Planning Commission should continue to take a lead role in coordinating inter-municipal protection efforts.

In recent years, UVLSRPC's Connecticut River water resource planning activities have focused on a watershed approach to tributaries. UVLSRPC has continued working closely with the Connecticut River Joint Commissions and their local subcommittees to implement their Connecticut River Corridor Management Plan and has also been working with a few Connecticut River sub-watershed committees UVLSRPC assisted with a successful nomination of the Cold River to the NH Rivers Management and Protection Program and now provides staff support to the Cold River Local Advisory Committee, assisting with the development of a corridor management plan and providing other forms of technical assistance. In the Sugar River, UVLSRPC has developed and implemented an outreach program to educate officials about water quality protection needs. The local Mascoma River Local Advisory Committee has played a similar valuable role, including the nomination of the Mascoma River to the New

Hampshire Rivers Management and Protection Program. The UVLSRPC has also been providing technical assistance and outreach to the Mascoma Watershed Conservation Council.

In the Lake Sunapee area, a number of projects have been undertaken. In the late 1980's, as a first step toward working together to protect the area's important resources, the three towns of Sunapee, Newbury and New London began receiving direct assistance with the day-to-day activities of the towns' planning boards through UVLSRPC's Circuit Riding Planner program. This led to the creation of a full-time position for planning and zoning in Sunapee. In the early 1990's, UVLSRPC worked closely with representatives from each of these three shoreline communities to develop a model shoreline ordinance for the Lake and continued to work with the towns' planning boards to successfully gain adoption of many of the provisions of this model. Most recently, UVLSRPC, in cooperation with LSPA, conducted a comprehensive watershed study as the first step in a nutrient modeling project that will provide further insight into Lake Sunapee's land use-water quality connection.



Floodplains

After major flooding from Hurricane Irene in late August of 2011, the Region has made a lot of efforts to reevaluate development in its floodplains. Floodplains are those low-lying lands onto which water spreads out after overflowing the banks of streams and rivers during periods of snowmelt or heavy precipitation. In addition to providing critical storage areas for floodwaters, they provide the surface over which a river’s meanders can shift over time. The Floodplains Map shows the Regions 100 year and 500 year floodplains.[22]

Floodplain development results in damage to private property and public investments such as roads and utilities, risks to public health and safety, and increased flooding downstream. Floodplains provide important habitat for furbearing mammals, a number of amphibians, several species of turtles, and numerous breeding and migrating birds.[23]

Surface Water Quality

The establishment of water quality standards is one of the key components of the federal Clean Water Act, setting the desired water quality goals to be met by the state.

Water quality standards can be defined as specific provisions of state or federal law that are adopted to "protect the public health and welfare, enhance the quality of the water, and serve the purposes of the Clean Water Act."

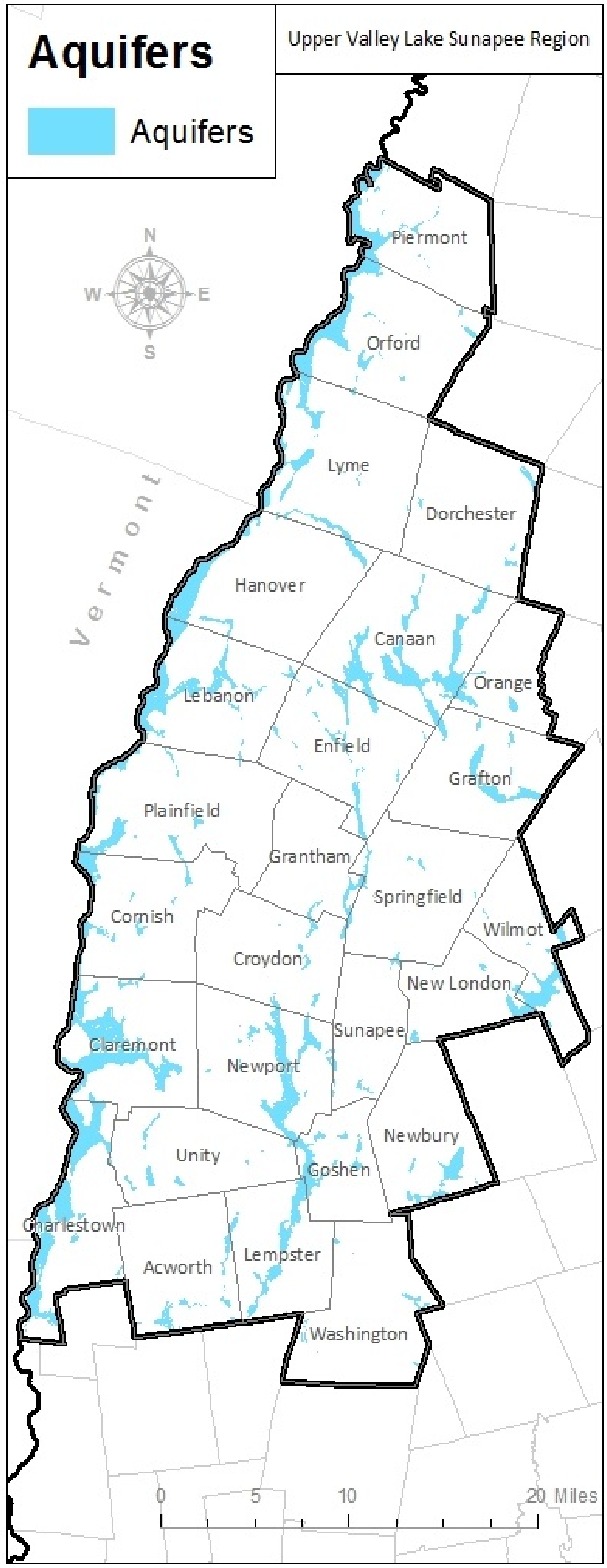
Water quality standards set a goal for the physical, chemical, and biological integrity of the state's waters are maintained and provide for the protection and propagation of fish, shellfish, wildlife, and recreation that takes place in and on the water. Water quality standards require states to designate various uses to their water bodies, which in turn determine the level of water quality to be achieved in order to meet the goals of the Clean Water Act. New Hampshire defines these designated uses by classifying the water bodies.

Since 1991, the surface waters of New Hampshire have been classified by the state legislature (RSA 485-A:8) as either Class A or Class B. Class A waters are considered optimal for use as water supplies after adequate treatment. Sewage discharges are prohibited in these water bodies. Class B waters are considered acceptable for fishing, swimming, and other recreational purposes, and for use as water supplies after adequate treatment has been applied. Classification reflects water usage but does not reflect actual water quality. Prior to 1991, some water bodies were in a Class C category and were considered usable only for non-contact recreational purposes such as fishing and boating, and for some industrial purposes. All Class C water bodies were legislatively upgraded to Class B in 1991. Water body classifications can be made for entire river or stream systems, or only for specific segments.[24]

Water body classifications are supported by establishing numeric and narrative criteria. Numeric criteria are specific measures of water quality that are considered scientifically sound in order to protect the designated use of the water body/segment. These usually include parameters such as dissolved oxygen, temperature, pH, metals, nutrient overload, algae, harmful bacteria, and toxic pollutants.

The final component of New Hampshire's Water Quality Standards are specific provisions established to ensure that degradation of existing beneficial uses and the level of water quality necessary to protect the existing uses are maintained and protected. These anti-degradation provisions apply to such things as new or increasing point and nonpoint discharges of pollutants, alterations to the hydrology of a system caused by dams or flow diversions, and all activities that would lower water quality and affect the beneficial uses. Provisions are established for Class A, Class B, and Outstanding Resource Waters, which include national forest waters and those designated as natural under the New Hampshire Rivers Management and Protection Program.[25]

The quality of our surface water is threatened by uses that take place not only on the shores of, but also within the watersheds of, our lakes, ponds, rivers and streams. For example, runoff from developments in steep slope areas in one town may result in erosion and the sedimentation of a brook or water body in another town far from the boundary of the parcel being developed. Improper silvicultural and agricultural practices may also result in erosion and sedimentation downstream. Contamination of water resources may be caused by nonpoint sources, such as road sand and salt, snow dumps, septic systems, pesticides, herbicides and fertilizer, or by discharge of domestic or industrial wastes. Some nonpoint pollution sources have been identified for New Hampshire towns by the Water Division of the NH Department of Environmental Services.



It is the nonpoint sources of water pollution that are difficult to effectively control. Unlike point sources of pollution where the effluent from the end of a pipe can be sampled, monitored and treated, nonpoint sources of pollution are incremental and dispersed making them difficult to manage. Land use developments generate nonpoint sources of water pollution temporarily during construction and on an ongoing basis after construction. The more intensively land is developed, such as higher density residential use and commercial and industrial use, the more impervious surface coverage is created, resulting in poorer water quality for receiving waterways. High density areas could be beneficial by leaving other areas open for protection, as opposed to allowing people to have large housing lots filled with chemically managed lawns or paved driveways and patios that increase impervious surfaces and nonpoint pollution. Increased imperviousness prevents water from soaking into the ground, increasing the amount of runoff, and the rate at which runoff occurs, thereby increasing the contributions of nonpoint source pollution to nearby waterways. In this Region, we are fortunate to currently have surface waters with good water quality.

Groundwater

Water that is found in the ground in the saturated zone of the ground – below the water table - pores of subsurface deposits is known as groundwater. The term aquifer describes water-saturated earth materials from which a water supply can be obtained. Sixty percent of the Region depends on groundwater aquifers as a main source of drinking water. (See Aquifer Map[26]). There are three types of aquifers in New Hampshire: stratified drift, till and bedrock. The basic difference is that stratified drift and till aquifers are composed of unconsolidated glacial deposits (loose earth materials), while bedrock aquifers are solid rock. In stratified drift aquifers, the materials are sorted sand and gravel. In till aquifers, the materials are an unsorted mixture of gravel, sand, silt and clay. In bedrock aquifers, the rock contains a varying size and quantity of fractures allowing the water to seep through and collect in the aquifer.

The amount of water that an aquifer can yield depends on factors such as aquifer material type, porosity, depth of saturation, and the extent (size) of the aquifer. Considering this type of information for the aquifers in the Region, an assessment of an aquifer's capability and importance as a water supply could be made. The higher the transmissivity (the potential for an aquifer to supply water to a well at any given location – calculated by multiplying the hydraulic conductivity of the aquifer material by the saturated thickness of the aquifer at that location), the more likely it will supply larger volumes of groundwater for longer periods.[27]

Wells are used by communities and private individuals to draw groundwater from an aquifer. In the Region there were over 3100 reported water wells in 2005.[28] Water users, such as a community or a commercial-industrial operation, typically require large volumes of water. To supply this amount of water on a continual basis, the well must have a large yield capacity. Only certain aquifers with the right hydrogeological characteristics may yield these amounts. On the other hand, the small volume residential or commercial user may not need a large volume well to supply its needs. A small volume domestic well will usually suffice and can be located most anywhere. However, when considering an aquifer's ability to supply water, the combined affect of many individual wells pumping from the same aquifer must be considered. In addition, large-volume wells may have a localized negative impact on an aquifer, unless well locations and pumping rates are regulated.

The water being pumped from wells generally comes from some of the precipitation landing within a watershed that seeps into the ground through a layer of permeable material. This water is commonly referred to as groundwater or aquifer recharge. Aquifer recharge may be differentiated into what is called direct and indirect recharge. Direct recharge is water falling directly over an aquifer's surficial extent, which is not lost to plants, soil moisture or evaporation, and which makes it way down into the aquifer. The direct recharge areas for stratified drift and till aquifers are the respective glacial deposit's surface areas. Direct recharge for bedrock aquifers is basically the entire overlying watershed. Indirect recharge involves water that is direct recharge to till or bedrock aquifers but moves through these aquifer areas and into stratified drift aquifers from which most high yielding wells draw water.

For the purpose of managing potential threats to the quality of water that reaches public water supply wells, the NHDES identifies a “wellhead protection area” (WHPA) for each well. The WHPA is the area from which groundwater and surface water are likely to reach the well. The Region has 75 WHPAs. WHPAs have been delineated for Enfield's Water Department’s wells and those associated with the Eastman Estates, as well as many other systems in the study area. These studies provided good examples of the inter-town nature of groundwater resources. Enfield's wells are located along the Enfield-Canaan line, with the bulk of the wellhead protection area in Canaan and a small portion in Hanover. Eastman Estates, a development primarily in Grantham, has its wells in neighboring Springfield. The majority of the associated wellhead protection area is also in Springfield.

Groundwater favorability maps have been produced by NH state agencies in cooperation with the United States Geological Survey. These maps show the general stratified-drift aquifer with a high, medium or low potential to yield water. The information is not presented at a scale which permits accurate boundary delineation but it does identify the general areas likely to be important as future groundwater sources, and therefore good areas for protection. The maps show that many of the Region's important aquifers are located along watercourses.

The NH Department of Environmental Services has been conducting detailed studies and GIS mapping of stratified-drift aquifers for several years in cooperation with USGS. GIS data for the lower Connecticut River basin is available at UVLSRPC and has been supplied to communities in that basin. A report and paper maps with the new detailed data are also available for the Lower Contoocook basin, which includes portions of Newbury and New London. This information will be of great help to communities for planning the protection of potential future water supplies.

With a view to identifying areas that have the greatest potential for high-yielding municipal wells, NHDES has also analyzed the available information about stratified-drift aquifers in light of the constraints to siting high-yield wells. The result, DES's Favorable Gravel Well Analysis, is available in both hard-copy and electronic forms. It is particularly useful in visualizing the extent to which potentially high- or medium-yield well sites are no longer available as a result of land uses that are incompatible with water supply wells, and which areas remain available.

The primary sources of groundwater contamination in New Hampshire are: fuel storage and transfer, improper management of hazardous waste, salt piles and salted roads. The State has instituted underground storage tank regulations to prevent groundwater contamination by leaky tanks and the associated piping. However, the state regulations only apply to commercial tanks over 1,000 gallons. Other groundwater protection techniques are discussed in a later section of this chapter.[29]

Improvement Strategies

- *Shift Program Focus to Watersheds and Sub-Watersheds and not just Water Bodies*

Currently most programs and regulations are focused on separate types of resources (e.g rivers, lakes, wetlands, groundwater) and uses. All of these issues are interconnected and need to be managed as a single watershed resource to better ensure the quality and quantity of water for the Region. State and local governments can work together to create and manage watershed programs.

- *Include local wetland protection requirements in zoning ordinances*

Assist municipalities in reviewing and developing a wetlands overlay district for zoning ordinances. The NHDES Innovative Land Use Planning Techniques : A Handbook for Sustainable Development is a good tool to use.

- *Require Stormwater Management Plans for Large-scale Developments*

All new major development proposals should include a stormwater management plan emphasizing infiltration, encouraging on-site stormwater management, emphasizing open vs. closed drainage systems, encouraging vegetated vs. mechanical systems and minimizing impervious surfaces.

- *Develop local NWI and soil combination maps to best represent all wetlands*

Current NWI Maps do not show all wetlands. Combining local NWI and soil maps will better represent all wetlands in a municipality.

- *Protect Forests Uplands for Water Quality Assurance*

Forests play an important role in protecting surface drinking water quality. Working with the USDA and its Forests to Faucets project data to help identify areas that supply surface drinking water, have consumer demand, and are facing significant development threats; develop conservation and management plans based on these locations; identifies watersheds where a payment for watershed services (PWS) project may be possible.

- *Assist Municipalities in Developing Drinking Water Source Protection Plan*

Identifies long-term water supply protection and management issues and options. A source protection plan consists of 1.) identification of drinking water sources and the areas that contribute water to those sources (source water protection areas); 2.) inventory of potential contamination sources (PCSs) within source water protection areas; 3.) assessment of risks posed by those PCSs; 4.) management plan to minimize risks to the water sources; and 5.) contingency plan for responding to emergency loss of the water supply. This plan sets priorities for actions to take to protect a water source. Actions taken by water system management, surrounding landowners, and the larger community are key to achieving comprehensive protection.

- *Assist Municipalities in Developing a Water Resources Chapter in Local Master Plans*

The Master Plan is the key document in local planning determining what ordinances and regulations a municipality may adopt. This chapter of the master plan should inventory groundwater and surface water resources, with emphasis on the connection between drinking water supply, and wetlands, lakes, ponds, and streams.

- *Collect and Evaluate Data Related to Existing Sources of Drinking Water Supplies (Public and Private)*

Identifies issues related to the total quantity and quality of existing water supplies; growing water consumption; locates studies concerning future water supplies; evaluates gaps in protection (ordinances, regulations…); identifies potential natural and human-made contaminants in local surface and ground waters; evaluates whether they influence the viability of a water source; and identifies long-term public health risks.

- *Develop/Adopt Private Water Well Testing Program*

Private water wells supply drinking water to 35 percent of New Hampshire's population. Private wells are not regulated or monitored for water quality or quantity by federal or state agencies. DES registers new private wells and recommends communities to require water quality and quantity testing. Hollis has a good example of this type of program in its zoning ordinance overlay districts.

- *Adopt Local Regulations to Require Native Vegetation Riparian Buffers and Setbacks for Wetlands and Surface Waters*

Natural riparian buffers around wetlands and surface water (rivers, streams, lakes, ponds) are the most effective ways to protect water quality and quantity, as well as wildlife habitat. Lyme is a good example of the recommended 100ft vegetated buffer. Lyme regulates activities in the buffer zones to forestry, agriculture, conservation, and passive recreation.

- *Assist Municipalities in Developing Local Groundwater Protection Efforts*

Establish procedures for the classification and development of groundwater; protective management and remediation of groundwater affected by regular contaminants; develop Best Management Plans and work alongside New Hampshire's Groundwater Protection Act.

- *Assist Municipalities in Developing other Water Source Protection Plans and Ordinances (Groundwater, Surface Water, Drinking Water)*

Assesses current and potential future land uses and impacts on water supply protection needs; limits high-risk uses; establishes a district boundary based upon technical studies delineating watersheds, stratified drift aquifers, or wellhead protection areas; and requires buffers and setbacks, measurable performance standards related to stormwater management and control of regulated substances.

- *Develop Floodplain Management Programs that Consider Water Quality*

Assist in developing a regional watershed approach to manage water resources, quality, quantity, and development. Develop a flood hazard overlay zoning district. A common problem is new development directly outside of floodplain causing more impervious surfaces leading to more stormwater runoff. This causes an extension of the floodplain and more contaminants being carried to source drinking water. (See Hazards Chapter for more Floodplain Management details and Strategies).

5.5 BIODIVERSITY

Vision

The region will protect and enhance our biodiversity by minimizing high value habitat loss and effectively controlling invasive species.

Existing Conditions

Biodiversity is the variety of life in all its forms and all the interactions between living things and their environment[30]. Biodiversity includes all of the species which inhabit an area, the interactions among species and the interactions with the immediate and surrounding environment. Biodiversity is a fundamental component of ecosystem health and integrity.[31] For example, the number of plants in an ecosystem has a profound effect on ecosystem functioning. Therefore, greater diversity is likely to enhance ecosystem functioning. Long-term scientific experiments conducted in Cedar Creek, CO, studying "Big Biodiversity," found that ecosystems with greater biodiversity were

Status and distribution of 21,395 plant & animal species in the US (NH rank)	
State Plant & Animal Diversity	2327 (rank 44)
Risk Level	2.8% (rank 43)
Endemism	5 (rank 33)
Extinctions	Total extinct (2) / Presumed Extinct (1) / Possibly Extinct (1) / (rank 44)
Vasular Plant Diversity	1631 (rank 40)
Vasular Plant Risk	2.1% (43)
Mammal Diversity	64 (42)
Mammal Risk	1.6% (45)
Bird Diversity	283 (rank 38)
Bird Risk	1.4% (rank 38)
Reptile diversity	19 (rank 46)
Reptile risk	10.5% (rank 14)
Amphibian Diversity	21 (rank 34)
Amphibian Risk	0.0 (rank 32)
Freshwater Fish Diversity	50 (rank 41)
Freshwater Fish Risk	6.0% (rank 40)
Source: Bruce A. Stein. 2002. States of the Union: Ranking America's Biodiversity. Arlington, Virginia: NatureServe.	

more productive and stable, better able to soak up carbon dioxide emissions, and that the value of biodiversity grew over time. The loss of biodiversity has the potential to negatively impact ecosystem functioning as a whole. [32] Biodiversity in New Hampshire is relatively stable, according to data from NatureServe (2002), compared to other states in the country. While there may be *less* risk to biodiversity here, there is still risk. NH is the fastest growing state in the Northeast, with an increase of more than 17% from 1994 to 2004.[33] The greatest threat to biodiversity in New Hampshire is the conversion of wildlife into development also called habitat destruction.[34] Habitat degradation and habitat fragmentation are also part of development and increase risk to the long-term survival of species. Therefore, limiting future threats from of the impacts of climate change and non-native invasive species will be critical.

In the Upper Valley Lake Sunapee (UVLS) region this can be partially addressed by municipalities through the Master Planning process, and regulatory means such as subdivision regulations and zoning ordinances. An important step to protecting biodiversity and other natural resources in our communities is, of course, to first learn what exists. This can be effectively accomplished by conducting a town-wide natural resource inventory (NRI). Many of the towns in the UVLS Region have already addressed the importance of protecting biodiversity within their communities through some of these measures.

Fragmentation, especially in combination with habitat loss, poses one of the greatest challenges to conserving biodiversity and is compounded by a changing climate. Maintaining habitat connectivity has emerged as a point of agreement among scientists for providing a permeable landscape in which all species can adapt to changes, especially when this is done in conjunction with protecting high quality habitat.[35]

Protected Lands and Protected Habitats

Approximately 27% of the state of NH is protected. Most of this land is federally protected as part of the White Mountain National Forest, but about 75% of that land is predominantly in the northern part of the state.[36] The State Department of Resources and Economic Development owns a variety of lands referred to as "reservations," which includes state forests, state parks, natural areas, historic sites, geologic sites, recreation trails, memorial areas, wayside areas, resource centers, state forest nurseries, heritage parks, information centers, agricultural areas, fishing piers, administrative facilities, demonstration forests, islands, and lands under lease to the department.[37] Each land category has different management goals. For example, state parks are properties with developed or otherwise specific recreation uses and state forests are associated with undeveloped land and managed for a variety of natural resource values and may have some public restrictions.[38] Approximately 5.7% of the state-owned forest lands are within the UVLS Region. (See Section 5.3 of this plan for additional details on state forests in the UVLS Region.)

The Fish and Wildlife Department manages lands primarily as Wildlife Management Areas (WMAs). The State of New Hampshire, Fish and Game Department owns more than 5,000 acres in the Region and manages the lands for wildlife habitat, called *Wildlife Management*

Areas. (See Section 5.3 of this plan for additional details on Wildlife Management Areas in the UVLS Region.)

Regardless of ownership, permanent land protection, both public and private, is viewed as the surest and most effective tool to ensuring the protection of biodiversity.[39] In sum, the state owns approximately 22,170 acres of land within the UVLS region and UVLS municipalities own another 3,926± acres. Municipal lands are typically held for facilities, town forests, parks and public open space. There is a variety of levels of protection on both state and municipal lands. An additional 2,785± acres of privately protected permanently conserved lands are within the Region. This amounts to nearly 60,000 acres of relatively protected, widely undeveloped land within the Region which provides essential habitat for wildlife and plants.[40]

State and Federal Programs

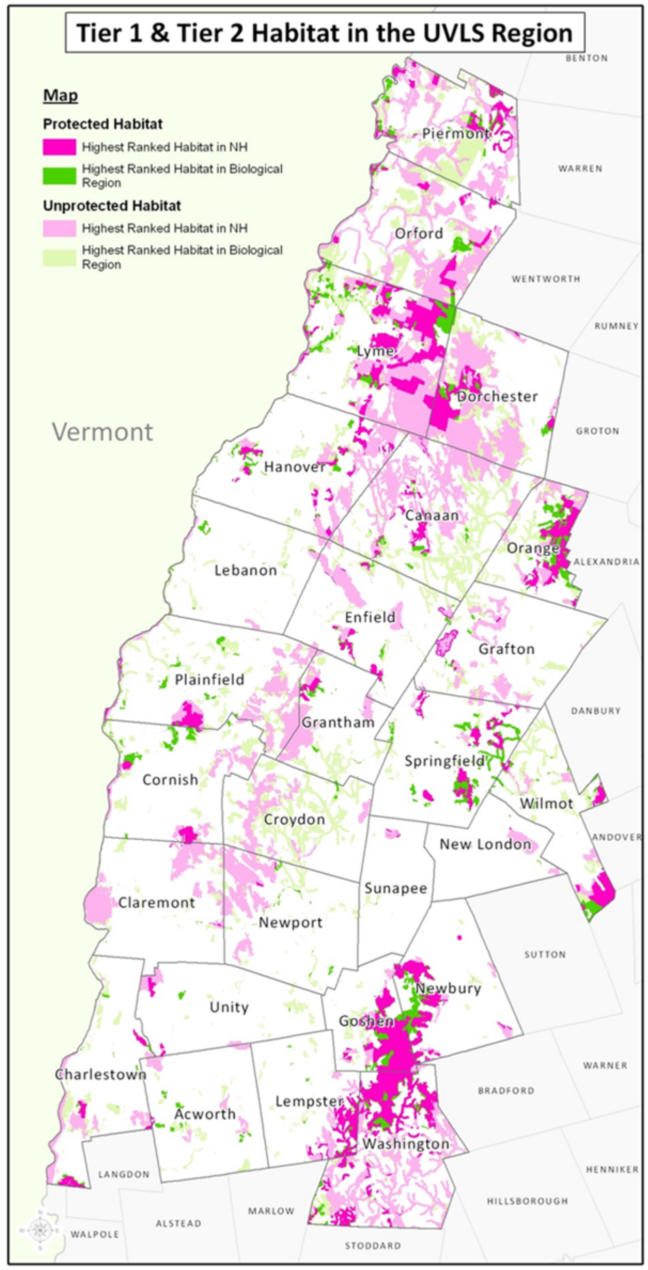
In 2001, Congress created the Wildlife Conservation and Restoration Program and State Wildlife Grants Program to support wildlife conservation before species become endangered and expensive to protect. Part of this program required that each state devise a Wildlife Action Plan (WAP) to conserve wildlife habitat and critical habitat. The New Hampshire WAP, first approved in 2006, updated in 2010 and amended to include a section about change in 2013, is unparalleled to any prior planning effort in the state. The plans must have a variety of components at minimum including: the distribution and abundance of wildlife species; descriptions of locations and relative condition of key habitats and community types; descriptions of risks which may affect species or their habitats and should include priority research and survey efforts; descriptions of conservation actions; proposed plans for monitoring identified species and their habitats; 10 year plan review; plans for coordinating the development, implementation, review and revision of the plant with federal, state and local agencies; and a public participation strategy.[41]

State of NH - Conservation Land - by Municipality and Ownership Type

Source: Provided by NH Department of Revenue Administration, Municipal & Property Division; Data source: NH GRANIT Conservation Lands Layer, most recently updated April 2013

Municipality	Fee Ownership Type				Total Fee Ownership Acres
	Federal Acres	State Acres	Municipal Acres	Non-Profit Acres	
Acworth		208.59	1,724.89		1,933.49
Canaan		437.15	20.20	62.33	519.68
Charlestown		1,021.98	496.73		1,518.71
Claremont		111.70	435.47		547.17
Cornish	139.12	55.26	493.70	669.44	1,357.52
Croydon					0.00
Dorchester	64.77	510.19		11.87	586.84
Enfield		4,166.80	54.10	616.32	4,837.22
Goshen		1,017.53		114.82	1,132.35
Grafton		209.31		1,434.84	1,644.16
Grantham		22.20	443.37	456.43	922.00
Hanover	1,943.86	19.38	1,744.45	640.76	4,348.44
Lebanon		27.94	85.11		113.05
Lempster		395.73	980.07	1,992.30	3,368.10
Lyme	3,340.30	59.41	304.79	351.49	4,055.99
New London			363.21	233.84	597.05
Newbury	165.05	2,860.90		1,242.96	4,268.92
Newport		72.98	269.45		342.42
Orange		4,741.98		71.25	4,813.22
Orford	1,261.82	72.03			1,333.85
Piermont	2,207.71	295.52	199.33		2,702.56
Plainfield		108.77	388.02	630.11	1,126.89
Springfield		7,105.74	374.97		7,480.71
Sunapee		151.53	420.92		572.45
Unity		12.44	1,514.65		1,527.09
Washington		5,008.42	759.16	668.62	6,436.20
Wilmot		1,740.02		172.78	1,912.81
Total in UVLS Region		**22,170.33**	**3,926.50**	**2,785.72**	**59,998.89**

While the WAP is not regulatory in nature, the science-based approach helps inform municipalities about existing natural resources. Scientific and geographic modeling, largely co-occurrence modeling, was utilized to identify areas within the state of the greatest conservation need. In the Plan, habitat types were digitally mapped and then ranked according to their biological condition and risk of degradation. The figure right illustrates the Region's protected and unprotected Tier 1 & Tier 2 wildlife habitat. Tier 1 is of greatest conservation priority because it represents the top 10-15% of habitat in the entire state. Tier 2 is habitat that is of high conservation priority at a regional scale because each region has unique species and habitat types that are unique and therefore important to that particular area. Some of these habitats are already protected either as state, municipal or private conservation lands. Municipalities can prioritize permanent protection by identifying lands in their community which are unprotected Tier 1 or Tier 2 habitat, of highest priority to the State and the Region. Figure 2 clearly illustrates that there is still a lot of important habitat unprotected and vulnerable to development and other risks in the UVLS region, particularly the northern section.



The Natural Heritage Bureau (NHB) facilitates the protection of the state's biodiversity by maintaining records about rare, threatened and endangered plant and animal species within our state as well as rare and/or exemplary locations of natural communities. Municipalities can use this information to assist prioritizing areas of biological priority within their community. While this may be considered a "coarse" approach and may not capture other important species occurring within a region, it is useful, particularly in towns which have not invested in a natural resource inventory (NRI). An NRI would yield the most comprehensive information and would incorporate the NHB information into the report as well as verifying the NHB information. Additionally, the NHB suggests that its statewide data can be used as a reference to assist in the identification of high quality examples of natural community types and that by protecting these areas and connections among them this would ensure that ecological processes remain functionally intact, and therefore, regionally important.

The Land and Community Heritage Investment Program (LCHIP) is a competitive program funded through state appropriations and license plate fees to help fund public and private land conservation projects throughout the state. For the fiscal years of 2014 & 2015 there is approximately $4,000,000 available. Towns, cities, counties and not-for-profits can present a project with request for funding which much matched by private funds or funds from another grant. Depending on the project, the information in the application may include data from the NH WAP and from the NH NHB. Of the more than 700 applications that the program has received since it began in 2000 it has helped conserve over 260,000 acres in the state, impacting more than 141 different communities.[42]

A commonly used statewide program which assists in protecting natural resources, although not permanently, is the Current Use (CU) Program (RSA 79-A). Current Use was enacted in 1973 with the purpose of protecting open space. Today, it serves an important role in maintaining traditional land uses and therefore preserving the rural character or the state. This is incentivized through the utilization of a tax rate which is based on the traditional uses of the land, such as agriculture and woodlots, rather than that of the economic "highest and best use" which is typically development[43].

Qualifying parcels, generally those with greater than 10 contiguous acres of undeveloped land used for farming, forestry or so-called unproductive land, can receive a significant reduction in their tax assessment. Wetlands of any size may also qualify. A substantial penalty is assessed when a tract is removed from the program for development. This program has effectively protected open space in the state of NH, with about 74% of eligible land enrolled in the program.[44] From 2000 to 2013 the program has enrolled an additional 5,324± acres into the program in the UVLS Region, an increase of about 0.8 %, amounting to a total of 464,435± acres, or 69.8% of the Region's land area enrolled in the CU program.[45] Over the past thirteen years, the most significant change in the type of enrollment is the amount of forestland that has documented stewardship, meaning the landowner is working with a forester and has a forest management plan.

Town	County Name	Farm Land Acres	Forest Land Acres	Forest Land With Documented Stewardship	Unproductive Land Acres	Wetland Acres	Total CU Acres	Total of Parcels In CU	Total Town Acres
Acworth	Sullivan	1892.12	11524.94	5986.83	209.77	124.4	19738.06	449	24998.9
Canaan	Grafton	1669.27	15026.69	7252.15	422	1326.21	25696.32	714	35275.9
Charlestown	Sullivan	2614.96	8934.45	2654.92	559.78	103.3	14867.41	394	24345.5
Claremont	Sullivan	3320.54	10956.98	3400.63	578.13	0	18256.28	477	28193
Cornish	Sullivan	2500.86	10521.98	8911.83	122.05	179.69	22236.41	527	27269.7
Croydon	Sullivan	561.57	6026.3	12329.4	1275.97	696.46	20889.7	158	24028.8
Dorchester	Grafton	218.6	3418.28	21950.78	119.76	510.5	26217.92	206	28889.9
Enfield	Grafton	637.15	10628.94	1271.46	73	368.13	12978.68	429	27615.6
Goshen	Sullivan	445.68	4744.49	5201.42	559.71	164.87	11116.17	210	14420
Grafton	Grafton	536.62	12875.16	5338.92	690.99	45.22	19486.91	400	27139
Grantham	Sullivan	193	3203	5411	1373	138	10318	194	17950.9
Hanover	Grafton	1374	12551	5101	187	233	19446	407	32087.1
Lebanon	Grafton	1449.31	6914.61	4069.83	446.51	475.67	13355.93	282	26415.2
Lempster	Sullivan	379.9	12025.76	1798.42	42.93	527.2	14774.21	345	20956.2
Lyme	Grafton	2946	12521	9805	293	600	26165	419	35215.8
New London	Merrimack	604	4177	1678	317	0	6776	281	16267.9
Newbury	Merrimack	313.51	5475.07	5694.44	485.79	271.04	12239.85	270	24382.6
Newport	Sullivan	1173.61	14459.94	3052.92	170.37	632.28	19489.12	501	27930.3
Orange	Grafton	160.69	7587.76	682.57	81.74	83.4	8596.16	134	14799.7
Orford	Grafton	1657.61	7809.77	14464.11	1274.38	73.57	25279.44	414	30577.8
Piermont	Grafton	2582.08	7439.96	7017.13	1172.55	530.03	18741.75	253	25582.2
Plainfield	Sullivan	2946.04	17128.37	6522.77	528.49	798.07	27923.74	604	33914.3
Springfield	Sullivan	608.61	8749.42	4178.89	53.19	498.59	14088.7	277	28478.8
Sunapee	Sullivan	497	4574	1007	260	407	6745	226	16099.1
Unity	Sullivan	829	13358.85	1847.05	822.67	23.28	16880.85	379	23806.3
Washington	Sullivan	465.3	10926.77	6873.63	334	610.99	19210.69	452	30524
Wilmot	Merrimack	648.13	9163.71	2650.46	189.89	268.8	12920.99	365	18955.4

Figure represents information provided by the NH Department of Revenue, Municipal and Property Division, for the state of NH in 2013. Information above pertains only to the Upper Valley Lake Sunapee Region.

Open forest lands which are provided as state lands, town lands and private conservation lands each play an important role in protecting biodiversity by:

- increasing permeability and connectivity which allows species to adapt to climate change and the ability to shift ranges and maintain genetic diversity;
- Preserving large blocks of forested habitat which is necessary for a number of species that are important to our state such as the black bear, bobcat, moose & white tailed deer.

Climate Change Impacts

How will climate change impact the Region's biodiversity? The complete answer is complicated because species will respond to changes in their environment based on their individual and specific habitat needs and physiological tolerances, which in turn influence community composition, structure and resilience.[46] In an attempt to understand this question, the State of NH amended the Wildlife Action Plan (2006) in 2013 with a document titled *Ecosystems and Wildlife: Climate Change Adaptation Plan*.[47] In just the eight years since the first WAP, the scientific community has developed a greater understanding of the potential changes of climate change and the magnitude of those changes. A large component of the 2013 NH WAP amendment was a set of habitat-based vulnerability assessments based on a modified list of the habitat classifications in the 2006 NH WAP. Of the 24 habitat types that the Plan addresses, there are 19 in the UVLS Region.

The 2013 NH WAP Amendment summarized the predicted changes to the NH climate as the following:

- Temperatures will increase, with a slightly larger median increase in winter than summer
  - More days per year with extremely high temperatures (> 90°F)
  - Fewer days with snow
  - Longer growing season (more frost free days)
  - Earlier ice-out, later ice-in of lakes and rivers
- Changes in total precipitation are uncertain, but seasonality and intensity is likely to vary
  - Increased winter precipitation, with more of it falling as rain
  - More frequent heavy rains
  - Increased likelihood of summer drought
  - Stream flow is likely to become more variable as a result of higher temperatures, drought, and more intense precipitation events
  - Fire is more likely as a result of higher temperatures and increased drought
  - Increased frequency of intense storms is predicted, including wind and rain
  - Sea level is expected to rise
  - Changes in ocean and estuary pH and salinity may occur as a result of increased freshwater runoff, temperature changes, shifting ocean currents, and increased CO2 dissolution.

These changes will undoubtedly affect all plant and animal species in the State and in the Region. The effects will directly impact plant and animal physiology, range location and extent, and phenology. Wildlife that may be more biologically and/or physically resistant to change will be required to adapt to the changes in their habitat distribution, altered plant species composition within ecosystems, altered physical conditions and/or a combination of these factors.[48] Many species will change their geographic range, migrating northerly and to higher latitudes. The changes are expected to have rippled effects within ecosystems and not all species responding to the changes at the same rate. Changes in phenology, such as timing of resource availability and changes in flowering or nesting dates may also alter community dynamics including such interactions as predator-prey competition and herbivore-vegetation dynamics as well as species co-occurrence patterns.[49] Many changes will impact those species which will have the most difficulty adapting. According to the USDA's Climate Resource Center, characteristics of species and communities most at risk include those with specific and restricted geographic ranges, currently fragmented distributions or at risk of fragmentation, and those that already survive at the margins of their range. Additional risk factors include limited dispersal ability, low genetic diversity, a species strong affinity to aquatic habitats, narrow physiological tolerance, and late maturation.[50]

Habitats

Freshwater Ecosystems

Freshwater ecosystems are as physically diverse as they are biologically diverse. They include channelized surface waters with continuous flow, open and relatively still waterbodies – either connected or isolated – and an enormous variety of wetland habitats. Because nearly all wetlands are in lowland areas and channel precipitation from the surrounding landscape, sometimes distant upland activities impact these often sensitive ecosystems.[51] An enormous number of plants and animals – vertebrates, invertebrates, and microorganisms depend on freshwater ecosystems for their survival. Freshwater fish alone accounts for over ¼ of all living vertebrate species on earth.[52] Unfortunately, freshwater habitats are the most vulnerable to climate change. Freshwater biodiversity in North America is projected to experience an extinction rate five times greater than that of terrestrial biodiversity.[53] These extreme predictions are due to the sensitive nature of freshwater ecosystems. Additionally, they depend on physical features, such as volume, quality and flow as well as water temperature and the impacts to these ecosystems often come from distant locations.[54] Currently, freshwater ecosystems make up about 6% of the Region's land area. While total annual precipitation is not expected to change significantly the timing and stochastic nature of the predicted storm events will likely have sometimes dramatic impacts. The predicted increase of the frequency of 100-year floods and overall changes in precipitation will likely mean less predictable, seasonal increases in surface water as well as seasonal changes in soil moisture due to higher temperatures and longer periods of drought.[55] These effects are certain to changes water temperatures which may result in reduced oxygen levels in streams and lakes, leading to declines in aquatic species diversity and increased stress on coldwater fisheries.[56]

Terrestrial Ecosystems

The UVLS region is approximately 84% forested, consistent with the rest of the state. In general terms, forested ecosystems are thought to be more resilient to climate change than freshwater habitats. However, some forest types may be more vulnerable than others. The complex community dynamics within forested ecosystems make it quite difficult to precisely predict the impacts to the biodiversity in the Region. As individual species react to increases and changes in temperature based on individual tolerances entire communities may change and shift within the region, and new community compositions may form as southern species that were at the northern edge of their range migrate north. Some species complex groups may migrate together, such as the predicted expansion of the oak-hickory complex northward and the contraction of aspen-birch habitat.[57] Some species that already subsist in restricted habitats may be extirpated from the Region, such as the balsam fir, if there is no habitat available to move to. The greater stress on trees from changes in temperature and precipitation will likely increase the frequency of the pine beetle pest and other insect attacks will become more frequent as milder winters encourage the early emergence forest pests and reduced mortality of some forest insect pests.[58] In general, it is predicted that the hardwood-pine forests of the state and Region will move northerly and upslope and that the Appalachian oak-pine forests will increase in extent.[59]

The Region's forests ecosystems will also continue to be threatened by development and land use conversion. This causes a loss of forestland, but also causes habitat fragmentation which reduces species capacity to adapt to a changing climate as their habitats become increasingly smaller and disconnected. While NH is the second most forested state in the US, with about 84% of the land forested, the state has lost more than 148,000 acres of forest to development since 1997. Another 288,000 acres (5% of forestland, statewide) are projected to be lost by 2025.[60] Increased demand for alternative energy facilities and their associated transmission lines is likely to add additional fragmentation of habitat to the Region's forest landscapes, particularly higher elevation forests and ridge lines.[61]

Another current concern of many scientists is the compounded interactions among ecosystems and increased carbon dioxide (CO_2) in the atmosphere. In the eastern U.S., elevated temperature and atmospheric CO_2 concentrations will likely continue to enhance sequestration by forests, but this sequestration may be offset by forest fragmentation and losses due to disturbances by invasive insects.[62] Currently, US forests take up 250 million metric tons of carbon per year, but that figure is expected to decrease as forests, especially in the northeast, reach maturity.

Special Habitat Areas

Floodplain Forests

Floodplain forests are the critical habitat areas that have developed over centuries in the low, flood prone areas along rivers, typically less than 20 ft above the river channel.[63] Floodplain forests are a unique disturbance-adapted habitat. They provide a number of ecosystem services including filtering pollutants from our water sources and improving water quality, controlling erosion and buffering against flooding.[64] In the UVLS Region there are more than 5,500 acres of this special habitat, located primarily along the Connecticut River and its major tributaries including the Mascoma River and the Sugar River. There are thirteen different river channel and floodplain natural communities in NH.[65] Along the Connecticut River, floodplain forests consist of silver maple trees and a diversity of wildflowers and fern.[66] Whereas, along the smaller rivers and streams, floodplain forests are mostly red maples, black ash, black cherry, and ironwood with shrubs and vernal pools.[67] A number of species are associated with floodplain forests including the Jefferson salamander, northern leopard frog, the wood turtle, the red shouldered hawk, cerulean warbler, eastern red bat and the silver haired bat.[68]

In the future, as the climate continues to change, floodplain habitats may experience more flooding, possibly with unpredictable timing and/or duration, and will also be affected by summer droughts.[69] This may impact species composition and species richness due to greater colonization of non-native plant species and the migration of generally more southern plant species.[70]

Grasslands

Grasslands are characterized by their vegetation: native and non-native grasses and wildflowers and the absence of trees and shrubs. Most grasslands are the result of land clearing and require maintenance or they will eventually revert back to forest. Most of the grasslands in the Region today are agricultural hay fields and pasture. Grasslands may also wet meadows and may be the result of other land uses and land management practices. Grasslands in New England are not as expansive as those in the Midwest and some parts of the southern and western United States, but they all provide similar benefits to humans and ecological communities. They are major contributors to food production and provide ecological services such as aquifer recharge, pollination, and recreational opportunities.[71] The history of grasslands in NH, similar to that of the Midwest, includes burning by Native Americans for agricultural purposes and to improve forage for game species.[72] Beavers have also had a critical role in the historic conversion of habitat to grassland meadows. Today, grassland acreage is declining across the state. A portion of the Region, primarily Grafton County, has the highest concentration of remaining grassland acres in the State.[73] The largest threat to grassland habitats is land conversion. Grasslands are frequently considered high-value developable lands, with permeable soils. However, in NH grasslands provide food and habitat to more than 70 species of wildlife.[74] There are a number of obligate species which require managed grasslands in part of their life cycle. The bobolink, a migratory songbird, is the most common grassland-nesting bird in NH.[75] It breeds exclusively in grasslands larger than five acres from the northern United States to southern Canada. Bobolink populations have experienced decline for the last forty years due in part to grassland management practices.[76] Mortality increases if management practices, such as cutting regimes, interfere with the bobolink nesting periods. The eastern meadowlark, Savannah sparrow, grasshopper sparrow (state threatened species) and the northern harrier (state endangered species) all require grassland breeding habitat between 15 and 30 acres or greater and have been documented in portions of our Region. Today, this habitat is thought to be relatively resistant to climate change, as it is found in a large variety of climates across the world.[77] There are approximately 57,000 acres of grassland habitat in the UVLS region, about 8% of the land area.

Vernal Pools

Vernal pools are little studied and often overlooked micro that provide important habitat. Vernal pools exist everywhere, but are most common in the river floodplain. They characteristically appear as the ground thaws and snow melts following the winter season, and they provide important breeding habitat for many invertebrate and vertebrate species, including spotted salamanders. Other unique ecosystems that provide important habitat and functions are forested floodplains and meadowlands, which are important nesting habitat for bird species such as the declining Eastern meadowlark.

Wildlife

Mammals

Mammals are both advantaged and disadvantaged by the resources required for their lifecycle. Often there are different seasonal requirements and habitats for their food, denning and breeding. In the northeast, many of our mammals are migratory and require a separate winter and summer or breeding habitat. This also increases the size of their range requirements and therefore, often increases their risk to damaging impacts of habitat fragmentation, habitat destruction and climate change. There are more than 60 mammals in NH, and many of them live at least a portion of their life in the Region (see table below). The largest mammals in the Region, such as the black bear and moose, have the largest ranges. While the small mammals, such as rodents and insectivores (shrews), often have smaller ranges. Small mammals comprise the largest and most diverse group and occur in greater abundance. All mammal groups are expected to be affected by climate change and are presently affected by habitat loss and fragmentation. In sum, changes in mammalian communities will have profound impacts on ecosystems and may directly affect human societies.

Mammals of New Hampshire			
Mammal Name	Regional Extent	Mammal Name	Regional Extent
Bat, Big Brown	Throughout Region	Mouse, Woodland Jumping	Throughout Region
Bat, Eastern Red	Seasonal; Documented in Piermont, potentially in Springfield	Muskrat	Throughout Region
Bat, Hoary	Seasonal; Potentially found in Springfield	Opossum, Virginia	Throughout Region
Bat, Little Brown	Limited at risk distribution since 2010	Otter, River	Throughout Region
Bat, Northern Long-eared	Proposed for listing as Federally Endangered in August 2014	Pipistrelle, Eastern	Not in Region
Bat, Silver-haired	Not in Region	Porcupine	Throughout Region
**Bat, Small-footed	Documented in Piermont	Porpoise	Not in Region
Bear, Black	Throughout Region	Raccoon	Throughout Region
Beaver	Throughout Region	Rat, Norway (i)	Throughout Region
Bobcat	Throughout Region	Seal, Harbor	Not in Region
Chipmunk, Eastern	Throughout Region	Shrew, Long-tailed	Throughout Region
Cottontail, Eastern	Throughout Region	Shrew, Masked	Throughout Region
**Cottontail, New England	Not in Region	Shrew, Pygmy	Throughout Region
Coyote	Throughout Region	Shrew, Short-tailed	Throughout Region
Deer, White-tailed	Throughout Region	Shrew, Smoky	Throughout Region
Dolphin, Common	Not in Region	Shrew, Water	
Fisher	Throughout Region	Skunk, Striped	Throughout Region
Fox, Gray	Throughout Region	Squirrel, Gray	Throughout Region
Fox, Red	Throughout Region	Squirrel, Northern Flying	Throughout Region
Hare, Snowshoe	Throughout Region	Squirrel, Red	Throughout Region
Lemming, Northern Bog	Not documented in Region	Squirrel, Southern Flying	Throughout Region
Lemming, Southern Bog	Throughout Region	Vole, Meadow	Throughout Region
**Lynx, Canada	Federally Threatened; Not predicted in Region	Vole, Rock	Throughout Region where habitat is available
*Marten, American	Not in Region	Vole, Southern Red-backed	Throughout Region
Mink	Throughout Region	Vole, Woodland	Throughout Region
Mole, Hairy-tailed	Throughout Region	Weasel, Long-tailed	Throughout Region
Mole, Star-nosed	Throughout Region	Weasel, Short-tailed (Ermine)	Throughout Region
Moose	Throughout Region	Whale, Humpback	Not in Region
Mouse, Deer	Throughout Region	Whale, Minke	Not in Region
Mouse, House (i)	Throughout Region	Whale, Pilot	Not in Region
Mouse, Meadow Jumping	Throughout Region	**Wolf, Gray (not yet in NH)	Not in Region
Mouse, White-footed	Throughout Region	Woodchuck	Throughout Region
*State Threatened **State Endangered (i) Introduced +Breeds in NH			
State Totals: There are a total of 63 mammal species in NH. 8 of the species are of Conservation Concern (vulnerable to extinction due to rarity and biological fragility) and 5 species are threatened/endangered listed species.			

Amphibians

Amphibians are already in trouble on a global scale. About 1/3 of amphibian species are at risk of extinction due to factors including habitat loss, disease, invasive species, and pollution.[78] Adding the effects of climate change to the already struggling taxa is worrisome.[79] Amphibians are often very sensitive to temperature and moisture regimes and have a narrow tolerance for variation.[80]

Alterations and/or increased fluctuations in a habitat's hydroperiod, or the timing of water availability, due to climate change may negatively impact pond-breeding amphibians, for example, by disrupting the annual reproductive cycle or increasing mortality or increasing exposure to predation.[81]

Amphibians of New Hampshire		
Frogs & Toads	Currently documented	Historically documented
Bullfrog (*Rana catesbeiana*)	Throughout most of Region	
Green frog (*Rana clamitans*)	Throughout most of Region	
Mink frog * (*Rana septentrionalis*)	Not documented	
Northern leopard frog * (*Rana pipiens*)	Orford, Lyme, Springfield, Charlestown	Piermont, Claremont
Pickerel frog (*Rana palustris*)	Throughout most of Region	
Wood frog (*Rana sylvatica*)	Throughout most of Region	
Spring peeper (*Pseudacris crucifer*)	Throughout most of Region	
Gray treefrog (*Hyla versicolor*)	Hanover, Grafton, Newbury	Cornish, Orford
American toad (*Bufo americanus*)	Throughout most of Region	
Fowler's toad** (*Bufo fowleri*)	Canaan, Grafton	
Salamanders	Currently documented	Historically documented
Eastern newt (*Notophthalmus viridescens*)	Throughout region	Throughout region
Blue-spotted salamander* (*Ambystoma laterale*)	Washington	Cornish
Jefferson salamander** (*Ambystoma jeffersonianum*)	Washington	Cornish
Marbled salamander*** (*Ambystoma opacum*)	not documented	not documented
Spotted salamander (*Ambystoma maculatum*)	Throughout most of Region	Throughout most of region
Four-toed salamander (*Hemidactylium scutatum*)		Hanover
Dusky salamander (*Desmognathus fuscus*)	Newbury	Orford, Lyme, Dorchester, Cornish, Springfield
Spring salamander (*Gyrinophilus porphyriticus*)	Newbury	Orford
Two-lined salamander (*Eurycea bislineata*)	Throughout most of Region	
Northern Redback salamander (*Plethodon cinereus*)	Plainfield, Orford, Piermont, Grafton, Newbury, Washington	Cornish
Slimy salamander@ (*Plethodon glutinosus*)	not documented	not documented
Mudpuppy (*Necturus maculosus*) thought to be introduced	Piermont, Charlestown	Cornish
Source: NH Wildlife Action Plan http://www.wildlife.state.nh.us/Wildlife/Nongame/frogs.htm		
*State Concern **State Threatened ***State Endangered Species @Reported historically but uncertain if still exists in state or if native		
State Totals: There are a total of 22 amphibian species in NH. 5 of the species are of Conservation Concern (vulnerable to extinction due to rarity and biological fragility) and 2 species are threatened/endangered listed species.		

Additionally, changes in the seasonal timing of events and fluctuating weather conditions are also predicted to have negative effects on amphibian populations.[82]

There are 22 species of amphibians in NH. All but three of the amphibian species in NH are found in our Region, however, many species are only documented in a handful of towns (see Table below). Protecting amphibian habitat today is essential to assisting the survival of the species in the future.

Reptiles

Like amphibians, reptiles are animals that are highly vulnerable to climate change as well as habitat loss. In NH, the list of reptiles includes 11 snake species and 7 turtle species. In the Region, there are only two snake species commonly found throughout, the Garter snake and the Milk snake. There are also only two species of turtle found commonly in the Region. The Wood turtle, a species of state concern, is documented in most of the Region's towns, but its population is relatively low (see table right).

Reptiles of New Hampshire

Snakes	Currently documented	Historically documented
Garter snake (*Thamnophis sirtalis*)	Throughout most of Region	
Ribbon snake* (Thamnophis sauritus)	Not documented	Newport
Brown snake (*Storeria dekayi dekayi*)	Not documented	Sunapee
Northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*)	Throughout most of Region	
Northern Ringneck snake (*Diadophis punctatus edwardsii*)	Lebanon, Claremont, Charlestown	
Smooth green snake (*Opheodrys varnalis*)	Lyme, Newport, Croydon, Sunapee, Springfield	Orford, Canaan, Acworth, Lempster
Milk snake (*Lampropeltis traingulum triangulum*)	Throughout most of Region	
Eastern hognose snake*** (*Heterodon platirhinos*)	Not documented	
Norther black racer** (*Coluber constrictor constrictor*)	Not documented	
Northern water snake (*Nerodia sipedon sipedon*)	Washington	
Timber rattlesnake*** (*Crotalus horridus*)	Protected distribution	
Turtles	**Currently documented**	**Historically documented**
Blanding's Turtle*** (*Emydoidea blandingii*)	Not documented	
Eastern Box Turtle* (*Terrapene carolina carolina*)	Not documented	
Common Musk Turtle (*Sternotherus odoratus*)	Not documented	
Eastern Painted Turtle (*Chrysemys picta*)	Throughout Region	
Snapping Turtle (*Chelydra serpentina*)	Throughout Region	
Spotted Turtle** (*Clemmys guttata*)	Canaan	Cornish, Grafton
Wood Turtle* (*Glyptemys insculpta*)	Throughout most of Region	

Source: NH Wildlife Action Plan http://www.wildlife.state.nh.us/Wildlife/Nongame/frogs.htm

*State Concern **State Threatened ***State Endangered Species [@]Reported historically but uncertain if still exists in state or if native

State Totals: There are a total of 18 reptile species in NH. 7 of the species are of Conservation Concern (vulnerable to extinction due to rarity and biological fragility) and 2 species are threatened/endangered listed species.

Reptiles are ectothermic, meaning their body temperature, and therefore energy, is controlled by the outside temperature, which makes them highly sensitive to fluctuations in temperature as well as seasonal changes, both predicted to influence the Region as the climate changes.[83] Climate change therefore may have indirect effects on the population dynamics of species through indirect means. For example, a study found that a warmer climate may be causing snakes to become more active and seek more food, including a larger number of baby bird, which may in turn affect some bird species around the world.[84] Turtles are also greatly affected by changes in temperature. Specifically, turtles have temperature-sensitive sex determination (cooler temperatures may produce male only nests, and the alternative, female only) which means that temperature changes have the potential to alter the sex ratios of populations, potentially affecting future reproduction and evolutionary fitness.[85] Additionally, the increased frequency of floods and the resulting fluctuations in water levels have been documented to displace and cause increased mortality in semi-aquatic turtles, particularly the wood turtles, in the northeast.[86] In addition to the threats posed by climate change, reptiles in the Region are continually threatened by habitat loss and adults being killed on the roadways.[87]

Birds

NH and the northeastern US, is home to the greatest diversity of breeding bird species in the continental US.[88] NH supports more than 300 different species of birds. Many species, including warblers and thrushes, have, in some cases, 90% of their global population breeding in this region. However, the populations of many seemingly common species are declining at alarming rates. For NH's breeding bird species, 37% (69 species) have increasing or stable populations, 35% (65 species) are in decline and 28% (52 species) have uncertain or unknown population trends.[89] Shrubland bird populations are experiencing the greatest decline. The top threats to populations in the northeast include: climate change; forest fragmentation and conversion to commercial and residential development; and incompatible forest management or land use.[90] Wind farms are another deadly threat to birds, but clearly little in comparison to climate change.[91] Climate change is expected to affect bird populations across the world quite rapidly over the next 50 or more years. It will affect the geographic range of these sensitive animals along elevational gradients, shifting breeding ranges to higher latitudes and higher altitudes.[92]

NH Bird Species predicted to lose summer and winter ranges		
Bird Name	**Summer Range Lost**	**Winter Range Lost**
Bohemian Waxwing (*Bombycilla garrulus*)	100%	52%
Canada Warbler (*Cardellina canadensis*)	100%	
Black-Throated Blue Warbler (*Setophaga caerulescens*)	100%	40%
Blackburnian Warbler (*Setophaga caerulescens*)	100%	
Evening Grosbeak (*Coccothraustes vespertinus*)	98%	58%
Black-Throated Green Warbler (*Setophaga virens*)	98%	30%
Source: National Audubon Society. 2014. Audubon's Birds and Climate Change Report: A Primer for Practitioners. National Audubon Society, New York. Contributors: Gary Langham, Justin Schuetz, Candan Soykan, Chad Wilsey, Tom Auer, Geoff LeBaron, Connie Sanchez, Trish Distler. Version 1.2.		
State Totals: There are a total of 315 bird species in NH. 33 of the species are of Conservation Concern (vulnerable to extinction due to rarity and biological fragility) and 19 species are threatened/endangered listed species.		

A recent study by the National Audubon Society found that of the 588 North American bird species with ranges in the United States, 314 will lose more than fifty percent of their current climatic range by 2080.[93] Of the species which frequent New Hampshire, four will loose 100% of their summer range and two species will lose 98% of their summer range by 2080, making their presence in NH less visible (see table above).

Improvement Strategies

One of the greatest threats and challenges to maintaining or even enhancing biodiversity across the Region is parcelization. It is essential for communities to identify where their critical habitats and most important unprotected resources are and make a plan to protect them. However, funding for conserving lands is becoming more and more competitive. Federal and state grants seem to be dwindling. It would be proactive for communities to begin to think about what lands are important to protect and strategies on how they will fund their protection.

Municipal land use planning and regulations play an important role in reducing risk to important and critical habitat in communities. With regard to biodiversity, the overarching priorities for the region should have a long-term focus and prioritize the areas with significant existing biodiversity and provide for connectivity to other areas of significant biodiversity which therefore provides the ability for movement. A town must identify and map, through comprehensive means such as a natural resource inventory, the natural resources it has presently where they are located and what the threats are. A good exercise for prioritizing the results would be to use a planning model such as the Forest Land Evaluation and Site Assessment (FLESA) process.[94] For this process, each parcel is evaluated and weighted and ranked using a point system.

Biodiversity Improvement Strategies
• Assist municipalities in auditing their local Master Plan and regulations to identify barriers and opportunities for the protection of important habitat and natural resources.
• Assist municipalities in conducting Natural Resource Inventories (NRIs) to identify the existing natural resources and critical habitat areas within the town.
• Assist municipalities in maintaining landscape connectivity and wildlife corridors through land use planning to facilitate permeability and therefore, provide capacity for range shifts and species adaptation as the climate warms and changes.
• Assist municipalities in the identification of local land priorities for open space protection that include core areas of important wildlife habitat.
• Assist towns in developing Forestry and/or Conservation Districts or Natural Resource Overlay Districts which require a biological impact report prepared by a qualified consultant prior to the approval of development in identified sensitive habitat areas.

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UVLSRPC Regional Plan 2015

Chapter 6

Historic, Cultural and Recreational Resources

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6.1 INTRODUCTION

Vision

A region that may respond to opportunities for growth and change while maintaining the historic and cultural assets most valued.

What are Historic and Cultural Resources?

Historic and cultural resources include assets such as archaeology, geography, architecture, folklore, traditional crafts, fine arts, and music specific to a local region. From the practices and places of the indigenous peoples of our region to our covered bridges and traditional music, all are part of a story that provides both a sense of place and a source of pride. The richness of those resources binds us together in our communities, and offers an attraction for visitors, scholars, and entrepreneurs that add to our overall social and economic well being.

The region has an abundance of historic and cultural assets that have been highly valued and conserved. Beginning with the aboriginal peoples that inhabited the Region as early as 1500 BCE, to the European settlements with town charters granted in 1761, through to the current era; past and present have so far successfully blended to shape this region along the Upper Connecticut River Valley.

Importance of Historic and Cultural Resources in Regional Planning

The historic structures and sites which survive from earlier periods are tangible evidence of a community's past residents, significant places, and activity. The preservation of these resources is fundamental to the retention of a sense of place, identity and continuity. Village centers, early cemeteries, railroad structures, covered bridges, mill buildings, farmlands, churches, town halls, libraries, agricultural buildings, and modest one-and two-story frame dwellings sporadically dotting the landscape are all important surviving elements of the region's history.

Community attitude surveys conducted during the course of preparation of local master plans in UVLSRPC communities show an average of 90% of those surveyed support preservation of historic resources.

The practical and aesthetic aspects of historic preservation recur in many of the aspects of a regional plan, including culture and arts, economic development, housing, recreation, and scenic resources. Historic structures and sites are nonrenewable.

Historic preservation including the management of the built environment can be an important calling card to attract and retain businesses, tourists, and residents, and is a tool for economic development. With historic resources providing shelter for much of the region's population, it is also a way of life and a mechanism to maintain an area's unique identity.

Although some significant historic sites and resources in the region are described here, it is not a complete and comprehensive inventory of all regional resources but rather a departure point for community discussion of future preservation efforts.

Our collective challenge will be to respond to opportunities for growth and change while maintaining the historic and cultural assets we most value.

6.2 HISTORY OF THE REGION

Aboriginal Inhabitants

The human occupation of the Upper Valley Lake Sunapee Region began long before European settlers arrived in the 18th century. Little is known about the earliest native population inhabiting the area, but it is probable that by 1500 B.C.E. aboriginal people were migrating along the Connecticut River and its tributaries as the glaciers receded and tundra gave way to a more permanent environment. By 1500 CE, the Upper Valley was a frontier between two tribes, the Iroquois to the west and Algonquin to the north and east. Small migratory hunting and fishing bands occupied the area for a month or two at a time.

By 1600, most of New Hampshire and Vermont, as well as parts of Canada and northern Massachusetts, were inhabited by indigenous people called the Western Abenaki; those occupying the Upper Valley were the Sokoki. It has been estimated that there were 10,000 Western Abenaki in New Hampshire, Vermont, Canada, and Massachusetts in 1600. About one third, 3,800, inhabited the Upper Valley. Epidemics caused by the infectious diseases that European settlers brought with them

devastated the native population; of a possible ten thousand Western Abenakis only two hundred and fifty were reported to have survived. In the Upper Valley, those that survived gradually abandoned the area for Quebec, due to continued hostilities with the Iroquois and European settlers.

Early European Settlement

Charlestown, earlier known as Number 4 (a.k.a. Fort No. 4), was the first town in the Region, chartered by Massachusetts in 1735. As frontier town for twenty years beginning in the 1740's, Fort No. 4 was part of a cordon of forts,, including Chesterfield (No. 1), Westwood (No. 2), Walpole (No. 3),which protected the region from long-standing incursions by the French from Quebec and Native allies.

Above: Fort No. 4 in Charlestown, New Hampshire

The Fort itself, 3/4 acre square, was constructed in 1743 on the west side of lower Main Street.

As the northernmost outpost in the Connecticut River Valley, Charlestown's position was enhanced by its role as a trading center for the surrounding countryside and a gateway to settlements farther north. During the next half century, Charlestown was the economic hub of the Region. Until local mills were established, grains from towns as far away as Hanover and other northern settlements were brought to Fort No. 4 to be ground.

Settlement of the area was greatly stimulated by soldiers passing through the area from the French and Indian War, returning to homes in Massachusetts and Connecticut with their accounts of fertile and promising lands to the north, and by the fact that virtually all of the good agricultural land in southern New England had been settled by the 1760's.

Following the British conquest of Quebec in 1759, hostilities ceased, attracting to this region settlers primarily of English Puritan descent from southern New England, particularly Connecticut. The origins of many towns in the region date to 1761, when Benning Wentworth, Governor of New Hampshire, granted charters to sixteen towns, eight on either side of the Connecticut River. Most of the remaining towns received their charters in the following decade.

Remote as it was from the heart of the American Revolution, the Upper Valley area did not totally escape the impacts of the conflict. For many years, what is now Western New Hampshire and Vermont was disputed territory. Twice between 1778 and 1782 the New Hampshire Upper Valley towns seceded and joined Vermont. An early plan would have made the Upper Valley an independent state called "New Connecticut," with a capitol in what is now Hanover.

Influence of Religion on the Region

Of all the early proprietors, certainly none was to leave a larger legacy than Eleazar Wheelock of Hanover, a Congregationalist minister originally from Connecticut. The establishment of Dartmouth College was an outgrowth of the Indian Charity School that Wheelock had conducted in Connecticut for more than a decade to provide formal education to Native Americans.. On December 13, 1769, the Governor issued the charter creating the College and granted it 1,300 acres in the southwest part of Hanover. Dartmouth, the tenth of Colonial America's institutions of higher learning, was the last to receive its charter from the Crown. Since its establishment in 1769, the Dartmouth campus has been a showplace of American architecture, bearing the imprint of the visions and buildings of a variety of designers, including Ammi B. Young, Charles Rich and Jens Larson.

In the towns they settled in the region, the Puritans established Congregational churches as centers for the spiritual, cultural, social, and civic life of their communities. As the towns grew and prospered, their civic and religious buildings evolved into the classic New England meetinghouses which grace our towns as landmarks and focal points which are significant and distinctive expressions of American architecture.

The "Congregational Way" is based on the spiritual freedom of all believers and the sovereignty and self-government of each congregation. Its independent polity was the foundation of town-meeting local government and American democracy..

By the early nineteenth century the Congregationalists diversified into the related free-church Protestant denominations of Baptists, Unitarians, Universalists, and Methodists.

The Shakers, who followed a religion founded in the latter part of the eighteenth century, were one of the era's breakaways from traditional Protestantism and were unique at the time for seeking women for leadership. Jane Wardley and Ann Lee were among the most important of these. The Shakers established a community in Enfield in 1782. Shakers believed the dignity of work and in the communal ownership of all worldly goods. Their members were required to live a celibate life and living quarters for men and women were separate. They were known for a simplicity and industriousness that is reflected in their utilitarian design in furniture, homes, tools and farms. Although there were 6,000 believers at the peak of the Shaker movement, there were only 12 Shaker communities left by 1920 and only one remains today.

The Enfield Shaker Historic Site is listed on the [National Historic Register](). Many of its granite buildings were constructed in the mid-19th century and were designed by Lebanon, NH architect Ammi B. Young. The religious group occupied the site until the early twentieth century. In 1927, the site was sold to the Missionaries of La Salette, who converted it into a seminary, school and conference center. The La Salettes built the Mary Keane Chapel, a neo-classical revival chapel, which is part of the museum.

Another influential religious society, the Quakers, arrived in the region in the 1820's. The first Quakers were also among the dissenting Protestant groups, breaking away from the established Church of England. These Quakers attempted to convert others to their understanding of Christianity, traveling both throughout Great Britain and overseas, preaching the gospel. Some of the early Quaker ministers were women. They believed in the universal priesthood of all and emphasized a personal direct relationship with God acquired through reading and studying the Bible. Quakers focused their private life on developing behavior and speech reflecting emotional purity and the light of God.

Quakers were known for their refusal to participate in war or to swear oaths, their plain dress, and opposition to slavery, and to alcohol consumption. In West Unity, known locally as Quaker City, their simple clapboarded meeting house dating to 1820 survives today.

Above: Meeting House in Washington,New Hampshire

A humble and picturesque building in the southern part of the Town of Washington, NH is honored as the Mother Church of the Seventh-day Adventists. Today, they are a world-wide denomination with over eleven million members with churches in over 200 countries. The meeting house was built in 1842 by a local group of farmers calling themselves Christian Brethren, who dissented sharply from the strict Congregationalism of the Church in Washington Center. Many of the Christian Brethren became Adventists about the time this building was first used. Seventh-day Adventists are a Christian Protestant denomination distinguished by its observance of Saturday, the original seventh day of the Judeo-Christian week, as the Sabbath and by its emphasis on the imminent second coming of Jesus Christ. The sect is also known for its emphasis on diet and health and lead early movements for reform of healthcare and the creation of hospitals.

Subsistence Farming to Industrial Revolution

Early development in the region was based on subsistence farming and raising sheep. In many of the Connecticut River towns, development can be characterized as "gone downhill," reflecting changing attitudes toward the hills. Initially few favored the flatlands near the river; the majority of early residents sought the hilltops where they felt the farmland was better, less swampy and more easily cleared. Yet, in much of the Upper Valley as early productivity diminished, hillsides reverted to woodland.

Population in this region during this era peaked around 1840. As in most of New England, the region's population began by a slow decline in the second half of the 19th century. The opening of rich lands in the Midwest, construction of canals and railroads which enabled western farmers to transport goods eastward, a dramatic decline in wool prices triggered by competition, and the availability of jobs in urban mill centers resulted in a massive exodus of farmers from New England, and from many of the region's smaller towns.

Throughout the state, population decline in the late 19th century was largely due to the inability of New Hampshire farms to compete against Midwest farms, leaving New Hampshire hillsides a maze of stonewalls, cellar holes and new forests.

The earliest hotel on Lake Sunapee was established in the early 19^{th} century. At this point in time, subsistence farming was transformed to commercial production as transportation along the Connecticut River was supplemented and diverted by the completion of various turnpikes. Completed in 1801, 1803, and 1804, the Second, Third, and Fourth NH Turnpikes all ran to the Upper Valley from Amherst (NH) to Claremont, New Ipswich to Walpole, and from Concord to Lebanon-Hanover.

These main routes were supplemented by the Grafton Turnpike, opened in 1806 and running from the Orford Bridge through Lyme, Canaan, Grafton, and Danbury to meet the Fourth New Hampshire Turnpike in Andover. The Croydon Turnpike, following basically the same route as Route 10 today, was constructed in 1804 between Lebanon and Lempster. It was less significant to the area because it did not provide a direct route to Concord.

Early Transportation

Logically accompanying the construction of turnpikes and roads was the building of bridges over the Connecticut River. By 1800, bridges spanned the Connecticut River between Walpole, NH and Bellows Falls, VT ; Cornish, NH and Windsor, VT, and Hanover, NH and Norwich, VT improving upon the ferries used by the first settlers in the Upper Valley. Covered bridges were introduced to protect the wooden trusses so frequently damaged by the region's severe weather. Constructed in 1866, the Cornish-Windsor Bridge is the longest surviving covered wood bridge in the United States and an important regional landmark.

After years of use, river and turnpike traffic were virtually abandoned in the 1840's with the advent of the railroads, although the need for bridges, in this case railroad bridges, over the Connecticut increased. The semi-isolation of the Upper Valley was largely brought to an end by the completion of the Northern Railroad from Concord to Lebanon in 1847. By 1850, tracks were laid from Bellows Falls up the Connecticut River on the New Hampshire side, through Charlestown and Claremont, over to Windsor and then to White River Junction. The Concord and Claremont Railroad opened in 1871.

The railroad, with its ready access to markets, transformed Upper Valley towns like Lebanon, Claremont, White River Junction, and Newport situated on major transportation routes from agricultural communities to industrial centers. These four communities were the only ones to increase their population significantly in the late half of the nineteenth century, as a result of the combined effects of the railroads and the development of water power to run a variety of mills.

In Lebanon, industrial development was characterized by three overlapping bases centering on iron, wood, and wool-based industries. Claremont industries included textiles, machine tools and a wide range of other manufactured products were produced Newport was an early center of textile production. Later, in the face of competition from southern cotton mills, Newport turned toward the manufacture of alternate items such as shoes.

It was the union of railroad, steamboat, and resort which set the stage for the most colorful era of Lake Sunapee's history. Beginning in 1849, when the railroad reached Newbury at the southern tip of the Lake, shore frontage became susceptible to resort development with steamboats used to move passengers, baggage, and supplies from station to resort. The earliest commercial lake boat on Sunapee appeared in 1854 and was propelled by horses. More conventional steamboats proliferated after 1876, including the Lady Woodsum, the Edmund Burke, the Kearsarge, and others, for a total capacity of 2,000 passengers.

The Armenia White, the largest steamer ever to sail Sunapee, was 101 feet long, with a capacity of 650 persons. New York summer residents typically arrived via Claremont Junction and Boston visitors arrived via Concord. Once the passengers were aboard steamboats, a complete trip around the Lake to disperse summer residents took about three hours, with major landings at Sunapee Harbor, Georges Mills, Lakeside, Blodgett's, Brightwood, Pine Cliff, Lake Station, Soo-Nipi, Burkehaven, and Granliden. The last steamboat, the Kearsarge, stopped running in 1932. Its pilot house is preserved in the Lake Sunapee Historical Society Museum in Sunapee Harbor. Road construction brought the steamboat era to an end.

Tourism and Summer Visitors

The area's natural attractiveness to vacationers has been a constant since the 19th century, resulting in the in-migration of affluent retirees, second home builders and summer residents. Major transportation developments, including the construction of regional and local airports and the construction of Interstates 89 and 91, have made it possible for industries to establish in outlying areas instead of at sources of power and rail transportation, which once dictated the location of industries. The Northern Railroad was abandoned in the 1980's. In recent years, West Lebanon, located near the junction of the interstates, has grown into an important regional retail center. Development of this commercial base, as well as the expansion of Dartmouth College and the Dartmouth Hitchcock Medical Center, continues to fuel an unprecedented period of growth in the region.

Soon, the ten mile length of Lake Sunapee became lined with cottages, boat houses and resort hotels. Thousands descended upon the Lake, some temporarily, while others, such as John Hay, built lavish summer residences. Today, none of the grand hotels survive. The last remaining hotel was demolished in 1968. New Hampshire's natural beauty attracted 19th century vacationers and seasonal residents to other towns in the region, as well. For example, during the mid-19th century, the existence of mineral springs in Unity brought hordes of health seekers to town for the benefits of drinking and bathing in the crystal clear waters. The medicinal properties of the mineral waters were first discovered by settlers in 1789. Development of the summer resort area at Lake Sunapee contributed to the spring's loss of popularity.

The establishment of the Cornish Colony in the late 19th century was to have a great impact on the economic and cultural life of Plainfield and Cornish. Beginning in 1885, prominent American artists - painters, sculptors, writers (editors, novelists, playwrights, and poets), architects, musicians and naturalists were attracted to the area as a place to work and relax. The unusual beauty of the New Hampshire hills along the Connecticut River provided the Arcadian serenity and seclusion they sought. These artists, primarily from New York, found mutual encouragement and intellectual stimulation from one another and came to be known as the Cornish Colony. Many of them built homes in Plainfield and Cornish, some as year-round inhabitants, others as summer residents.

The Colony flourished from 1885 to 1930, its number reaching about 90 members during these years. Some Colonists who attained national prominence and who chose to live in the area were Maxfield Parrish, Augustus Saint-Gaudens, George de Forest Brush, Winston Churchill, William Howard Hart, and Charles Platt. They affected the region economically, culturally and, to some extent, though most indirectly, socially. There existed an unusual sense of responsibility to the area among the members of the Colony, as they made conscious efforts to share their aesthetic values with the native residents. They affected the Town in a more substantial way than summer tourists generally affect other communities. They contributed a large share of town tax money and provided many of the local inhabitants with full- or part-time employment, patronized local markets, and created several commercial enterprises such as a creamery and grist mill. This financial influx occurred at a critical period in New Hampshire's history, when agriculture as a prime economic resource was failing.

Above: Saint-Gaudens National Historic Site in Cornish, New Hampshire

In addition to building architecturally remarkable dwellings, many of which still stand, the Colonists fostered the Town's intellectual and artistic life by supporting the Town's libraries, by encouraging participation in local dramatic productions, and by stimulating interest in beautifying the town. One permanent institution was the Mothers and Daughters Club, begun in 1897 at the suggestion of Colony women, for the mutual improvement of its members, who included both Colonists and natives. The first such club in New Hampshire and one of the first in the United States, it provided a forum for stimulating lectures and discussions, and for arts and crafts and other activities.

Regional Preservation and Conservation Efforts

Much of the most basic and, yet, most important responsibility for historic preservation is undertaken by private owners through routine repairs and maintenance. Pride in ownership and regular maintenance alone can be responsible for remarkable preservation results. As can be seen in the following table, according to the 2010 U.S. Census more than 40% of the Region's housing units were built before 1940. This suggests a high percentage of buildings of potential historic significance, and an indication of the need for renovation and preservation of older structures.

Supplementing the actions of individual owners, historical societies and other citizen groups greatly enhance public awareness of the importance of preserving a community's historic resources through exhibits, slide shows, walking tours, pamphlets and publications. Figure 6.2.1 is a summary of regional historical society buildings and museums open to the public.

Figure 6.2.1- Historical Society Buildings and Historical Museums in the UVLSRPC Region

Acworth	1865 South Acworth Village Store and Union Hall http://acworthian.org/History_of_Acworth.html
Canaan	Historical Museum www.rootsweb.com/~nhchs
Charlestown	Little Red School House; Fort at No. 4 www.fortat4.org
Claremont	Claremont Historical Museum http://www.claremonthistoricalsociety.org/
Cornish	26 School Street, Cornish Flat; www.facebook.com/CornishHistoricalSociety Saint-Gaudens National Historic Site www.nps.gov/saga
Dorchester	Historical Museum on the Town Common http://www.aannh.org/heritage/grafton/dorchester.php
Enfield	Lockehaven Schoolhouse, Shaker Village Museum www.shakermuseum.org Enfield Center Schoolhouse
Grafton	Library Road; www.graftonhistoricalsocietynh.org Ruggles Mine http://www.rugglesmine.com/
Grantham	Society and Town Archives www.granthamhistoricalsociety.org
*Hanover	Daniel Webster Cottage operated by Historical Society; Dartmouth College Collection; Webster Hall, Dartmouth College www.dartmouth.edu/~speccoll/
Lebanon	Carter Mansion, Dana House, Soldiers Memorial Building
Lempster	Lempster Meeting House http://www.lempsternh.org/FLMH/index.html
New London	Old New London 19th Century Village Reproduction www.newlondonhistoricalsociety.org
Newbury	Sherman Hall www.newburyhistorical.org
Newport	Town Museum - Old County Courthouse/District #7 Schoolhouse www.newporthistory.org
Orange	Historical Museum in the Town House; Unofficial Website http://www.orangenh.us/photo-album/orange-history/

Plainfield	Mothers and Daughters Clubhouse; Maxfield Parish State Set at Town Hall http://www.plainfieldnh.org/historical.html
Springfield	Springfield HS Center School#1 www.springfieldnh.net/historical
Sunapee	Flanders-Osborne Stable - Historical Society Museum Sunapee Harbor http://www.sunapeehistoricalsociety.org/
Washington	Historical Museum/District #5 Schoolhouse www.ultimate.com/washington/whs
Wilmot	Historical Room in Town Hall, Wilmot Flat http://www.wilmothistoricalsociety.org/

6.3 HISTORIC RESOURCE PRESERVATION

National Register of Historic Places and Districts

The National Register of Historic Places is the official list of the nation's resources worthy of preservation. Established by the National Historic Preservation Act of 1966 and administered by the National Park Service within the Department of the Interior, the Register lists properties of local, state and/or national significance in the areas of American history, architecture, archeology, engineering, and culture. Resources may be nominated individually or in groups, as districts or multiple resource areas, and must generally be older than 50 years.

In New Hampshire, any individual may prepare a nomination application. National Register forms, maps and photographs are submitted to the New Hampshire Division of Historical Resources for review by the State Review Board. Following approval at the State level, they are sent to Washington, D.C. for final review, approval and listing.

Benefits of National Register Listing include the following:

1. *Recognition of local, state, or national significance often stimulating appreciation of local resources and encouraging pride in ownership.*
2. *Provision for review and amelioration of effects which any federally funded, licensed or assisted project might have on the property.*
3. *Eligibility for certain Federal tax benefits (investment tax credits) for the rehabilitation of income-producing buildings and the charitable deduction of donations of easements.*
4. *Qualification for Federal preservation grants when funding is available.*

Once nominated, a National Register district must have the approval of a majority of property owners, with each owner having a single vote, regardless of the number of eligible properties he may own and regardless of whether the property contributes to the district's significance. For a single privately owned property with one owner, the property will not be listed if the owner objects. Listing in the Register does not interfere with a property owner's right to alter, manage, dispose of or even demolish his property unless, for some reason, Federal funds are involved. Nor does National Register listing require that an owner open his property to the public.

In New Hampshire, there are nearly five hundred listings, of which approximate fifty are districts. Appendix II lists the more than forty individual buildings and eleven districts in the Upper Valley Lake Sunapee Region which are listed on the Register.

National Register listing can be an important tool for identifying and planning the future of significant resources. Listing can act as a catalyst to change public perception and improve an area's image, but cannot, in itself, prevent major detrimental alterations or even demolition. It remains an important psychological first step toward historic awareness, respect and protection. Register listing can help a community weigh proposed actions more carefully, so that it does not inadvertently expend its long-term assets in realizing immediate objectives.

National Register Listings

All but four of the twenty-seven towns in the UVLSRPC Region have listings on the National Historic Register: Croydon, Grafton, Grantham, and Orange. In many of the towns, several places have been recognized for their historic value.

An example of these is The Fells Historic Estate & Gardens http://www.thefells.org/ which is one of New England's finest examples of an early 20th-century summer estate. Located on Lake Sunapee in Newbury, NH, it boasts 83.5 conserved acres of beauty and tranquility. Visitors may learn the legacy of its founder, diplomat and statesman John Milton Hay, during historic guided tours of the 22-room Colonial Revival home and explore forest succession and nature's diversity while walking woodland trails; and enjoy the renowned gardens. The Fells is listed on the National Register of Historic Places and is a preservation project of The Garden Conservancy.

In 1960 the Hay family donated 675 acres to the Society for Protection of NH Forests. Upon the death of Alice in 1987, the remaining 164 acre-estate was given to the U.S. Fish and Wildlife Service (USFWS) as part of their wildlife refuge system. In 2008 84 acres including the historic buildings and grounds were divested from USFWS and The Fells, an independent not for profit 501c (3) organization, who had cared for the property since 1995 became owners. The remaining 80 acres continues to be owned and managed by USFWS.

A complete inventory of the region's Historic Register locations can be found in Appendix III.

Historic Districts and Design Control Districts

The NH Division for Historical Resources provides a wealth of information and guidance for communities that wish to register or designate historic sites within their towns. http://www.nh.gov/nhdhr/

The term "historic district" can refer either to a locally designated historic district or, as has been previously discussed, to a National Register Historic District. Both are useful preservation tools but differ in the way in which they are established and the protection they afford. An historic area may be both a locally designated historic district and a National Register District.

An historic district is a geographic area of historic, cultural or aesthetic importance and is characterized by a grouping of structures and/or sites which physically and spatially comprise a specific environment. Buildings in an historic district may represent a cross section of ages and styles but should be unified by past events or by plan or physical delineation. Simple, honest 19th century homes, mills and stores can, and should, comprise the nucleus of a district when they create a distinctive setting.

The purpose of an historic district is to protect and preserve areas of outstanding architectural and historic value from alterations and additions which might detract from an otherwise distinctive character. The historic district controls on property development serve to assure property owners that investments made in rehabilitating significant structures will not be negated by incongruous development on neighboring properties.

The most comprehensive preservation tool available to local governments under New Hampshire State law is the creation and administration of a local historic district. As authorized by R.S.A. 674:45, an historic district commission may be designated by local town meeting or a city council to prepare a suitable ordinance which establishes a framework for the commission's decisions and administration. Historic district legislation may be adopted in communities with no local zoning ordinance, planning board or building inspector.

The New Hampshire enabling legislation identifies the following purposes of historic districts:

"Preserving an area which reflects cultural, social, economic, political and architectural history;

- *Conserving property values;*
- *Fostering civic beauty;*
- *Strengthening the local economy; and*
- *Promoting the use of the district for the education, pleasure and welfare of community citizens."*

After preparing an ordinance, the local commission is given authority to consider whether any proposed construction, exterior changes, or demolition of any structure or use within the district is consistent with the ordinance. Alterations and additions within a district are individually reviewed in respect to their mass, scale and detailing in relation to surrounding structures.

Properly administered, historic districts do not freeze or stop the movement of time, but provide compatibility within a recognized and defined area of architectural and historic importance.

Each individual ordinance must outline precisely permitted and prohibited actions and regulated activities. Ordinances take on varying degrees of strictness. Permitted activities may include routine maintenance, repair of existing features, and interior alterations or improvements, provided the work does not change the exterior or appearance of the building. In general, prohibited activities might include artificial siding, lighted signs, mercury vapor lighting, etc. Also, the historic district legislation allows for a community to establish a mechanism to transfer development rights from one property to another. This concept addresses the importance of maintaining certain areas important to a community's character, such as a collection of mill buildings in a downtown, despite the fact that existing structures and lands often have a development potential far beyond their current use.

Plymouth State University Study – Local Historic Districts

Students in the Preservation Planning and Management course at Plymouth State University researched the locally designated historic districts, Historic District Commissions and Heritage Commissions of New Hampshire. The students used online research and direct communication with the towns of New Hampshire to find fifty-six towns in New Hampshire have locally designated historic districts. The districts are of varying ages, sizes, and hold differing levels of protection. The districts are managed and governed by Historic District Commissions, Heritage Commissions, and other groups in New Hampshire that have locally designated historic districts.

Of the 96 towns researched, 84 towns were found to have a local Historic District Commission, Heritage Commission or a local historic district. The remaining 12 towns appear to have abandoned their former commissions and districts.

The Certified Local Government (CLG) program is designed to provide an opportunity for local governments to become more directly involved in identifying, evaluating, protecting, promoting and enhancing the educational economic value of local properties of historic, architectural and archeological significance. Created by the 1980 amendments to the National Historic Preservation Act, the CLG program requires that the Division of Historical Resources (DHR) designate at least 10 percent of its annual Historic Preservation Fund allocation from the Department of the Interior to local governments that have become Certified Local

Governments.

A local government wishing to become a CLG must fulfill certain requirements indicating its commitment to local preservation. One requirement is establishing a historic preservation review commission, which may be either a historic district commission, or a heritage commission with historic district responsibilities. The local government appoints to the commission professional and lay members with varied expertise and interest related to historic preservation, and "shall take into consideration the appointee's demonstrated interest and ability to understand, appreciate and promote the purposes of the…commission."

In addition to its other responsibilities, the historic district or heritage commission serves as an advisory body to the municipal government and to the land use boards (planning board, Zoning Board of Adjustment, and conservation commission). In that role, it becomes the coordinating body for municipal preservation activities. It prepares reports on National Register of Historic Places nominations, for all properties within the community (not just those within a historic district), sponsors public information programs on historic preservation, and prepares applications for matching grants from the CLG share of the state's annual Historic Preservation Fund allocation, if the community chooses to apply for grant funds. The DHR provides training for the CLG commission on its CLG responsibilities and on preservation topics in general.

The entire municipality, and not the Historic District or Heritage Commission alone, is designated as a "Certified Local Government." After certification, ongoing technical assistance is available from the DHR to help the community and the historic district (or heritage) commission conduct historic preservation projects, address preservation issues and opportunities, and resolve concerns relating to federally-assisted activities that may affect historic properties.

The matching grants available to municipalities that have become Certified Local Governments can be used to fund community preservation activities such as survey, National Register, preservation planning and educational projects. In some years, grants are also available for architectural plans and specifications, engineering reports, and even "bricks and mortar" work on National Register properties. "The Certified Local Government for New Hampshire" describes the program in detail. For further information, call or write: Certified Local Government Program, New Hampshire Division of Historical Resources, 19 Pillsbury Street, Concord, NH 03301-3570 Phone:(603) 271-3483.

The locally designated historic districts are found throughout the central and southern part of New Hampshire. No historic districts were identified within or north of the White Mountains. The most northern town with a historic district was Sandwich, NH at the southern edge of the White Mountains.

Five towns in the Upper Valley Lake Sunapee Region are among those with Certified Local Government designated historic districts. They are: Canaan, Claremont, Dorchester, Lebanon, and Newport.

See: Local Historic Districts of New Hampshire with Their Historic District Commissions and Heritage Commissions; (Plymouth StateUniversity, 2012) http://www.nh.gov/nhdhr/publications/documents/lhd_surveyreport2012.pdf

National Historic Landmarks Program

To identify places of national significance, mark them and encourage private initiative in their preservation, the designation of national historic landmarks was begun in 1960. Constituting a step beyond National Register listing, there are less than 2,000 National Historic Landmarks Nationwide.

To attain the designation of national historic landmark, a property must be studied by National Park Service historians, architects or archeologists, usually as a part of a major theme in American history. The property should meet three criteria: significance in a given field, association with individuals and events, and integrity. National Historic Landmarks are automatically listed in the National Register of Historic Places.

Within the UVLSRPC Region, there are currently two National Historic Landmarks. The Salmon P. Chase Birthplace and Boyhood Home is located on Rt. 12A in Cornish and was designated a National Historic Landmark in 1975. Built in 1790, this 2-story frame structure was the childhood home (1808-1816) of Chase, who served Ohio in the U.S. Senate (1849-55, 1861) and as Governor (1855-59), and the nation as Secretary of the Treasury (1861-64) and Chief Justice (1864-73). In the latter capacity, he presided over the impeachment trial of President Andrew Johnson. Chase's picture appears on the U.S. $10,000 bill. The property was restored in the 1980's by Peter Burling and is operated as a bed and breakfast.

The Augustus Saint-Gaudens Memorial is located off Rt. 12A, also in Cornish. The Memorial consists of the home, gardens and studios of one of America's most eminent sculptors, who moved into the house in 1885 and spent many of his most productive years here, until his death in 1907. The property was designated a Landmark in 1962 and is now operated by the National Park Service as the Saint-Gaudens National Historic Site. The site is open daily from the last weekend in May through October. The buildings are open from 8:30 am - 4:30 pm daily and the grounds from 8:00 am until dark. A small admission fee is charged. Each summer, the Memorial sponsors concerts and exhibitions by contemporary painters and sculptors.

Historic Building Rehab Tax Credits

To be eligible for the largest federal tax credit, a building must be a certified historic structure, and be listed either individually on the National Register or contributing to a Register Historic District or certified Local District. Certified rehabilitation work must adhere to the Secretary of the Interior's Standards for Rehabilitation, a list of 10 standards developed to ensure that significant features of a building will not be compromised (see appendix).

Scenic Road Designations

New Hampshire State Law R.S.A. 231:157-8 enables a community to designate any road as scenic unless it is a Class I or II highway. Upon petition of 10 persons who either are voters of the town or whose lands abut the proposed designated road, a vote can be held at a town meeting to consider the proposal. A positive vote at the town meeting can designate a scenic road.

A scenic road designation protects trees and stone walls situated on the public right-of-way. After designation of a scenic road any repair, maintenance, reconstruction or paving work done with respect thereto shall not involve or include the cutting or removal of trees, or the tearing down or destruction of stone walls, or portions thereof, except with the prior written consent of planning board or official municipal body. (R.S.A. 231:158).

Designation of scenic roads enables a community to preserve the rural environs around its historic structures. A scenic road designation also stimulates pride in, and respect for, the existing landscape. This is an especially appropriate and important tool in the Upper Valley Lake Sunapee Region, owing to its rural qualities and the inseparable bond here between architecture and landscape.

Easements

Across the country, preservation easements have proven to be an effective tool for protecting significant historic properties. An easement is a property right that can be bought or sold through a legal agreement between a property owner and an organization eligible to hold easements. In New Hampshire, R.S.A. 447:45-47 covers conservation, preservation, and agricultural conservation restrictions, commonly known as easements. Property owners have found that easements provide them with two important benefits. First, the character of a property is protected in perpetuity and, the donation of an easement may make the owner eligible for certain tax advantages. Costs of such a program may be significantly lower than buying properties outright to protect these valuable resources, particularly when easements can be acquired by donation. Significant historic resources remain in private hands but are protected from certain types of alteration, as the organization holding the easement is given the right to review any proposed changes to the structure.

Archaeological Study Areas

Areas with proximity to bodies of water, such as the Connecticut River and other smaller tributaries, hold great potential for prehistoric and historic archeological areas. Historically, these water bodies were lined with mills seeking to harness their water power. Cellar holes and crumbling foundations bear silent witness to early settlers whose homes were abandoned as families moved downhill or were destroyed by fire. Investigation of these areas, as well as the dock sites which once lined the banks of the Connecticut River and prehistoric sites, yield much useful information. The record of these ancient times is fragile; much has already been lost through vandalism, rebuilding and new development, agricultural activity, road construction, and the inherent acidic nature of waterfront soils. Since this report deals primarily with the region's architecture, investigation by qualified archeologists is necessary to determine the actual potential of these areas.

Above: Archaeological Excavation at Fort No. 4, in Charlestown.

A comprehensive survey of archeological resources has not thus far been prepared, but the N.H. Division of Historical Resources maintains a database of known archeological sites. Additionally, development projects subject to review by the NH Department of Environmental Services Land Resources Management Program require review of potential impacts to historic and archeological sites.

Stone Walls

In 1791 the NH General Court decreed that "if any person shall dig up or carry away any stones, ore, gravel, clay or sand belonging to the proprietors of any common land, or to any particular person or person, every such offender shall forfeit and pay treble damages to the party or parties injured thereby, and also a sum not exceeding five pounds." Except for an amendment in 1842 which added "turf or mold" among the protected resources, and increased the penalty to fifteen pounds, the statute remained the same. In 2009, prompted by local thefts of stone walls, the legislature amended RSA 539:4, specifically focusing on stone walls.

The long history of the statute was retained, but added the words "stone from a stone wall" and replaced the fifteen pound penalty to, "shall forfeit to the person injured treble damages base on the cost of materials and restoration, and including attorney's fees and costs."

The New England stone walls, observed author Tom Mooney of the Providence Journal in a May 2009 article "…which for generations have stood as icons to forebears' gritty resolve against an inhospitable terrain, are prompting much emotion these days."

The NH Division of Historical Resources suggests that stone wall protections become part of subdivision and site review regulations and that maintenance of municipally-owned stone walls be included in the Capital Improvement Program (CIP).

Figure 6.2.2- Regional Historic Resources & Protection Summary

Municipality	Historical Society	Enrolled Local Historic District	National Register Listings	Historic Resource Surveys
Acworth	Yes	No	Yes	---
Canaan	Yes - 1993	1968 -CLG	Yes	---
Charlestown	Yes - 1978	Yes	Yes	
Claremont	Yes - 1963	1969 - CLG	Yes	
Cornish	Yes - 1973	No	Yes	
Croydon	Yes - 1999	No	No	---
Dorchester	Yes - 1965	1981-CLG	Yes	---
Enfield	Yes - 1976	Yes	Yes	---
Goshen	Yes - 1969	No	Yes	Complete - 1982
Grafton	No	No	No	---
Grantham	Yes - 1993	No	No	---
Hanover	Yes - 1961	Yes	Yes	---
Lebanon	Yes - 1958	1996-CLG	Yes	---
Lempster	Yes - 1977	No	Yes	---
Lyme	Yes - 1961	No	Yes	
New London	Yes - 1954	No	Yes	---
Newbury	No	No	Yes	---
Newport	Yes - 1975	1980-CLG	Yes	Complete - 1999
Orange	Yes - 1976	No	No	---
Orford	Yes - 1996	No	Yes	---
Piermont	Yes - 1976	No	Yes	---
Plainfield	Yes - 1978	No	Yes	---
Springfield	Yes - 1985	No	Yes	---
Sunapee	Yes - 1978	No	Yes	---
Unity	Yes - 1984	No	Yes	---
Washington	Yes - 1982	No	Yes	---

Note: CLG means Certified Local Government designation with NHDHR.

For additional information about the projects on file with the NH Division for Historic Resources go to http://www.nh.gov/nhdhr/programs/documents/areas.pdf

Historic Markers

Originated by the N.H. Legislature in 1955, the aim of the Historical Marker Program is the erection of markers designating events, people, and places of historical significance to the State of New Hampshire. Communities who would like to be considered for a marker submit a draft of information to be included on a marker, bibliographic information, background historical material and a proposed location for the marker. The material is reviewed by a state committee comprised of members from the Highway Department and the State Historic Preservation Office. More information about historical markers is available on line at http://www.nh.gov/nhdhr/markers/intro.html

Any municipality, agency, organization, or individual may propose a marker to commemorate significant New Hampshire places, persons, or events. In approving a marker, the DHR takes into consideration the distribution of markers by geographical regions, chronological periods, and historical themes. Preference is given to placing markers at locations that are not already adequately marked.

The marker text should stress why the subject is distinctive and significant to the state's residents and visitors, and why it merits the special status conferred by a state marker. A footnote citation must cite the source of information for each historical fact presented in the draft text, with two sources that do not cite each other to support any superlative claims (oldest, first, etc.). Copies of the source material should be submitted. Sponsors should propose a marker location, but the Department of Transportation selects the final location to insure safety and compliance with road regulations.

A petition asking for support of this marker subject and location, signed by 20 citizens of New Hampshire, must also be submitted. The subject and location of the marker must be clearly stated at the top of each petition page for the petition to be valid.

The proposed text and research are reviewed by the DHR, which reserves the right of final decision, and which will make editorial changes for each text to make it consistent with current marker practices. The DHR and the sponsor must agree on a final text before a marker order can be placed.

When a proposed text is approved, the marker can be ordered under the regular, state-funded marker program, which is limited to approximately 10 markers per year, and can only be used for markers on the state-maintained highway system. Co-operative markers can be ordered for placement on locally-maintained roads or municipal lands, or when the state funds have been exhausted for the fiscal year. Sponsors of co-operative markers assume full responsibility for the cost of the marker and future maintenance through a formal agreement with the state program. At present, markers cost approximately $1500 to $1800, and there is a waiting list for both regular and co-operative markers.

The NHDHR and the NH Department of Transportation share responsibility for the historical highway marker program under RSA227C:4x and RSA236:40-44. For more information, please contact the DHR at 603.271.3483 or by e-mail at preservation@dcr.nh.gov.

Historic Resource Preservation Strategies

Historic Resource Preservation Strategies
• Provide technical assistance to communities developing nominations for National Historic Register recognition.
• Encourage additional utilization of federal tax credits for buildings on the National Historic Register that are adaptively rehabilitated.
• Promote municipal participation in the NH Division of Historic Resources Certified Local Government (CLG) Program.
• Provide technical assistance to municipalities in establishing local Historic Districts, Demolition Review Ordinances, or other historic preservation regulatory measures.
• Collaborate with municipalities to designate and Promote Scenic Roads & Byways (e.g. Lake Sunapee Scenic Byway and Connecticut River Scenic Byway).
• Encourage municipal utilization of conservation easements as a tool for protecting significant historic properties.
• Work with municipalities to ensure that stone wall protections become part of subdivision and site review regulations, and that maintenance of municipally-owned stone walls be included in the local Capital Improvement Program (CIP).

6.4 RECREATION

Vision

Retain the region's rural character and protect the natural environment that provides recreation opportunities and scenic beauty that are so highly valued by the region's residents and visitors.

Existing Conditions

During the numerous outreach events conducted by the UVLSRPC in 2012 the following priorities ranked high on the list: recreation opportunities, appreciation for and a desire to retain rural characteristics, protection of wildlife habitat, and clean air and water. There are rivers, lakes, mountains, forests, farms, and a seemingly endless supply of scenic vistas abound in the region. The scenic beauty and high recreation potential attract both dynamic labor force and 4-season tourism.

While the region is mostly rural, agriculture is not the dominant economic activity despite a renaissance for local food production. Except for the land adjacent to and in Connecticut River Valley, the terrain and soils preclude large-scale farming. Much of the land is forested or otherwise in its natural state and provides extensive habitat for wildlife and potential wilderness recreation for the area's residents and visitors. This diversity of the land enhances residential value, as well as recreational opportunities and it is these natural resources that are so highly valued in surveys and interviews undertaken for this plan.

Expansion of the Dartmouth-Hitchock Medical Center and business expansion in and around the region's largest municipalities underscore the need to protect and expand regional and local recreation opportunities, and to set aside adequate public open space and ensure public access to natural resources for recreational enjoyment.

Public Recreation Lands

State-owned parks, forests, and wildlife management areas constitute the most substantial public land holdings within the region. The largest portion of state lands available for recreation in our Region include: Gile Memorial State Forest, almost entirely within Springfield; Mt. Sunapee State Park, largely in Newbury; Cardigan Mountain State Forest, in eastern Orange; and Pillsbury State Park, in Washington and Goshen. The larger wildlife management areas in the region include: McDaniel's Marsh in Springfield; Enfield Wildlife Management Area, primarily in Enfield; Huntington Hill, in Hanover; and Cummins Pond and Mascoma River Wildlife Management Area, in Dorchester. Smaller state land holdings are scattered throughout the Region.

Federally-owned land also offers significant recreation resources. The Appalachian Trail corridor, comprising approximately 4,000 acres, and managed by the U.S. National Park Service, United States Forest Service, and the nonprofit Appalachian Trail Conservancy, runs through Hanover, Lyme, Orford, and Piermont. The Saint-Gaudens National Historic Site, managed by the National Park Service, is used for a variety of activities. The Fells Historic Estate & Gardens (see page 6-12) is listed on the National Register of Historic Places, and has been donated to the Society for Protection of NH Forests and to the U.S. Fish and Wildlife Service (USFWS) as part of its wildlife refuge system.

There are extensive conserved privately owned lands in our region that generously allow access to the public, including lands owned and protected by the Upper Valley Land Trust, the Ausbon Sargent Land Trust, the Hanover Conservancy, the Nature Conservancy, the Society for the Protection of New Hampshire Forests, and other private non-profit conservation organizations.

The majority of communities in the region do not have large tracts of locally owned or protected land available to residents and visitors for recreation. There are several exceptions, such as Hanover, Lebanon, Grantham, New London, Sunapee and Lempster. However, most towns have only small pieces of land conserved for this purpose.

Recreational Waters

Public access to rivers and lakes for recreation purposes continues to be a concern for the region's residents. Some access is currently afforded through public parks and other public properties located along the shore lands of lakes and rivers. "Public waters" in New Hampshire are prescribed by common law as great ponds (natural water bodies of 10 acres or more in size), tidal waters, and public rivers. These common law public waters are held by the State in trust for the people of New Hampshire. Certain New Hampshire statutes define public waters in different ways. Ensuring suitable public access to the region's recreational waters is important. New Hampshire Suitable public access implies access that is safe, sound environmentally, and appropriate for the type of access proposed.

Connecticut River

Nine municipalities front the 56-mile stretch of the Connecticut River that runs along the western border of the region. With its watershed in two countries, four states, and many communities, not all of which have river frontage, the Connecticut River is a recreation resource which requires a well-coordinated approach to planning and management. Recreation is, of course, just one of many, sometimes competing, uses of the River.

The Connecticut River is popular throughout New England among kayakers and canoeists for its tranquility and scenery. The river is nationally and internationally renowned among rowers and scullers for its extensive, clean, and calm flatwater amid an outstanding natural setting, as the home of many high-school, college, and masters rowing clubs and as the venue of many regattas, races, and national and Olympic training events.

Whereas in the past, our river was dubbed "America's best-landscaped sewer," decades of careful environment stewardship have transformed it into "the most beautiful place for rowing in all of North America."

The Connecticut River Joint Commissions (CRJC), enabled by both New Hampshire and Vermont legislatures, plays a leading role in a number of issues relating to the Connecticut River. For example, through a cooperative effort by CRJC, Upper Valley Land Trust and landowners, campsites for Connecticut River canoeists have been developed and public information resources and maps created to facilitate recreational use of the river. Recreational use of the river continues to be a priority as the CRJC

Local River Subcommittees updated River Recreation plans in 2013, and maintain a corridor management plan for the Connecticut River.

Within the regional boundary along the 56-mile stretch of the Connecticut River are twelve river access points available to the public:
State owned in Orford, Lebanon, Cornish, and Clarement; Municipally owned in Lyme (Hewes), Hanover (Wilson's Landing), Lebanon (East Wilder), and Charlestown (Patch)..
Private—Wilder Dam (Lebanon) and Charleston Lower Landing (both owned by TransCanada) offer access to the public; Ledyard Boat Club (Dartmouth College in Hanover) and North Star Canoe Rentals (Cornish) offer boat rentals; and Pastures Campground (Orford) allows river access with charge.

In addition there are several places of public river access on the Vermont shore.

The federal re-licensing process for TransCanada Hydro Northeast could result in improved and extended public river access.

Lake Sunapee
Like the Connecticut River, Lake Sunapee is an inland jewel and has been a significant recreational resource since the 19th century [reference Historic Resources]. Bordered by three communities and managed by the State of NH, coordination and planning to maintain this regional resource is challenging. The Lake Sunapee Protective Association (LSPA) plays a significant role in efforts to protect the Lake. The LSPA and representatives from the three towns bordering Lake Sunapee developed model shoreline protection regulations which were subsequently customized and adopted by each of the three lake-side communities.

Other Recreation Waters
Lakes and ponds meet many important recreation needs in the Region. Near Lake Sunapee, in New London, are Little Sunapee Lake and Pleasant Lake, also of considerable size and of interest to recreation seekers. Farther north, Mascoma Lake and Crystal Lake in Enfield are important, as is Goose Pond in Canaan. More remote to the population centers but, nonetheless, popular recreation sites are Lake Tarleton and Lake Armington in Piermont, and an extensive grouping of lakes in Washington. Among the latter, Millen Lake, Ashuelot Pond, and a finger of Highland Lake, which extends into Washington from the south, are popular. Many small lakes and ponds dot the Region. (See Natural Resources Chapter)

Two of the Connecticut River's major tributaries are located in the region: the Mascoma River, and the Sugar River, which have several public access points. Each offer boating, swimming and fishing and are important recreation resources. The Sugar River delivers a substantial volume of flow at its junction with the Connecticut River. The Mascoma River links Mascoma Lake with the Connecticut River.

In addition, many small streams throughout the region have recreation value to residents for swimming, fishing, and as the focus for riverside walks and general outdoor enjoyment.

Hiking

The Upper Valley Lake Sunapee Region

supports numerous publicly aceessible hiking trails, of which many are of local importance, some of regional importance, and one of national significance. The latter is the Appalachian Trail (AT). Each year, thousands of people hike the Appalachian Trail. In its path are lowlands, such as the Connecticut River valley, as well as strenuous climbs to mountain peaks. The highest elevations along the stretch in our region are in Hanover, where the trail traverses Moose Mountain (2,300 feet); in Lyme, ascending Smarts Mountain (3,240 feet); and the peak of Mt. Cube (2,911 feet), in Orford. Trail shelters are conveniently located. The Appalachian Trail is maintained and managed by local hiking clubs. In this region, the Dartmouth Outing Club works with the Appalachian Trail Conference (ATC) to coordinate volunteer trail maintenance and monitoring. Through the hard work and cooperation of ATC, community groups and landowners, the lands and easements associated with the AT have been expanded to increase the natural buffer between hikers and current and future adjoining land uses. The AT is the locus of the northern section of a regional trail network. AT planners welcome additional AT access points via hiking trails. This regional resource presents tremendous opportunities for recreation and tourism-related enterprises.

Several hiking trails of regional importance are located on state lands. Cardigan State Park has over ten miles of trails which lead to the 3,100 foot summit of Mt. Cardigan. The rugged wilderness of Pillsbury State Reservation offers two miles of maintained hiking trails. Mt. Sunapee State Park, which is a major year-round recreation area with a network of trails, is one of the most popular hiking areas in the Region. The Sunapee-Monadnock Greenway Trail, which stretches from Mt. Sunapee to Mt. Monadnock in southern New Hampshire, is one of the most challenging hiking trails in New Hampshire. Winslow State Park also attracts many hikers up its steep mile-long hiking trail to the summit of Mt. Kearsarge (2,937 feet) and is part of the Sunapee-Ragged-Kearsarge Greenway.

Many municipalities have increasingly extensive and increasing public trail networks, often traversing and linking parks, conservation lands, and lands owned by cooperative non-profit organizations and institutions, and by generous private owners. Trail maps are available through municipal offices and websites.

Whereas private lands throughout the nation rarely accommodate public trail access, northern New England has developed an active tradition of public/private partnership in the creation and maintenance of trails that citizens can enjoy.

Through the efforts of the Sunapee-Ragged-Kearsarge Greenway Coalition, a braid of trails has been developed circling Lake Sunapee and linking the summits of Sunapee, Ragged, and Kearsarge Mountains, with links to local trails and the Sunapee Monadnock Greenway and would provide a part of the link to the AT.

Efforts have been underway to link existing trails to develop an interconnected system of recreation corridors built on the foundation provided by the AT and Sunapee-Monadnock Greenway.

The Claremont Parks and Recreation

Department also has a maintained trail system at the 325 acre Moody Park. The trails can be used for hiking, running and mountain biking. Moody Park also offers winter recreation with an outdoor skating rink, and trails that can be used for cross-country skiing or snowshoeing. The Sugar River Recreational Trail, an abandoned railroad right-of-way, offers 8-miles of opportunity to enjoy the natural beauty of the area. The trail stretches between Claremont and Newport and is designed for walking, horseback riding, snowmobiles, cross country skiing, mountain biking, and fishing. The trail weaves through the river's wooded shores, crosses the river and its feeder streams on several bridges.

http://www.nhstateparks.org/explore/bureau-of-trails/sugar-river-recreational-trail.aspx

Upper Valley Trails Alliance

The Upper Valley Trails Alliance formed in 1999 is a community coalition dedicated to "··· advocating for the use, maintenance and development of trails in the region. Through education, outreach & stewardship···" The organization works "···to

- promote active lifestyles through trail use in all seasons,
- connect people and places through a regional trail network, and
- lead a coalition of local trail groups and advocates."

They maintain a comprehensive directory of trails and publish guides and books about the region's trails. Through volunteer efforts, existing trails are maintained and new ones are constructed. The group works with landowners and municipalities to secure access rights to trails. Whenever possible they work to connect trails for recreation and travel.

Rail Trails

Several railroad rights-of-way have been converted to trails. The non-profit Friends of the Northern Rail Trail in Grafton and Merrimack Counties has successfully converted into a rail trail all but the easternmost two miles of the Northern Rail Line between Concord and Lebanon. It is New Hampshire's longest rail trail and is on right-of-way purchased by the State. Efforts are underway by the City of Lebanon and the non-profit Mascoma River Greenway to extend this rail trail from downtown Lebanon to West Lebanon and eventually across the river to White River Junction.

A rail trail which runs along the Sugar River between Claremont and Newport, and which crosses now-rate railway covered bridges, has become popular.

The future rails-to-trails movement will bear watching following a Supreme Court ruling handed down on March 10, 2014.

These old railway rights-of-way offer precious opportunities since it would take a great deal of time, money and effort to consolidate rights-of-way such as these ever again. As the number and extent of rail trails continue to increase and as these rail trails become connected into large regional networks, their potential for recreation, health, and tourism will grow into even greater significance and value.

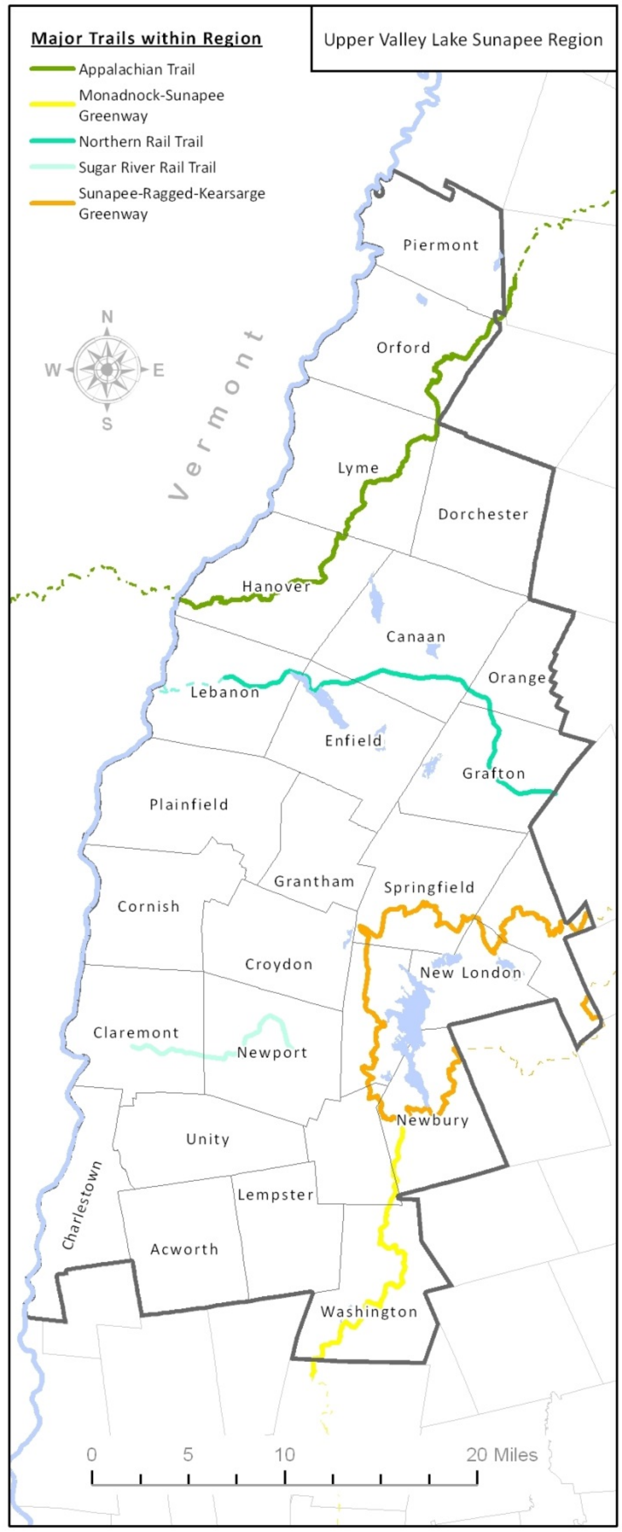


Figure 6.4.1- Key Regional Trails

Camping and Picnicking

Although there are several privately owned campgrounds in the Region, public camping facilities are scarce. There are twenty pond-side tent sites in Pillsbury State Park and Mt. Sunapee State Park offers sites for group camping. The system of Connecticut River campsites developed by the Upper Valley Land Trust offers additional camping opportunities for canoeists.

Picnic areas are available in all State Parks and in the Corps of Engineers at nearby Union Village Dam, North Hartland Lake recreation areas, and Ascutney State Park across the Connecticut River in Vermont.

There are also municipal and privately owned picnic areas which serve regional recreation needs. Foremost among these are four sites along the Connecticut River, which coincide with access to the river: two New England Power Company picnic areas, one adjacent to Wilder Dam, and one in Charlestown, Lyman Point Park at the White River confluence in Hartford, Vermont, and the Storrs Pond Recreational Area in Hanover, and at the Boston Lot and City Forest in Lebanon. Additionally, waterfront municipal picnic facilities in Sunapee and New London provide scenic views of Sunapee Lake, Little Sunapee Lake, and Pleasant Lake.

Winter Recreation

Mt. Sunapee State Park has ten miles of cross-country ski trails, and Pillsbury State Park has logging roads suitable for cross-country skiing, these are, as a rule, not groomed or patrolled and are shared with and groomed for snowmobiles. There are several commercial touring centers in the region which provide groomed, well marked trails for all levels of ability, as well as rentals and other services.

There are numerous publicly accessible cross-country ski trails, some groomed, most are not. These trails are on municipal lands and others are on private lands at the permission of the landowners. A robust volunteer tradition maintains these trails and continued public access depends on cooperative efforts among landowners, recreationalists,, and volunteers.

Two publicly-owned facilities for downhill skiing are located in the Region. The most important is Mt. Sunapee at Mt. Sunapee State Park in Newbury, with a vertical drop of 1,500 feet, and with double chairlifts and bar tows. Mt. Sunapee also provides snowmaking.

The City of Lebanon owns and manages a small ski area at Storrs Hill . Founded in 1922 by Erling Heistad, this local recreation program provides winter recreation for all ages and offers skiing, snowboarding, and ski jumping lessons to all age groups.

The Lebanon Outing Club maintains three jumps (K-10, K-25, K-50) and a community alpine ski slope at Storrs Hill. The Club has a storied history in eastern ski jumping and the Olympics. Storrs Hill remains in operation due to the support of local residents.

Community value and commitment to fostering outdoor recreation opportunities at affordable prices for local residents of all ages is evidenced by the efforts of several non-profit winter recreation areas.

Whaleback Ski Area located in Enfield, NH after years of struggling to operate as a profit-making enterprise has recently been re-opened as a non-profit. Community members came together in the spring of 2013 when the privately owned ski-area shuttered operations. This group was united in their recognition of the importance of Whaleback as a community asset and formed The Upper Valley Snow Sports Foundation (UVSSF), a non-profit, charitable organization with the mission of supporting and enhancing a sustainable snow sports experience in the Upper Valley. UVSSF is striving to preserve Whaleback because every youth and adult in the Upper Valley who wants to ski or snowboard should have an opportunity to do so at their local mountain. <http://www.whaleback.com/>

Arrowhead Recreation Area in Claremont, NH was established in 1962. Like many of the regions' small ski hills, it weathered industry changes and closures and remained unused for a number of years. Ski operations were returned to the area in 2002 for the first time in many years under the management of the Arrowhead Recreation Club, a non-profit all volunteer organization. The Arrowhead Recreation Club is the primary hub for winter time operations at the ski area. Their purpose is to educate children and adults by fostering and encouraging all forms of outdoor recreation, including, but not limited to, instruction and training in alpine skiing, cross-country skiing, snowboarding, tubing, hiking, biking as well as motorized operation such as ATV and snowmobiling, all offered at affordable rates. The City of Claremont played a role in supporting Arrowhead, assisting with purchase of the area ski lift. Arrowhead is a highly valued community and regional resource. <www.arrowheadnh.com>

Dartmouth Skiway located in Lyme, NH
http://skiway.dartmouth.edu/
Dartmouth Skiway is owned and operated by Dartmouth College and is open to the public. It offers more than 100 ski-able acres spread over two mountains and a variety of terrain for skiing or snowboarding. The Skiway has: a 968-foot vertical drop, affordable ski tickets, a full-service day lodge and terrain grooming. It has a long tradition as the home of nearly 100 Dartmouth All-Americans and more than 30 national champions.

Snowmobiling
The snowmobile clubs in the region organize and maintain many of the trails for winter use. In some areas of the region, such as Lyme-Dorchester, the Plainfield-Croydon, and the Claremont-Charlestown-Ackworth-Lempster-Unity areas, trail networks are quite extensive. As with all recreational use that occurs due to the generosity of the landowner, if the property changes hands, the right to use the trail corridor could vanish. Planning for changes in trail use rights may be something for communities to consider as they assess their recreational and natural assets.

In addition to small local trail networks, an extensive snowmobile trail corridor extends from Dorchester in the north to Acworth in the south, roughly paralleling the Connecticut River. This stretch is a segment of a statewide corridor trail system, sponsored by the State of New Hampshire. The Sugar River Trail, described in the preceding section, along with the I-89 bike path from North Grantham to Purmort are both important snowmobile trails.

The entire 58-mile length of the Northern

Rail Trail is open to snowmobiles.

Use of Unmaintained (Class-VI) Roads
Every town in the region has roads which are not maintained. These provide a tremendous recreational opportunity. Although not appropriate for vehicular use, many serve snowmobilers, horseback riders, skiers, fishermen, hikers, and mountain bikers. Some towns have created maps of these roads for recreational users. Towns should consider developing such maps to open up new opportunities to residents who may not be aware of these resources. These unmaintained roads also provide opportunities for linking existing trail systems.

Hunting and Fishing

Large tracts of uninterrupted vegetation cover the diverse topography of this region, creating suitable habitat for a wide range of game animals. The most common upland game species are white-tailed deer, bear, moose, snowshoe hare, cottontail rabbit, bobcat, fisher cat, fox, gray squirrel, grouse, woodcock, pheasant and turkey. Aquatic species include beaver, otter, muskrat, raccoon, mink and waterfowl, such as ducks, teals and the hooded merganser.

A good deal of hunting takes place on private property; however, some of the most game-rich areas are in the public domain. The most important of these public hunting grounds are the Wildlife Management Areas, managed by the New Hampshire Department of Fish and Game.
Although their purpose is to manage wildlife populations they also provide recreation opportunities through hunting permits.

The Enfield Wildlife Management Area is the largest in the region and also the largest in the State. It encompasses close to 3,000 acres of northern hardwood, several ponds and associated marsh lands that are habitat for upland and aquatic species.

McDaniel's Marsh Wildlife Management Area includes over 600 acres in Springfield and Grafton. Many upland and aquatic species are hunted in this area. McDaniel's Marsh is also one of the best waterfowl hunting grounds. The Department of Fish and Game is providing a number of wood duck nest boxes to maintain the breeding population. Enfield has the extensive Henry Laramie and Lower Shaker Wildlife Management Areas.

Two Connecticut River marshes managed by the Department of Fish and Game are located at the northern end of the Region, Reed's Marsh (65 acres) in Orford and Wilder Management Area (60 acres) in Lyme. Many upland and aquatic species are hunted in Reed's Marsh. The Wilder Management Area, an important waterfowl area, provides wood duck nest boxes and offers hunting of many aquatic and upland species. Other sizeable Wildlife Management Areas in the region include Huntington Hill (439 acres) in Hanover, and at the Mascoma River and Cummins Pond in Dorchester.

All New Hampshire State Parks allow hunting to some extent. Restrictions relate primarily to skiing, camping, and trail areas. A large range of upland and aquatic species is present in the State Parks. However, deer is the most commonly hunted game animal. The State Forests also allow hunting and are, in general, less restrictive than the State

Parks. The NH Fish and Game Department is an excellent resource for information about the region's varied species, habitat, and hunting areas.

Straddling the boundaries of Plainfield, Grantham, Cornish, Croydon and Newport is Corbin Park, a private game reserve on 25,000 acres. Hunting privileges are attained by paying a high membership fee. Some unusual species, such as boar and elk, are among the game animals hunted in Corbin Park.

Although several critical habitat areas have been protected as wildlife management areas or as a result of land conservation for other purposes, most habitats remain on private lands. Efforts at protection of critical habitat areas, such as deer wintering areas, wetlands, stream buffers, and other wildlife travel corridors between habitats, must continue if the region's wildlife resource is to survive human population encroachment.

Fishing is probably the most easily realized recreational activity in the Upper Valley Lake Sunapee Region. Due to the variety of water body sizes, depths and elevations, fishing enthusiasts who live in or visit our region have access to both warm water and cold water fisheries. Cold water fish found in this area include brook, rainbow, lake and brown trout, salmon, northern pike and smallmouth bass. The warm water species include pickerel, largemouth bass and walleyes.

Containing a variety of habitat types, the larger rivers tend to offer both cold and warm water fisheries. In the Connecticut River, smallmouth and largemouth bass are plentiful, although the smallmouth bass is most common. Other abundant species include shad, walleyes and northern pike. Rainbow trout is also readily available, along with bass and pike in the White River. The Mascoma and Sugar Rivers are also trout streams. Both rivers yield brook trout, rainbow trout and brown trout. Brook trout can also be found in most of the region's small streams with good currents and clean bottoms.

Most lakes and ponds in the Region contain one or more game fish species. As a rule, a given pond offers either cold water fish, such as trout or salmon, or warm water fish, primarily bass, pickerel, and perch. However, a few of the larger lakes, for example, Lake Sunapee and Mascoma Lake, support species from both groups. Interestingly, of these game fish species, only the brook trout, lake trout, shad and pickerel are native to our Region. Smallmouth and largemouth bass, landlocked salmon, pike, walleyes and the other varieties of trout were all introduced. The ability of fish populations to survive, thrive and reproduce depends on a variety of factors. These include human activities that affect water quality and temperature, as well as fishing pressure itself, and also competition with other fish species. Many of the fisheries in the Region are managed by the New Hampshire Fish and Game Department, some as "put and take" fisheries to provide annual fishing opportunities for residents and visitors, and others, with the aim of developing self-sustaining breeding populations. The success of these programs, like the region's fish populations in general, is dependent on the continued availability of suitable habitat.

Boating and Swimming

Canoeing, sailing and power-boating opportunities exist on many lakes, on the Connecticut River and on other large streams. For white water enthusiasts and other paddlers, the Connecticut River offers many levels of difficulty along this fifty-six mile reach of the River. Through the efforts of the Upper Valley Land Trust, a series of campsites is available for use by canoeists who desire more than a day's paddle. The northernmost segment, up to Bedell Bridge State Park in Haverhill, navigable by kayak and canoe, is predominantly flatwater since the construction of Wilder Dam, around which significant portages have to be made. A good place to take off is the (private) Pastures Campground in Orford, just south of the Morey Memorial Bridge linking Fairlee, VT and Orford, NH. The slow water continues south but the beautiful agricultural scenery makes up for some of the strenuous paddling in other stretches. Clay Brook, a tributary on the New Hampshire side, offers additional scenic views and birding opportunities. Grant Brook in Lyme offers scenic paddling through a protected state wildlife area.

Portage is recommended around Sumner Falls/Hartland Rapids for all but the most experienced paddlers.

There is a State of NH access point off Route 12A, between the Blow-Me-Down Brook and the covered bridge in Cornish, not far from Saint-Gaudens National Historic Site. After a stretch of steep banks, the restricted views become increasingly wider, taking in agricultural fields and Mt. Ascutney foothills. The water is relatively quick.

Several stretches of the larger Connecticut River tributaries are also popular for canoeing and kayaking. One of these is the Sugar River, from downtown Newport to the Claremont line.

Boating on the lakes is more diversified than on the Connecticut River and its tributaries. Power boats and sailboats are more common here. Smaller boats are used on nearly every lake or pond that is accessible to area residents, frequently in conjunction with fishing.

Boaters' care is increasingly necessary in order to prevent the spread of aquatic invasive species, animal as well as vegetative, which can be easily introduced from boats into water bodies, befouling them and reducing water quality and native species health and diversity.

Public swimming beaches are in short supply throughout the Region. Along the banks of the Connecticut River there are no designated public swimming areas. Small ponds, too, though often suitable for swimming, lack public access and public facilities. The existing public beaches are, therefore, crowded on warm summer days. This is particularly true for Lake Sunapee, Little Lake Sunapee, and Pleasant Lake. The only other public beaches of regional significance are on Canaan Street Lake in Canaan and Indian Pond in Orford. Locally known swimming holes on rivers and streams offer another alternative for some residents. These are often on private lands that offer no guarantee of continued use by the public. Public Beach access is limited, with the exception of Sunapee State Beach; the other public beaches are in municipal ownership.

Sightseeing
Residents and tourists, alike, enjoy drives along the region's roadways to view the fall foliage, the greening of the fields in springtime, and scenic views of rivers, mountains and farmland. The region's historic land use patterns and conservation lands all contribute to the character of the Region that makes sightseeing such a popular activity. These characteristics which contribute to the region's scenic quality, and methods for maintaining them, are discussed in the Natural Resources chapter.

Developed Recreation Facilities and Recreation Programs
Developed recreation facilities, such as ball fields and skating rinks, are another important component of the region's recreation resources. The level of development of these facilities is quite variable among communities and depends mainly on the population and available funding. Many communities in the region have recreation programs with organized and coordinated activities. These can range from summer programs for children to youth hockey and ski instruction. Larger communities, such as Lebanon, Hanover, Claremont, and Newport, have full-time staff to organize these programs. Smaller communities rely on part-time employees and volunteers to meet the increasing demand for programs for all ages and seasons.

As new facilities are needed and local funding sources feel the pressures of school budgets and overdue road maintenance, consideration of inter-municipal cooperation on facilities might create new opportunities and options. Operations and maintenance of most recreational facilities are locally financed, and recreation departments and commissions often find it challenging to compete with other departments for resources. Sharing facilities can help reduce this burden.

Recreation Improvement Strategies
• Develop a Regional Safe Routes to Play plan.
• Support the development of the “Quabbin to Cardigan” trail network.
• Coordinate with municipalities, the Central New Hampshire Regional Planning Commission, and statewide partners to develop a feasibility study evaluating the potential for extending the Sugar River Rail Trail to points east.
• Assist the City of Claremont in implementing the Bobby Woodman Rail Trail Action Plan.
• Implement the water quality improvement strategies detailed in Chapter 5 (Natural Resources) of this Plan to ensure that swimming, boating, and fishing opportunities remain abundant in the region.
• Implement the forest lands improvement strategies detailed in Chapter 5 (Natural Resources) of this Plan to ensure that hunting opportunities remain abundant in the region.

APPENDIX I- REGIONAL HISTORIC LOCATIONS

Acworth	Brooks Gorge Honor Roll - World War I Memorial Flagpole To those who served in Desert Storm Town House - Acworth 1821 United Church of Acworth 1821
Canaan	Canaan Honor Roll - Civil War To Korean Conflict Canaan Street National Register of Historic Places Old Meeting House and Town Hall Erected in 1793 Old North Church Built 1826 - Congregational
Charlestown	Main Street - Charlestown - National Historic District Civil War Monument Crown Point Road 1760 Fort at No. 4 Gen. John Stark's Expedition to Bennington 1777 Honor Roll, World War I In Memory of the Deceased Members of Old No. 4 Fire & Hose Company Site of Johnson Cabin Where They Were Captured by Indians (sic) 1754 Site of the Stockade of Fort No. 4 Site of Walker Tavern 1769-1793 The Old Iron Kettle Spring To Mark the site of the Old Fort No. 4 Built 1743 Vietnam-Lebanon-Granada-Panama-Persian Gulf Memorial World War II & Korean Conflict Memorial
Claremont	Old Saint Mary's - NH First Catholic Church Charles R. Puksta Bridge First Roman Catholic Church In Honor of Claremont Soldiers Who Served in the Rebellion 1861-1865 In Memory of Our Brothers & Sisters Who Served Our Country Names of Revolutionary Soldiers Buried In This Cemetery Revolutionary Patriots Buried In This Yard Site of Old Tavern House - Lafayette Stopped Here 1825 Union Church - Oldest Standing Episcopal Church In NH 1771-1773 West Claremont Burying Ground - 1768 (Old Church and Plain Roads)
Croydon	Croydon Flats Settled 1766 Croydon Settled 1766 (East Village) Croydon Turnpike - Original Carriage Toll Road to Hanover Honor Roll - World War I

Enfield	200 Ft to School House - Drive Slowly
	Honoring B. Wayne Campbell
	In Memoriam to Fred A. Fogg 1864-1946
	In Memoriam to Jesse R. Lovejoy 1863-1945
	In Praise of Our Pioneers In Faith - The LaSalette Missionaries
	Memorial Water Fountain A Gift of Warren Clough
	North Residence 1830 (LaSalette)
	Old Schoolhouse 1851
	Shaker Village Settled 1793, Shakers
	This Mill Stone from the McElwain Blacksmith Shop
	Town House Enfield Center 1843
	Union Church Enfield Center 1836
Cornish	Civil War Monument
	Cornish-Windsor Bridge
	Honor Roll - World War I
	Honor Roll - World War II
	Korea & Vietnam Honor Roll
	Monument to All Cornish Veterans
Cornish	Saint-Gaudens National Historic Site
	Salmon Portland Chase
	The Cornish Colony
	Winston Churchill
Dorchester	Cheever Chapel 1905
	Welcome to Dorchester
Goshen	Capt. John W. Gunnison
	Honor Roll - Revolutionary War thru World War I
	Honor Roll - World War II thru Vietnam
Grafton	Grafton Center Cemetery 1812
	Grafton Congregational Church 1798
	Honor Roll - World War I & II
	Memorial Flagpole Dedicated to Leslie E. Seaman's 38 Years of Service
Grantham	Grantham Honor Rolls
	In Memory of Grantham Firefighters
	Memorial Arch - Dedicated to Emil A. Hanslin
Hanover	In Memory of Captain Stephen F. Mack
	Revere Bell
	Site of First Dartmouth College Building 1770
	Tuck Drive

Lebanon	Blue Star Memorial Highway Civil War Soldier Dedicated to the Deceased Members of the Lebanon Fire Department George W. Currier Principal West Lebanon High School 1925-1958 Honor Roll - World War I In Grateful Tribute to the Deceased Firemen of West Lebanon McShane Bell Nathan Lord House Site of First Meeting House in Lebanon 1772-1792 Site of Tilden Ladies Seminary 1854-1890 Spruce Tree Planted Signifying Unity Between Lebanon & W.Lebanon To All Men & Women of Lebanon Who Served Their Country in Time of Need
Lempster	Civil War Monument AOur Fallen Heroes 1861-5" (East Lempster) Guide Sign with Mileages & Pointing Hand Honor Roll World War I & II In Memory of Alonzo Ames Miner, D.D. (East Lempster) Lempster Town Hall, Built 1794, Moved 1822
Lyme	In Memory of Volunteer Soldiers & Sailors of Lyme Lyme Founded 1761 To All Those from Lyme Who Served Their Country In Times of Conflict Tribute to George Weymouth M.D. - Our Doctor Lyme Academy
Newbury	Center Meeting House
New London	Civil War & World War I Memorial Colby Sawyer College 1837 County Road Falling Water and Early Industry Herrick Homestead and Tavern Hominy Pot Honor Roll World War II In Memory of Marion Duncan McGann Lakeside Landing for Steamboats Little Sunapee Lake Meetinghouse of the First Baptist Church of New London New London Inn 1792 New London's First Town Meeting Old Colby Academy 1837 Old Main Street Oren D. Crockett 1850-1942 Triangle Garden Pleasant Street Pioneers Primal Peoples

	Scytheville-Elkins Bandstand Scytheville Park, Site of Old Scythe Factory Site of First Church Constituted 1788 Site of Pleasant Street Schoolhouse 1821-1967 Soo-Nipi Park The Colby Hill School The Home of Moses Trussell (1753-1843) The Old Campus The Sargent Common Willow Farm World War II Memorial
Orford	Common Lot #34 - Mustering Site 12th NH Regiment Rev War East Common - Lot #34-35, Lot #36 Highway Guide Sign Honor Roll - World War I House Built in 1788-1809 By Orford's Founder John Mann Orford Honor Roll Riding or Driving Prohibited on This Mall Riding or Driving Prohibited on This Mall The Ridge Welcome to Orford - Home of Samuel Morey Inventor West Common
Piermont	Honor Roll - World War I Honor Roll - World War II & Vietnam
Plainfield	Classes 1915-1916 Kimball Union Academy
Springfield	Entering John F. Gile Memorial Forest, 6500 Acres State Forest Gardner Memorial Wayside Park Honor Roll, World War I Springfield 1769 Charter Granted Springfield Meetinghouse & Townhouse 1799 Walter C. Gardner III, Memorial Wayside Park
Sunapee	Honor Roll - World War 1917-1919
Unity	Honor Roll Veterans Honor Roll World War I Unity Incorporated July 13, 1764
Washington	Birthplace of the Seventh Day Adventist Church Brigadier General Sylvanus Thayer, The Father of West Point,

Civil War Memorial
East Washington N.H.
Spanish American War & World War I Memorial
Washington Center School, Erected 1813
Washington Incorporated 1776 Town Meetinghouse Built 1787
Washington N.H. The First Town Inc., Under Name of George Washington

APPENDIX II – NATIONAL HISTORIC REGISTER LOCATIONS

Acworth	Acworth Congregational Church Acworth Silsby Library
Canaan	Canaan Meetinghouse Canaan Street Historic District
Charlestown	Charlestown Town Hall Charlestown Main Street Historic District Farwell School North Charlestown Historic District
Claremont	Claremont City Hall Hunter Archeological Site Central Business District Monadnock Mills Claremont Warehouse No. 34 William Rossiter House David Dexter House English Church
Cornish	Saint-Gaudens National Historic Site, House and Studio Cornish-Windsor Covered Bridge Kenyon Bridge Salmon P. Chase Birthplace First Baptist Church of Cornish Trinity Church Dingleton Hill Covered Bridge
Dorchester	Dorchester Community Church Dorchester Common Historic District
Enfield	Enfield Shaker Historic District Centre Village Meeting House Hewitt House Enfield Village Historic District
Hanover	Hanover Town Library Great Hollow Road Stone Arch Bridge Sphinx Tomb Epic of American Civilization Murals
Lebanon	Stone Arch Underpass Colburn Park Historic District

	Spring Hill Farm
Lyme	Moses Ken House Lyme Center Historic District Lyme Common Historic District
New London	Dr. Solomon M. Whipple House Baptist New Meeting House
Newbury	Center Meeting house Hay Estate
Newport	Sullivan County Courthouse Pier Bridge Wright's Bridge Nettleton House Isaac Read House Town Hall and Courthouse Little Red School House 1835 District No. 7 Richards Free Library Newport Downtown Historic District South Congregational Church
Orford	Orford Street Historic District Samuel Morey Memorial Bridge
Piermont	Sawyer-Medlicott House Piermont Bridge
Plainfield	Blow-Me-Down Covered Bridge Mothers' and Daughters' Club House Plainfield Town Hall Meriden Town Hall Blow-Me-Down Grange
Unity	Unity Town Hall
Washington	Washington Common Historic District

UVLSRPC Regional Plan 2015

Chapter 7

Utilities, Infrastructure, and Public Services

TABLE OF CONTENTS

7.1 WATER, SEWER, AND STORMWATER INFRASTRUCTURE

Above: The Connecticut River in the Town of Cornish.

Vision

The region's water, sewer and stormwater infrastructure will be resilient and maintained in a state of good repair to support existing development centers and local economic development initiatives.

Water Supplies (From Source to Tap)

Only 1% of all water on earth is fresh and accessible, and most of it is groundwater. The other 99% of water on Earth is salt water or glacial ice. Today, the technology to treat the remaining 99% of water sources is not efficient and too expensive to deploy on a large scale. The protection, use, and quality of fresh water sources is vital to the region's public health, fire protection, economic development, and quality of life.[1]

Water Sources and Protection

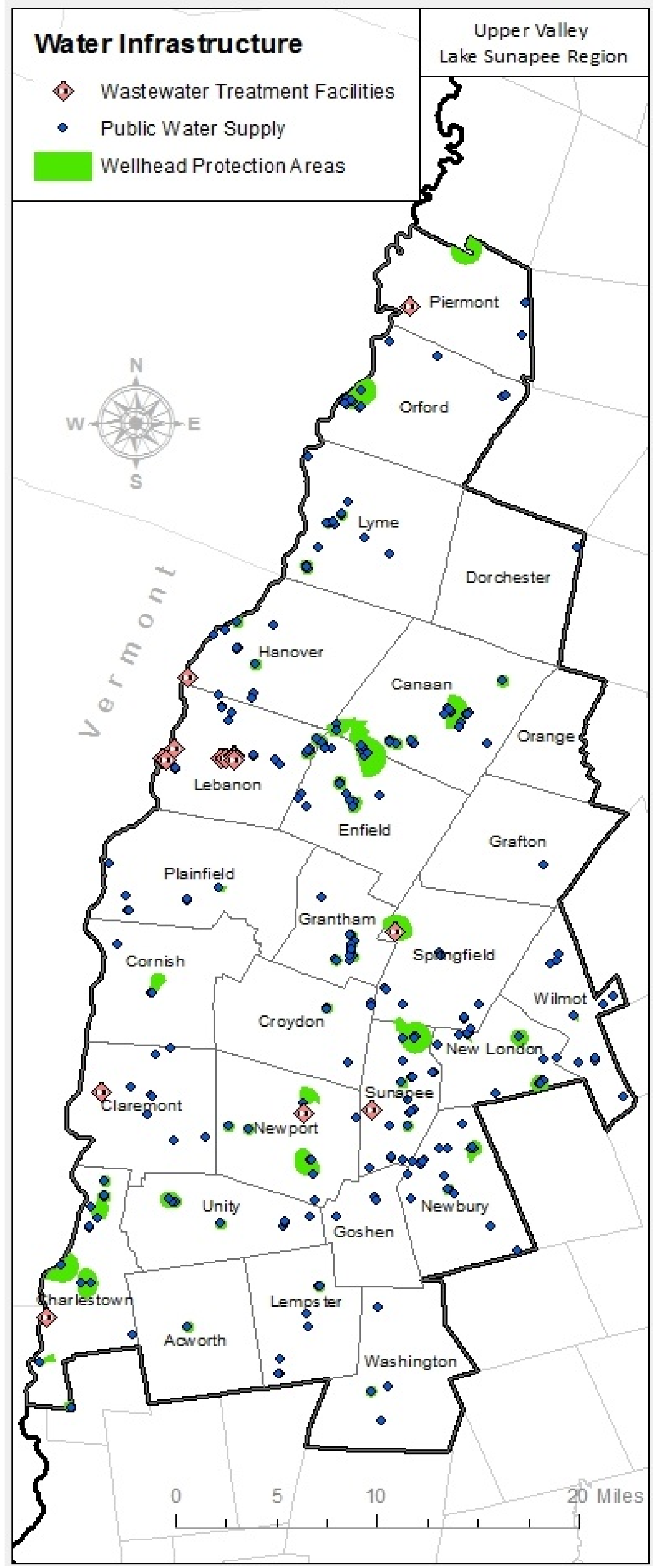
The Region's drinking water comes from surface water and groundwater supplies which are recharged from rain and snowfall within the watersheds.

Some municipalities, such as Claremont, Hanover, Lebanon, New London, Newport, Springfield, and Sunapee rely on nearby rivers, lakes, and reservoirs for their primary source of drinking water. Other municipalities including Canaan, Enfield, Grantham, and Plainfield rely on groundwater through stratified drift aquifers or bedrock wells as their primary source of drinking water. Some municipalities share in joint water systems to assist smaller adjacent towns. For example, New London and Springfield share the same water system precinct. Residents and businesses outside of the region's municipal drinking water systems rely on private wells as their main source of drinking water.[2]

The protection of drinking water sources is important to public health and the quality and quantity of drinking water supplies. For more information on water resource protection see the Water Resources section of the Natural Resources Chapter of this plan.

Private Residential and Non-Residential Community Systems

Many residents and businesses in the region are not connected to a municipal drinking water system and rely on private wells or community systems as their source of drinking water. Private water wells supply drinking water to approximately 35 percent of New Hampshire's population, but are not regulated or monitored for water quality or quantity by federal or state agencies. The New Hampshire Department of Environmental Services (DES) registers new private wells and recommends that communities require water quality and quantity testing. The DES Private Well Testing Program encourages well owners and local governments to perform laboratory tests to test water quality in wells to protect consumers from harmful contaminants. The town of Hollis, NH has a good example of this type of program in the form of a zoning overlay district. [3]



Regulation, Maintenance, and Protection of Drinking Water Supplies in the Region

Public water supplies in the region are depicted on the water infrastructure map (see right).[4] There are 358 public water supplies in the region. Twenty-six of the twenty-seven municipalities in the region are home to at least one public water supply.

The following table shows regulation, maintenance, and protection initiatives that are detailed in individual municipal Master Plans addressing drinking water source quality and protection:

Figure 7.1.1- Municipal Source Water Protection Strategies in the UVLSRPC Region

Strategies	Communities	
Convening Drinking Water Protection Committees and/or Developing Source Water Protection Plans	Canaan New London	Lebanon
Identifying Watershed Protection Areas and/or Developing Shoreland Protection District Plans	Canaan Charlestown Claremont Grantham Hanover	Lebanon New London Newport Plainfield Sunapee
Developing Aquifer/Groundwater Protection Zones Plans and Ordinances	Canaan Grantham Hanover Lebanon	Newport Plainfield Sunapee
Implementing a Regular and Standardized Water-Testing Program	Canaan Lebanon	Plainfield
Conducting Public Education and Outreach	Canaan Charlestown Hanover	Lebanon Newport Plainfield
Encouraging Low Impact Development	Canaan Charlestown Grantham Hanover Lebanon	New London Newport Plainfield Sunapee
Conserving Land Near Water Sources	Canaan Claremont Lebanon	Grantham Hanover
Developing Recreation Standards and Limits	Canaan Grantham	Hanover
Upgrading and/or Expanding Aging Infrastructure	Charlestown Enfield New London Lebanon	Newport Sunapee Springfield
Developing and Enforce Floodplain Development Regulations	Enfield Hanover	Newport Lebanon
Completing a Wetlands Source Inventory and Mapping	Grantham Hanover	Lebanon Newport
Preparing Drought Management Measures	Hanover	Lebanon
Coordinating with Other Municipalities in the Region	Grantham Hanover Lebanon	New London Newport Springfield
Identifying Stormwater Management Measures to Minimize Non-Point Pollution	Croydon New London	Newport Plainfield
Identifying and/or Developing a Future Water Supply	Enfield Hanover	Lebanon

Water Use (From Tap to Drain)

Water has two different uses: consumptive and non-consumptive. Consumptive use of water occurs when the water is removed from the source and unavailable for other uses. Examples of consumptive use are irrigation, livestock, industrial use, public water supply, mining/extraction, and cooling of thermoelectric power generation. Non-consumptive use occurs when the water remains in or is immediately returned to the source. An example of non-consumptive use is hydroelectric power generation.[5]

Projected Regional Water Use in 2020

NHDES and the U.S. Geological Survey (USGS) created a study using U.S. Census block data to estimate the amount of water demand, use, withdrawals, and wastewater return flows for each census block in the state for the years 2005 and 2020.[6]

Total water withdrawal (community and household wells) in the UVLSRPC Region is estimated to be 11.2 million Gallons per Day (MGD). That demand is projected to be filled from 48.8% Groundwater and 51.2% Surface Water sources. Total wastewater return flow in the region is estimated to be 12.5 million Gallons per Day in 2020. This increased demand will place additional pressure on the water and wastewater systems that have experienced capacity issues, including the systems in Lebanon and Hanover.

Positive Recharge Examples

Surface Water (Commercial, Industrial, Mining, Fish Hatcheries)

Domestic Groundwater

Non-Consumptive Use Examples

Hydroelectric Power

Negative Recharge Examples

Groundwater (Commercial, Industrial, Mining, Fish Hatcheries)

Snow Making

Irrigation

Thermoelectric Power

Community System (No Recharge)

The following table highlights water demand in selected municipalities across the UVLSRPC Region.

Figure 7.1.2- Municipal Water Use in the Region [7]

Town	Municipal Water Use
Canaan	• Capable of yielding 1 Million Gallons per Day
Claremont	• Capable of yielding - 1 Million Gallons per Day • Plant Capacity - 4 Million Gallons per Day • Currently operating - 1.8 Million Gallons per Day (33%capacity)
Eastman	• Eastman Village Water District (private) serves all of Eastman • Some properties have private wells
Enfield	• Groundwater Bedrock Wells Capacity – 110 Gallons per Minute • Average Daily Consumption – 40,000-50,000 Gallons • Demand is 73% residential, 19% multi-family, 5% commercial, 3% other
Grantham	• Private wells serve most residences and businesses
Hanover	• Average demand – 1.2 Million Gallons per Day • Estimated combined safe yield of all sources o Prior to disinfection improvements – 2.5 Million Gallons per Day o After improvements – 2 Million Gallons per Day • System has 1695 users o 1472 residential, 189 commercial, 19 municipal, and 15 industrial (population served estimated less than 10,000 people)
Lebanon	• Source Capacity – 7.93 Billion Gallons • One well site capable of yielding 1 Million Gallons per Day • Average use – 1.56 Million Gallons per Day o Demand is 42% residential, 42% commercial, 13% industrial, and 3% municipal • Plant capacity average daily demand – 3.5 Million Gallons per Day • Demand could reach plant capacity by 2026
New London/ Springfield	• Inter-municipal water precinct for portions of the towns of New London and Springfield o Average consumption of 280,000 gallons/day in winter and 320,000 gallons/day in summer o Colby Point wells have maximum capacity of 750,000 gallons/day
Newport	• Serves more than 5,000 individuals
Plainfield	• Plainfield (municipal and private) relies solely on groundwater • Meriden Village Water District capable for expansion
Sunapee	• Two storage tanks – 300,000 and 700,000 gallons • 506 service connections to Village system • Reservoir serves 195 homes

Issues Affecting Water Use in the Region[8]

- *Development of Larger Lots*
  - Larger lot sizes correlates with more lawncare, toilets, sinks, showers, dishwashers, hot tubs, and pools.

- *Climate Change*
  - A substantial amount of water is used for lawns, golf courses, and crops. The amount of water used is affected by temperature and precipitation. When the temperature increases, more water is used. A longer growing season also has an affect on the amount of water use and affects soil absorption.

- *Aging Infrastructure*
  - Leaks in infrastructure can cause a substantial amount of water loss over time. Some older water infrastructure in New Hampshire contain blow-off valves where water is released to prevent lines from freezing.

- *Lack of Public Education*
  - Public education and support for water conservation is important. Facts regarding the importance and availability of water, protection of water sources, conservation of use, treatment and distribution facilities, and infrastructure need to be available and disseminated to the public in order to gather support for water conservation efforts.

- *Conservation Investments*
  - Conserving water and updating infrastructure (both community systems and business/residential systems) can be costly in the initial capital outlay but cost-effective in the long-term.

There are many reasons why water conservation is important including the following[9]:

- Growing competition for water supplies;
- Concerns regarding impacts of water withdrawals and uses on water resources, stream flows and patterns, wetlands, and aquatic life;
- Cost and issues of developing and using other water sources;
- Cost of treating and pumping water;
- Cost of wastewater treatment process;
- Cost of expanding the capacity of current water systems;
- Growing support for environmental protection and natural resource conservation.

Wastewater Treatment and Discharge (From Drain to Source)

Above: *Hanover Wastewater Treatment Plant*

Over 80% of the water quality problems in New Hampshire waters are related to pollutants found in stormwater runoff and wastewater (NHDES, 2012).[10]

Sanitary Sewers

The most common municipal sewer systems in the region are sanitary sewers. Sanitary sewers are underground pipe systems that transport sewage from houses and commercial buildings to a wastewater treatment facility (WWTF) for treatment or disposal. Some industrial locations are served by sanitary sewers that carry industrial wastewater.

Although sanitary sewer systems work well to transport sewage safely to a treatment facility, occasional discharges of untreated sewage can happen. These discharges are called sanitary sewer overflows (SSOs). SSOs can be caused in many ways including blockages, power failures, vandalism, aging infrastructure, line breaks, defects allowing stormwater and groundwater to overflow the system, and inadequate design, operation, and maintenance. The U.S. Environmental Protection Agency (EPA) estimates there are at least 23,000 – 75,000 SSO events per year. The untreated sewage could contaminate nearby water sources causing water quality issues, public health concerns, and wildlife and environmental impacts. This estimate does not include sewage backup into buildings which could cause further public health concerns as well as property damage.[11]

Combined Sewer Systems

In the late 1800s, many American communities combined their waste system with existing stormwater drainage sewers into a combined sewer system in one pipe. These systems would then drain into nearby water bodies. At the time, it was thought that there would be enough dilution to render the water harmless.

Combined sewer systems (CSSs) collect domestic sewage, municipal wastewater, and stormwater runoff in a single pipe system. This wastewater is transported to a wastewater treatment facility (WWTF) to be treated and then discharged to a nearby water body. CSSs are designed to hold a certain capacity during normal precipitation events. However, during heavy rainfall or snowmelt, the combined sewer system will occasionally overflow and discharge excess wastewater into nearby water bodies.

These combined sewer overflows (CSOs) can contain untreated stormwater, sewage, industrial waste, toxic materials, and other debris that are potential sources of water pollution. These pollutants can pose a risk to public health, wildlife, and water quality for recreation or consumption.[12]

The City of Lebanon has been working with the EPA and New Hampshire Department of Environmental Services (NHDES) to abate its CSOs. In the spring of 1996, the EPA issued an administrative order for Lebanon to complete a CSO facility plan to identify the most cost-effective solution to meet and maintain water quality standards. In 2000, the EPA approved Lebanon's CSO facility plan and required the city to eliminate their seven remaining CSO outfalls by the end of 2012. This date was later extended to the end of 2020. The overall project is being accomplished in phases to separate the combined sewer system into separate sewer and stormwater systems. The City of Lebanon also is required to complete an assessment of its wastewater collection system's capacity, management, operation and maintenance practices to identify sources of infiltration/inflow and eliminate sanitary sewer overflows.[13]

Septic Systems

Approximately one in four U.S. homes have on-site septic systems or a small community cluster system to treat their wastewater (U.S. EPA 2014).[14]

Septic systems are underground wastewater treatment structures that are primarily utilized in rural areas. Septic systems use a combination of nature and technology to treat wastewater from domestic plumbing sources. If the system is working properly, the wastewater will be treated to protect public health and preserve water quality.

Septic systems that are properly maintained are a good way to treat wastewater. However, these systems can malfunction, causing pollution and public health risks. Homeowners and property owners are usually responsible for maintaining on-site septic systems, which can require hiring professionals to inspect and clean the septic tank. Septic system life can be extended if homeowners practice water conservation and avoid flushing large items or grease down their drains.

State and local governments are responsible for regulating individual on-site septic systems with EPA guidance and assistance. The EPA regulates larger-capacity septic systems and also provides guidance, manuals, and policies to help guide on-site septic management programs. The EPA has also developed a program to educate homeowners about septic systems called *SepticSmart*.[15]

Stormwater Management

Water from rain or snow melt that does not infiltrate into the ground is called stormwater. In undeveloped areas, stormwater infiltration happens naturally. The stormwater moves into soils where bacteria, nutrients, and contaminants are filtered out and the naturally-filtered water recharges nearby groundwater sources. Each soil type has its own rate of infiltration, which is the volume of water that infiltrates into the ground in a given period of time.

Development creates impervious surfaces (e.g. buildings, roads, sidewalks, parking lots, etc.) that prevent stormwater from infiltrating into soils, which can affect water quality and water movement (hydrology). The increase in impervious surfaces can directly affect water quality by increasing the amount of pollutants and bacteria in stormwater. These changes to water quality could affect wildlife, habitat, recreation, drinking water supply, and treatment costs. Increased impervious surfaces would cause a higher volume of stormwater to flow and collect over a larger surface causing higher flows in receiving streams. The velocity of the stormwater at this volume can cause flash flooding and erosion along routes to receiving streams. [16]

Stormwater Infrastructure

Most stormwater infrastructure in the region is a municipal separate storm sewer system (MS4). (This excludes the remaining combined sewer systems in Lebanon. See section on Combined Sewer Systems on Page 7-8). A MS4 is a stormwater system made up of catch basins, culverts, curbs, gutters, ditches, man-made channels, storm drains, and drainage systems along roads and municipal streets. The MS4 is publicly owned by a state, city, town, or other public entity.

NPDES Phase II Requirements

The EPA's National Pollutant Discharge and Elimination System System (NPDES) Stormwater Phase II establishes requirements for small MS4s to regulate land disturbances greater than one acre. The requirements apply to municipalities located in or near an urbanized area or central place (as defined by the U.S. Census). New Hampshire has 45 communities that must comply with NPDES Phase II requirements including Charlestown, Claremont, Enfield, Hanover, Lebanon, and Newport. These communities are required to develop and implement a stormwater management program to reduce the discharge of pollutants from its MS4s to the "maximum extent practicable".[17]

Inventorying Stormwater Infrastructure

New Hampshire's nine regional planning commissions, in coordination with the New Hampshire Department of Environmental Services (DES), Department of Transportation (DOT), and the University of New Hampshire (UNH) have been partners in the development of the New Hampshire Statewide Asset Data Exchange System (SADES). Through SADES, a computer mapping program has been developed to assist inventorying stormwater culverts in the state. With UVLSRPC assistance, the Town of Grantham began an inventory of its town-owned culverts using the SADES mapping program in the summer of 2014. The benefit of using this program is that the Town of Grantham Department of Public Works will know the location of each culvert, the condition of the culvert and surrounding structures, and environmental information about the surrounding receiving water body. This information is useful in developing maintenance and upgrade priorities for stormwater infrastructure, and understanding where stormwater flows in the event of a hazard spill or heavy pollution.

Green Infrastructure

Another method of stormwater management systems is utilizing green infrastructure. Green infrastructure mimics nature by using vegetation, soils, and natural processes to soak up and store water in more developed areas. Examples of green infrastructure include rain gardens, permeable pavements, planter boxes, bioswales, and green roofs to help connect habitat and vegetation throughout impervious surfaces to assist in stormwater management.

The City of Lebanon has developed a *Green Infrastructure* section in its *Long-Range Multimodal Transportation Plan.* In the plan, the City outlines a variety of Best Management Practices (BMPs), such as higher engineering standards for managing stormwater runoff, less tree and vegetation removal when developing areas, and clustering development to conserve land and reduce infrastructure costs. By utilizing these measures, the City can better manage stormwater and maintain water quality.[18]

Pollution Prevention and Treatment

Stormwater is a non-point pollution source and the management of stormwater is the responsibility of everyone in the community. Some simple ways people can help lower the risk of stormwater pollution include maintaining motor vehicles to reduce the risk of fluid leaks and other vehicle debris, limiting fertilizer and chemical uses especially near storm drains and stormwater flow ways, and avoiding littering because it can clog stormwater infrastructure and pollute receiving water bodies.

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While one method of reducing stormwater-related pollution risk is reducing development, development is needed for the region's social and economic growth. Thus, the most practical way to reduce the risk to water quality from stormwater is to limit land disturbances during development. Limiting land disturbances and development in certain areas will help to slow stormwater flow, maintain peak flows, increase infiltration areas, and treat stormwater on-site.

An emerging way to address stormwater management is through performance-based zoning ordinances that require natural buffers of thick vegetation around surface waters such as lakes, wetlands, ponds and streams. These buffers will help slow down the flow of stormwater and help filter out contaminants before discharging to receiving surface water.

Stormwater management is important during all stages of development including planning and design, design review, construction, and post-construction controls. The EPA and NHDES require permits to address the impacts of developments on large sites, but they do not require permits on smaller sites. These small-scale developments can have impacts on water quality if not regulated. The EPA and DES encourage communities to adopt local stormwater management ordinances to help regulate development on small-scale sites.[19]

Strategies for Regional Water Protection, Treatment, Use, and Wastewater Discharge

- *Enhance Public Education and Engagement Initiatives*
  - It is important to educate the public on water importance, resources, protection, use, infrastructure, and conservation. It is also important to engage the public in efforts to protect and conserve water resources. Most communities and homeowners in the region use septic systems. Educating the community on their own infrastructure and systems, through programs such as the EPA's *SepticSmart,* can help maintain water quality.
- *Shift Program Focus to Watersheds and Sub-Watersheds Rather than Water Bodies*
  - Currently most programs and regulations are focused on separate types of resources (rivers, lakes, wetlands, groundwater) and uses (drinking water treatment, wastewater, point pollution). All of these issues are interconnected and need to be managed as a single watershed resource to better ensure the quality and quantity of water for the region. State and local governments can work together to create and manage watershed programs.
- *Maintaining and Repairing Infrastructure*
  - Maintaining and repairing all infrastructure systems including; drinking water, storm water, wastewater, and water storage is essential. Regular maintenance will prolong the life of infrastructure, reducing the need for costly capital expenditures.
- *Increase Utilization of Low-Impact Development (LID) and Green Infrastructure*
  - Low-Impact Development (LID) and Green Infrastructure refers to the use of vegetation, soils, and natural processes to manage stormwater. LID techniques and green infrastructure are cost-effective approaches to stormwater management and should be integrated into municipal Master Plans.
- *Assist Municipalities in Developing Financial Assistance Programs for Septic System Repair and Replacement*
  - An obstacle that many septic system owners face is the costs of repair or replacement of the system. Developing financial assistance programs will help make repair and replacement more affordable.
- *Assist Municipalities in Adopting Stormwater Management Ordinances*
  - The NHDES encourages municipalities to develop and implement Stormwater Management Ordinances to supplement EPA and DES regulations. The DES outline for Municipal Stormwater Management Ordinances focuses on post-construction methods to reduce pollution and erosion caused by stormwater runoff that affects water quality and hydrology.
- *Assist Municipalities in Completing Stormwater Infrastructure Inventories and Mapping*
  - Assist municipalities in assessing and mapping current stormwater infrastructure using the SADES mapping

program and DES and DOT guidelines. The data collected in the culvert inventory mapping is useful for identifying the location of the culvert, condition of the structure, receiving systems or water bodies, flow patterns, environmental details, and if the culvert is functioning at high capacity.

- *Consider Establishing Conservation Rates*
    - New Hampshire communities generally have low water rates for water consumers. There have been suggestions to change the rate structure and charge increasing rates for greater water use in order to encourage water conservation.[20]

- *Recycle and Reuse Wastewater*
    - Wastewater that has been treated (but is not suitable for drinking) or is a by-product of wastewater treatment processes can be recycled for many other uses such as irrigation for parks, crops, and golf courses, mixing concrete, or firefighting. This water can also be treated further to help replenish groundwater supplies.

- *Fix Leaking Drinking Water Pipes*
    - Each year, many drinking water systems lose up to 20% of treated drinking water due to leaks and failures in piping systems. Fixing leaking infrastructure can significantly reduce the loss of treated drinking water and save on energy costs.[21]

- *Promote the EPA's WaterSense Program*
    - The EPA's WaterSense program (similar to the EPA's EnergyStar Program for electricity) helps consumers and businesses conserve water by setting labeling standards for products, such as shower heads, faucet fixtures, clothes washers, dishwashers, and other appliances that are 20% more water-efficient than competing products. These products not only conserve water but can also save consumers money through cheaper water bills and possible rebates or tax incentives.

- *Require and Provide Incentives for Agricultural Water-Use Efficiency and Soil and Manure Management*
    - Agriculture is a major user of groundwater and surface water. Agricultural soils of prime, statewide, or local importance account for over 30% of the total land area in the region. (See Agriculture section in the Natural Resources Chapter of this plan.) While not all of this land is used for agricultural purposes, agricultural water-use efficiency is important to conserving water resources. Strategies that can be used in the region include switching from flood irrigation to drip irrigation or reducing the use and control of nitrogen-rich fertilizers through better soil management practices.

7.2 BROADBAND INFRASTRUCTURE AND DEVELOPMENT

Vision

The region will have fast, reliable, and affordable broadband service through a competitive marketplace throughout all parts of the region.

Why Is Broadband Important?

Broadband is, in 2014, what electricity was to New Hampshire in the 1930's - a necessity. As a predominantly rural state, the availability of high-speed internet is one of the most significant factors that will impact the ability of communities in New Hampshire to achieve economic growth and maintain quality of life. In a relatively short period of time, fast and reliable broadband has become essential for economic and community development and is critical infrastructure for public safety, education, health care, business and government operations.

Communities today face many challenges: a competitive global marketplace; an aging population; the need for a better-educated and better-prepared workforce; and access to health care. These issues are magnified in rural areas as the distance between households and services makes it difficult to access certain resources and opportunities. The financial resources traditionally available to overcome these challenges are often unavailable to rural communities and regions. New solutions are required. Broadband can help community leaders find innovative solutions to these challenges.

There is no doubt that we live in an information society, and broadband connects us to opportunities and services. Whether training for a new skill, a new language, or completing an online course - broadband facilitates access to information in many different forms. In 2010, it was estimated that there were almost 200 million Americans or 63% with access to broadband at home, up from 8 million or 3% in 2000. While this is an impressive increase, there are still many Americans with insufficient access to broadband services.

Regional Broadband Demand

The Upper Valley Lake Sunapee Regional Broadband Stakeholders Group identified that different users of broadband in the region have unique needs: for family, for business, for schools and students, for telework, for healthcare delivery, for visiting nurse associations, for municipalities, and for non-profits. The needs and demands by sector are based on feedback from surveys (including the 2013 phone survey conducted by UNH Survey Center), two public forums and fifteen sector-specific interviews.

Three major themes cross-cut all sectors and are evidence of how quickly "online business" has become mainstream and is transforming how business is conducted:

- *Telework/Tele-education:* Employees are increasingly working beyond the four walls of their employers' headquarters, e.g. at home, satellite locations, and travelling for business locally and globally. Both employers and employees face challenges to achieving a connected workforce because there is limited high-capacity broadband service in residential and rural neighborhoods. Educational institutions also seek tele-education opportunities, either online learning as a supplement to the classroom or curricula delivered fully online.
- *Doing More Business Online:* All businesses and organizations interviewed reported that they have a growing dependence on online interaction with external companies or organizations. It is essential to have

sufficient broadband service to conduct online business with suppliers, customers, accounting/billing services, electronic medical records firms, off-site IT/security back-ups and partnering organizations, such as Inter-Library Loan, Code Red reverse 911 system and state agencies.

- *Online Training and Professional Development:* Access to training and professional development online, including keeping up to date with training on ever-changing technology is imperative. There is a particular need for training in sectors that rely on volunteers, such as local government, social services and public safety.

New Hampshire Broadband Mapping and Planning Program (NHBMPP)

The New Hampshire Broadband Mapping and Planning Program (NHBMPP) is a comprehensive, multi-year initiative that began in 2010 with the goal of understanding where broadband is currently available in New Hampshire, how it can be made more widely available in the future, and how to encourage increased levels of broadband adoption and usage. Funded through the National Telecommunications and Information Administration (NTIA), the NHBMPP is part of a national effort to expand broadband access and adoption.

The NHBMPP is managed by the GRANIT (Geographically Referenced Analysis and Information Transfer) System within the Earth Systems Research Center at the University of New Hampshire (UNH), and is a collaboration of multiple partners. These include: the NH Office of Energy and Planning (OEP), NH Department of Resources and Economic Development (DRED), UNH Cooperative Extension (UNHCE), UNH Information Technology (UNHIT), and the state's nine regional planning commissions (RPCs).

Broadband Availability in the Region

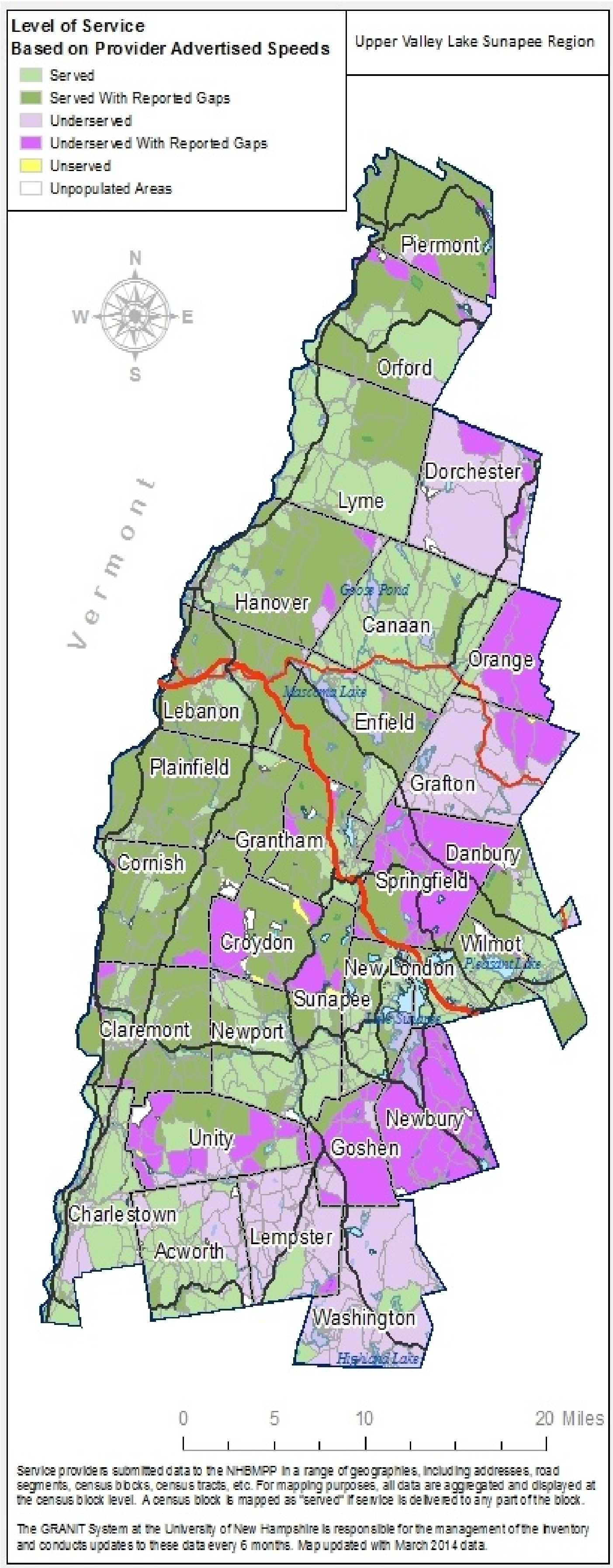
Most residents of the region have access to one or more types of broadband service, but there is wide variety in the speed and quality of service. In a 2013 phone survey of residents of the Southwest and Upper Valley Lake Sunapee regions conducted by the UNH Survey Center, 88% of survey respondents reported that they have wired service to their home (DSL, cable or fiber). Where there are gaps in wired service, residents and business owners rely on fixed wireless (5%), satellite (3%) or cellular service (3%).

Only 1% of survey respondents reported that they rely on dial-up Internet service and 16% reported that they do not have Internet service at home. Of the 16% without Internet service, 7% gave the primary reason for not having Internet as "It is not available where I live." The lack of availability of any type of broadband service remains an issue in two areas: (1) pockets of unserved roads in rural areas with low population density and (2) gaps or "dead zones" in cellular service coverage due to terrain and limited cell tower deployment, primarily in rural areas.

For most of the region, there is now the question of broadband service capacity – a question of speed. To better analyze this question, the New Hampshire Broadband Mapping and Planning Program (NHBMPP) established a multi-tiered system for levels of service *(See Level of Service Map):*

- *Served*
  - Maximum Advertised Download Speed: 6+ Megabits per second (Mbps)
  - Maximum Advertised Upload Speed: 1.5+ Mbps

- *Underserved*
  - Maximum Advertised Download Speed: 768 kbps - 6 Mbps
  - Maximum Advertised Upload Speed:



200 kbps - 1.5+ Mbps

- *Unserved*
    - o Maximum Advertised Download Speed: < 768 kbps
    - o Maximum Advertised Upload Speed: < 200 kbps

Reported Gaps are areas where the NHBMPP has received responses indicating that no service is available. Additionally, areas where speed tests have been completed that do not meet the minimum speed criteria are flagged as having a gap in service.

The Upper Valley Lake Sunapee region is unevenly served by a level of broadband service that would allow for intensive internet applications. The 6 Mbps/1.5 Mbps level of service is available in more than two-thirds of municipalities in the region, but in nearly all towns, residents have reported gaps in service. The southeastern part of the region (Acworth, Unity, Lempster, Goshen, Washington and Newbury), the northeastern part (Springfield, Grafton, Dorchester, Orford and Piermont) and parts of Grantham and Croydon are underserved, meaning that the highest advertised broadband service speed is less than 6 Mbps/1.5 Mbps.

Level of Competition

In New Hampshire, more than sixty companies provide broadband internet services to residences, businesses or both. The technology used to deliver broadband varies (e.g. cable, DSL, fiber, T-1 lines, fixed wireless, cellular and satellite) and the speed tiers and pricing structures offered also vary widely. Wired and fixed wireless service commonly provide unlimited data service at a given speed tier, although the delivered service speed may vary considerably from the advertised maximum speed. Cellular and satellite service providers commonly set monthly data caps or "throttle" service speeds for heavy users, which stymies the full utilization of broadband services for residents and business owners who rely on these technologies.

The highest degree of competition in the broadband marketplace (considering all types of technology, speeds and pricing) is in the municipalities of Lebanon, Hanover, Enfield, Plainfield and Claremont. The southeastern and northeastern parts of the region, as well as parts of Croydon and Grantham have lower levels of competition.

While there may be several choices within a community, there is not necessarily a competitive choice because each provider offers a different type of service at a different price point. The 2013 survey found that 43% of survey respondents in the Southwest and Upper Valley Lake Sunapee regions reported that they are using their current internet service provider because they consider it to be the only option available. For respondents that have a dialup or satellite connection, 59% say that it is the only option available.

Towns without cable franchise agreements (between the municipality and the cable company that authorizes the company to provide service in the town) tend to have lower levels of competition and lower maximum speeds. As of January 2014, New London is the only municipality in the Upper Valley Lake Sunapee region with two cable franchise agreements: one with Comcast, one with TDS Telecom.

Investments in Expansion

Significant improvements have been made over the last five years to bring basic broadband service to unserved areas; the gaps where people must rely on dial-up, satellite or cellular service are gradually shrinking. At the same time, incremental progress is being made to roll out fiber-optic broadband service capable of providing high-capacity bandwidth up to 1 Gigabits per second speeds, but much more work remains to be done to provide broadband capable of serving the region's needs in the future.

FairPoint Communications recently completed an expansion of broadband service to 95% of their customers. This was a requirement of the New Hampshire Public Utilities Commission's approval of FairPoint's 2008 purchase of Verizon's land-line telephone service areas. To fulfill the 95% requirement, FairPoint has extended broadband service to more than 100,000 additional homes and business in 215 communities around the state over the past five years, a total investment of $72 million. This includes service expansions to areas of the Upper Valley Lake Sunapee region that were previously reliant on dial-up or satellite Internet service, including neighborhoods in Canaan, Croydon, Dorchester, Enfield, Goshen, Grantham, Hanover, Lebanon, Lempster, Newbury, Newport, Orange and Sunapee.

In addition, FairPoint will be investing in an additional $3.3 million in further broadband expansion efforts. Approximately $2.8 million of service quality penalty monies incurred during 2009 through 2011 are being invested through an agreement with the New Hampshire Public Utilities Commission, with FairPoint contributing $500,000 on its own. It is estimated that an additional 2,500 homes and businesses will receive DSL broadband service. Areas in the Upper Valley Lake Sunapee region that have recently had service extensions include sections of Charlestown, Claremont, Enfield, Goshen, Grafton, Lyme, Newport, Orange, Piermont, Unity, and Wilmot. Looking ahead, FairPoint received $848,000 in Connect America Funds that it will leverage to bring broadband access or higher speeds to areas of eighteen towns over the next three years, including parts of Lyme and Newbury.

DSL is the most common technology used in FairPoint's broadband expansion, although the Seacoast and greater Nashua areas of the state have a faster fiber-optic service called FAST, which has speeds of up to 50 Mbps. The Town of Newbury reports that their town offices are served by fiber optic service through FairPoint, and two other companies are rolling out fiber-optic networks in other parts of the region. TDS Telecom is advertising a "Fiber-to-the-Home" initiative in the Towns of New London and Wilmot and the Twin Lake Villa section of Springfield, as well as other towns outside of the Upper Valley Lake Sunapee region. New Hampshire FastRoads, LLC, has constructed Fiber-to-the-Home in two census blocks in the Town of Enfield and a fiber-optic backbone through parts of Orford, Lyme, Hanover, Lebanon, Enfield, Springfield, New London, Sunapee, Newport, Claremont, Goshen and Lempster. Five service providers are now offering service over the fiber-optic network and FastRoads is beginning the planning process for the next phase of construction.

Regional Broadband Plan

The Upper Valley Lake Sunapee Regional Planning Commission, advised by a group of broadband stakeholders representing multiple interests from 19 communities in the region, developed a Regional Broadband Plan to better understand current broadband (or high-speed Internet service) availability in the region, to identify the challenges and barriers to universal access, and to plan for increased broadband adoption and utilization over the next six years.

This plan establishes four performance-based goals to achieve the regional vision of "fast, reliable and affordable broadband service through a competitive marketplace throughout all parts of the Upper Valley Lake Sunapee Region" and "a future with rural regions having the opportunity to access broadband services equal to that in metropolitan areas."

The regional broadband plan is intended to serve as a comprehensive document that describes broadband availability in the Upper Valley Lake Sunapee region and identifies ways to increase broadband adoption and utilization. The plan serves as a guidance document for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for and utility of broadband now and into the future.

Looking ahead to future needs, the Federal Communications Commission's National Broadband Plan calls for gigabit service (1 Gbps or higher down/up) to all community anchor institutions by 2020. Currently, this speed is only available in a few locations in the region – one census block in Hanover, three census blocks in Claremont, four census blocks in Washington and eleven census blocks in Lebanon. Again, the southeastern and northeastern parts of the region, as well as parts of Croydon and Grantham, have the lowest speeds of broadband available.

2020 Broadband Goals for our Region

1. Provide affordable broadband service that would support telework and tele-education (20 Mbps download, 10 Mbps upload) in all areas of the region.
2. Build "Gigabit Communities" – expand "big broadband" (1 Gbps download, 1 Gbps upload) to all community anchor institutions and city/town centers, with extensions to residential and outlying areas.
3. Encourage marketplace entry of competitive, innovative service providers.
4. Work towards parity in broadband service availability across the rural areas of our region, the downtowns and village centers of our region, and metropolitan areas in the Northeast.

Issues and Challenges

Key Challenges to Broadband Expansion

A number of geographic, economic and regulatory barriers exist that make it difficult for the Upper Valley Lake Sunapee region to have universal broadband access. The region's low population density creates a low return on investment for wired broadband expansion, while hilly terrain presents physical barriers to wireless broadband deployment. Financing options and funding sources are limited for expanding broadband to unserved and underserved areas, which is compounded by utility pole attachment issues that increase the costs of expanding wired broadband and create delays in deployment.

Unlike other northern New England states, New Hampshire lacks state-level leadership, which has led to smaller broadband expansion efforts as well as slow progress on financing and regulatory reforms to facilitate additional expansion. Municipalities in the region, lacking the leverage and clout of larger entities and more populated regions, have struggled to have their need for better broadband heard and understood at the state level.

Broadband Development Strategies

The Regional Broadband Plan focuses on five high-priority strategies:

- Expand financing options and funding sources for enhancing both telework-supporting and gigabit broadband.
  - Priority Action: Support reform of the federal Connect America Fund (part of the Universal Service Fund) to allow more funds to be available to New Hampshire broadband providers for expansion.
  - Priority Action: Pass state legislation that promotes new options for broadband financing, such as tax credits for companies that extend service to underserved areas and permitting municipalities to bond for broadband expansion.
- Remove barriers to entry into the marketplace by competitive, innovative service providers.
  - Priority Action: Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way to streamline providers' access to poles and underground conduit.
  - Priority Action: Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.
- Enable municipalities in our rural region to plan proactively for broadband service expansion and improvements.
  - Priority Action: Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.
- Build statewide leadership capacity to promote broadband.
- Overcome barriers of affordability and digital illiteracy.

Note: Following the release of the UVLSRPC Regional Plan, the Federal Communications Commission (FCC) has revised the federal definition of broadband to connection speeds of 25 megabits per second or higher. More information can be found at www.fcc.gov.

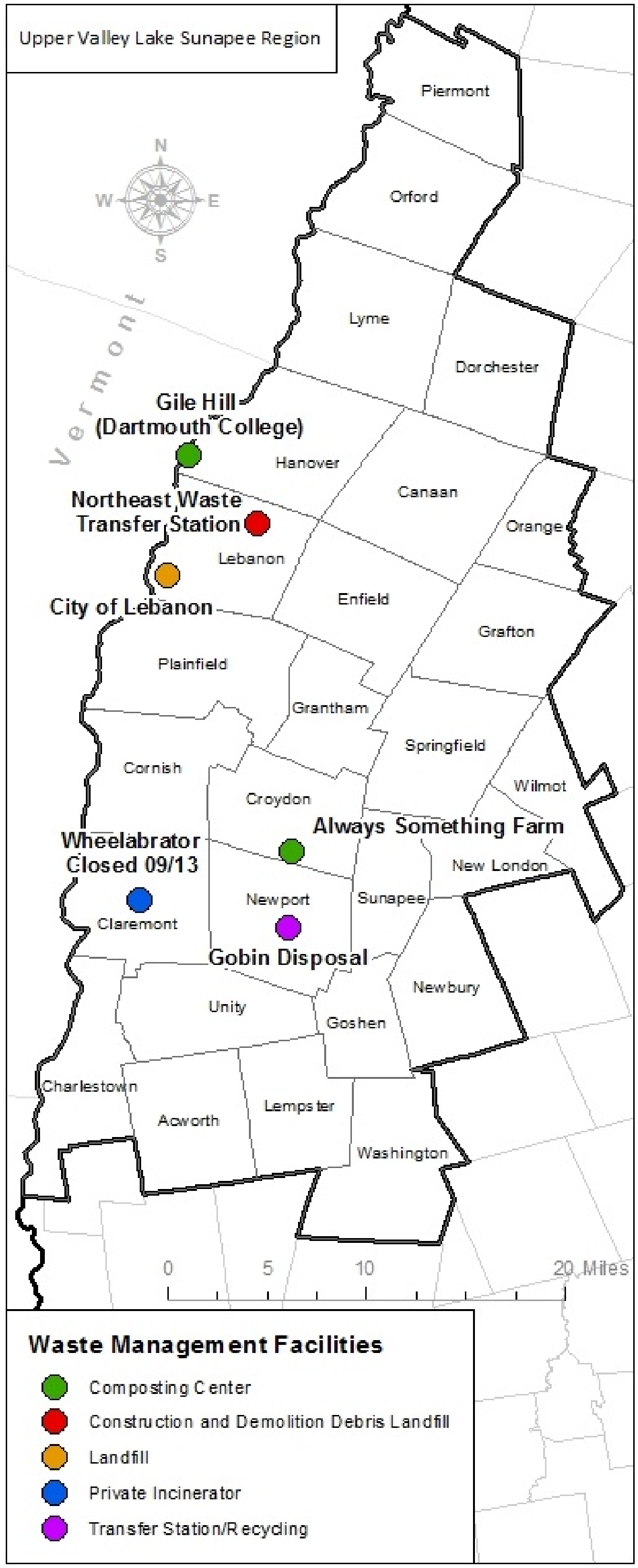
7.3 WASTE MANAGEMENT

Vision

All residents and businesses in the region will have access to efficient, environmentally responsible, and affordable waste management. The region's waste generation will be reduced through increased recycling, composting, and purchase of products containing recycled materials, and utilization of products with lower toxicity.

Managing Waste Demand

Every residential household as well as commercial, institutional, and industrial entity generates waste. The question is what to do with all of that waste. It must go somewhere. Should it be reused, recycled, composted, or disposed of at an incinerator or at a landfill? Or perhaps the first question is can the amount of waste generated be reduced in the first place so it does not have to be managed. The *Waste Management Facilities Map (right)* shows the location of waste management facilities in and around the region.



Source Reduction and Reuse

We are a consumer society, and nationally, waste generation is linked to the health of the economy. The stronger our economy, the more things people buy—thus, replacing items and throwing them in the trash. According to a study by Economist Michael McDonough of Bloomberg Brief, there is a tight correlation between waste shipped by rail to landfills and Gross Domestic Product.

Reducing waste generation is called "source reduction." For a household, this might include buying in bulk, reusing items such as food containers, reducing toxicity such as using nontoxic cleaners, sharing or renting large items like rototillers instead of buying them, or taking an old sheet and cutting it up into cleaning rags instead of buying cloths. These same concepts can be used by businesses and institutions. There are many ways to reduce waste generation. For industrial entities, this can include re-evaluating how products are made to considering more efficient methods that not only reduce waste but also save costs. Source reduction saves natural resources, conserves energy, reduces pollution, reduces the toxicity of our waste, and saves money for consumers and businesses.

Some states are looking at “product stewardship,” which requires the retailer to take back any product remainder or its packaging, such as paint. Several states have passed legislation to join with PaintCare, including Vermont, Maine, Connecticut, Rhode Island, Minnesota, California, and Oregon. PaintCare is an industrial driven organization developed by the American Coatings Association to assist states in developing paint take-back programs. When customers purchase paint in these participating states, the cost will be adjusted to pay for the take-back program. The customer can then return to a designated drop-off site with any leftover paint for reuse, remanufacturing, recycling, or incineration. This is a relatively new organization that will work to provide greater local remanufacturing opportunities to produce new paint from old. The New Hampshire legislature recently considered a paint product stewardship bill, and will likely revisit the topic in a future legislative session.

Recycling and Composting

Recycling is the collection of used, reused, or unused items that would otherwise be considered waste to be sorted and processed into raw materials. The raw materials, such as aluminum or glass, are then remanufactured into new products. An important part of recycling is “buying recycled” products to provide a market for recycling. For example, aluminum (soda), steel (canned food), glass (bottles and jars), boxboard (cereal), and molded paper (egg cartons) are all cost-effectively recycled.

Composting takes wastes such as food scraps, yard trimmings and other organic materials (potentially paper products) and converts them into a useable soil amendment for gardeners and landscapers. New Hampshire regulations make it more difficult to compost food waste than in other states. It is hoped that the NH Department of Environmental Services will revise their regulations to make it easier for food waste composting programs to develop in NH. About 15% of the waste stream is made up of food waste and about 14% is yard trimmings. Certain types of paper could also be composted if the temperature of the composting pile were high enough.

Recycling and composting prevent the emission of many greenhouse gases and water pollutants, save energy, supply valuable raw materials to industry, create jobs, stimulate the development of green technologies, conserve resources for future generations, and reduce the need for new landfills and incinerators.

Some states and municipalities mandate recycling and composting. Vermont recently passed Act 148 which requires facility owners and haulers that offer services for managing trash to also offer services for managing mandated recyclables, leaf and yard materials, and food residuals.

New Hampshire laws ban landfill disposal or incineration of several items as provided in the following table:

Figure 7.3.1- Banned Landfill Disposal Materials in New Hampshire

Banned Material	Year/RSA	Examples	Alternative Management
Wet-Cell (lead acid) Batteries	1991 – RSA 149-M:27, II	Vehicle batteries	Valuable for resale or return to manufacturer or scrap dealer
Leaf & Yard Waste	1992 – RSA 149-M:27, III	Leaves, brush, limbs	Can easily be composted at the home or the transfer station
Electronics	2007 – RSA 149-M:27 IV	Any video display device, central processing unit of a computer, or non-mobile video display media recorder/player	Collections at transfer stations or one-day collections; some retailers take back; donations
Mercury Items	2008 – RSA 149-M: 58	Fluorescent lamps, thermometers, thermostats, tilt switches, manometers, button batteries	Can be collected at HHW collections, but expensive; towns can collect lamps; Thermostat Recycling Corporation
Construction & Demolition (C&D)	2007: RSA 125-C: 10-c (prohibits combustion of the wood component	Until 1/1/14, municipal transfer station may continue to burn unpainted and untreated C&D wood (this may be extended)	Salvaged wood components may be reused for their original purposes; some C&D is ground up and used as daily landfill cover

Some municipalities choose to require recycling and some have instituted a “pay-as-you-throw” system of residential waste disposal. This is a way to encourage recycling by making it free or cheaper than throwing away the trash. The Town of Unity has special bags for waste disposal at a fee while recycling is free. This incentive program encourages people to recycle.

Recycling equipment can be expensive. Municipalities can apply to the *New Hampshire the Beautiful* program for funding to pay for recycling equipment and signs. They also support recycling in schools by purchasing recycling collection containers and trailers through the New Hampshire School Recycling Club.

Energy Recovery

Energy recovery from waste is the conversion of waste materials into useable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion, and landfill gas recovery. This process is call waste-to-energy.

The Lebanon landfill is developing a waste gas recovery system to generate energy. A waste-to-energy incinerator owned by Wheelabrator in Claremont recently closed in September 2013. Although the facility provided energy and a disposal option for surrounding municipalities, there were many local concerns that the facility was causing unacceptable levels of air pollution.

Disposal

Landfills are the most common form of waste disposal nationally. There is only one solid waste landfill in the region: The Lebanon Solid Waste and Recycling Facility owned by the City of Lebanon. Several older landfills existed in the region, but closed when more stringent regulations were adopted by the state and federal governments.

There are two landfills outside the region that the region's municipalities use: 1) The Mount Carberry Landfill in Berlin, NH; and 2) The North Country Environmental Services Landfill in Bethlehem. In addition, commercial waste companies collecting municipal waste may haul it to their own landfills out of state. This would include Vermont, although they have stringent laws about accepting out-of-state municipal solid waste. Vermont does allow disposal of out-of-state construction and demolition waste. The State of Vermont's waste management practices impact our region.

Currently, several Vermont towns take their waste to the City of Lebanon's landfill. A potential landfill in North Hartland, Vermont may change that although for the moment it has been determined to be unlikely. If the Vermont towns currently using the Lebanon landfill switch to taking their waste to another facility, then the Lebanon facility may provide more options for communities that currently do not have a contract to use the Lebanon landfill. This might save long hauling distances for some towns, and is dependent upon total costs for transportation and the disposal (tip) fee.

While the City of Lebanon has taken many steps to responsible manage their landfill, including expanding recycling and purchasing digesters, the capacity of the Lebanon landfill is finite.

Hazardous Waste

Most households, businesses, and industries generate at least some hazardous waste. Households purchase hazardous products every day from the local grocery store such as cleaners, oil-based paint and paint-related products, nail polish and remover, glues, automotive fluids, pesticides, swimming pool chemicals, and mercury-containing devices like the batteries in hearing aids, cell phones, tools, computers, and singing greeting cards.

Businesses and industries have a lot of the same hazardous waste as households, but they may also have hazardous wastes from their manufacturing processes.

When hazardous waste is dumped down the drain or flushed down the toilet, it goes into a septic system or wastewater treatment plant. These facilities are not designed to remove all chemicals from the water, which could result in pollution in our streams and rivers.

Methods of managing hazardous waste include not producing it in the first place. There are often non-toxic or less-toxic alternatives to hazardous products. These were mentioned in the "Source Reduction" section of this plan.

There are also collection systems for hazardous waste to keep it out of the waste stream of our disposal landfills and incinerators that are not intended for hazardous waste, including:

1. Permanent collection sites;

2. One-Day hazardous waste collections including satellite collections in more rural towns.

In the region, there are typically 14 communities that participate in the Commission's annual household hazardous waste collections. This number and the municipalities vary somewhat each year depending on the preference of the municipalities. Historically, about 900 households in the region participate in any given year. The cost per household ranges from $45 to $60 depending upon the quantity of waste brought, the type of materials, and the amount of grants obtained to offset the cost. Other collections also occur in the region. For example, Grantham provides a municipal collection every other year.

Hazardous waste management is expensive, yet it is much cheaper than cleaning up contaminated water and soil. Typically, hazardous waste is not recycled. It is taken to landfills and incinerators that are licensed to accept hazardous waste. This is not ideal, but even though hazardous waste is still being discarded, it is done in a responsible way to prevent accidents and pollution.

Universal Waste & Used Oil

Universal wastes are a special group of hazardous wastes that are very common. The NH Department of Environmental Services has made it easier to manage these types of waste because they are so common. This does not include used oil, but includes antifreeze, batteries, cathode ray tubes (e.g. TV/computer screens), fluorescent lights, mercury-containing devices such as thermometers and thermostats, and some pesticides.

Universal waste collection methods are much less expensive than accepting this waste at a special hazardous waste collection. Identifying and disposing of universal waste can result in municipal cost savings.

Many municipalities accept universal wastes and used oil at their transfer stations. Not all municipalities accept all the universal waste items or used oil due to lack of staff or liability concerns. There are also some stores and garages that will take back selected automotive materials (e.g. antifreeze and batteries) or used oil for free.

Municipalities may take advantage of programs for collecting some waste items, including:

1. Using the State DES contract for municipal collection of fluorescent bulbs and ballasts;

2. Obtaining a State DES oil collection grant for equipment to collect oil;

3. Working with the Thermostat Recycling Corporation program to provide a collection system for thermostats at an initial one-time $25/container fee;

4. Using the free Call2Recycle program to collect rechargeable batteries;

5. Using the motor vehicle reclamation program – a municipal fund developed from registration fees to pay for the management of used tires, used oil, and motor vehicle batteries; and

6. Applying for a State DES household hazardous waste grant (the Commission does this on behalf of municipalities participating in the regional collections).

Unwanted Medicines

Many people have medicines in their bathroom medicine chest or other cupboards where they are collecting old prescriptions in case they need them later. This is a dangerous practice for many reasons. Taking, or selling, someone else's pain medication is becoming increasingly common.

There are also poisonings from accidental misuse of medications. For example, when someone with poor eyesight may take the wrong medicine, or an elderly person can't remember if he/she took their medication and takes it twice, or a child thinks the pills are candy, or the dog chews through the bottle and eats the medication, poisoning results. These sound like unusual events, but in 2012, the U.S. Poison Control Centers received half a million calls. In 2009, The Northern New England Poison Center managed nearly 6,000 pediatric poisoning exposures in New Hampshire alone.

Proper storage of medicines so that no one but the appropriate user can access them is important to prevent intentional and unintentional misuse. Proper disposal of unwanted or expired medicines can eliminate household clutter and reduce the possibility of accidental poisonings.

Improper disposal can also pollute our groundwater. Accordingly, medicines should not be dumped down the drain or flushed down the toilet. In partnership with the Dartmouth Hitchcock Medical Center Pharmacy, the Commission has provided unwanted medicine collections in conjunction with its annual household hazardous waste collection days. In addition, during the summer of 2013, the Town of Hanover and the City of Lebanon installed medicine drop boxes in their police stations. This is a great way to provide accessible proper disposal. There have also been federally-provided medicine collections twice per year by the U.S. Drug Enforcement Administration.

If there is no collection available, the U.S. Environmental Protection Agency and the State of New Hampshire recommend putting the medicines in the trash rather than putting them down the drain.

The number of deaths in New Hampshire attributable to drug-related deaths – the majority of which are prescription drug-related – has outnumbered traffic related fatalities in four out of the last five years.

The New Hampshire rate of young adults reporting non-medical use of pain relievers in the past year is the second highest among the states and territories.

Call to Action: Responding to New Hampshire's Prescription Drug Epidemic, July 2012
The New Hampshire Governor's Commission on Alcohol and Drug Abuse Prevention, Intervention, and Treatment.

Waste Management Improvement Strategies

- Educate the public about banned landfill items, universal waste collection programs, household hazardous waste collection programs, and unwanted medicine disposal and collection programs.
- Provide technical assistance to municipal leaders and transfer station workers about proper waste management and available funding programs to assist in providing opportunities for responsible waste management.
- Increase participation on Household Hazardous Waste Collections by expanding rural satellite collections.
- Continue to develop the Healthy Home: Clean Safe and Save program to promote non-toxic household cleaning alternatives.
- Install additional unwanted medicine drop boxes at police stations around the region.
- Partner with waste haulers to provide adequate recycling and composting opportunities to increase participation rates.
- Create a culture of waste reduction and hazardous waste reduction by increasing communication between the public and municipal waste management programs.
- Work with NH DES to amend the food waste composting regulations. This might require pilot food waste composting programs.
- Encourage schools to increase their recycling programs and develop food waste composting programs.
- Encourage cooperation between municipalities to share resources and combine marketing efforts.

[1]United States Environmental Protection Agency. *Water: Drinking Water*. 06 October 2014. October 2014. <http://water.epa.gov/drink/>.

[2] UVLS Individual Municipal Master Plans.

[3] New Hampshire Department of Environmental Services. *Private Well Testing Program*. 2014. October 2014. http://des.nh.gov/organization/divisions/water/dwgb/well_testing/index.htm.

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[5] New Hampshire Department of Environmental Services. "Water Use and Conservation." December 2008. *New Hampshire Water Resources Primer.* October 2014. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter7.pdf.

[6] United States Geological Survey. *New Hampshire and Vermont Water Use Estimates for 2005 and Projections for 2020*. 2014. October 2014. http://nh.water.usgs.gov/project/nhvtwateruse/index.htm.

[7] New Hampshire Department of Environmental Services. "Water Use and Conservation." December 2008. *New Hampshire Water Resources Primer.* October 2014. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter7.pdf.

[8] New Hampshire Department of Environmental Services. "Water Use and Conservation." December 2008. *New Hampshire Water Resources Primer.* October 2014. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter7.pdf.

[9] New Hampshire Department of Environmental Services. "Water Use and Conservation." December 2008. *New Hampshire Water Resources Primer.* October 2014. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter7.pdf.

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[11] United States Environmental Protection Agency. *Sanitary Sewer Overflows and Peak Flows*. September, 2014. October 2014. http://water.epa.gov/polwaste/npdes/sso/index.cfm.

[12] United States Environmental Protection Agency. *Combined Sewer Overflows*. September, 2014. October 2014. http://water.epa.gov/polwaste/npdes/cso/index.cfm.

[13] New Hampshire Department of Environmental Services. *Combined Sewer Overflows (CSOs)*. 2012. October 2014. http://des.nh.gov/organization/commissioner/pip/factsheets/wwt/documents/web-9.pdf.

[14] United States Environmental Protection Agency. *Septic Systems Fact Sheet*. 2007. October 2014. http://water.epa.gov/aboutow/owm/upload/2009_06_22_septics_septic_systems_factsheet.pdf.

[15] United States Environmental Protection Agency. *Septic (Onsite/Decentralized) Systems*. September, 2014. October 2014. http://water.epa.gov/infrastructure/septic/index.cfm.

[16] United States Environmental Protection Agency. *Stormwater*. September, 2014. October 2014. http://water.epa.gov/polwaste/npdes/stormwater/index.cfm.

[17] United States Environmental Protection Agency. "Stormwater". *Water: Stormwater.* September 2014. http://water.epa.gov/polwaste/npdes/stormwater/index.cfm.

[18]City of Lebanon, New Hampshire. *Integrated Land Use and Transportation Implementation Plan.* November, 2014. December, 2014. http://lebcity.net/BComm/agendas/Planning%20Board/2014/11-24-14/plnbrditem4cMultiModal.pdf

[19] United States Environmental Protection Agency. *Stormwater*. September, 2014. October 2014. http://water.epa.gov/polwaste/npdes/stormwater/index.cfm.

[20] New Hampshire Department of Environmental Services. "Water Use and Conservation." December 2008. *New Hampshire Water Resources Primer.* October 2014. http://des.nh.gov/organization/divisions/water/dwgb/wrpp/documents/primer_chapter7.pdf.

[21] Natural Resources Defense Council. *Water Efficiency Saves Energy: Reduce Global Warming Pollution Through Water Use Strategies*. March 2009. October 2014. http://www.nrdc.org/policy/.

UVLSRPC Regional Plan 2015

Chapter 8

Energy-Efficient Communities

TABLE OF CONTENTS

8.1 ENERGY-EFFICIENT COMMUNITIES

Vision

The region's built environment will become increasingly energy-efficient through existing building retrofits, energy-efficient new construction, and energy-conscious site development practices. Local governments will be leaders in energy-conscious policies and practices and renewable energy initiatives.

Statewide Energy Overview

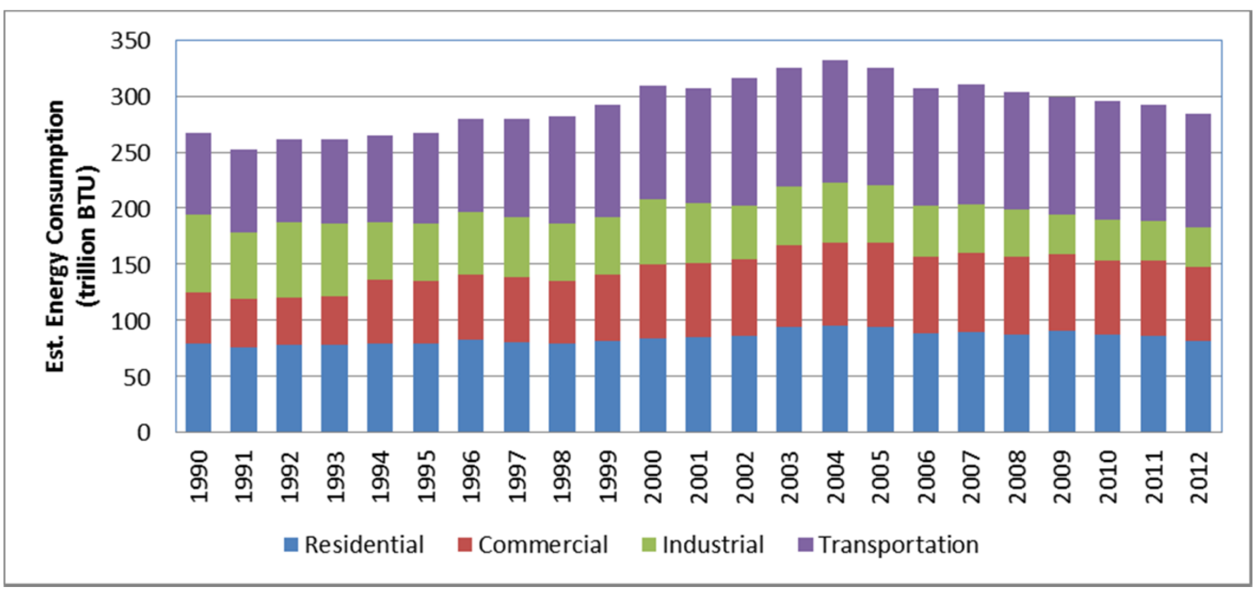
Energy use, conservation, and renewable energy generation are increasingly important topics in New Hampshire communities. This state has a broad range of challenges and opportunities to secure a future energy supply that is both abundant and affordable.

The *New Hampshire 10-Year State Energy Strategy* (2014) developed by the NH Office of Energy and Planning presents an in-depth analysis surrounding energy supply and demand issues for the State. The *NH State Energy Strategy* serves as a good reference for communities and individuals seeking information not contained in this chapter.

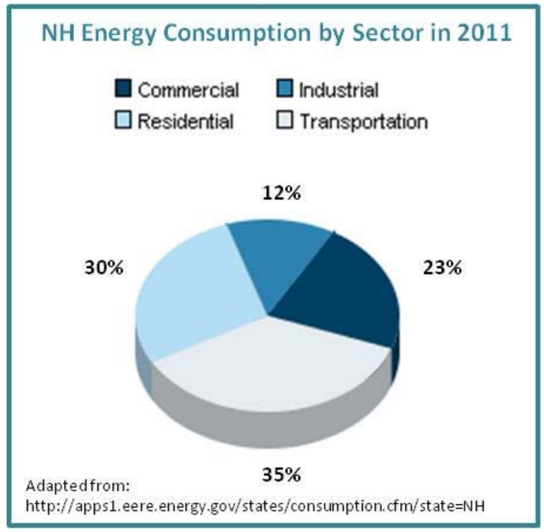
Statewide Energy Trends

The existing energy circumstances for New Hampshire present concerning trends, particularly with regard to affordability and reliability. In 2012, New Hampshire ranked eighth nationally among all states in per capita consumption of energy, but ranked 23rd for per capita energy expenditures. These rankings indicate a disproportionately high cost for energy on the national level. In 2013, statewide energy expenditures totaled nearly $5.9 billion, which is approximately 9% of State GDP. Much of that money left the state to pay for imported fuels.

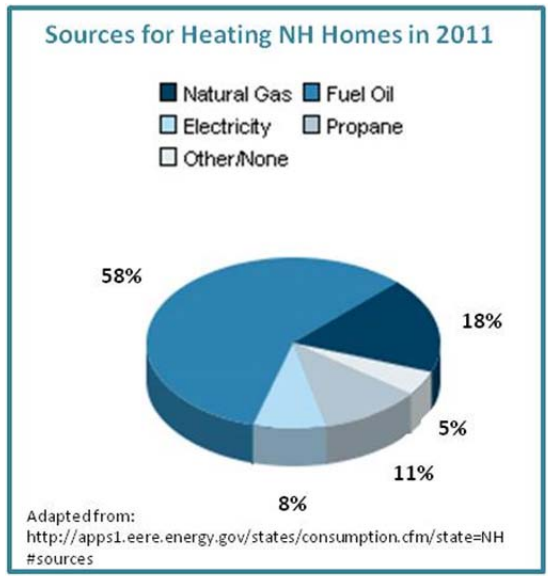
Figure 8.1.1- History of New Hampshire Statewide Energy Consumption by Sector[1]



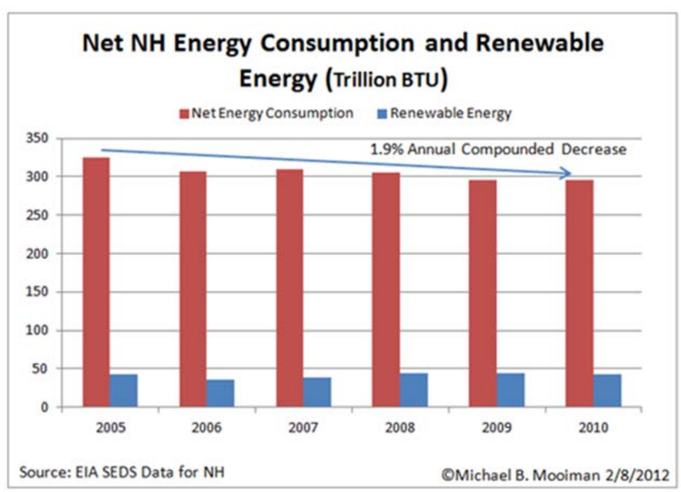
New Hampshire faces many challenges in planning for its energy future. A critical challenge is the rural nature of the state. New England is at the end of the energy pipeline and the energy distribution networks, electrical or otherwise, are more susceptible to disruptions in service and cost volatility because of the need to maintain network capacity, particularly when demand is high. Network vulnerabilities to severe weather events also cause substantial public safety and economic issues when energy supplies cannot reach customers.



In 2011, the transportation sector accounted for 35% of statewide energy consumption and residential energy followed closely, at 30%.[1] Advances in technology and state and federal policies and initiatives have resulted in greater efficiency across many sectors including vehicle fuel efficiency, energy-efficient building construction and renovation materials and practices, appliances, and equipment. A "business as usual" analysis projects overall statewide energy demand will decline at a moderate rate over the next 20 years, largely due to increased efficiency in the transportation sector. Energy costs, however, will likely continue to increase over this period resulting in a net increase in energy costs to consumers.[2]



Home heating contributes significantly to residential energy consumption. It is estimated that the vast majority (nearly 90%) of New Hampshire homes use imported heating fuel and energy sources. Seasonal heating is a critical issue for individual quality of life, and reliance on imported energy sources underscores



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1 U.S. Energy Information Administration, http://www.eia.gov/state/?sid=NH

2 *New Hampshire 10-Year Energy Strategy, Appendix A: Baseline Energy Forecast*, 2014, NH Office of Energy and Planning

vulnerability to national and international markets and political events.

As total energy consumption declined from 2005 to 2010, the proportion of renewable energy consumption increased. In 2013, 16% of the state's net electricity generation came from renewable energy with hydroelectric facilities providing slightly more than half of the electricity, and biomass facilities supplying most of the rest (largely supplied by wood products sourced locally from within the state).

> ***NH Electricity Rate Increases Shock Residents*** (Valley News, Jan. 5, 2015)
>
> Residents and business owners across New Hampshire are facing increased electricity rates up to 100 percent due to seasonal rate increases by electric utilities. The increased electricity costs are due to various factors including spikes in the cost of fuels used to generate electricity and the closure of major regional power plants. Regional households and businesses are trying to cope with the increased costs.

There are opportunities for increased use of renewable energy resources (e.g. biomass, geothermal heat, hydroelectric, wind, solar, etc.) in New Hampshire as they become more economically viable. Renewable energy resources, which are often locally or regionally available, are an important long-term consideration to introduce diversity into the array of energy resources for the state. Currently, renewable energy sources comprise a small share of the state's energy portfolio and are increasing annually. New Hampshire's Renewable Portfolio Standard (RPS) requires 24.8% of electricity sold to come from renewable energy resources by 2025.

The use of energy for electricity, heating, and transportation is inextricably linked to community planning and environmental quality. Many communities have begun taking action to manage energy consumption and promote renewable energy generation. Energy, which was once assumed to be a limitless resource beyond local or regional control or influence, has become a resource to be managed by communities, large institutions, and individual residents. Motives for these actions include:

- Economic Benefits – Energy efficiency practices and local or regional renewable energy supplies translate to lower energy costs over time and retaining energy expenditures in the local and regional economy.
- Environmental Benefits – Reduced energy demand and increased local renewable energy supplies reduce the emission of greenhouse gases. Promoting regional renewable biomass (wood and organic materials) energy industry encourages retention of forestlands as an economic resource.
- Resiliency and Stability – A diverse local energy supply portfolio mitigates the volatility of national and international energy supply chains.

Achieving the Statewide Energy Vision

The *NH State Energy Strategy* included a gap analysis to identify the most promising means to overcome a "business as usual" energy scenario and achieve the Statewide Energy Vision.[3] The following bullets summarize opportunities that are both economically justified and technically feasible across the state.

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[3] *New Hampshire 10-Year Energy Strategy, Appendix C: Resource Potential Analysis*, 2014, NH Office of Energy and Planning

Below: Lempster Windmills as Viewed from Mount Cardigan

- *Increase Energy Efficiency:* Increase energy efficiency of residential and commercial buildings and maximize opportunities to take advantage of new heating technologies. Increase transportation fuel efficiency and reduce vehicle miles traveled.
- *Expand Thermal & Transportation Fuels:* Expand the available fuel types for heating and transportation fuels. Opportunities for heating fuels include renewables (e.g. biomass and solar) and new technologies (e.g. ground source or air source heat pumps). Expand available alternative transportation fuel sources like electricity and natural gas.
- E*xpand Renewable Power Generation & Energy Infrastructure*: Expand solar and wind generation, either as utility-scale developments or for on-site residential and commercial use. Incorporating heating (e.g. district heating) and power generating facilities also has significant potential for improving the energy infrastructure.

Regional Energy Overview

The Upper Valley Lake Sunapee Region is rural and is situated a fair distance from major energy and fuel production and distribution points. Except for electrical power utilities and local foresters supplying cordwood to residents, the region imports nearly all of its energy. Based on information provided in the *NH State Energy Strategy,* the region is particularly vulnerable to disruptions in energy supply or fluctuations in energy costs.

Regional Energy Supply

There are a number of regional electrical generators that are of sufficient size (1 MW capacity or larger) to be considered of regional significance. The majority of these facilities are fueled by renewable energy sources. These sites include:[4]

- Lempster Wind, LLC – Lempster, NH: Wind, 24 MW capacity
- Springfield Power, LLC – Springfield, NH: Wood, 16.1 MW capacity
- Dartmouth College Heating Plant – Hanover, NH: Petroleum, 7 MW capacity
- Wilder Dam, TransCanada Hydro Northeast Inc.: Hydro, 41.3 MW capacity
- Mascoma Hydro Corp, Lebanon, NH: Hydro, 1.5 MW capacity
- Lower Village Water Power Project, Marlborough Hydro Corp – Claremont, NH: Hydro, 1.2 MW capacity

[4] US Energy Information Administration, http://www.eia.gov/state/?sid=NH

- Sweetwater Hydroelectric- Claremont, NH; Hydro, 0.9 MW capacity.
- Wheelabrator Claremont Facility, Wheelabrator Environmental Systems – Claremont, NH: Biomass, 4.5 MW capacity (Note: This facility is presently not operational.)

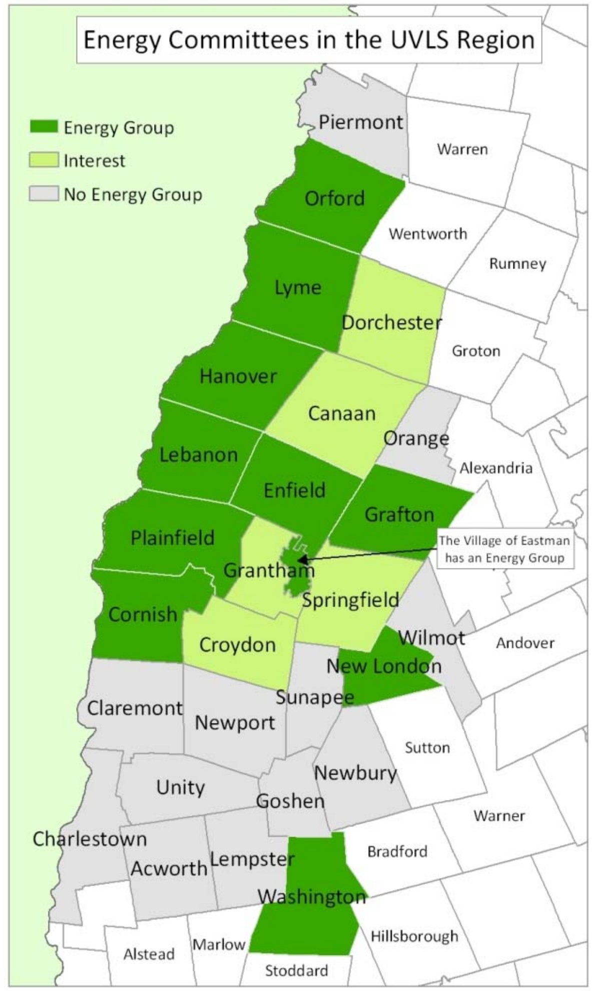
The economic potential for electricity generated from terrestrial wind is higher than from any other source and the technology continues to be developed, making wind power an economically viable opportunity to expand renewable power generation in the near term.

Regional Energy Committees

Approximately half the communities in the region either have an active volunteer group focusing on energy issues or have stated an interest in developing such a group over the past year. The functions of these groups may be advisory to the municipal government, or be authorized to maintain a fund to conduct energy studies or implement energy-related projects on behalf of the municipality. Per RSA 38-D:4, an energy committee, commission, or advisory group (however organized by the municipality) may "research municipal energy use and cost and make such information available to the town," and "[m]ake recommendations to local boards and committees pertaining to municipal energy plans and sustainable practices such as energy conservation, energy efficiency, energy generation, and zoning practices."

Regional Energy Opportunities and Challenges

The Sustainable Energy Resource Group (SERG) and Vital Communities, two regional non-profit organizations with a focus on promoting local energy action, host an



annual Upper Valley Energy Roundtable for energy committees in Vermont and New Hampshire to convene and discuss current energy projects and initiatives. During the 2013 roundtable event, the attendees conducted a strategic analysis of the region's energy supply and demand. Specifically, the attendees identified Strengths, Weaknesses, Opportunities and Threats, otherwise known as a SWOT Analysis, of energy supply and demand topics. A summary report of the analysis results is included in Appendix A of this chapter.

The SWOT analyses for energy supply and demand track closely with the *NH State Energy Strategy*, but provide a more informed local perspective on these issues.

Regional energy-related opportunities include:

- Encouraging renewable energy sources, both utility-scale electrical power generation and on-site residential and commercial-scale facilities;
- Harnessing local expertise and the spirit of innovation at regional research facilities and educational institutions;
- Promoting rural public transportation services and rideshare programs to reduce vehicle miles traveled by commuters;
- Promoting local economic opportunities by supporting local industries, agriculture, and services. Local economic activity reduces reliance upon external resources;
- Continuing with educational efforts to increase local understanding of energy conservation and renewable energy supply opportunities;
- Increasing the local electric vehicle charging station infrastructure.

Regional energy-related challenges include:

- The upfront cost of energy efficiency retrofits or renewable energy facilities are difficult for some residents or businesses to cover.
- Consumer understanding or knowledge of the benefits of energy-efficient products requires more education.
- The rural landscape makes energy distribution, both on roads and through power lines, costly and vulnerable to disruption.
- The rural landscape limits the availability of viable transportation choices. Travel distances or seasonal limitations are often barriers to walking or biking on a regular basis and rural public transportation is not feasible for all communities.
- Building and housing stock are old and require substantial improvements to meet current energy efficiency standards.
- Low energy costs offset the desire for individuals or organizations to implement energy conservation measures.
- "Not in my back yard" – local resistance against new electrical generator utilities.

Land Use and Energy Efficiency

Much of the region's growth over the last 40 years occurred as dispersed, rural and suburban development. This low-density growth pattern has resulted in increasing travel distances and commuting costs for residents.

It is important to recognize the impact that land use can have on energy efficiency and energy consumption at the community level. Energy-efficient land use planning for developed areas may include broadening potential land uses and encouraging infill development to allow an appropriate mix of uses. Examples of such benefits include allowing small-scale commercial retail uses in a traditionally residential area, which could encourage residents to walk or bike to neighborhood stores rather than drive to regional malls; or encouraging redevelopment of existing buildings that may result in private investment in improving a building's energy efficiency.

On a regional scale, municipalities should have regional discussions to coordinate land use patterns that reduce vehicle miles travelled for residents, commuters, and visitors.[5]

[5] *New Hampshire Climate Action* Plan, 2009, New Hampshire Department of Environmental Services

Strategies for Energy-Efficient Communities

- Provide technical assistance to communities in evaluating their energy resources and developing local Energy Plans (either as part of the Master Plan or as a standalone Energy Plan). Regular review and updates of an Energy Plan should be on the same schedule as the Master Plan.

- Assist communities in maximizing energy efficiency in municipal buildings and facilities. Benchmarking, tracking, and reporting energy use and savings to community members and decision makers will demonstrate the benefits of energy efficiency and energy management practices.

- Support expansion of renewable energy facilities for both private use and utilities. Municipalities should address renewable energy facilities within their master plans and place reasonable regulatory standards for development of private and utility-scale facilities.

- Encourage mixed use development and village development, conservation/open space subdivision, alternative transportation access, and preservation of agricultural lands.

- Pursue opportunities for public-private partnerships to further local energy priorities and initiatives, which may include grant opportunities and aggregated purchasing programs. An example is the Vital Communities Solarize program.

- Continue supporting rural public transportation services and transportation demand management initiatives to reduce per capita vehicle miles traveled.

- Conduct public outreach and education on energy topics. Seek opportunities to utilize or promote federal and state programs to fund outreach and education in collaboration with regional energy committees and energy-focused non-profits.

- Promote community initiatives to reduce collective energy consumption through community-based energy challenges.

- Review and incorporate recommended policies and strategies addressed in the *NH State Energy Strategy* in local master plans.

8.2 ENERGY-EFFICIENT CONSTRUCTION

Energy Use in the Residential Sector

The *New Hampshire Climate Action Plan* (2009) identified that much economic and environmental benefit could come from action to make *existing* residential buildings 70% more efficient. This increased efficiency would reduce the very high projected CO^2 emissions for the state and would produce the very high projected overall net economic benefits.[6]

Energy conservation, the act of changing habits to reduce consumption, can certainly contribute to energy savings without an initial investment. Turning the water off when brushing teeth or doing the dishes, turning off the TV and radio when not watching or listening, and turning lights off when you leave a room are all ways to reduce energy consumption. There are also many energy saving lighting choices available including energy-saving incandescent lighting (aka Halogen), LED lighting, and CFL lighting. However, in order to significantly reduce overall energy costs it often involves going beyond conservation and moving toward improving efficiency.

To improve the efficiency of an existing home, focus on the whole-house system and tighten the building envelope. The greatest amount, about 45%, of energy in a home is used for heating. Sealing leaks and insulating are the most cost-effective ways to increase energy efficiency and maintain heat.[7] Address air leaks by caulking windows and sealing cracks to the outside that may be around fireplace flues, electrical outlets, doors, and plumbing fixtures before insulating. Once completed, add or replace poor insulation in the attic, basement, walls, and floors. Insulating the attic in particular, can help maintain heat in the winter and keep it cooler in the summer.

For those needing financial assistance to achieve energy savings, the Upper Valley Region has a variety of non-profit resources. The Sustainable Energy Resource Group (SERG) is a leading voice and resource for residential and municipal energy assessments, education, and technical assistance. They provide public "Button Up" workshops to the region which focus on the importance of weatherizing and insulating homes, *buttoning up* the building envelope. Weatherization projects and other building repairs are completed by COVER's volunteer-led on-the-ground crews throughout the year, assisting low-income residents throughout the region.

Once the building envelope is tight, addressing the heating may be important. There are federal and state incentives focused on just that. New Hampshire's Office of Engineering and Planning is a good resource for a current list of statewide incentives (http://www.nh.gov/oep/energy/saving-energy/incentives.htm). Look for furnaces with high

[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] *EnergySavers: Tips on Saving Money & Energy at Home.* US Department of Energy. energysavers.gov

Annual Fuel Utilization Efficiency (AFUE). The national minimum is 78%, but some Energy Star® models are greater than 90%.[8] Nearly 2/3 of the homes in NH are heated using natural gas, but there are a number of renewable alternative.[9] Heat pumps are currently the most efficient form of heating providing up to three times more heat than energy they use and can reduce electricity consumed for heating by as much as 40%.[10] There are three different types of heat pumps: air to water, air to air and ground source heat pumps.[11] Heat pumps don't burn fuels they are powered by electricity, but can even be powered by solar electricity. [12] Whatever method of heating that is chosen, all can be as much as 10% more efficient by installing programmable thermostats.

Water heating is the second greatest amount of energy expended in a residence, accounting for as much as 18% of the total.[13] There are several ways to reduce the energy input to heating household water that don't require much investment if any at all. For example, by turning down the thermostat on the water tank heater to a lesser temperature, the tank will work less and be more efficient. Insulating the water tank will help reduce thermal heat loss. Replacing an old, inefficient water tank with an Energy Star® model or consider a tankless water heater will have a larger initial investment but could save as much as 30% in energy savings.[14] Adding aerators to bathroom and kitchen faucets can reduce the amount of water used as well.

Best Energy Efficiency Upgrades for Residences	
1.	Improve insulation in attic, walls, basement and crawlspace
2.	Upgrade your heating system to a high efficiency Energy Star® rated model
3.	Upgrade hot water heating system to the most efficient possible and install low-flow showerheads and faucet aerators.
4.	Make home as airtight as possible with air sealing and weather stripping while adding proper ventilation systems.
5.	Apply for related grants & incentives to help you lower the up-front cost of energy efficient renovations.
http://www.citygreen.ca/best-practices-energy-efficiency-homes-and-buildings#model	

Windows are also an important component to a home's energy system. Single pane windows should be replaced with double-pane windows with low-e coatings to reduce heat loss.[15] However, it can be very costly to replace windows, so if that isn't possible install tight fitting, insulating window shades and close them at night to protect against cold drafts or install storm windows which can reduce heat loss by as much as 50%.[16]

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8 *EIbid*

9 http://apps1.eere.energy.gov/states/residential.cfm/state=NH#sources

10 *EnergySavers: Tips on Saving Money & Energy at Home.*US Department of Energy. energysavers.gov

11 http://www.revisionenergy.com/solar-space-heating-maine-new-hampshire.php

12 Ibid.

13 *EnergySavers: Tips on Saving Money & Energy at Home.*US Department of Energy. energysavers.gov

14 *Ibid.*

15 *Ibid.*

16 *Ibid*

Municipal Retrofits

The long-term goal of the Building Technologies Office of the US Department of Energy is to reduce energy use by 50%, compared to a 2010 baseline.[17] One way the DOE has spearheaded this reduction is with the Better Buildings Challenge, a public-private partnership committed to a 20% reduction in commercial building energy use by 2020. With $10 million in funding from the DOE, the NH Better Buildings program was established to reduce energy use in the state by a minimum of 15% through residential and commercial energy efficiency upgrades.[18] The state also offers State Energy Program (SEP) grants for a variety of projects including building improvements and electric power and renewable energy.[19]

In 2012, the Union Block Project in the City of Claremont included retrofitting this historic building built in 1888. The project was completed with funding from the NH Community Development Finance Authority, Southwest Community Services and the Retail Merchants Association. The retrofit included: installing new low-e insulated glass and doors at some of the storefront, refurbishing an historic skylight with low-e insulated glass, adding spray foam and blown in cellulose to the attic for an R-value of 60, and air sealing the basement. HVAC work included adding ventilation and solar thermal hot water system. The most significant part of the project was changing the heating system from a one zone steam system to a multi-zone forced hot water system, fired by wood pellet boilers. A solar hot water system was also installed. This project resulted in a 60% reduction in energy demand and 75% reduction in energy cost while keeping Union Block an historic center to Claremont's business district. Tot total energy project cost was $572,225 which resulted in an annual $58,658 energy cost savings and 406,310 CO^2/lbs per year emissions reduction.[20]

Schools

Schools in the Region have also undertaken energy retrofit projects. The EnergySmart Schools Program supported K-12 public and private schools pursuing energy efficiency initiatives by helping them understand where their energy dollars were being spent and identifying opportunities for improving operations and reducing costs.[21] In the Region, Plainfield Elementary School, the Kearsarge Regional Middle School, New London Elementary School and the Piermont Village School utilized this program.

The Plainfield Elementary School has completed some retrofit projects: The exit signs were replaced with high efficiency LED signs throughout the school; New high efficiency lights were installed in the gym; A school-wide energy management system was implemented including installing controls for the HVAC system: Occupancy sensors were installed in the

[17] http://energy.gov/eere/buildings/building-technologies-office
[18] http://www.nh.gov/oep/energy/programs/betterbuildings/index.htm
[19] http://www.nh.gov/oep/energy/programs/sep/index.htm
[20] http://www.nhenergy.org/uploads/1/6/7/3/16738072/union_block_2013.pdf
[21] http://www.nhschoolbenchmarking.com/

classrooms, gym, offices and restrooms to turn off lights when the rooms are vacant; Timers were installed on juice vending machines to moderate energy use; and 15 classrooms were modified using air sealing, heat recovery ventilation and super insulation. Since 2005, energy use at Plainfield Elementary School has dropped by 45%. Last year they saved $35,241 in energy costs.[22]

Additionally, solar panels were installed on the roof of the Lyme Elementary School in 2009 with the hope of providing 10-20% of the energy for the school. The output today is about 15 kWh.

The cost of energy upgrades and retrofits often prohibit or limit the scale of projects for municipalities as well as residents. There are a large number of financial incentives available to municipalities, businesses, schools and residences in the state of NH that wish to move to cleaner energy. The Clean Energy Authority (http://www.cleanenergyauthority.com/) is a great resource for available funding and incentive programs. Additionally, many towns in the Region have organized energy committees which facilitate residential educational programs and often act as a resource for finding financial incentives that are available. Energy committees also have assisted in recent and ongoing town-wide *Solarize* events.

The Sustainable Energy Resource Group (SERG) surveyed Upper Valley Energy Committees in May 2014 to get updates on what activities their communities were undertaking. Generally, the NH towns in the Upper Valley reported focusing on *Solarize* projects (Plainfield, Lyme, Hanover, Cornish) and streetlight plans (Lebanon, Orford, Grafton).

Municipalities in the Region are also incorporating Energy into their Master Planning process. Beginning in 2010, the UVLSRPC and partners received an Energy Technical Assistance & Planning (ETAP) Grant - a two year, federally funded program developed by the NH Office of Energy and Planning under the Energy Efficiency Conservation Block Grant (EECBG). Through this program the UVLSRPC has assisted eight towns, and completed six Energy Chapters for the town's Master Plans.

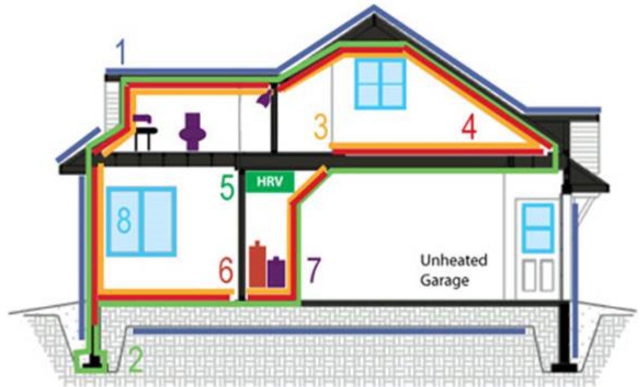
In 2012, the City of Lebanon adopted a comprehensive Energy Plan for the City initiated by Lebanon's Energy Advisory Committee. This undertaking was accomplished with the assistance of Vital Communities and the UVLSRPC. The Plan is an important tool with which the City can use for guidance and a tool for prioritizing projects. The Plan evaluated the existing condition of municipal buildings, the City's transportation network, and other related infrastructure such as the location of the City's streetlights.

The State Office of Energy & Planning recommends that municipalities establish energy efficiency goals and improve coordination and design efficiency programs. Adopting green energy ordinances and adopting the newest building codes are also good tools to decrease energy use. It is important to improve access to financing for the low income population who wish or need to make energy improvements.

[22] http://www.nhenergy.org/uploads/1/6/7/3/16738072/project_profile_plainfield_elementary_school.pdf

New Construction

Components of an Energy Efficient Home



1. Weather barrier outside	2. Continuous air barrier
3. Moisture barrier inside	4. Thermal barrier
5. Mechanical ventilation	6. High efficiency heating
7. High efficiency hot water tank & low-flow fixtures	8. Thermal window system

Adapted from: http://www.citygreen.ca/best-practices-energy-efficiency-homes-and-buildings

There are a variety of energy-efficient methods that have been developed to guide green construction of new buildings. The two most commonly used for green design and construction are the US Green Building Council's (USGB) Leadership in Energy & Environmental Design (LEED) and US Environmental Protection Agency's (EPA) Energy Star® Program. Each standard provides a framework which must meet strict energy efficiency guidelines for certification.[23]

Some important considerations in green design and construction projects that are common among all methods include considerations about the scope of the entire project as a whole, from site planning and design, sustainable construction (minimizing energy and material waste throughout the building cycle), efficient design of the building envelope, consideration of environmental air and light quality to maximize health and utilization of solar and other renewable on-site technologies for electricity and heating.[24]

Net Zero Construction, also known as zero energy building, is the process of constructing a highly energy-efficient home which supplies an energy output to the grid equal to the amount of energy required for the house system management. This typically requires that renewable on-site resources are available to supply more than half of the energy to the house and that zero-energy and renewable energy concepts are integrated into the design and site plan. Because this is not easily achieved, there are not too many of these buildings constructed at this time, but continued advances in the renewable energy sector may provide greater opportunities for this to be achieved more easily in the future.

23 http://www.usgbc.org/leed
24 http://www.epa.gov/oaintrnt/projects/policy.htm

APPENDIX A- REGIONAL SWOT ANALYSIS

A Strengths, Weaknesses, Opportunities, and Threats Analysis (SWOT) is a strategic planning tool to evaluate internal and external influences upon a common vision or specific goal. SWOT analyses are a common method for a company or organization to assess its capacity to execute a plan or achieve an attainable goal. In the context of regional planning, and regional visioning for the future of sustainable energy resources, the SWOT analysis evaluates the internal and external factors as they may pertain to the region's inherent assets and likely areas of need. The following notes and summary text are based on a dynamic and fast-paced exercise conducted at the May 8, 2013 Upper Valley Energy Roundtable; an annual, bi-state event convening local energy committees together to support and promote energy-related initiatives.

The following pages summarize the collective inputs from the attendees at the roundtable. These notes are intended as the beginning of local and regional visioning discussions addressing energy supplies and demand to promote the overall vision of sustainable and vibrant communities.

REGIONAL ENERGY VISIONING—A SWOT ANALYSIS FOR THE UPPER VALLEY'S ENERGY FUTURE

DISCUSSION ABOUT THE CURRENT AND FUTURE ENERGY SUPPLY

Upper Valley Energy Roundtable, Wednesday, May 8, 2013

STRENGTHS: What internal factors, or assets, in the Upper Valley support reliable and sustainable energy supplies?

- Available renewable energy resources:
  - Hydro, wind, solar, biomass, and geothermal energy sources.
- Spirit of innovation:
  - Regional commercial/industrial/institutional in research and development of new technologies
  - Engaged and involved local individuals who are knowledgeable, caring, and clever
- Progressive and improving energy supply resources
  - Harvesting methane and biomass from landfills
  - Improving renewable technologies

OPPORTUNITIES: What external factors to the Upper Valley could support reliable and sustainable energy supplies?

- Expand use of local renewable energy supplies
  - Hydro, wind, solar
- Improve existing distribution technologies
  - Smart Grid implementation
  - Increase number of local power generation sites using local fuels
  - Improve efficiencies of transmission lines and transportation networks
- Local/Regional/Statewide initiatives:
  - Carbon tax
  - Energy efficiency and local renewables incentive programs
  - Develop an electric vehicle infrastructure (charging stations)

WEAKNESSES: What internal factors in the Upper Valley may have a negative impact on reliable and sustainable energy supplies?

- Energy supply network:
  - Principally imported from outside the region and the U.S.
  - Electrical power line loss over long distances
  - Reliance on fossil fuels
  - Higher costs for most energy sources—transportation costly
- Limited local energy sources
  - Region not great for wind generation
  - Limited diversity in local fuel sources
  - High cost to maintain renewable energy facilities
- Barriers to expanding local energy supply:
  - High cost
  - Limited capital, financing, or incentives
  - Substantial permitting and regulatory requirements
  - Rural region increases basic costs

THREATS: What external factors may have a negative impact on the Upper Valley's reliable and sustainable energy supplies?

- Lack of public/political support:
  - Not in my back yard—resistance to having projects next door
  - Public opinion/apathy
  - Lack of funding (nationally) for technological advancement
- Vulnerability of energy resources:
  - Centralized energy supply/distribution (national/international)
  - Resource shortages and military conflicts impact local supplies
  - Resource depletion
  - Aging infrastructure
- Climate change—extreme weather conditions impacting supply chains and possible future availability of fuel sources

REGIONAL ENERGY VISIONING—A SWOT ANALYSIS FOR THE UPPER VALLEY'S ENERGY FUTURE

DISCUSSION ABOUT THE CURRENT AND FUTURE ENERGY DEMAND

Upper Valley Energy Roundtable, Wednesday, May 8, 2013

STRENGTHS: What internal factors, or assets, in the Upper Valley improve efficient energy demands?

- Communities working to reduce energy demands
    - Energy conservation initiatives
    - Modifying land use regulations to increase energy efficiency (e.g. transportation options)
    - Strong community groups advocating energy efficiency
- Growing public interest in local agriculture and local businesses:
    - Limits required travel distances for goods/services
    - Focuses on local economic gain
- Public and commercial transportation
    - Successful transit programs in the region
    - Local interest in regional bus, passenger train
    - Rail freight in use in the region

OPPORTUNITIES: What external factors to the Upper Valley could increase or promote efficient energy use?

- Modify individual/community behaviors
    - Utilize emerging technologies to improve monitoring/managing use of energy (e.g. Smart Grid)
    - Educate the public and businesses about energy conservation
- Increase energy efficiency standards and practices
    - Develop energy efficiency standards in land use regulations
    - Adopt local energy building codes that exceed statewide or national standards
- Promote local economic opportunities
    - Focus on local/regional products and services
    - Reduce transportation costs/energy expenditure
    - Local production and consumption
    - Seek opportunities to improve the local energy economy

WEAKNESSES: What internal factors in the Upper Valley may have a negative impact on the level of energy consumption?

- Consumer choices lack of awareness regarding conserving energy:
    - Resistance to behavior changes that may cause perceived inconvenience
    - Up-front costs to adopting energy efficient practices not compared with long-term benefits
    - Consumer awareness or desire to employ energy efficient needs more work
- High cost and more effort to implement energy conservation practices:
    - Limited capital or incentives to improve efficiency
    - Rural landscape makes transit, walking, biking difficult as transportation options
    - Old building/housing stock may need substantial improvements

THREATS: What external factors may have a negative impact on the Upper Valley's energy consumption?

- Policies and cheap power
    - Energy prices kept artificially low
    - Low energy costs offset desire of the individual to conserve energy resources
    - Possible long-term detrimental impacts to the local and national economies
- Rural areas have sparse population
    - Geography—the distances between communities
    - Technological limitations (e.g. effective range of electric vehicles) limit opportunities to reduce energy consumption
- Old housing stock—cost of increasing energy efficiency of housing may be cost prohibitive for residents.
- Climate change may have a detrimental impact on some fuel supplies like hydro power (drought) or biomass

UVLSRPC Regional Plan 2015

Chapter 9

Hazards and Adaptation

TABLE OF CONTENTS

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.

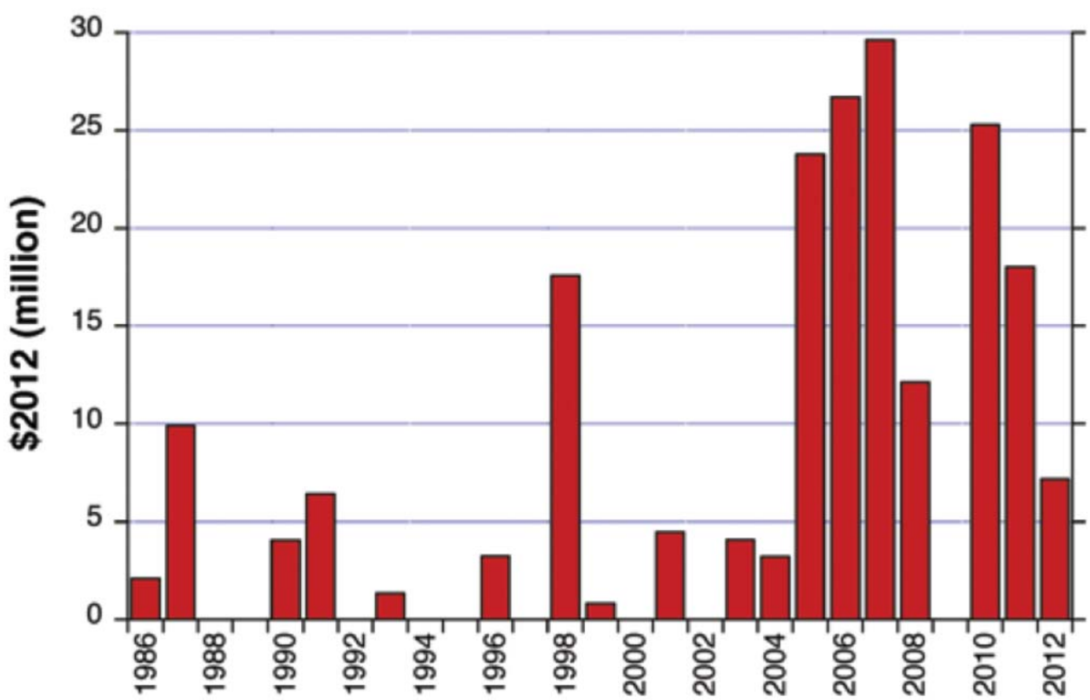
Not all programs, however, are activated for every disaster. The determination of which programs are activated is based on the needs found during the damage assessment and any subsequent information that may be discovered.

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:

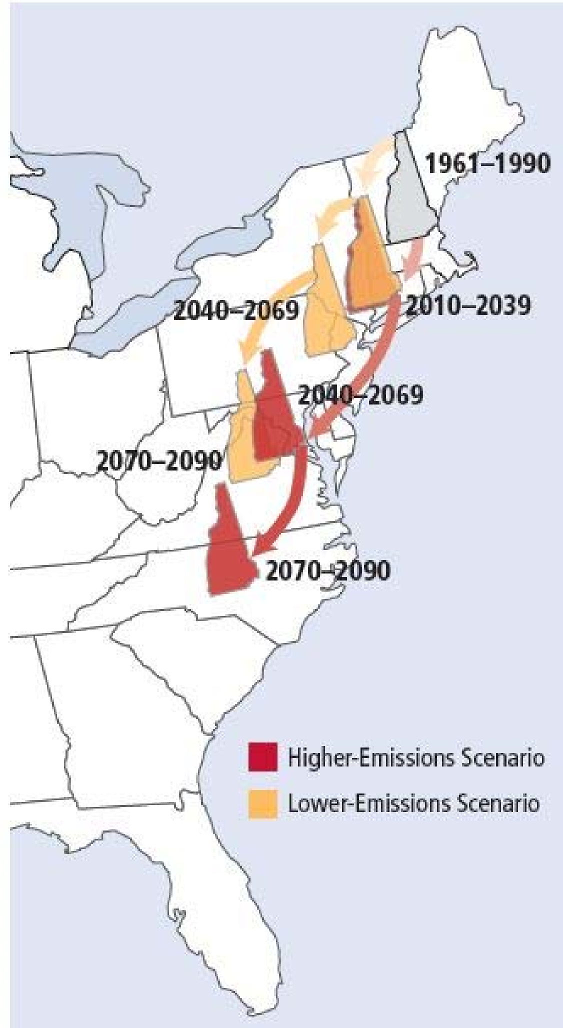
- Lower Emission Scenario: Global improvements in energy efficiency and development of renewable energy results in reduced emissions of heat-trapping greenhouse gases below 1990 by the end of the twenty-first century.
- Higher Emissions Scenario: Fossil fuels are assumed to remain a primary energy resource 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 Scientists[2]

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 adaptation[4] 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:

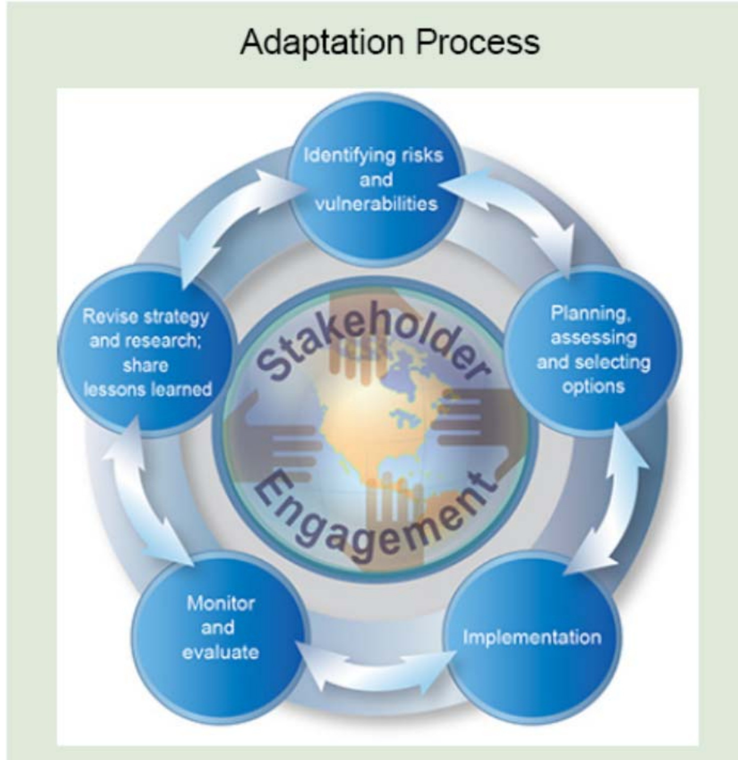
- *Under current conditions, 12% of culverts are undersized for a severe storm event.*
- *35% of culverts are expected to be undersized by mid-21st century for a similar storm event.*

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 Upper Valley Region of Vermont and New Hampshire.



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

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 slops 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

Climate Change in Southern New Hampshire

PAST, PRESENT, AND FUTURE

A PUBLICATION OF THE SUSTAINABILITY INSTITUTE AT THE UNIVERSITY OF NEW HAMPSHIRE

climate solutions new england

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climate solutions new england

Climate Solutions New England (CSNE) promotes regional collaboration toward the goal of greater energy self-reliance and weather resilience that contribute to healthy, prosperous, and sustainable communities across New England. CSNE is an initiative of and led by faculty and staff from the Sustainability Institute and the University of New Hampshire. Learn more at www.climatesolutionsne.org.

Climate Change in Southern New Hampshire

PAST, PRESENT, AND FUTURE

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Acknowledgements

The research and writing of this report were completed on behalf of the nine Regional Planning Commissions (RPCs) in the state of New Hampshire and carried out under contract with the Nashua RPC and the Granite State Future project using Sustainable Communities Regional Planning Grant funds administered by the U.S. Department of Housing and Urban Development.

Additional support for this research was provided by the National Science Foundation funded New Hampshire Experimental Program to Stimulate Competitive Research (EPSCoR) project titled "Interactions Among Climate, Land Use, Ecosystem Services, and Society" (Award # EPS 1101245). Visualizations of the data and downscaled climate model simulations presented in this report can also be viewed online at the NH EPSCoR Data Discovery Center (http://epscor-ddc.sr.unh.edu). We also thank the several external reviewers who provided comments that significantly improved the report and Laurel Lloyd for copy-editing the report.

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EXECUTIVE SUMMARY

EARTH'S CLIMATE CHANGES. It always has and always will. However, an extensive and growing body of scientific evidence indicates that human activities—including the burning of fossil fuel (coal, oil, and natural gas) for energy, clearing of forested lands for agriculture, and raising livestock—are now the primary force driving change in the Earth's climate system. This report describes how the climate of southern 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.

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 (Keene, Durham, and Hanover) show that, 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; this increase has been dramatic at some sites in southern New Hampshire. The impact of this increase in large precipitation events is 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 twenty-seven days in Durham and twelve days in Hanover.

In addition, more than a century of observations shows that spring lake ice-out dates on Lake Winnipesaukee and Lake Sunapee are occurring ten to twenty days earlier today than in the past.

To generate future climate projections for southern New Hampshire, simulated temperature and precipitation from four Global Climate Models (GCMs) were statistically downscaled using historical weather observations. We accounted for a range of potential future fossil fuel use by using two very different future global emission scenarios. In the lower emissions scenario, improvements in energy efficiency, combined with the development of renewable energy, reduce global emissions of heat-trapping gases (also known as greenhouse gases) below 1990 levels by the end of the twenty-first century. In the higher emissions scenario, fossil fuels are assumed to remain a primary energy resource, and emissions of heat-trapping gases grow to three times those of today by the end of the century. Although both scenarios are possible, the current global emissions trend from 2000 through 2012 suggests that, in the absence of concerted international efforts to reduce emissions, climate change will likely track or exceed that projected under the higher emissions scenario over the course of this century.

As heat-trapping gases continue to accumulate in the atmosphere, temperatures will rise in southern

New Hampshire. Depending on the emissions scenario, mid-century annual average temperatures may increase on average by 3 to 5°F, and end-of-century annual average temperatures may increase as much as 4°F under a lower to 8°F under a higher emission scenario. Summer temperatures may experience the most dramatic change, 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 the hottest days will be hotter, raising concerns regarding the impact of extreme, sustained heat on human health, infrastructure, and the electrical grid.

Extreme cold temperatures are projected to occur less frequently, and extreme cold days will be warmer than in the past. 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 reduce cold temperature constraints that currently limit the spatial extent of some marginally over-wintering pests and invasive species.

The growing season will get longer, which may provide opportunities for farmers to grow new crops. However, many existing crops will likely experience yield losses associated with increased frequency of high temperature stress, an increase in soil erosion and crop failure resulting from more frequent extreme precipitation events, inadequate winter chill period for optimum fruiting, and increased pressure from invasive weeds, insects, or disease.

Annual average precipitation is projected to increase 17 to 20 percent by end-of-century. Larger increases are expected for winter and spring, exacerbating concerns regarding rapid snowmelt, high peak stream flows, and flood risk. Southern New Hampshire can also expect to experience more extreme precipitation events in the future. For example, under the high emissions scenario, events that drop more than four inches of precipitation in forty-eight hours are projected to increase two- to three-fold across much of southern New Hampshire by the end of the century.

Observed changes in climate over the past several decades are already having a significant impact on New Hampshire. The projected changes in the climate of southern New Hampshire over the next century will continue to impact our environment, ecosystems services, economy, and society in a myriad of ways. Because some future changes are inevitable, smart choices must be made to help our society and our ecosystems adapt to the new climate normal. With prompt action that improves the efficiency with which we use energy and significantly enhances sources of renewable energy, many of the most extreme consequences of climate change can be avoided and their worst impacts reduced. Our hope is that the focused information presented in this report provides local and regional stakeholders with relevant input for decision-making, serving as a foundation for the development of local and regional climate change adaptation plans, as well as regional mitigation plans to reduce emissions of heat-trapping gases.

I. INTRODUCTION

"Climate change is occurring, is very likely caused by human activities, and poses significant risks for a broad range of human and natural systems. Each additional ton of greenhouse gases emitted commits us to further change and greater risks."[1]

Over most of Earth's 4.5 billion year history, large-scale climate variations were driven by natural causes including gradual shifts in the Earth's orbital cycles, variations in solar output, changes in the location and height of continents, meteorite impacts, volcanic eruptions, and natural variations in the amount of greenhouse gases in the atmosphere.[2] Today, however, the story is noticeably different. Since the Industrial Revolution, atmospheric concentrations of heat-trapping gases, or greenhouse gases, such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have been rising as a result of increasing emissions from human activities.[3] The primary source of CO_2 comes from the burning of fossil fuels such as coal, oil, and natural gas. Carbon dioxide is also produced by land use changes, including tropical deforestation. Agricultural activity and waste treatment are critical sources of CH_4 and N_2O emissions. Atmospheric particles released during fossil fuel combustion, such as soot and sulfates, also affect climate.

As human-derived emissions of heat-trapping gases continue to rise, analysis of data collected around the globe clearly documents ongoing and increasingly dramatic changes in our climate system. These changes include increases in global atmospheric and ocean temperatures, atmospheric water vapor, precipitation and extreme precipitation events, and sea levels. They also include reductions in the volume and areal extent of spring and summer Arctic sea ice, reductions in northern hemisphere snowcover, melting of mountain glaciers, increases in the flux of ice from the Greenland and West Antarctic ice sheets into the ocean, and thawing permafrost and methane hydrates.[4] Detailed reviews of the extensive body of evidence from peer-reviewed climate science publications conclude that it is extremely likely that the majority of warming observed over the last fifty years have been caused by emissions of heat-trapping gases derived from human activities.[5]

The northeast United States has already experienced an overall warming over the past century, with an increase in the rate of warming over the past four decades. This change in our regional climate has been documented in a wide range of indicators, including increases in temperature (especially in winter), in overall precipitation, in the number of extreme precipitation events, and in the proportion of winter precipitation falling as rain (as opposed to snow). Observed changes also include a decrease in snow cover days, earlier ice-out dates, earlier spring runoff, earlier spring bloom dates for lilacs, longer growing seasons, and rising sea levels.[6]

To examine how climate change might impact our region in the future, we used scenarios of future emissions of heat-trapping gases as input to global climate models (GCMs). However, GCMs operate on the scale of hundreds of miles, too large to resolve the changes over southern New Hampshire. For that reason we used state-of-the-art statistical techniques to downscale the regional temperature and precipitation simulations generated by the GCMs to observed conditions at individual weather stations across southern New Hampshire.[7] The results show that, over the coming century, southern New Hampshire's climate is expected to continue to become warmer and wetter in response to increasing emissions of heat-trapping gases from human activities. The implications for southern New Hampshire are significant: hotter summers and warmer winters, more invasive pests and weeds, and an increase in precipitation and the frequency of extreme precipitation events. All of these impacts are greater under a higher emissions scenario versus a lower emissions scenario, and by the end of the century as compared to earlier time periods.

These changes will have repercussions on the region's environment, ecosystem services, economy, and society. A detailed analysis of the impacts of climate change on specific natural resources and other sectors (including forests, agriculture, recreation, water resources, human health, and invasive pests) is beyond the scope of this climate assessment. Fortunately, there is a wealth of analysis on the potential impacts of climate change across New England and the northeast United States in the peer-reviewed scientific literature.[8] For example, warmer temperatures affect the types of trees, plants, and crops likely to grow in the area but will also allow an expansion of invasive pests and weeds. Long periods of very hot conditions in the summer are likely to increase demands on electricity and water resources. Hot summer weather can also have damaging effects on agriculture, human and ecosystem health, and outdoor recreational opportunities. Less frequent extreme cold in the winter will likely lower heating bills and reduce cold-related injury and death, but rising minimum temperatures in winter will likely open the door to invasion of cold-intolerant pests that prey on the region's forests and crops. Warmer winters will also have an impact on a wide range of snow and ice related winter recreation.[9] More extreme precipitation events, combined with an expansion of impervious surface associated with development, will increase the risk for both the frequency and magnitude of flooding.

In addition to the changes described above and in the body of this report, Earth's climate history, as read through the analysis of natural archives, including ocean sediments, ice cores, and tree rings, reveals several "tipping points"—thresholds beyond which major and rapid changes occur that can lead to abrupt changes in the climate system.[10] The current rate of emissions of heat trapping gases is changing the climate system at an accelerating pace, making the chances of crossing tipping points more likely. There is a growing recognition that gradually changing climate can push both natural systems and human systems across key tipping points. However, accurately predicting if and when these tipping points will be crossed has proven challenging. Because of this uncertainty, the potential impact of crossing these tipping points is not discussed in detail in this report. However, the potential to cross key tipping points in the climate system should, where feasible, be integrated into our decision-making processes.

If we respond regionally and globally to the grand challenge of significantly reducing our emission of heat-trapping gases (this is called mitigation), we can avoid the more catastrophic climate change. And if we begin to plan locally and regionally for the unavoidable climate change that we have already baked into the climate system over the next several decades, we can adapt and avoid, manage, or reduce the consequences of our changing climate. This is called adaptation. Both mitigation and adaptation are necessary components of a sustainable future. We must reduce the impact we are having on climate, and we must prepare to adapt to the changes that are already underway.

The research and writing of this report, and a companion report for northern New Hampshire, were completed with support from the Granite State Future project (Sidebar). For this report, we define meteorological stations located south of 43.90°N latitude as falling within southern New Hampshire (Figure 1). This is north of Lake Winnipesauke but south of the notches. For the climate assessment for northern New Hampshire, we define meteorological stations located north of 43.75°N latitude as falling within northern New Hampshire. This provides an overlap of 0.15 degrees latitude, or about seventeen miles. Communities that lie within this overlap (for example, Plymouth, West Rumney, and Tamworth) can use either report. In addition, there is site-specific climate information provided in the climate grids (Appendix B) which contain historical and projected future thirty-year climatologies for twenty-five Global Historical Climatology Network-Daily (GHCN-Daily) meteorological stations across southern New Hampshire for the historical period (1980–2009) and the future (2010–2039, 2040–2069, 2070–2099).

Other New Hampshire-specific reports provide additional information and analysis beyond what is contained in this report. A climate assessment for New Hampshire's coastal watershed, which includes detailed analysis of sea level rise and coastal flooding, was published in 2011.[11] Under the leadership of the Department of Environmental Services, New Hampshire completed a detailed Climate Action Plan in 2009.[12] New Hampshire Fish and Game has recently updated its Wildlife Plan to include an Ecosystems and Wildlife Climate Adaptation Plan.[13] The New Hampshire Department of Health and Human Services is currently developing an assessment and adaptation plan to respond to the public health impacts of climate change using the Center for Disease Control's BRACE framework (Building Resilience Against Climate Effects).[14] There is also a statewide project funded by the National Science Foundation—Experimental Program to Stimulate Competitive Research (EPSCoR)—that is studying the interactions among climate, land use, ecosystem services, and society.[15] Many additional resources are referenced in Chapter IV.

GRANITE STATE FUTURE[16]

Granite State Future is a project of the nine New Hampshire regional planning commissions (RPCs) to update regional plans. Formed by municipalities in the late 1960s and 1970s, the RPCs are mandated to undertake technical studies and develop comprehensive plans for their regions. In 2011, the RPCs jointly applied for and were awarded a U.S. Housing and Urban Development—Sustainable Communities Regional Planning Grant to carry out their legislated duty, believing that a coordinated effort would be a more efficient use of resources. Throughout the state, regions and localities are facing difficult decisions about investments in the future. Decision makers often have to prioritize and make tough choices. The nine regional plans will provide a concise story of what the citizens and communities in each region value, what they want for the future, and their ideas for getting there. The regional plans will be supplemented with a robust suite of statewide research, including climate assessments for northern and southern New Hampshire. These regional stories will be accompanied by technical analyses including: regional housing needs and fair housing and equity assessment, transportation, economic development, environment, water infrastructure, climate change impacts assessments, energy efficiency and green building, and other issues identified by the regions.

II. HISTORICAL CLIMATE CHANGE

"Global climate is changing now and this change is apparent across a wide range of observations. Much of the climate change of the past fifty years is due primarily to human activities." [17]

Annual and Seasonal Temperature Trends

Annual and seasonal minimum and maximum temperatures have been increasing across southern New Hampshire over the past one hundred years, and the rate of warming has increased over the past four decades. The largest temperature increases over the past four decades have occurred in winter.

Temperature is one of the most commonly used indicators of climate change. Today, temperatures have risen as a result of increased emission of heat-trapping gases from human activities and will likely continue to rise across southern New Hampshire over the foreseeable future. The temperature records from three long-term United States Historical Climatology Network (USHCN)[18] meteorological stations in southern New Hampshire (Keene, Durham,[19] and Hanover; Figure 1) provide a continuous record of temperature change for the last century in southern New Hampshire. A detailed description of the sources of high-quality meteorological data used in this report, quality control procedures, and statistical methods used to quantify historical trends in climate across southern New Hampshire and assess the statistical significance of those trends are described in detail in Appendix A.

Long-Term Temperature Trends: 1895–2012

All three weather stations show long-term temperatures increases over the period of record;

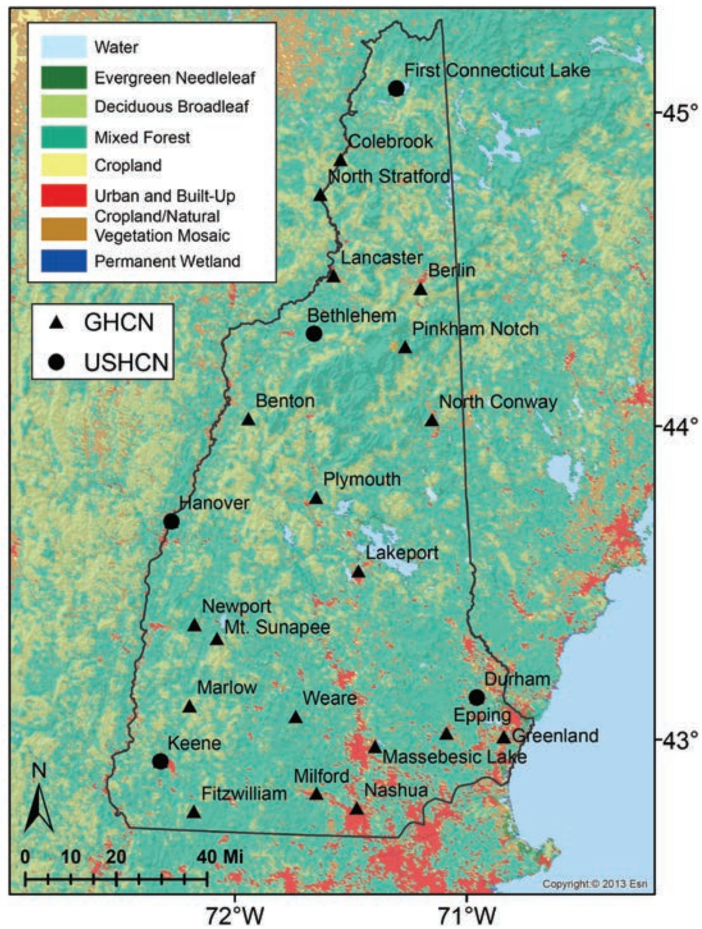


FIGURE 1. Map of New Hampshire showing land cover and the location of United States Historical Climate Network (USHCN) stations (black triangles) and Global Historical Climatology Network-Daily (GHCN) stations. For this report, the USHCN stations are the source of historical climate data in New Hampshire over the time period 1895–2012, while the GHCN-Daily stations are the source of data since 1960. For this report we define southern New Hampshire as all those meteorological stations that are south 43.90°N latitude.

increases in minimum temperatures are generally greater compared to increases in maximum temperatures (Figures 2 and 3). As is common in New England, significant year-to-year variability is evident at all three stations. Cool temperatures dominate the first half of the twentieth century, followed by a warm period in the 1940s to 1950s (more evident in maximum than minimum temperatures). Temperatures cool slightly through the 1960s and 1970s (again, a more dominant trend in maximum temperatures), followed by the current warm period of increasing temperatures from 1970 to the present. Despite these decadal-scale variations, all stations show consistent long-term increases in both minimum and maximum temperatures. Overall, more than half of the warmest years in terms of average annual maximum temperatures have occurred since 1990, and 80 percent or greater of the warmest years in terms of average annual minimum temperatures have occurred since 1990.

Recent Temperature Trends: 1970–2009

We also analyzed temperature trends for the same three stations over the last forty-three years, 1970–2012 (Table 1). This period coincides with a marked increase observed in global temperatures as a result of human activities, and also defines what

CLIMATE VERSUS WEATHER

"Climate is what we expect. Weather is what we get."

–Robert Heinlein

Weather refers to the hourly and daily changes in local conditions, such as temperature, precipitation, humidity, and wind. Climate is the long-term average of these indicators. Climate normals are often expressed as thirty-year averages of climatological variables, including temperature, precipitation, and growing degree days. Because climate is a long-term average, shifts in climate are harder to observe than changes in weather. However, by tracking temperature and precipitation trends and patterns over long periods of time (decades to centuries) and in response to changing atmospheric conditions—such as rising concentrations of heat-trapping gases or changes in solar output or volcanic eruptions—researchers can identify long-term patterns in climate as distinct from day-to-day weather patterns. In other words, even if we are in the middle of a record cold snap this week (that's weather), long-term temperature can still be rising (that's climate).

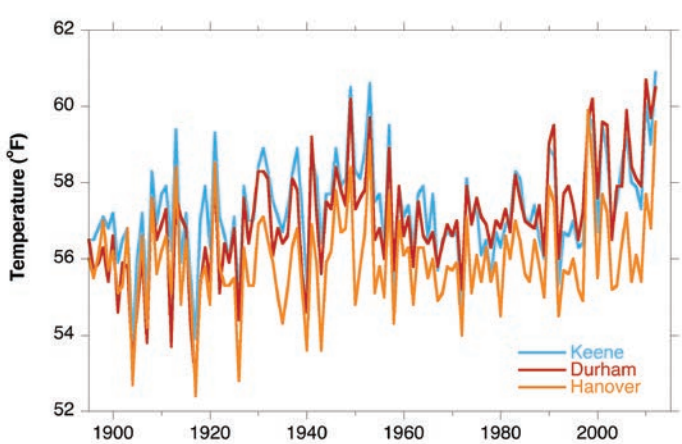


FIGURE 2. Annual *maximum* temperature records for USHCN stations in southern New Hampshire for the period 1895–2012.

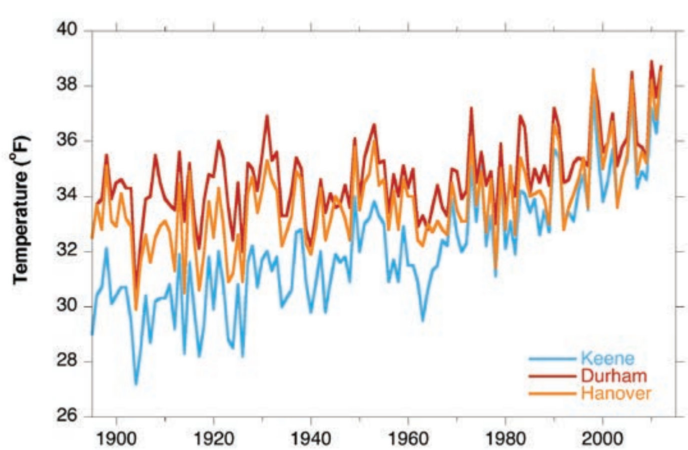


FIGURE 3. Annual *minimum* temperature records for USHCN stations in southern New Hampshire for the period 1895–2012.

we would consider "typical" climate today. Over the more recent time period, all three USHCN stations show significant warming trends in annual and most seasonal temperatures (for maximum temperature, Durham shows significant warming trends in annual and seasonal maximum temperatures, while significant maximum temperature trends are fewer in the Keene and Hanover records). These trends are much higher for both annual and seasonal temperatures relative to the long-term 1895–2012 rates of warming, consistent with the greater increase in global temperature over the same time period.

At the seasonal level, there is a dramatic increase in the rate of winter warming, which surpasses all other seasonal rates of warming over the last four decades at all three stations for both minimum and maximum temperatures. The rate of warming in Durham winter maximum and minimum temperatures over the past four decades increased by a factor of four relative to the 1895–2012 trend. The large increases in winter temperature may be linked to decreasing snow cover (see discussion below) through changes in surface albedo, or reflectivity.

Parameter	Durham		Keene		Hanover	
	1895–2012	1970–2012	1895–2012	1970–2012	1895–2012	1970–2012
TMAX (°F per decade)						
Annual	**<u>0.21</u>**	**<u>0.55</u>**	**<u>0.09</u>**	**<u>0.61</u>**	0.05	0.25
Winter	**<u>0.20</u>**	**<u>0.80</u>**	0.10	**<u>0.71</u>**	0.08	0.37
Spring	**<u>0.32</u>**	**<u>0.72</u>**	0.10	0.58	**<u>0.15</u>**	0.29
Summer	**<u>0.27</u>**	**<u>0.47</u>**	**<u>0.12</u>**	0.35	0.08	-0.05
Fall	**<u>0.11</u>**	**<u>0.48</u>**	0.04	**<u>0.68</u>**	-0.05	**<u>0.60</u>**
TMIN (°F per decade)						
Annual	**<u>0.20</u>**	**<u>0.58</u>**	**<u>0.50</u>**	**<u>0.82</u>**	**<u>0.25</u>**	**<u>0.74</u>**
Winter	**<u>0.28</u>**	**<u>0.93</u>**	**<u>0.58</u>**	**<u>1.70</u>**	**<u>0.36</u>**	**<u>1.45</u>**
Spring	**<u>0.18</u>**	0.24	**<u>0.45</u>**	0.31	**<u>0.23</u>**	**<u>0.60</u>**
Summer	**<u>0.25</u>**	**<u>0.71</u>**	**<u>0.49</u>**	**<u>0.47</u>**	**<u>0.27</u>**	**<u>0.60</u>**
Fall	**<u>0.14</u>**	**<u>0.83</u>**	**<u>0.50</u>**	**<u>1.11</u>**	**<u>0.22</u>**	**<u>0.61</u>**
Growing Season (Days per decade)						
	NA	10.0	NA	2.8	NA	5.9
Precipitation (inches per decade)						
Annual	**<u>0.56</u>**	1.63	0.32	2.02	0.26	1.16
Winter	-0.03	-0.61	0.45	0.16	0.37	-0.11
Spring	0.08	0.20	0.21	0.14	0.20	0.22
Summer	0.14	**<u>0.93</u>**	0.31	0.57	0.27	0.55
Fall	**<u>0.27</u>**	0.26	0.32	1.12	0.24	0.19
Snowfall	NA	**<u>-9.14</u>**	NA	0.34	NA	-3.44
Snow Covered Days (days per decade)						
Winter	NA	**<u>-6.6</u>**	NA	0.0	NA	-2.9

NA means data not available

TABLE 1. Annual and seasonal trends in temperature, precipitation, and snow-covered days for the period 1895–2012 and 1970–2012 for three USHCN stations located in southern New Hampshire. Trends were estimated using Sen's slope; trends that meet the Mann-Kendall non-parametric test for statistical significance (p<0.05) are highlighted in **<u>bold and underlined</u>**.

Extreme Temperature Trends

While the number of hot days has increased only slightly across southern New Hampshire since 1960, the number of cold days has decreased and temperature on the coldest day of the year has increased significantly, reflecting the greater warming the region has experienced during the winter compared to other seasons.

Trends in annual and seasonal temperature may be too subtle for individuals to detect from personal experience. However, temperature extremes may provide more obvious evidence of warming. Changes in the distribution of both hot and cold extreme temperatures can lead to increased duration, frequency, and intensity of heat waves,[21] lengthening of the growing season, and northward expansion of invasive insects like the woolly adelgid (Adelges tsugae), an aphid-like insect that has decimated stands of eastern hemlock from Georgia to Connecticut since the 1950s[22] and ticks that carry Lyme disease.[23] Increasing trends in minimum daily temperature are indicators of nighttime warming, while trends in maximum daily temperature provide insight to daytime processes.

Daily temperature records are available back to 1960 for Durham, Hanover, Keene, and Nashua from the Global Historical Climatology Network-Daily (GHCN-Daily)[24]; these daily temperature records have been homogenized.[25] In this analysis, we use a suite of simple indicators for tracking changes in temperature extremes over the period 1960–2102 (Table 2), consisting of trends in the: (1) number of "hot days" per year warmer than 90°F, (2) number of "cold days" per year colder than 32°F, (3) maximum temperature on the hottest days of the year, and (4) minimum temperature on the coldest day of the year. These four indicators of extreme temperature were analyzed for the period 1960–2012 as that is the longest period for which consistent daily records are available for the four stations analyzed here.

Location	Days > 90°F		TMAX(°F) Hottest Day of Year	
	1960-2012 average	Trend (days/decade)	1960-2012 average	Trend (°F/decade)
Hanover	6.0	0.1	94.4	0.0
Durham	8.3	0.8	95.0	0.0
Keene	7.5	0.0	94.9	0.0
Nashua	7.7	0.7	95.1	0.0

Location	Days < 32°F		TMIN(°F) Coldest Day of Year	
	1960-2012 average	Trend (days/decade)	1960-2012 average	Trend (°F/decade)
Hanover	151	**-3.8**	-18.9	**1.3**
Durham	150	**-5.0**	-14.5	**1.9**
Keene	158	0.50	-16.8	**2.2**
Nashua	154	**-5.0**	-12.1	**2.6**

TABLE 2. Extreme temperature trends for four GHCN-Daily stations in southern New Hampshire for the period 1960–2012. Trends are estimated using Sen's slope; statistically significant trends ($p<0.05$) are highlighted in **bold and underlined.**

The number of hot days has increased slightly over the last five decades in Durham and Nashua (+0.8 and +0.7 days per decade, respectively), while the maximum temperature on the hottest day of the year shows no trend. Conversely, there is a significant reduction in the number of cold days in Hanover (-3.8 days per decade), and Durham and Nashua (-5.0 days per decade for both sites). The minimum temperature on the coldest day of the year at all four stations has also shown a significant warming of +1.3 to +2.6°F per decade, consistent with the much greater warming in winter temperature compared to other seasons.

Length of the Growing Season

Since 1960, the length of the growing season in southern New Hampshire has increased by fifteen to fifty-two days.

While freezing temperatures affect all commercial, agricultural, industrial, recreational, and ecological systems, the human system most sensitive to changes in the length of the growing season is agriculture.[26]

The length of the growing season is defined as the number of days between the last frost of spring and the first frost of winter. For our analysis, we have used a threshold of 28°F for a hard frost. This period is called the growing season because it roughly marks the period during which plants, especially agricultural crops, grow most successfully. A late spring or early fall hard frost may lead to crop failure and economic misfortune for the farmer. Earlier starts to the growing season may provide an opportunity to diversify crops and create new opportunities for farmers with sufficient capital to take risks on new crops. A longer growing season may also result in increased frequency of heat stress, inadequate winter chill period, and increased pressure from invasive weeds, pests, or disease.

While it might seem that switching to alternative warm-season crops represents a beneficial response to a longer growing season, farmers would then have new competitors who might have advantages such as better soils and a yet longer growing season.[27] It is possible that a significant change in the length of the growing season could alter the ecology of the landscape across New Hampshire, including an increase in transpiration (release of water vapor from plants) and a consequent decrease in soil moisture,[28] perhaps necessitating more use of irrigation.

The length of the growing season has been getting longer across southern New Hampshire (Figure 4), with a significant increase of +5.9 days per decade in Hanover, and +10.0 days per decade in Durham and Nashua (Table 3). The length of the growing season also increased in Keene, although the trend is not significant.

The impact of the increase in temperatures across New England is also documented by the changes in USDA plant hardiness zones, defined as the average annual minimum winter temperature, divided into 10°F zones.[29] As winter temperatures have risen over the past several decades (Table 1), an update of the 1990 USDA hardiness zone map in 2006 revealed a northward shift in hardiness zones, with approximately one-third of New Hampshire shifting to a warmer zone.[30] Across the northeast, lilacs, apples, and grapes also show earlier bloom dates, consistent with the warming trend across the region.[31]

Annual and Seasonal Precipitation Trends

Annual precipitation has increased slightly over the past century. However, over the past four decades, the rate of the increase is two to three times greater than the long-term average.

Temperature and precipitation trends are linked in the Earth's climate system by the hydrological cycle

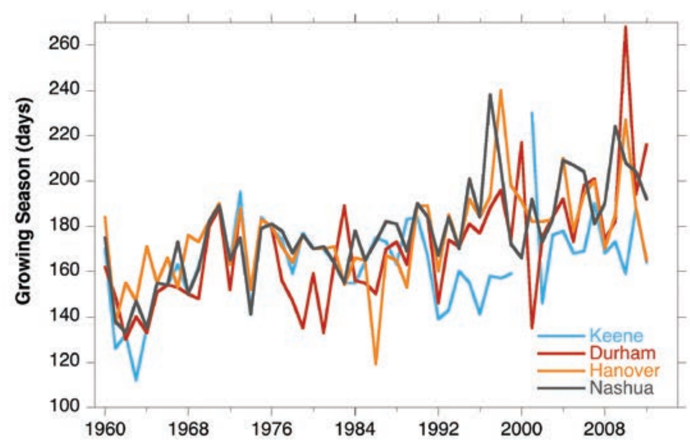


FIGURE 4. Length of the growing season for four GHCN-Daily stations in southern New Hampshire, 1960–2012.

Location	Growing Season	
	1960–2012 mean (days)	Trend (days/decade)
Hanover	175.9	**5.9**
Durham	170.4	**10.0**
Keene	164.4	2.8
Nashua	177.2	**10.0**

TABLE 3. Length of growing season for four GHCN-Daily stations in southern New Hampshire for the period 1960–2012. Trends are estimated using Sen's slope; statistically significant trends (p<0.05) are highlighted in **bold and underlined.**

(Figure 5). Increases in precipitation may accompany increases in temperature because warmer air masses can hold more moisture. Regions with abundant moisture sources, such as New England, can therefore expect to see increases in the total amount and intensity of precipitation as temperatures continue to rise.[32]

Long-Term Precipitation Trends: 1895–2009

The USHCN historical precipitation records have undergone rigorous quality checks for outliers and missing values.[33] Over the period 1895–2012, all three stations in the region exhibited modest increasing trends in annual precipitation (Figure 6; Table 1). In Durham, annual precipitation increased at a statistically significant rate of +0.56 inches/decade, or +6.7 inches over the past 118 years, an increase of about 8 percent. Keene experienced an increase of +0.32 inches per decade, and Hanover +0.26 inches per decade, although neither trend was significant at the 95 percent level ($p<0.05$). Durham shows the greatest seasonal increase during the fall, while the largest trends at Keene and Hanover occur during the winter. All three sites also show a consistent record of low precipitation during the mid-1960s, indicative of the region-wide drought that occurred at that time (Figure 6; also see Sidebar on following page).

Recent Precipitation Trends: 1970–2012

Since 1970, all three stations show an increase in annual precipitation, although none were found to be statistically significant (Table 1). The rate of increase in annual precipitation from 1970–2012 is double to triple the long-term (1895–2012) increase. These increasing trends in precipitation are being driven by higher than average precipitation totals from 2005 to 2011. For example, the Mother's Day storm of May 13–16, 2006 (10.3 inches in four days in Durham) and the April 16, 2007 Patriot's Day storm (4.5 inches in one day in

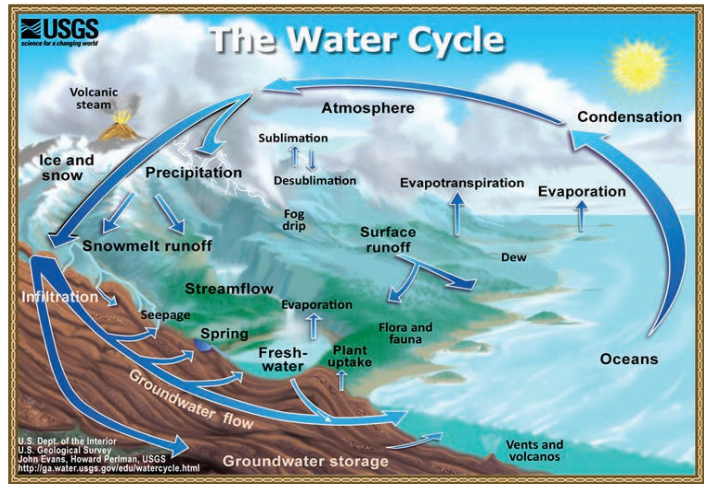


FIGURE 5. A schematic representation of Earth's water cycle that depicts the movement of water among key reservoirs (the oceans, atmosphere, snow and ice, lakes, groundwater) via key water cycle processes (evaporation, condensation, precipitation, transpiration, runoff, infiltration). Image from US Geological Survey (USGS). More information on the Earth's water cycle available online at: http://ga.water.usgs.gov/edu/watercycle.html

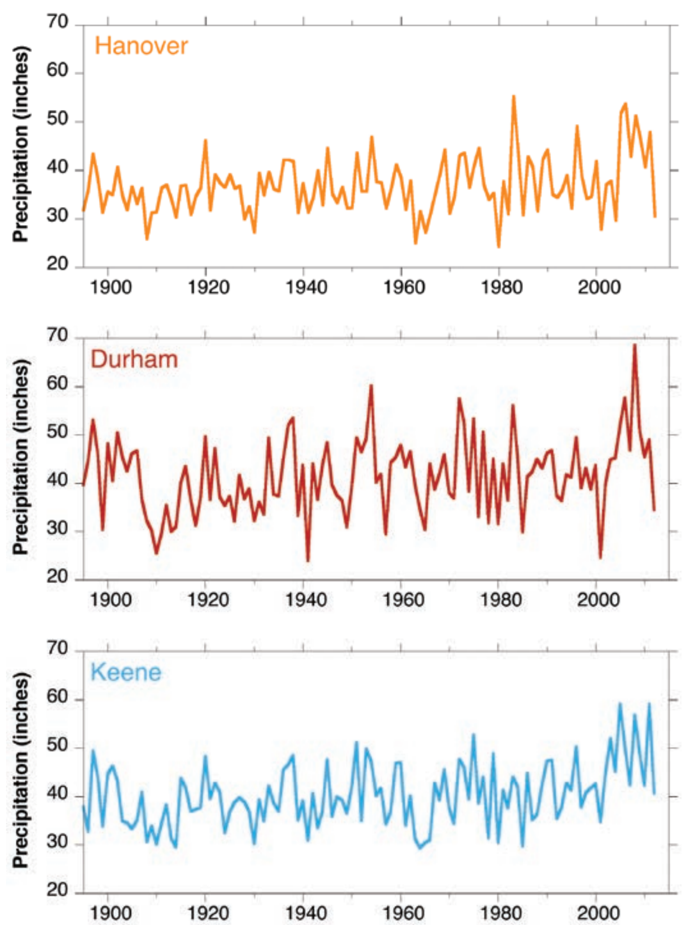


FIGURE 6. Annual precipitation records for USHCN stations in southern New Hampshire, 1895–2012.

Durham) no doubt contributed to record precipitation totals visible at the tail end of the 118-year time series (Figure 6).

Seasonal precipitation (Table 1) is increasing in spring, summer, and fall at all three sites, but decreasing during winter in Durham and Hanover (although only the summer trend in Durham is statistically significant). Decreases in winter precipitation at Durham and Hanover are primarily the result of decreasing snowfall between December and February (see *Snowfall* section on page 18).

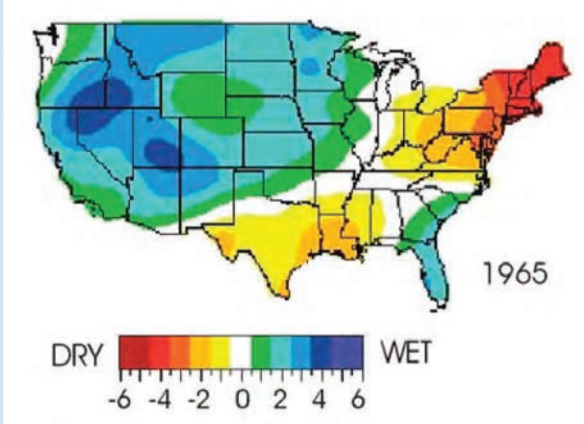
Extreme Precipitation Trends

While overall increases in precipitation have been modest, the frequency of the most extreme precipitation events (4 inches in 48 hours) has increased four to ten times since 1960, depending on the location of the station.

Climatologists have many metrics for defining a precipitation event as extreme. Using data from the USGCN-Daily stations, we quantify trends in three categories of extreme precipitation events: (1) greater than 1 inch in 24 hours, (2) greater than 4 inches in 48 hours, and (3) wettest day of the year.

Of the nine USGCN-Daily stations in southern New Hampshire that have sufficiently complete data to be included in our analysis (see Appendix A for details), seven show increasing trends in the number of events that produce more than 1 inch of precipitation (water equivalent) in 24 hours (Table 4); only Durham and Milford do not show a trend. The trends for the other seven stations range from an increase of +0.4 to +1.2 events per decade, equivalent to an increase of +2.1 to +6.4 events since 1960. These results are consistent with previous analyses.[35] Even greater changes are apparent when records of the largest precipitation events are examined—those that produce over 4

1960s DROUGHT ACROSS THE NORTHEAST UNITED STATES[34]



The Palmer Drought Severity Index (PSDI) uses temperature and rainfall data to determine dryness. It is most effective in determining long term drought (several months to years). Zero is normal; minus 4 is extreme drought. Note the values below minus 4 for all of New England in 1965. Image from the NOAA National Climatic Data Center.

The drought of the 1960s was the most severe drought experienced by New Hampshire and New England over the past several hundred years. The drought had numerous negative impacts, including severe water shortages, degraded water quality, fish kills, increases in the number and severity of forest fires, and severely degraded pasture conditions. Extreme drought conditions affected over 60,000 square miles by the summer of 1965, when the drought reached its peak.

Precipitation shortfalls during spring and summer were the primary cause of the drought, but what caused the decrease in precipitation? Prevailing circulation patterns showed an unusually deep mid-tropospheric trough positioned just off the Atlantic Seaboard that pulled northerly cold, dry air masses over the Northeastern United States. The exact causes of the unusual jet stream pattern remain a mystery, but some scientists have concluded that colder than average sea surface temperatures along the continental shelf triggered the drought pattern of the 1960s.

inches of precipitation (water equivalent) in a 48-hour period, and which commonly result in flooding of our communities. Of the nine stations in southern New Hampshire, eight show an increase in the number of 4-inch precipitation events (Figure 7). Lakeport, Newport, Mt. Sunapee, Durham, Marlow, Keene, Milford, and Nashua show a four- to ten-fold increase in the number of these events per decade since the 1960s. Nashua experienced an astounding fourteen events from 2003 to 2012.

The amount of precipitation falling on the wettest day of the year is also rising (Table 4), with overall increases of about +0.1 inches per decade, equivalent to about half an inch more rain on the wettest day of the year over the past five decades.

Location	1 inch in 24 hrs		Wettest Day of the Year	
	1960-2012 mean (events/yr)	Trend (events/decade)	1960-2012 mean (inches)	Trend (inches/decade)
Hanover	7.6	0.4	2.21	0.08
Lakeport	9.0	**1.0**	2.48	0.14
Newport	8.3	**0.9**	2.39	0.09
Mt. Sunapee	11.3	**0.8**	2.74	**0.15**
Durham	10.5	0.0	3.08	0.06
Marlow	9.6	**0.8**	2.41	0.08
Keene	9.2	**1.2**	2.38	0.10
Milford	11.8	0.0	2.77	0.07
Nashua	11.8	**1.0**	2.66	**0.13**

TABLE 4. Extreme precipitation trends (greater than 1 inch in 24 hours) and wettest day of the year trends for USGCN-Daily stations located in southern New Hampshire for the period 1960–2012. Trends are estimated using Sen's slope; statistically significant trends ($p<0.05$) are highlighted in **bold and underlined**.

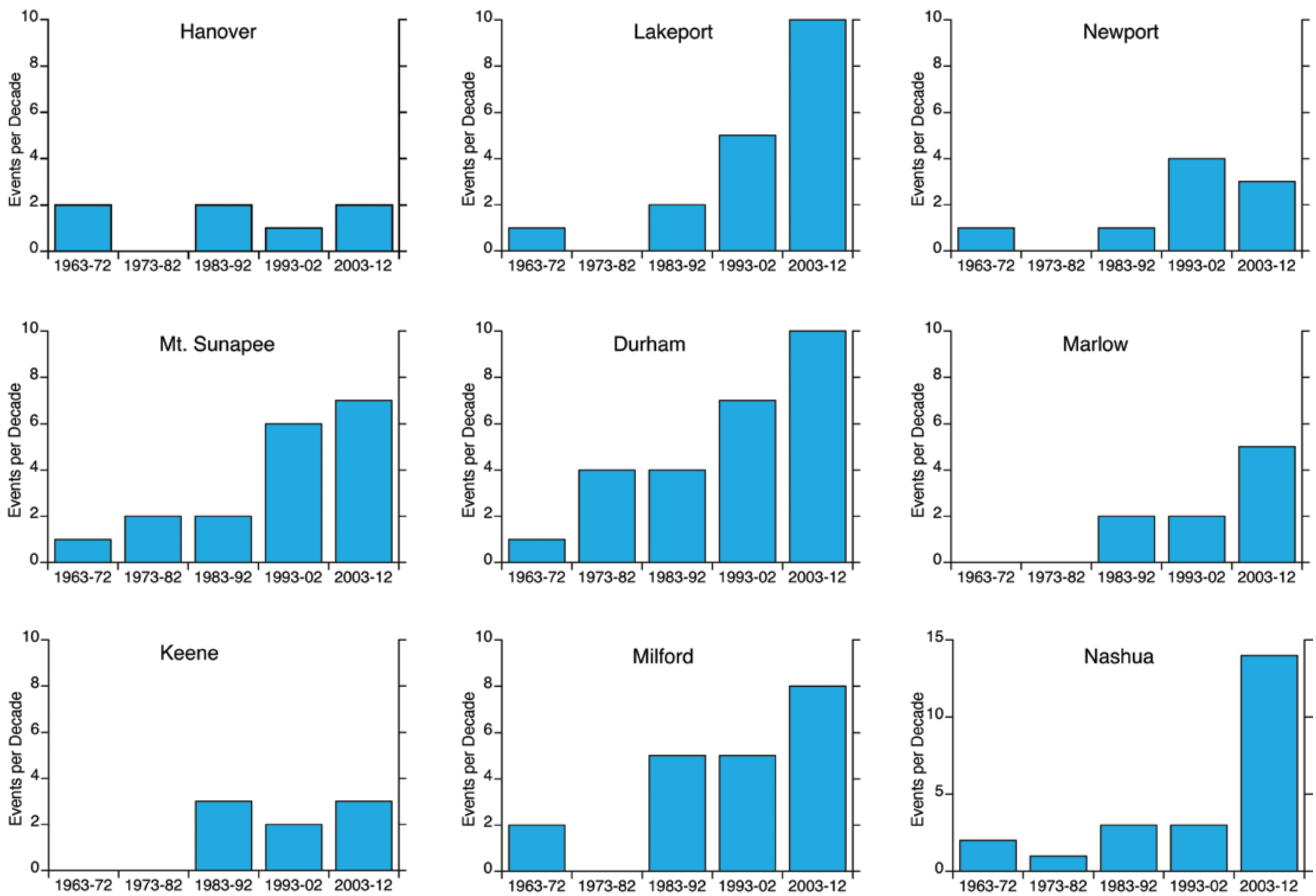


FIGURE 7. Trends in extreme precipitation events per decade (greater than 4 inches of precipitation in 48 hours) for nine GHCN-Daily stations in southern New Hampshire, 1963–2012.

Snowfall and Snow-Covered Day Trends

While snowfall shows no distinct trend across southern New Hampshire, the number of snow-covered days has decreased across most of the region over the past four decades.

If all else remains the same, warmer winters would be expected to reduce snowfall as more precipitation falls as rain versus snow. However, the response of snowfall trends to warmer winter temperatures is not as straightforward as might be expected. Warmer air masses hold more moisture; as long as temperatures remain below freezing, snowfall can be expected and may even increase in a slightly warmer climate. Only when temperatures rise above the freezing point can the region expect to see less snowfall in response to winter warming.

Observations show large spatial variability in snowfall trends throughout the northeastern United States.[36] Using data from the USGCN-Daily stations in southern New Hampshire, we calculate winter snowfall totals as the sum of all daily snowfall values for the months of December, January, February, and March (Table 5). Although traditionally designated as a spring month, we also include March in the winter analysis because snowfall and snow depth totals in March typically exceed those observed in December.

Overall, the mean snowfall trend for fourteen southern New Hampshire stations is a rather moderate decrease of -0.9 inches per decade. Six of the stations show decreasing trends in snowfall since 1970 (ranging from -1.4 to -9.1 inches per decade), two stations show no trend, and six stations show slight increasing trends (+0.2 to +2.6 inches per decade). Most of the reduction in snowfall is driven by decreases in December snowfall (eleven of the fourteen stations show a decreasing trend in December snowfall).

The number of snow-covered days in winter is closely tied to the amount of snowfall but also to temperature trends through feedback processes related to the high reflectivity (albedo) of freshly fallen snow (think of how bright it is after a snowstorm). Following a fresh snowfall event, the overall reflectivity of the ground decreases as the overlying snow pack melts, ages, and retreats. The retreat exposes bare ground that has a significantly lower albedo. The decrease in reflectivity causes a surface to warm as it absorbs more and reflects less of the sun's energy.

In this analysis, we consider a day "snow-covered" if the daily snow depth value is greater than 1 inch. Monthly snow-covered days for December to March are summed to calculate the total number of snow-covered days in a given winter.

Overall, the mean number of snow-covered days in southern New Hampshire has been decreasing at a rate of two days per decade (Table 6). Of the eight USGCN-Daily stations that have reliable snow cover data, only Durham and Milford show statistically significant decreasing trends (-6.6 and –6.1 days per decade, respectively). Two other stations show decreasing trends, three stations show no trend, and one station (Newport) shows a weak increasing trend. The stations

Location	1970–2012 mean (inches)	Trend (inches/decade)
Hanover	56.3	-3.4
Lakeport	58.8	-1.2
Newport	60.4	0.2
Mt. Sunapee	68.6	0.2
Durham	41.8	**-9.1**
Marlow	67.0	2.6
Weare	64.0	0.0
Epping	54.5	-2.5
Greenland	53.6	2.8
Massebesic Lake	44.4	-2.1
Keene	51.1	0.3
Milford	54.7	-1.4
Nashua	49.3	0.0
Fitzwilliam	60.7	1.5

TABLE 5. Annual mean snowfall amount and decadal trends for USGCN-Daily stations located in southern New Hampshire for the period 1970–2012. Station list is sorted from north (top of the table) to south (bottom of the table). Trends are estimated using Sen's slope; statistically significant trends ($p<0.05$) are highlighted in **bold and underlined**.

with decreasing trends are consistent with broader scale declines in North American mid-latitude snow cover extent quantified from analysis of satellite records.[37]

Lake Ice-Out Trends: Lake Winnipesaukee and Lake Sunapee

Spring ice-out dates have been getting earlier over the past 115 years. Since 1970, ice-out dates on Lakes Winnipesaukee and Sunapee are occurring about a week earlier.

Lake ice-out dates are frequently used as an indicator of winter/early spring climate change due to the close correlation with surface air temperature in the months before ice break-up.[38] Changes in the timing of lake ice-out can increase phytoplankton productivity[39] and subsequently deplete summer oxygen levels[40] as the phytoplankton blooms are decayed through bacterial respiration. Earlier ice-out dates also impact the ice fishing and snowmobiling industry by shortening the winter recreation season or, worse, eliminating it altogether during years when lakes do not ice over completely.

Records of lake ice-out have been kept on Lake Winnipesaukee since 1887, and on Lake Sunapee since 1869. For Lake Winnipesaukee, the criteria used to determine the official date of lake ice-out has varied over the years, but the vast majority of the record has been declared when the 230-foot long M/S Mount Washington can safely navigate between her port stops of Alton Bay, Center Harbor, Weirs Beach, Meredith, and Wolfeboro. The criteria for the official declaration of lake ice-out on Lake Sunapee have similarly varied throughout the years.

In 2010 and again in 2012, the earliest ice-out day (Julian day 83—March 24th in 2010 and March 23rd in 2012 because of the leap year) was recorded on Lake Winnipesaukee, breaking the previous record set on March 28th, 1921 (Julian day 87) by four days (Figure 8a). The latest ice-out ever declared on Lake Winnipesaukee occurred on May 12th, 1888 (Julian day 133). Overall, the ice-out dates have been getting earlier over the past 115 years. Since 1970, ice-out dates are occurring on average about a week earlier in the year.

The earliest ice-out date at Lake Sunapee also occurred in 2012 on March 23rd (Julian day 82). There has also been a clear trend to earlier ice-out dates over the past four decades. The recent trends of earlier ice-out dates for Lake Winnipesaukee and Lake Sunapee are consistent with twenty-eight other long-term ice-out records from New Hampshire, Maine, and Massachusetts.[41] In addition, the ice extent on the Great Lakes has decreased substantially since 1973 due to warmer winters[42]; less ice corresponds with more open water, which can result in heavier lake-effect snow in regions downwind of the Great Lakes.

Location	1970–2012 mean (days)	Trend (days/decade)
Hanover	85	-2.9
Newport	84	0.6
Durham	58	**<u>-6.6</u>**
Marlow	92	0.0
Weare	79	-0.8
Greenland	59	0.0
Keene	75	0.0
Milford	81	**<u>-6.1</u>**

TABLE 6. Annual mean snow-covered days and decadal trends for USGCN-Daily stations located in southern New Hampshire for the period 1970–2012. Station list is sorted from north (top of the table) to south (bottom of the table). Trends are estimated using Sen's slope; statistically significant trends ($p<0.05$) are highlighted in **<u>bold and underlined</u>**.

Impacts of Weather Disruption

One measure of the impact of weather disruption on New Hampshire is the money that the Federal Emergency Management Administration (FEMA) has spent on Presidentially Declared Disasters and Emergency Declaration (Figure 9).[43] From the period 1986 to 2004, there was only one event (the 1998 ice storm) where damages paid out by FEMA were greater than $10 million (in 2012 dollars). Conversely, five of the seven years between 2005 and 2012 had weather events where damages paid out by FEMA were greater than $10 million (in 2012 dollars). The most significant damages between 2005 and 2012 resulted from floods and ice storms. The shift in 2005 is not only due to an increase in extreme weather events, but also reflects the fact that our infrastructure (buildings, roads, electrical grid) has been developed in ways that make them vulnerable to damage from these extreme events.

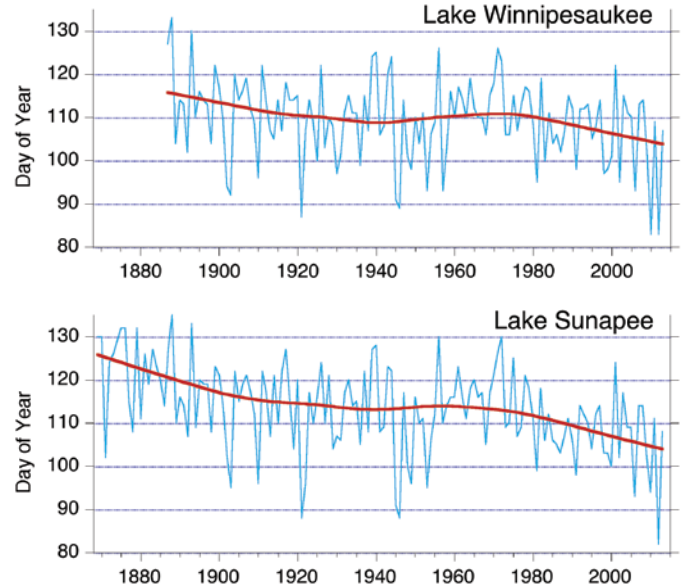


FIGURE 8. Annual ice-out dates (blue) in Julian days (number of days past January 1st) for Lake Winnipesaukee (1887–2013; top) and Lake Sunapee (1869–2013; bottom). Red line represents weighted curve fit uses the locally weighted least squares error (Lowess) method.

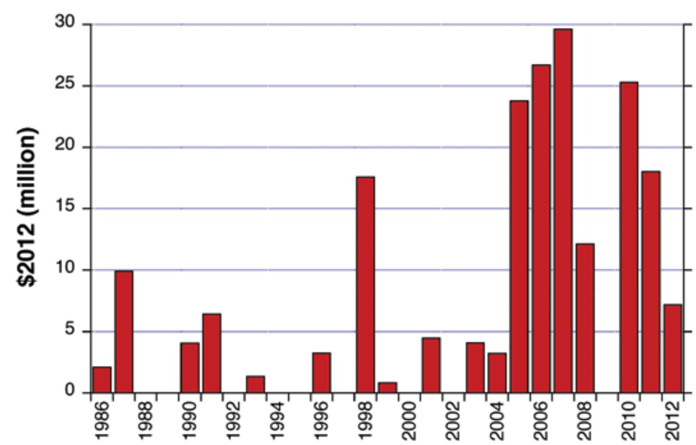


FIGURE 9. Federal expenditures on Presidentially Declared Disasters and Emergency Declarations in New Hampshire from 1999 to 2012. Expenditures adjusted to $2012 using the consumer price index. Note increase in expenditures since 2005.

III. FUTURE CLIMATE CHANGE

"Human-induced climate change is projected to continue and accelerate significantly if emissions of heat-trapping gases continue to increase. Heat-trapping gases already in the atmosphere have committed us to a hotter future with more climate-related impacts over the next few decades. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gases emitted globally, now and in the future." [44]

Projections of future climate were developed using four global climate models (GCMs)—complex, three-dimensional coupled models that incorporate the latest scientific understanding of the atmosphere, oceans, and Earth's surface—using two different scenarios of future global emissions of heat-trapping gases as input. The GCM simulations were then statistically downscaled using the Asynchronous Regional Regression Model.[45] Here, downscaling was conducted using the entire record from 1960 to 2012 to include as broad a range of observed variability as possible. Downscaling was conducted and tested using observed daily minimum and maximum temperature for twenty-five GHCN-Daily stations in southern New Hampshire (south of latitude 43.9 N; Figure 10, Table 7) and observed 24-hour cumulative precipitation for forty-one GHCN-Daily stations in southern New Hampshire (Figure 11, Table 8). Details of the methods used to develop projections of future climate, including global emission scenarios, GCMs, statistical downscaling model, and a discussion of uncertainty, are provided in Appendix A.

Station Name	Latitude (N)	Longitude	Elevation (ft)	StationID
Tamworth	43.90	-71.30	241	278612
Plymouth	43.78	-71.65	201	276945
Hanover	43.71	-72.29	178	273850
Grafton	43.57	-71.95	253	273530
Lakeport	43.55	-71.47	171	274475
Lakeport2	43.55	-71.46	152	274480
Franklin Falls	43.47	-71.67	131	273182
Franklin	43.45	-71.67	119	273177
Newport	43.38	-72.18	235	275868
Mt. Sunapee	43.33	-72.08	387	275629
Blackwater Dam	43.32	-71.72	183	270741
Durham	43.14	-70.95	23	272174
Deering	43.09	-71.87	325	271950
East Deering	43.07	-71.82	241	272284
Manchester	43.03	-71.48	64	275072
Epping	43.03	-71.08	49	272800
Greenland	43.02	-70.83	26	273626
Surry Mtn	43.00	-72.31	171	278539
Massabesic Lake	42.99	-71.39	77	275211
Keene	42.94	-72.32	156	274399
Peterboro	42.85	-71.95	311	276697
Windham	42.82	-71.33	67	279740
Nashua	42.79	-71.47	41	275712
Hudson	42.78	-71.41	56	274234
Nashua2	42.77	-71.45	27	275702

TABLE 7. Location of 25 GHCN-Daily stations in southern New Hampshire with minimum and maximum temperature data for the period 1960–2009 that were used to downscale Global Climate Model simulations. Station list is sorted from north (top of the table) to south (bottom of the table).

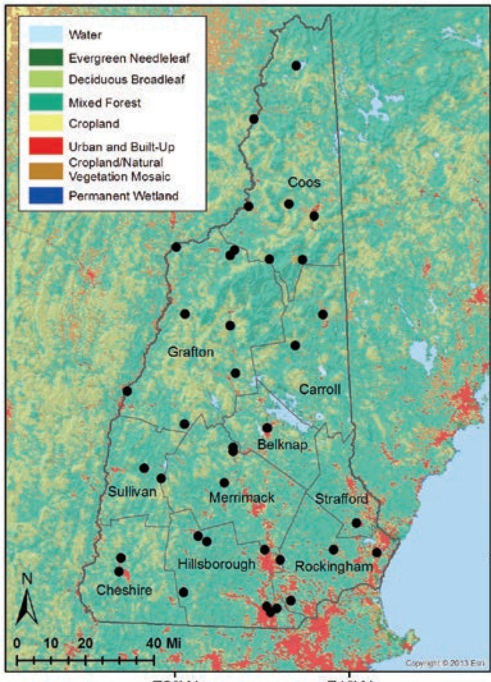


FIGURE 10. Location map for Global Historical Climatology Network (GHCN)-Daily stations (black dots) in New Hampshire with daily minimum and maximum temperature records for the period 1960–2012. Data used to investigate climate change in southern New Hampshire comes from the 25 stations below 43.9°N latitude.

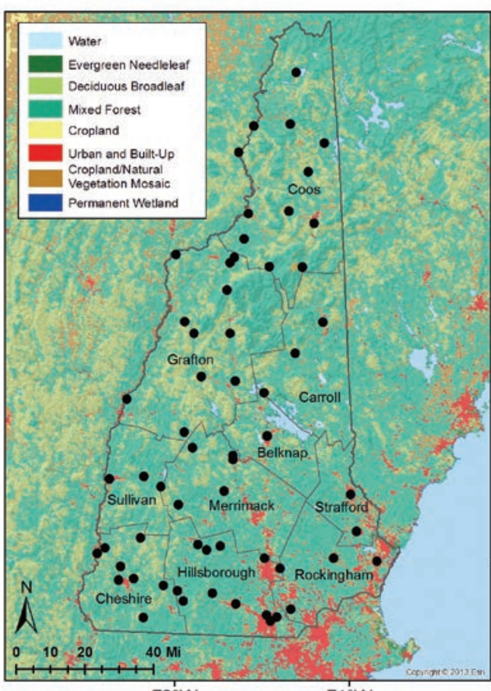


FIGURE 11. Location map for Global Historical Climatology Network (GHCN)-Daily stations (black dots) in New Hampshire with daily precipitation records for the period 1960–2012. Data used investigate climate change in southern New Hampshire comes from the 41 stations below 43.9°N latitude.

Station Name	Latitude (N)	Longitude	Elevation (ft)	StationID
Tamworth	43.90	-71.30	241	278612
West Rumney	43.80	-71.85	171	279474
Plymouth	43.78	-71.65	201	276945
Moultonboro	43.73	-71.48	183	275532
Hanover	43.71	-72.29	178	273850
Grafton	43.57	-71.95	253	273530
Lakeport	43.55	-71.47	171	274475
Lakeport2	43.55	-71.46	152	274480
South Danbury	43.50	-71.90	284	277967
Franklin Falls Dam	43.47	-71.67	131	273182
Franklin	43.45	-71.67	119	273177
Newport	43.38	-72.18	235	275868
Claremont Junction	43.37	-72.38	131	271552
Mt. Sunapee	43.33	-72.08	387	275629
Blackwater Dam	43.32	-71.72	183	270741
Rochester	43.30	-70.98	70	277253
Bradford	43.26	-71.98	287	270910
Durham	43.14	-70.95	23	272174
Marlow	43.12	-72.20	360	275150
Deering	43.09	-71.87	325	271950
Weare	43.08	-71.74	220	278972
East Deering	43.07	-71.82	241	272284
Walpole	43.07	-72.41	284	278858
Walpole2	43.05	-72.45	92	278855
Epping	43.03	-71.08	49	272800
Manchester	43.03	-71.48	64	275072
Greenland	43.02	-70.83	26	273626
Surry Mtn. Lake	43.00	-72.31	171	278539
Massabesic Lake	42.99	-71.39	77	275211
Otter Brook lake	42.95	-72.24	207	276550
Keene	42.94	-72.32	156	274399
Dublin	42.92	-72.07	454	272136
Edward Macdowell Lake	42.89	-71.98	296	275013
South Lyndeboro	42.88	-71.78	198	278081
Peterboro	42.85	-71.95	311	276697
Milford	42.84	-71.65	98	275412
Windham	42.82	-71.33	67	279740
Nashua	42.79	-71.47	41	275712
Fitzwilliam	42.78	-72.18	363	273024
Hudson	42.78	-71.41	56	274234
Nashua	42.77	-71.45	27	275702

TABLE 8. Location of 41 GHCN-Daily stations in southern New Hampshire with precipitation data for the period 1960–2009 that were used to downscale Global Climate Model simulations. Station list is sorted from north (top of the table) to south (bottom of the table).

Future Annual and Seasonal Temperature

Average annual temperatures are projected to increase by about 2°F in the short-term (2010–2039). Over the long-term (2070–2099), the amount of projected warming under the higher emissions scenario (+8 to +9°F) is twice that compared to the lower emissions scenario (+4°F).

Temperatures in southern New Hampshire will continue to rise regardless of whether the future follows a lower or higher emissions scenario. This is due to two reasons: first, because some amount of change is already entailed by past emissions; and second, because it is impossible to stop all emissions of heat-trapping gases today and still supply society's energy needs. For both of those reasons, the warming expected over the next few decades is nearly identical under a higher or a lower scenario. However, it is clear that the magnitude of warming that can be expected after the middle of this century will depend on which emissions pathway is followed during the first-half of the century (Figure 12 and 13; Table 9).

During the first part of the twenty-first century (2010–2039), annual temperature increases are similar for the lower (B1) and higher (A1fi) emissions scenarios for maximum and minimum temperatures. The warming by 2040 (Figures 12 and 13) therefore represents an amount of warming that we have already baked into the climate system (regardless of the emissions scenario followed) and an amount of warming we need to begin preparing for and adapting to.

The magnitude of warming begins to diverge during the middle part of the century (2040–2069), with the higher emissions scenario resulting in greater rates and overall amounts of warming compared to the lower emissions scenario. Temperature increases under the higher emissions scenario are nearly twice that expected under the lower emissions scenario by the

CLIMATE GRIDS AND MAPS OF FUTURE CLIMATE CHANGE

Chapter III of this report discusses many of the projected changes in climate under a higher and a lower future emissions scenario. Additional detailed information is provided in the climate grids (Appendix B), which contain historical and projected future 30-year climatologies for twenty-five Global Historical Climatology Network-Daily (GHCN-Daily) meteorological stations in southern New Hampshire (that is, south of 43.9° north latitude) for the historical period (1980–2009) and the future (near-term [2010–2039], medium-term [2040–2069], and long-term [2070–2099]). The projected values represent the statistically downscaled average of daily simulations from four GCMs. Temporal averages were first calculated for each individual GCM, and then the results of all four GCMs were averaged. The climate grids include thirty-year averages of daily measures for minimum and maximum temperature (annual, seasonal, extremes), length of the growing season, precipitation (annual, seasonal, extremes), and snow-covered days.

In addition, maps (similar to those shown in Figures 15 and 19) for the state of New Hampshire for all twenty-five climate indicators listed in Table 9 for the historical time period and for three thirty-year time periods in the future can be viewed online at the New Hampshire Experimental Program to Stimulate Competitive Research (EPSCoR) — Data Discovery Center.[46]

end of the twenty-first century (2070–2099). Overall, southern New Hampshire can expect to see increases in annual maximum and minimum temperature ranging from +4°F to +9°F by 2070–2099.

Historically, average winter temperatures showed the greatest warming over the past four decades,[47] but that isn't necessarily the case for future scenarios. While annual and seasonal maximum temperatures all increase, the largest increase occurs in the spring and summer seasons for both the lower (+6.6°F and +4.1°F, respectively) and higher (+8.7°F and +9.6°F, respectively) emissions scenarios by end of century. For minimum temperatures, the higher emissions scenario shows warming in all seasons (ranging from +8.3 - +9.3°F), while the lower emission scenarios shows the greatest amount of warming in the spring (+6.8°F) and winter (+5.0°F) by end of century.

With regard to climate impacts, the projected

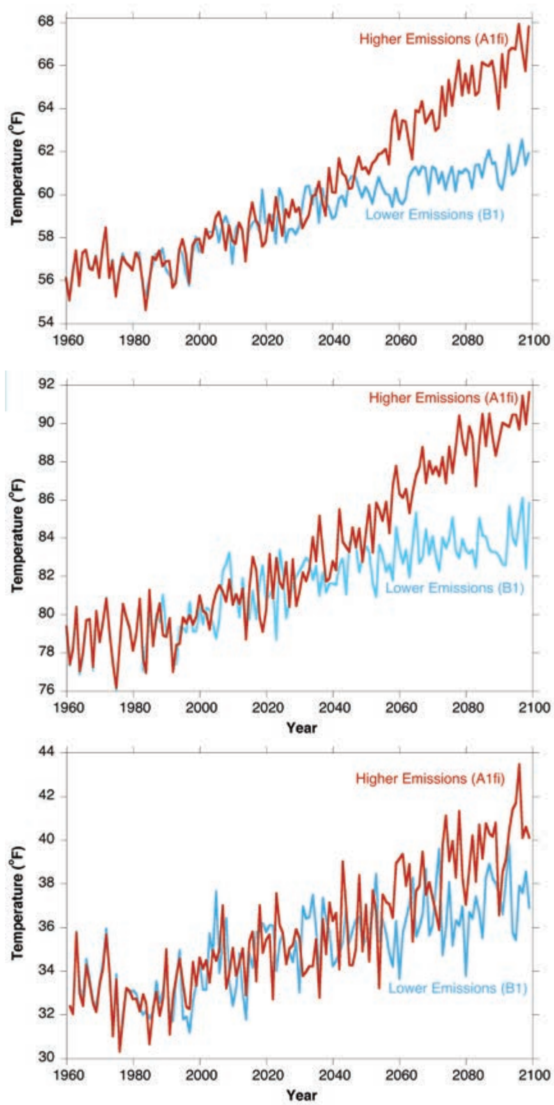


FIGURE 12. Modeled *maximum* temperatures for southern New Hampshire (averaged over 25 sites) from the higher emission scenario (A1fi; red line) and lower mission scenario (B1; blue line) for a) annual (top), b) summer (middle), and c) winter (bottom), 1960–2099.

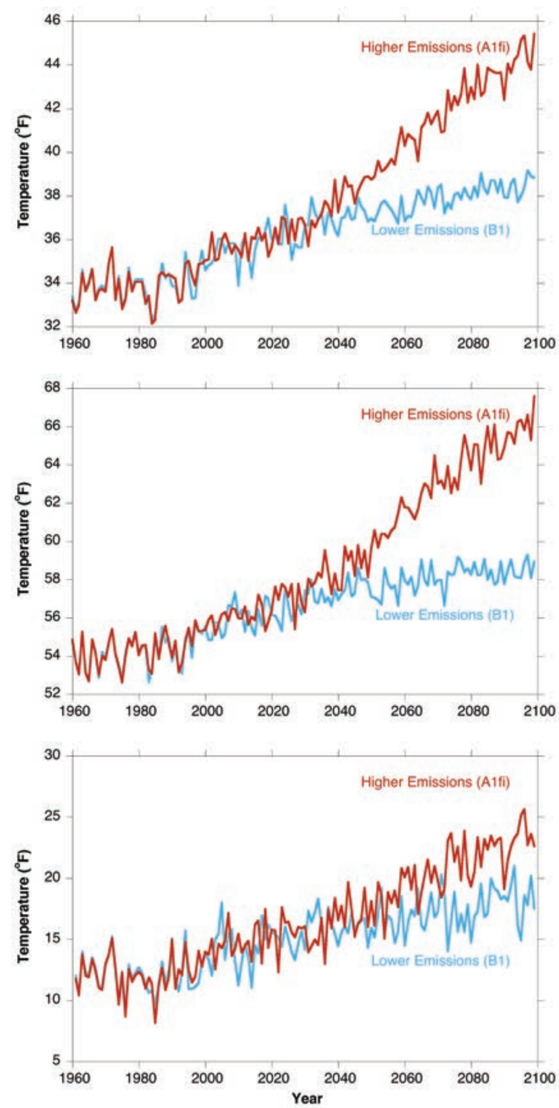


FIGURE 13. Modeled *minimum* temperatures for southern New Hampshire (averaged over 25 sites) from the higher emission scenario (A1fi; red line) and lower mission scenario (B1; blue line) for a) annual (top), b) summer (middle), and c) winter (bottom), 1960–2099.

increases in southern New Hampshire winter maximum and minimum temperature will very likely push regional average winter temperatures above the freezing point. With average winter temperatures above freezing, the region can expect to see a greater proportion of winter precipitation falling as rain (as opposed to snow), earlier lake ice-out dates, and a decrease in the number of days with snow cover. Warmer summer temperatures will likely lead to an increase in drought (through increased evaporation, heat waves, and more frequent and extreme convective precipitation events).

Future Extreme Temperature

As temperatures increase in southern New Hampshire, the number of very hot days is expected to become more frequent and the hottest days hotter, while extreme cold is expected to become less frequent and the coldest days less severe.

Extreme Heat

Increases in extreme heat are calculated using three metrics: (1) number of days above 90°F, (2) number of days above 95°F, and (3) average temperature on the hottest day of the year (Table 9). During the historical baseline period from 1970–1999, southern New Hampshire experienced, on average, seven days per year above 90°F each year, with more hot days at sites in the far southern regions of New Hampshire (for example, Manchester; Figure 14). By 2070–2099, southern New Hampshire on average can expect twenty-three days per year with daytime maximum temperatures above 90°F under the lower emissions scenario and over fifty-four days per year under the higher emissions scenario, about eight times the historical average (Figure 14). Under the higher emissions scenario, Manchester would experience over seventy days per summer with temperatures above 90°F, essentially making the summer a prolonged heat wave punctuated by slightly less uncomfortable days.

IMPACTS OF FUTURE CLIMATE CHANGE ON SOUTHERN NEW HAMPSHIRE

This report provides a detailed assessment of how climate will change across southern New Hampshire depending on the levels of future emissions of heat-trapping gases from human activities. The next step is to examine how climate change will impact the region's environment, ecosystem services, economy, and society. A detailed analysis of the impacts of climate change in southern New Hampshire is beyond the scope of this report. Fortunately, there is a wealth of analysis on the potential impacts of climate change across New England and the northeast United States provided in the reports and peer-reviewed scientific papers written as part of the Northeast Climate Impacts Assessment (NECIA).[48] The NECIA Executive Summary, Full Report, and state-based analysis are all available on the NECIA website.[49]

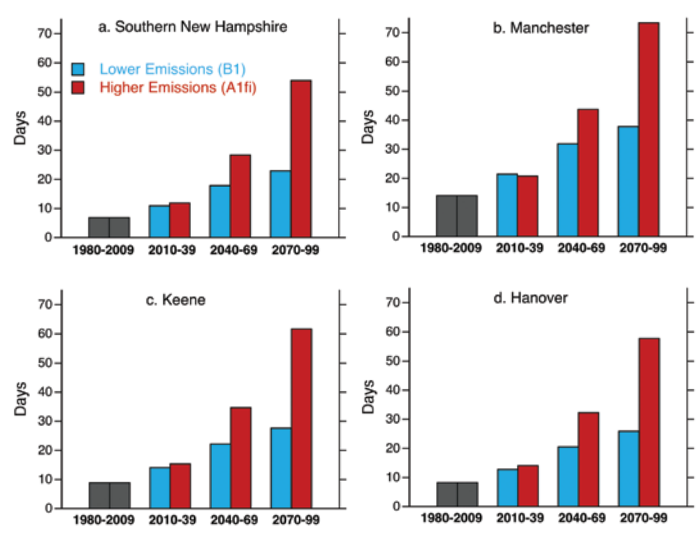


FIGURE 14. Historical (grey) and projected lower emissions (blue) and higher emissions (red) average number of days above 90°F per year, shown as 30-year averages for a) southern New Hampshire (average of 25 stations), b) Manchester, c) Keene, and d) Hanover.

Under the lower emissions scenario, Manchester would experience forty days per summer with temperatures above 90°F.

Between 1980–2009, extreme daytime maximum temperatures above 95°F were historically rare, occurring on average one day per year across southern New Hampshire. Under the lower emissions scenario, southern New Hampshire can expect to experience six days per year above 95°F (Table 9). Under the higher emissions scenario, the number of days above 95°F is expected to increase to twenty-two days per year by end of century.

As the number of extremely hot days per year increases, the average daytime maximum temperature on the hottest day of the year is also expected to increase (Figure 15). By the 2070–2099 period, the temperature on the hottest day of the year could climb to 98°F under the lower emissions scenario and upwards of 102°F under the higher emissions scenario compared to the historical average of 93°F.

Extreme Cold

Increases in extreme cold are calculated using three metrics: (1) number of days below 32°F, (2) number of days below 0°F, and (3) average nighttime minimum temperature on the coldest day of the year. Over the period 1980–2009, southern New Hampshire experienced on average 164 days per year with nighttime minimum temperatures below 32°F (Table 9), roughly the length of the winter season from mid-November through mid-April. Over the next century, these numbers are expected to decrease considerably. By the end of the century, southern New Hampshire could experience forty-four fewer days per year with minimum temperatures below 32°F under the higher emissions scenario, or about a 25 percent decline.

Under the lower emissions scenario, twenty fewer days per year are expected, or about a 12 percent decline by end of century.

Decreases in the number of extreme cold days below 0°F are more noticeable compared to days below 32°F. Southern New Hampshire currently

FIGURE 15. Historical (left) and projected (2070–2099) lower emissions (center) and higher emissions (right) average daytime maximum temperature on the hottest day of the year across New Hampshire.

experiences on average sixteen days per year when minimum temperatures fall below 0°F (Table 9). That number will be halved by 2040–2060 to about eight days per year under the lower emissions scenario, and only five to six days under the higher emissions scenario. By the end of the twenty-first century, results indicate a decrease of 88 percent under the higher emissions scenario and a decrease of 56 percent under the lower emissions scenario in the number of days with minimum temperatures less than 0°F.

The average nighttime minimum temperature on the coldest day of the year in southern New Hampshire currently averages -15°F. This is projected to gradually warm over this century. By the end of the century, the minimum temperature per year is expected to warm +8°F under lower emissions and +17°F under higher emissions (Table 9).

Future Growing Season

By the end of the century, the growing season is projected to lengthen by about two weeks under the lower emission scenario or five weeks under the higher emission scenario. However, hotter temperatures, reduced chilling hours, enhanced evapotranspiration, and more extreme precipitation will likely result in a decrease in crop yields.

A longer growing season may provide opportunities for farmers to grow new crops that require a longer (frost-free) growing season. However, analysis of the impact of future climate on agricultural production indicates that many crops will have yield losses associated with increased frequency of high temperature stress, inadequate winter chill period for optimum fruiting, and increased pressure from invasive weeds, insects, or disease that are currently not a significant factor in New Hampshire.[50] Furthermore, several weeds are likely to benefit more than crops from higher temperatures and increasing concentrations of atmospheric carbon dioxide.[51] Another concern involves the northward spread of invasive weeds like privet and kudzu, which are already present in the South.[52] More hot days also indicate a substantial potential negative impact on milk production from dairy cows, as milk production decreases with an increase in the thermal heat index.[53] Higher CO_2 levels result in stronger growth and more toxicity in poison ivy,[54] while higher temperatures combined with higher CO_2 levels also lead to substantial increases in aeroallergens that have significant implication for human health.[55]

The length of the growing season will continue to increase under both emission scenarios (Figure 16). In the short term (2010–2039), the average growing season is likely to be extended by eleven to twelve days across southern New Hampshire, an increase of about 7 percent. By the end of the century, the growing season is projected to increase by twenty days under the lower emission scenarios (12 percent increase) to forty-nine days under the higher emissions scenario (30 percent).

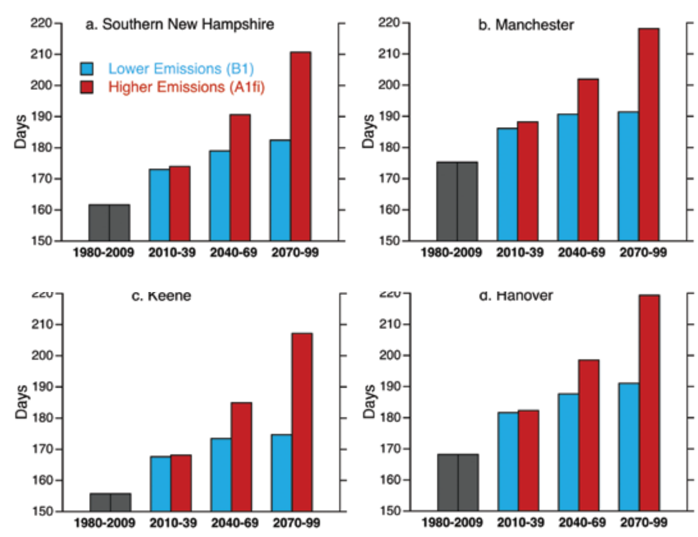


FIGURE 16. Historical (grey) and projected lower emissions (blue) and higher emissions (red) average length of the growing season (using a threshold of 28°F), shown as 30-year averages for a) southern New Hampshire (average of 25 stations), b) Manchester, c) Keene, and d) Hanover.

Southern New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.5	1.7	2.0	2.9	5.1	3.8	8.8
Winter TMIN	12.8	2.3	2.6	3.6	5.6	5.0	9.3
Spring TMIN	31.2	4.0	2.5	5.6	5.2	6.8	8.5
Summer TMIN	54.9	1.6	2.2	2.8	5.6	3.5	9.8
Fall TMIN	35.3	0.3	1.7	0.6	5.0	1.1	8.3
Maximum Temperature (°F)							
Annual TMAX	57.2	1.7	1.7	3.0	4.8	4.1	8.3
Winter TMAX	33.4	1.7	1.6	2.5	3.5	3.6	6.1
Spring TMAX	55.7	2.5	1.5	4.9	4.7	6.6	8.7
Summer TMAX	79.6	1.8	2.1	3.3	5.7	4.1	9.6
Fall TMAX	59.7	0.9	1.7	1.3	5.3	1.5	8.6
Temperature Extreme (days per year)							
<32°F	164.0	-9.5	-10.9	-15.8	-25.5	-19.5	-43.9
<0°F	16.0	-5.0	-5.1	-7.8	-10.6	-9.0	-14.2
>90°F	6.7	4.2	5.2	11.1	21.7	16.2	47.3
>95°F	1.0	0.8	1.2	2.7	7.0	5.1	21.8
TMAX on hottest day of year	93.1	1.8	1.4	3.0	4.8	4.6	9.0
TMIN on coldest day of year	-15.8	4.0	4.4	6.2	10.2	8.0	17.4
Growing Season (days)	162	11.1	12.0	17.0	28.6	20.4	48.7
Precipitation (inches)							
Annual mean	43.8	4.3	3.1	5.4	5.9	7.4	8.8
Winter mean	9.8	1.2	0.9	1.5	1.5	2.1	2.9
Spring mean	10.9	1.1	1.1	1.7	1.6	2.1	2.7
Summer mean	11.4	1.7	1.0	1.3	2.0	2.2	1.6
Fall mean	11.6	0.5	0.2	1.0	0.9	1.1	1.6
Extreme Precipitation (events per year)							
1” in 24 hrs	10.4	1.6	1.6	2.2	2.8	2.9	4.3
2” in 48 hours	3.7	2.0	2.0	1.0	3.0	1.5	4.2
Extreme Precipitation (events per decade)							
4” in 48 hours	4.3	2.6	0.7	3.9	4.0	6.1	7.6
Snow Covered Days	105	-9.6	-16.3	-15.0	-37.1	-23.7	-52.9

TABLE 9. Climate grid with historical and projected future 30-year climatologies for temperature (25 stations) and precipitation (41 stations) variables averaged across southern New Hampshire (south of 43.9° north latitude). Daily meteorological data was not available for all sites for the entire period of record, so the historical values (1980–2009) in these tables were derived from the downscaled GCM simulations. A climate grid for each of the 25 GHCN-Daily stations that recorded both temperature and precipitation are provided in Appendix B.

Future Precipitation

The amount of annual precipitation is projected to continue to increase over this century.

Future trends in annual and seasonal precipitation point toward wetter conditions in southern New Hampshire over the coming century, continuing the historical trend observed over the past four decades. Annual precipitation is projected to increase 17 to 20 percent under both emission scenarios by the end of the century, slightly more under the high emissions scenario compared to the low emissions scenario by the end of the century (Figure 17; Table 9). Under both emission scenarios, precipitation increases are largest during winter and spring and increase only slightly during the summer and fall.

Future Extreme Precipitation and Drought

The frequency of extreme precipitation events is projected to more than double by the end of the century under both lower and higher emission scenarios.

There are potential benefits that may result from an increase in total annual precipitation—alleviation of scarce water resources, less reliance on irrigation, and increased resilience to drought. In a world where freshwater resources will likely be stressed by the combination of precipitation reductions and warmer temperatures in some regions (for example, the south-western United States[56]) and increasing demand, increases in annual precipitation could be extremely valuable in many respects for New Hampshire and New England. However, those benefits may not occur if the increase in precipitation is primarily the result of an increase in extreme precipitation events, which can lead to excessive runoff, flooding, damage to

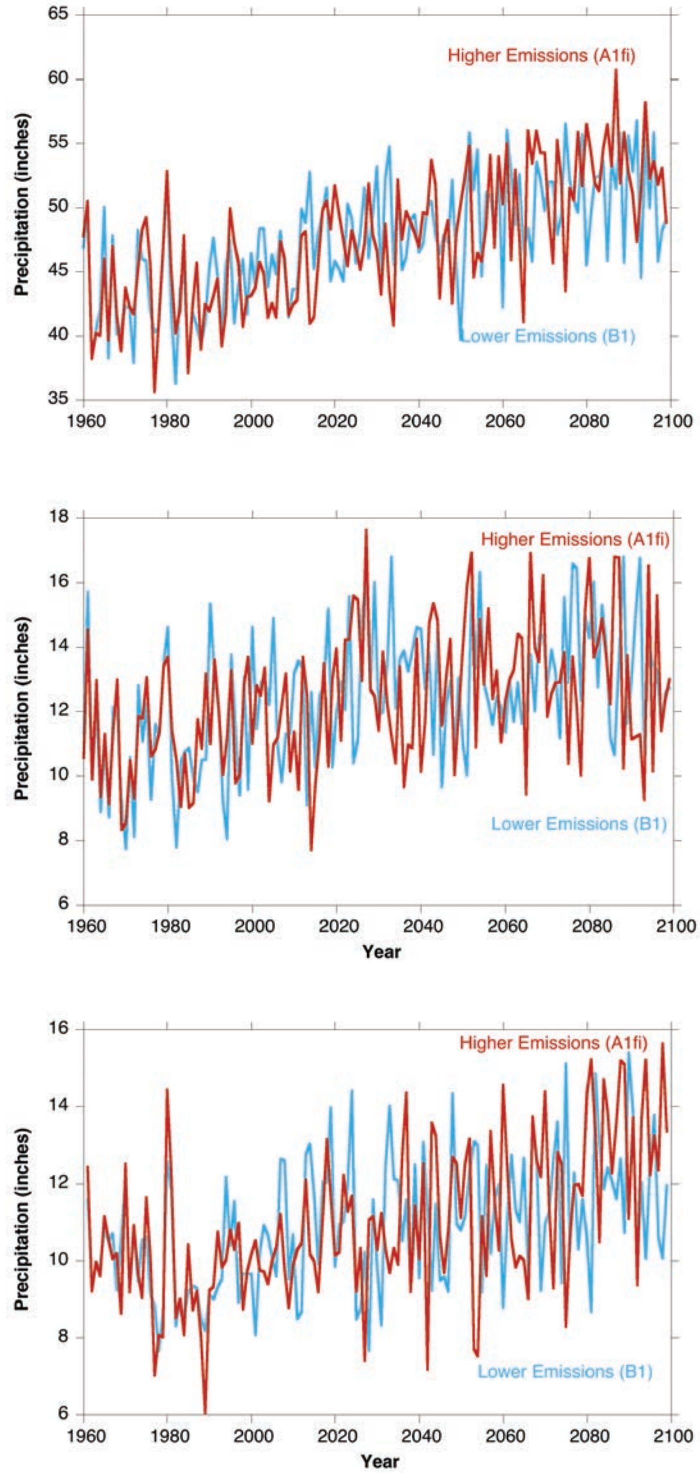


FIGURE 17. Historical and projected a) annual (top), b) summer (middle), and c) winter (bottom) precipitation for southern New Hampshire (averaged over 41 sites) from the higher emission scenario (A1fi; red line) and lower mission scenario (B1; blue line), 1960–2099.

critical infrastructure (including buildings, roads, dams, bridges, and culverts), increased erosion, and degradation of water quality.

The same three metrics described in the historical analysis are presented for higher and lower future emissions scenarios: (1) greater than 1 inch in 24 hours, (2) greater than 4 inches in 48 hours, and (3) wettest day of the year (Table 9). For all three metrics, it is clear that southern New Hampshire can expect to see more extreme precipitation events in the future, and more extreme precipitation events under the higher emissions scenario relative to the lower emissions scenario.

Historically, southern New Hampshire experienced 10.4 events per year with greater than 1 inch of precipitation in 24 hours. By 2070–2099, that will increase to 13.3 events under the lower emissions scenario and to 14.7 events for the higher emissions scenario in the medium- and long-term. For events with greater than 2 inches in 48 hours, southern New Hampshire averaged 3.7 events per year from 1980–2009, but that will increase to 5.2 events per year under the lower emissions scenario and will more

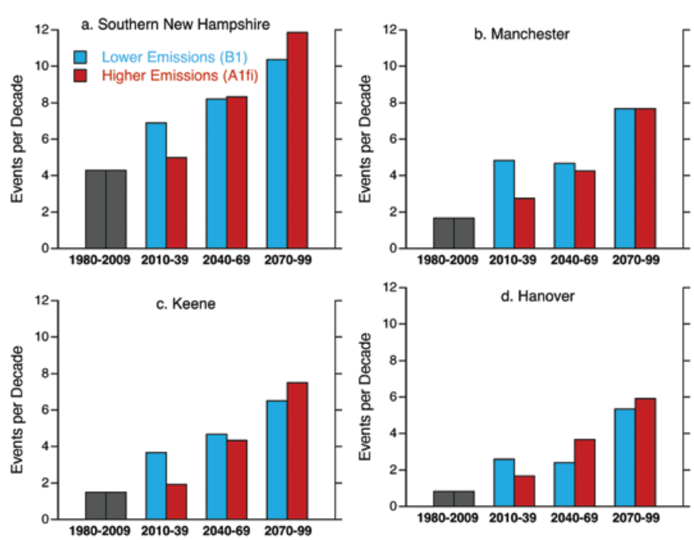


FIGURE 18. Historical (grey) and projected lower emissions (blue) and higher emissions (red) average number of precipitation events per decade with more than 4 inches of rain in 48 hours, shown as 30-year averages for a) southern New Hampshire (average of 41 stations), b) Manchester, c) Keene, and d) Hanover.

than double to 7.9 events per year under the higher emissions scenario. However, the largest changes are projected to occur for the more extreme precipitation events, here defined as greater than 4 inches in 48 hours. These are also the events that have seen the strongest historical increases. These events are expected to increase from the current 4.3 events per decade (again, averaged across southern New Hampshire; see Figure 7 for an example of the large spatial variability of these events across the region) to more than ten events per decade under the lower emissions scenario, and almost twelve events per decade under the higher emissions scenario (Figures 18 and 19).

No new analysis of future drought was performed for this report. However, hydrologic simulations from the Variable Infiltration Capacity (VIC) model are available, which use the same GCM inputs as the analysis presented in this report.[57] VIC is a hydrological model that simulates the full water and energy balance at the Earth's surface and provides a daily measure of soil moisture resulting from a broad range of hydrological processes, including precipitation and evaporation. Based on VIC simulations of soil moisture, a drought event was defined as the number of consecutive months with soil moisture percentile values less than 10 percent, with droughts being classified as short- (one to three months), medium- (three to six months), and long-term (six plus months). The results[58] indicate that over the long-term (2070–2099) under the higher emissions scenario, New Hampshire, New England, and upstate New York can expect to experience a two- to three-fold increase in the frequency of short-term drought and more significant increases in medium-term drought. These droughts are driven primarily by an increase in evapotranspiration resulting from hotter summers. Note that summer precipitation shows only a slight increase (Table 9), not enough to offset the increase in evapotranspiration resulting from hotter temperatures. Under the lower emissions scenario, the frequency of short- and medium-term drought increases only slightly by the end of the century. The frequency of long-term drought does not change substantially across New Hampshire in the future under either emissions scenario compared to the frequency of long-term drought in the past.

The projections of hotter summers and more frequent short- and medium-term droughts suggest potentially serious impacts on water supply and agriculture. Even very short water deficits (on the order of one to four weeks) during critical growth stages can have profound effects on plant productivity and reproductive success. During a drought, evapotranspiration continues to draw on surface water resources, further depleting supply. As a water deficit deepens, productivity of natural vegetation and agriculture drops. The projected drought also poses a risk to the summertime drinking water supply across the region.

Future Snow Cover

By the end of the century, snow-covered days are projected to decrease by 20 percent under the lower emissions scenario or 50 percent under the higher emissions scenario.

Changes in future snow cover will depend on both temperature and precipitation. As shown earlier, the projected increases in winter maximum and minimum temperature in southern New Hampshire will very likely push the regional average winter temperatures above the freezing point by the end of the twenty-first century. This suggests that a greater proportion of winter precipitation will fall as rain as opposed to snow. At the same time, precipitation is expected to increase in winter and spring, potentially increasing total snowfall in the near term as long as below-freezing temperatures continue to occur on days when precipitation is falling. Projected changes in the number of winter days with snow cover (greater than

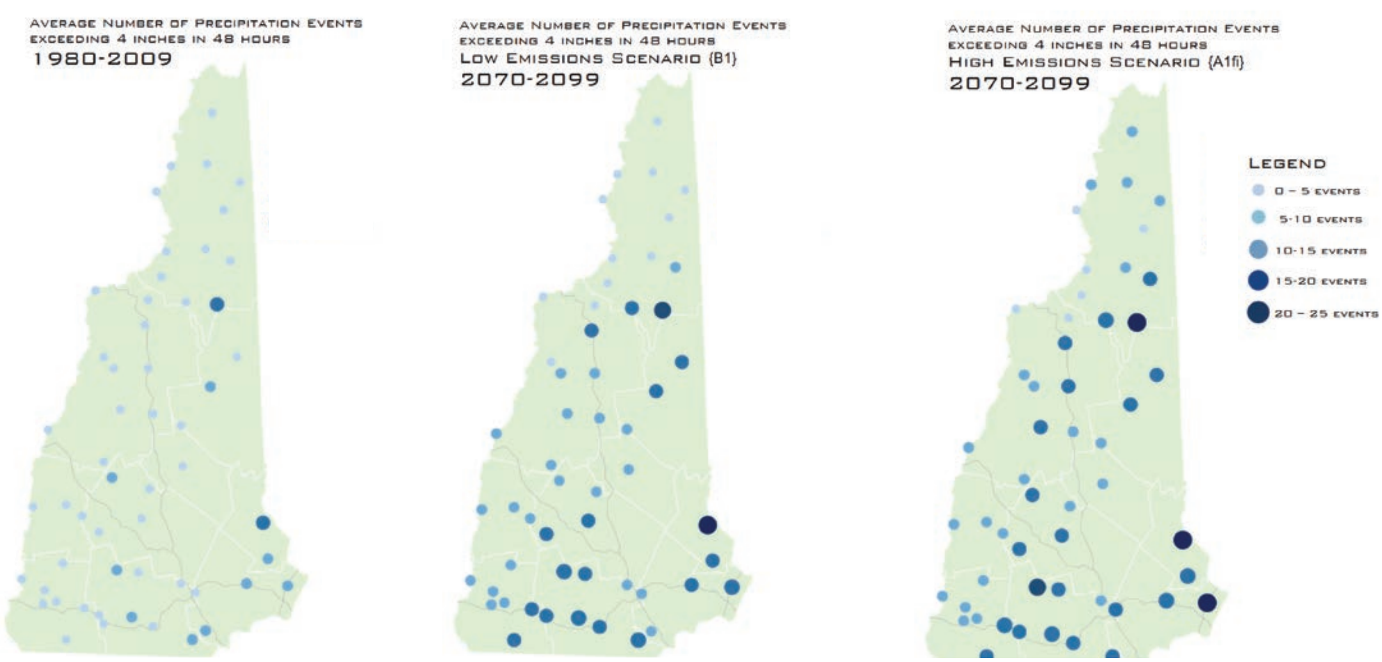


FIGURE 19. Historical (left) and projected (2070–2099) lower emissions (center) and higher emissions (right) average number of precipitation events per year that drop greater than 4 inches in 48 hours across New Hampshire.

1 inch) are examined for short- (2010–2039), medium- (2040–2069), and long-term (2070–2099) to evaluate which factor will dominate: temperature increases (which will decrease snow cover days) or precipitation increases (which would potentially increase snow cover days if the temperature remains below freezing).

Over the long-term, the influence of warming winter and spring temperatures will dominate over expected increases in winter precipitation. This means that the number of snow-covered days is projected to decrease for the rest of this century under both emissions scenarios (Figure 20; Table 9). Historically, southern New Hampshire experienced on average 105 days per year with snow cover. During the early part of the century, decreases in snow-covered days are expected to drop to 95 and 89 days for the lower and higher emissions scenarios, respectively. This trend continues through mid-century. By 2070–2099, snow-covered days are projected to number 81 days under the low emissions scenarios, and plummet to 52 days (a reduction of more than 50 percent) under the higher emissions scenario.

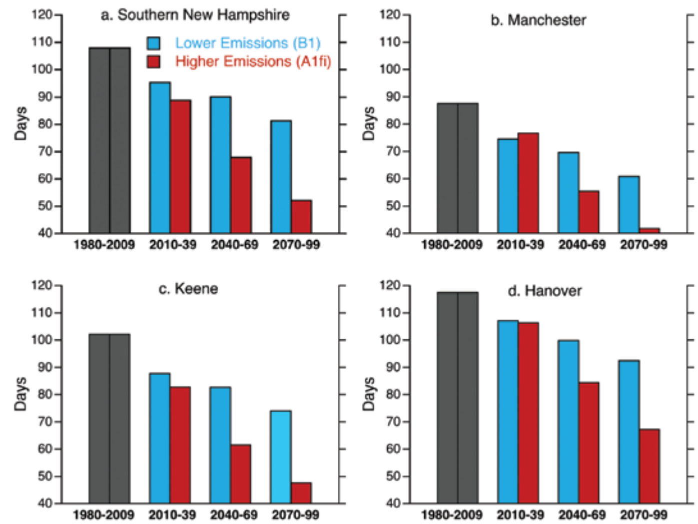


FIGURE 20. Historical (grey) and projected lower emissions (blue) and higher emissions (red) average snow-covered days (greater than 1 inch of snow), shown as 30-year averages, for a) southern New Hampshire (average of 41 stations), b) Manchester, c) Keene, and d) Hanover.

IV. HOW CAN NEW HAMPSHIRE'S COMMUNITIES RESPOND?

"America's response to climate change is ultimately about making choices in the face of risks: choosing, for example, how, how much, and when to reduce greenhouse gas emissions and to increase the resilience of human and natural systems to climate change." [59]

The results presented in Chapters II and III of this report (with results for specific towns in southern New Hampshire summarized in Appendix B), combined with the findings of recent regional,[60] national,[61] and international[62] assessments, summarize the risks posed by climate change and provide strong motivation for assessing and implementing a wide range of proactive anticipatory and response efforts. A pressing need for significant action to limit the magnitude of climate change (via mitigation) and to prepare for its impacts (via adaptation) is clearly warranted given the environmental, economic, and humanitarian risks associated with our changing climate.[63]

Mitigation and Adaptation

There are two broad responses for dealing with our changing climate: 1) mitigation of climate change through the reduction of emissions of heat-trapping gases and enhancing carbon sinks (for example, enhancing and preserving carbon storage in forests and soils), and 2) adaptation to the impacts of climate change, which refers to preparing and planning for climate change to better respond to new conditions, thereby reducing harm and disruption and/or taking advantage of opportunities. Mitigation and adaptation are linked; effective mitigation reduces the need for adaptation. Both are essential parts of a comprehensive dual-path response strategy.

Mitigation and adaptation at the global and continental level have been comprehensively addressed in the IPCC 2007 Working Group II (Impacts, Adaptation, and Vulnerability) and Working Group III (Mitigation of Climate Change) Fourth Assessment Reports.[64] More recent research will be summarized in the IPCC Fifth Assessment Reports from Working Groups II and III due out in the spring of 2014.[65] On the national level, a series of reports on America's Climate Choices and the recent National Climate Assessment provide advice on the most effective steps and most promising strategies that can be taken to respond to climate change, including adaptation and mitigation efforts.[66]

Effective responses aimed at reducing the risks of climate change to natural and human systems involve a portfolio of diverse adaptation and mitigation strategies. Even the most stringent mitigation efforts will not alleviate the climate change we have committed to over the next two-to-three decades (due to the long lived nature of carbon dioxide already in the atmosphere combined with the inertia within the climate system), which makes adaptation critical. Conversely, without significant mitigation efforts, a magnitude of climate change will very likely be reached that will make adaptation impossible for some natural systems, and many human systems will exact very high social and economic costs. A dual-path strategy of pursuing and integrating mitigation and adaptation strategies will reduce the negative consequences resulting from future climate change to a far greater extent than pursuing either path alone or doing nothing at all.

Mitigation

The single most effective adaptation strategy is mitigation of climate change through the reduction of emissions of heat-trapping gases. As is clearly illustrated by the very different climate futures that result from a higher emission versus a lower emission scenario, reducing emissions of heat-trapping gases reduces the amount of change to which we have to adapt. To be effective, mitigation requires concerted efforts from individuals, communities, businesses, not-for-profits, and governments (municipal, state, and federal), locally, nationally, and abroad. Such mitigation measures range from protecting our forests and soils (for carbon sequestration) to increasing energy efficiency in buildings, electricity generation, transportation systems, and other infrastructure to increasing the amount of energy produced from renewable sources.

The New Hampshire Climate Action Plan[67] was developed via the combination of a highly collaborative process involving hundreds of diverse stakeholders, transparent quantitative analysis, and

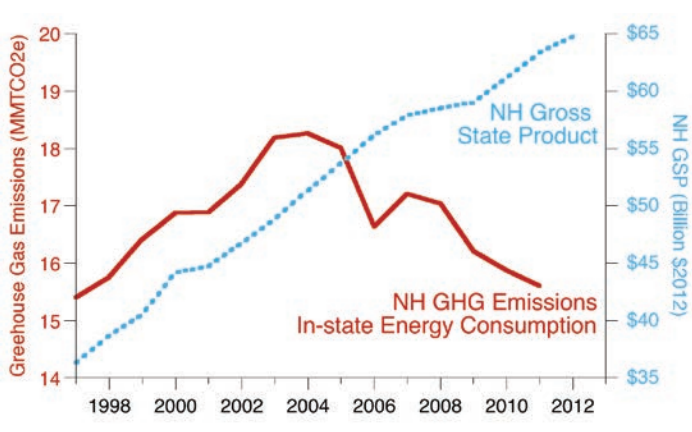


FIGURE 21. Comparison of New Hampshire's greenhouse gas emissions (red) versus its Gross State Product (GSP) (see endnote 83 for more information).

application of decision-relevant information.[68] The plan calls for a reduction in greenhouse gas emissions of 20 percent below 1990 emissions by 2025, and 80 percent below 1990 emissions by 2050.[69] To move toward this long-term goal and provide the greatest economic opportunity to the state of New Hampshire, the Climate Action Plan recommends sixty-seven actions to:

- Reduce greenhouse gas emissions from buildings, electric generation, and transportation
- Protect our natural resources to maintain and enhance the amount of carbon sequestered
- Support regional and national initiatives to reduce greenhouse gases
- Develop an integrated education, outreach, and workforce-training program
- Adapt to existing and potential climate change impacts

These actions serve not only to reduce emissions of heat trapping gases, but also to support a wide range of economic development. In fact, following an initial investment period, almost all of the recommendations provide a net positive economic benefit to the state of New Hampshire.

The New Hampshire Energy and Climate Collaborative is tracking progress toward meeting key targets set forth in the Climate Action Plan.[70] Overall, New Hampshire has experienced a decline in overall emissions of heat-trapping gases since 2004, even while the state gross product has continued to rise (Figure 21). This separation of economic growth from emissions of heat-trapping gases is exactly what must continue if we are to achieve the vision for emissions reduction targets set out in New Hampshire's 2009 Climate Action Plan, while also providing economic opportunities for New Hampshire residents.

A few examples of successful mitigation efforts in

New Hampshire include the Regional Greenhouse Gas Initiative, the Greenhouse Gas Emission Reduction Fund, Better Buildings project, NH Energy Efficiency Core programs, New Hampshire Office of Energy and Planning, Jordan Institute energy efficiency projects, University of New Hampshire EcoLine, 2009 Corporate Fuel Efficiency Standards, and Revolution Energy and ReVision Energy projects.[71] Additional recommendations for energy efficiency and renewable energy projects are provided in the Independent Study of Energy Policy Issues Report[72] and subsequent New Hampshire Energy Efficiency and Sustainable Energy (EESE) Board recommendations.[73]

Adaptation

Adaptation is the second key component of a dual-path strategy that serves as an effective response to the risks posed by climate change. Adaptation for communities essentially involves preparing and planning for the expected impacts of climate change to avoid, manage, and/or reduce the consequences.

Climate change affects everything from transportation, infrastructure, land use, and natural resources to recreation, public health and safety, and sense of place. Fortunately for New Hampshire communities, there are opportunities for adaptation available within existing planning and regulatory processes. Virtually every community member is either a stakeholder or an implementer. Gathering and applying local knowledge concerning the impacts and consequences of weather disruption will enhance the effectiveness of local adaptation. Every community should discuss, analyze, and then determine which adaptation strategies to implement based on its specific vulnerabilities to climate change and local economic, environmental, and social conditions. Therefore, efforts to address climate change should seek input, participation, and support from all members of your community. This may be achieved through specific outreach to neighborhoods or interest groups, municipal meetings, or through larger community events.

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

Adaptation strategies to protect the built environment fall into four broad categories:

No Action: To do nothing. This approach ignores the risks posed by climate change and continues a "business as usual" response.

Protect and Fortify: To keep an asset in place for a period of time. For flood protection, this commonly involves building physical barriers such as levees, berms, flood/tide gates, or sea walls. Protection is likely to be a common approach in low-lying population centers due to extensive development and investment. These strategies should be viewed as short-term solutions that do not necessarily improve community resilience (for example, when a physical barrier such as a levee fails, the impacts can be devastating).

Accommodate: To retrofit existing structures and/or design them to withstand specific extreme weather events. Freeboard requirements in building codes are a common accommodation strategy (essentially putting a building on stilts). This approach provides a safety factor and avoids damage by requiring that structures be elevated above a certain flood elevation, such as the 100-year flood elevation.

Retreat: To relocate or phase-out development in hazardous areas. In existing flood-prone areas, retreat can be the most effective and long-term solution.

While a rightly contested option, it may be best supplemented with a "wait and see" approach within areas identified as vulnerable in the future, commonly after a triggering event or when a particular threshold is reached (for example, when an asset in a high-risk area is damaged by over 50 percent of its original value and it is then relocated rather than repaired).

Adaptation actions may be implemented immediately or as iterative or delayed actions:

Here and Now: Actions taken in the near-term to build or improve existing infrastructure so that it is robust and resilient to a range of climate conditions. This approach may also involve the preparation of plans to implement future actions.

Prepare and Monitor: Options are identified to preserve assets and climate conditions are monitored so that appropriate response actions can be taken in the future.

In preparing a phased adaptive management strategy, policy and decision makers must recognize the tradeoffs between selecting one action over another (that is, investing now to protect for the long-term versus cost over time and risk associated with delaying such action). Sustained actions and investment need to be weighed against changing climate conditions over the long-term with incremental investment to protect and accommodate changing climate conditions in the short-term. Integrated actions that build upon one another to increase resiliency and decrease risk and vulnerability are preferred. Adaptation often provides both co-benefits and no-regrets actions. *Co-Benefits* refers to integrated efforts to address climate change impacts through proactive actions and mitigation that result in building capacity, resiliency, and protection of assets and resources that can also meet economic, societal, and environmental needs. For example, preserving floodplain forests and coastal buffers provides a carbon sink (mitigation) and keeps development out of a high-risk area (proactive adaptation), while also providing benefits to wildlife, recreation, sense of place, and more. *No Regrets* refers to actions that generate direct or indirect benefits that are large enough to offset the costs of implementing the options. For example, siting new infrastructure in areas that have no or low risk of flooding today and are not projected to be flooded in the future.

Planning Framework and Approaches for Adaptation

Using the climate assessment (such as this report) as a foundation, communities should conduct a vulnerability assessment of local assets and resources that can help guide common sense and flexible adaptation strategies and recommendations for local governments, businesses, and citizens to enable them to implement appropriate programs, policies, regulations, and business practices (Figure 22). Analysis and data from a vulnerability assessment can help identify priority assets, actions, and planning needs or identify deficits in data, information, or processes necessary to move forward in adapting to climate change. Once the vulnerability assessment is complete, communities should develop a flexible, staged, adaptation plan that is periodically updated and designed to be easily integrated into

FIGURE 22. Key steps for moving from a climate assessment to local and regional adaptation plans.

existing plans, policies, or practices. Communities also need to ensure that future development is consistent with the plan.

The Granite State Future project has developed a framework for the range of planning issues for New Hampshire communities as they prepare for and respond to climate change.[74] Material culled from that document relating to community planning is provided below.

> ***"Using the climate assessment as a foundation, communities should then conduct a vulnerability assessment of local assets and resources that can help guide common sense and flexible adaptation strategies and recommendations for local governments, businesses, and citizens to enable them to implement appropriate programs, policies, regulations, and business practices."***

To leverage the effectiveness and benefits of climate adaptation, key strategies and actions should be institutionalized across all levels of regional and local planning. As a matter of efficiency and practicality, planning for climate change should utilize existing plans, policies, and practices with the goal of reorienting them using the "climate lens" to incorporate future projected conditions or the new climate normal. Because state statute gives municipalities broad authority to regulate, significant components of climate adaptation planning will occur at the local level. To accomplish this, effective adaptation planning should seek to:

- Identify vulnerable assets and resources
- Guide planning, regulation, and policies at all scales
- Inform prioritization of state, regional, and private investments in areas at risk to future conditions
- Identify possible strategies and actions that provide economic, social, and environmental benefits
- Protect public health and safety
- Improve community awareness about the region's changing climate
- Preserve regional and community character and ensure sustainable outcomes

Planning Strategies

Ultimately, planning for climate change means using the wide range of planning tools and procedures available to integrate climate adaptation across all sectors. Just as the dual path of mitigation and adaptation are central to addressing climate change, a comprehensive multi-pronged planning approach is critical for ensuring that decisions are balanced, equitable, and long-lasting. It is equally important to recognize the values and benefits that ecosystem services provide for human enjoyment and survival. However, inevitably "tradeoffs" will be necessary to achieve desired goals and priorities. Following are examples of planning strategies that support comprehensive and effective implementation of climate adaptation. Many of these strategies can easily be combined or include mitigation strategies.

- 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
- Encourage Sustainability and Smart Growth planning (mixed use development and village development, conservation/open space subdivision, alternative transportation access, and preservation of agricultural lands)
- Conduct a Municipal Audit 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[75] to reduce flood insurance premiums
- Encourage cooperative agreements among municipalities (that is, for water and sewer services; equipment and inspectional staff/consultants; and integrated transportation, land use, and environment planning)
- Community participation and support (warrant articles, budget, and voluntary stewardship)
- Develop an action plan for regional implementation of recommended actions from the NH Climate Action Plan

Community Engagement and Laying the Foundation for Implementation

This section provides examples of how some New Hampshire communities have begun discussions and planning around adaptation. They also provide examples of external expertise and other support that is available.

Dover: Climate Change Role Play Simulation[76]

City officials and project partners gathered area residents to participate in a series of "climate change games," wherein people experience the challenge of negotiating through climate change planning while playing the role of a city official or resident. The goal of this effort was to assess local climate change risks, identify key challenges and opportunities for adaptation, and to test the use of role-play simulations as a means to engage the community about climate change threats while exploring ways of decreasing its vulnerability to climate change impacts. Dover was one of four towns participating in the National Oceanic and Atmospheric Administration (NOAA) funded New England Climate Adaptation Network.

Hampton, Hampton Falls, and Seabrook: Planning for Sea Level Rise[77]

With funding support from EPA's Climate Ready Estuaries Program, three communities of the Hampton-Seabrook Estuary used a cost-benefit analysis tool to evaluate potential impacts from storm surge and sea level rise to private real estate and public facilities. This effort considered lower and higher global emission and resulting climate change scenarios, the costs and benefits of taking action, and when it makes the most sense to implement adaptation strategies. As a result of their collaborative approach, the communities identified shared concerns and priorities such as preserving marshes to buffer shorefront properties from coastal storms, and a need to further consider climate change as a three-town working group.

Newfields: Extreme Weather Preparedness Action Plan[78]

The small coastal town of Newfields developed an extreme weather preparedness action plan. To begin, local leaders convened over thirty-five community members for dinner and discussion following a presentation of local climate change research from the University of New Hampshire. This information formed the basis for a series of small roundtable discussions about: (1) how extreme weather affects the people of Newfields and their natural resources and infrastructure, and (2) what possible actions the town could take to reduce these impacts. Two focus areas emerged (stormwater management and emergency preparedness), and community members continued to meet for six months to finalize an action plan to increase resiliency.

As a result, the town developed and immediately began implementing eighteen action items, including a discount generator purchase program led by the Chief of Police and an updated stormwater management regulation led by the planning board.

Exeter: Climate Adaptation Plan[79]

The Climate Adaptation Plan for Exeter (CAPE) initiative aspires to create a flexible science-based plan for managing local impacts to infrastructure, public safety, and natural resources (for example, fisheries, stormwater, and water quality). Residents and leaders of the "Citizens Working Group" worked closely with the science team to ensure the plan was informed by local concerns and priorities. The broader community was engaged periodically through large "community conversation" gatherings and presentations to town boards.

Durham: Climate Adaptation Chapter for Hazard Mitigation Plan[80]

The Town of Durham's "Leadership Team" developed a climate adaptation chapter for its Hazard Mitigation Plan. The plan provides a broad overview assessment of likely impacts from sea level rise and areas likely to experience future increases in flooding. The plan also outlines over a dozen regulatory and non-regulatory approaches appropriate for the community to take as next steps.

Lamprey River Watershed: Assessing Flood Risk[81]

Both the magnitude and frequency of freshwater flooding is on the rise in seacoast New Hampshire and around much of New England. This NOAA-funded research and outreach project analyzed changes in the extent of the 100-year floodplain in the Lamprey River watershed and projected future changes based on different scenarios of land use and climate change. The results clearly show that the 100-year floodplain and associated peak flood water discharge, as well as flood water surface elevations, have increased significantly between the production of the effective Flood Insurance Rate Maps (FIRMs, based on discharge data from 1935–1987) to current (2005) conditions, and will continue to increase in the future under the build-out scenarios developed as part of this research. Low impact development zoning was shown to have its greatest mitigation value in terms of resiliency in high impervious cover areas. This increase in the 100-year floodplain and 100-year flood discharge has important ramifications for natural resources, human well-being, emergency management, planning, and infrastructure. In addition, the risk of municipal legal liability associated with using the new 100-year floodplain maps is low, so long as municipalities follow sound planning principles.

City of Portsmouth, Coastal Resiliency Initiative[82]

The Coastal Resilience Initiative is the City of Portsmouth's first look at the potential impact from a changing climate focusing on impacts of sea level rise and coastal storm surge. The objectives of the study were to:

- Describe the range of climate change and sea level rise scenarios that researchers have identified for the New Hampshire Seacoast region
- Map four sea level elevations to show how these scenarios would impact the City of Portsmouth in the next forty to ninety years
- Using these maps, identify physical assets (buildings and infrastructure) and natural resources that are vulnerable to sea level rise and coastal storm surge

- Develop preliminary strategies for adapting to future conditions, as well as estimates of the costs of these adaptation actions
- Provide recommendations to guide adaptation planning, including policies and regulations

The study products include a set of flood elevation maps, a vulnerability assessment, a preliminary outline of potential adaptation strategies, and recommendations for future planning, regulation, and policies. This report represents a starting point for the city to identify avenues to implement adaptation measures that impart resiliency in the built environmental and protect natural systems.

Keene Cities for Climate Protection (CPC) Committee[83]

The Keene City Council officially created the CPC Committee in 2000. Its mission is to aid in the reduction of greenhouse gas emissions and increase the community's adaptive capacity to the expected impacts of a changing climate in order to protect the viability of the community and to protect public health, safety, and welfare. The city has adopted both a Climate Change Action Plan and a Climate Change Adaptation Action Plan, both of which are being implemented.

ADDITIONAL RESOURCES FOR ADAPTATION TO CLIMATE CHANGE

The Adaptation Toolkit for New Hampshire Communities[84] provides communities with a path to plan for future extreme weather events.

The Climate Adaptation Knowledge Exchange[85] 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.

Extreme Precipitation in New York and New England[86] provides an updated extreme precipitation analysis via an interactive web tool.

Forging the Link: Linking the Economic Benefits of Low Impact Development and Community Decisions[87] documents, through a series of case studies, the advantages of Low Impact Development in the economic terms of how municipal land use decisions are commonly made.

The Georgetown Climate Center[88] provides resources to help communities prepare for climate change, including the Adaptation Clearinghouse, Adaptation Tool Kits, lessons learned, and case studies.

Home Grown: The Economic Impact of Local Food Systems in New Hampshire[89] seeks to provide an answer to the question: What are local, healthy foods, and the food system that supports them, worth?

The Infrastructure and Climate Network[90] (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.

ADDITIONAL RESOURCES FOR ADAPTATION TO CLIMATE CHANGE (CONTINUED)

New Hampshire Building Energy Code Compliance Roadmap Report[91] maps out New Hampshire's existing energy code landscape, identifies barriers to energy code compliance across the state's residential and commercial building sectors, and presents a plan outlining New Hampshire-specific recommendations for achieving 90 percent energy code compliance by 2017.

NH Granit[92] is New Hampshire's Statewide Geographic Information System Clearinghouse. It offers an array of geospatial services, including: data development and distribution, spatial analysis, online mapping (including 100-year flood plain maps), cartography, and related technical services.

New Hampshire Lives on Water[93] is the final report of the New Hampshire Water Sustainability Commission and makes recommendations to ensure that the quality and quantity of New Hampshire's water in twenty-five years is as good as or better than it is today.

New Hampshire Local Energy Solutions[94] provides a gateway to information and resources that promote local energy solutions in New Hampshire. It is intended to empower those on energy committees, in municipalities, and schools to tackle the complexities of reducing our reliance on fossil fuel energy.

New Hampshire Office of Energy and Planning—Cost of Sprawl Tool[95] has been designed as a decision-support tool for New Hampshire's local and regional planners to evaluate the financial impact on local governments related to new development.

New Hampshire's Changing Landscape[96] 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.

The **New Hampshire Storm Smart Coast**[97] 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.

Transportation and Climate Change Clearinghouse[98] is the U.S. Department of Transportation website that provides information on transportation and climate change.

The **Upper Valley Adaptation Workgroup**[99] is building climate resilient communities in the Upper Valley through research, information sharing, and education.

V. CONCLUSIONS

An extensive and growing body of scientific evidence clearly shows that global climate is changing, and that human activities are the primary driver of that change over the past four decades. Climate change is already affecting the northeast United States and southern New Hampshire in many ways. Temperatures have begun to rise, particularly in winter. Precipitation is increasing, as is the frequency of extreme precipitation events. Lake ice-out dates are occurring earlier.

These and many other trends are projected to continue in the future. With few exceptions, much greater changes are anticipated under a higher emissions scenario as compared to a lower emissions scenario. In other words, depending on the amount of heat trapping gases that human activities pump into the atmosphere, annual average temperatures in southern New Hampshire could increase between 4°F and 9°F before the end of the twenty-first century. Warmer temperatures mean increased frequency of extreme heat events and decreases in extreme cold and days. Precipitation, especially in winter and spring, is expected to rise, as is the frequency of extreme precipitation events, exacerbating the risk of flooding. Snow-covered days are expected to decrease.

Because climate change is already affecting southern New Hampshire, and some additional warming is inevitable, it is essential to prepare to adapt to the changes that cannot be avoided. However, immediate and committed action to reduce emissions is the most effective means to keep future climate changes at those projected under the lower emissions scenario. The more we can reduce our fossil fuel emissions, the more ecosystems, human communities, and economic sectors will be able to adapt to those coming changes we cannot avoid.

"Because climate change is already affecting southern New Hampshire, and some additional warming is inevitable, it is essential to prepare to adapt to the changes that cannot be avoided. However, immediate and committed action to reduce emissions is the most effective means to keep future climate changes at those projected under the lower emissions scenario. The more we can reduce our fossil fuel emissions, the more ecosystems, human communities, and economic sectors will be able to adapt to those coming changes we cannot avoid."

APPENDIX A. METHODS

Historical Climate Change

To quantify historical trends in temperature and precipitation across New Hampshire, we used data from two high-quality meteorological data sets. Monthly temperature and precipitation observations for the time period 1895–2012 for three stations across southern New Hampshire (Figure 1; Hanover, Durham, and Keene) come from the U.S. Historical Climatology Network (USHCN) Version 2.5.[100] The observations from the USHCN data sets have been subjected to numerous quality assurance and quality control procedures that have corrected temperature records for time-of-observation biases and other non-climatic changes such as station relocations, instrument changes, changes in observer, and urban heat island effects through homogeneity testing.[101]

Daily temperature and precipitation observations are available for many stations across New Hampshire from the Global Historical Climatology Network-Daily (GHCN-Daily) Version 3.02-upd-2013051005[102]; these daily temperature records have been subjected to a number of quality assurance and quality control procedures[103] and have been homogenized.[104] We only used GHCN-Daily data for stations that had near complete records for the time period 1960–2012 (meteorological data from the GHCN-Daily data set prior to 1960 for New Hampshire were limited). For temperature and total precipitation, we excluded a year of data from our analysis if more than 10 percent of the data were missing for that year for a particular station. We also excluded the entire station from our analysis if more than 10 percent of the years were missing. For snowfall and snow covered days, the criteria we used for temperature eliminated all of the stations from our analysis. We therefore used different criteria for records of snowfall and snow-covered days: we excluded a year of data from our analysis if more than 20 percent of the data was missing for that year for a particular station. We also excluded the entire station from our analysis if more than 20 percent of years were missing.

All of the data we used in our analysis of historical climate trends across New Hampshire are available from the New Hampshire Experimental Program to Stimulate Competitive Research (EPSCoR)—Data Discover Center.[105]

All historical climate trends are calculated using Sen's slope[106] and expressed as change in units per decade. Sen's estimation of slope is succinctly described as the median slope of all possible slopes in an evenly spaced time series. As such, it provides a more robust trend estimation than the commonly used least squares linear regression, which may be sensitive to the start and end dates in a time series. The statistical significance of the slope is evaluated using the Mann-Kendall non-parametric test. Trends are considered statistically significant if $p<0.05$.

Historical Global Climate Model (GCM) Simulations and Future Emission Scenarios

Historical climate model simulations use external forcings or climate drivers (including atmospheric levels of greenhouse gases, solar radiation, and volcanic eruptions) consistent with observed values for each year of the simulation. The historical forcings used by the GCM simulations presented in this report are the Coupled Model Intercomparison Project's "20th Century Climate in Coupled Models" or 20C3M total forcing scenarios.[107] These simulations provide the closest approximation to actual climate forcing from the beginning of the historical simulation to the year 2000.

The historical simulation provides the starting conditions for simulations of future climate. To ensure the accuracy of the historical forcing scenario, it is customary in the climate modeling community for historical simulations to end at least five years before present. So although the GCM simulations were typically conducted after 2005, the historical total-forcing scenario ends and "future" scenarios begin in 2000. In the future scenarios, most external natural climate drivers are fixed, and human emissions correspond to a range of plausible pathways rather than observed values.

Future emissions scenarios depend on a myriad of factors, including: how human societies and economies develop over the coming decades; what technological advances are expected; which energy sources will be used in the future to generate electricity, power, transportation, and serve industry; and how all of these choices affect future emissions from human activities.

To address these questions, in 2000 the Intergovernmental Panel on Climate Change (IPCC) developed a series of scenarios described in the Special Report on Emissions Scenarios (SRES).[108] These scenarios describe internally consistent pathways of future societal development and corresponding emissions.

This analysis used the SRES emission scenarios A1fi higher and B1 lower emissions scenarios (Figure A1). These scenarios were chosen because they cover a broad range of plausible futures in terms of human emissions of carbon dioxide and other radiatively active species and resulting impacts on climate. At the higher end of the range, the SRES high emissions or fossil fuel intensive scenario (A1fi for *fossil-intensive*) represents a world with fossil fuel-intensive economic growth and a global population that peaks mid-century and then declines. New and more efficient technologies are introduced toward the end of the century. In this scenario, atmospheric CO_2 concentrations reach 940 parts per million by 2100, more than triple pre-industrial levels of 280 ppm. At the lower end, the SRES low emissions scenario (B1) also represents a world with high economic growth and a global population that peaks mid-century and then declines. However, this scenario includes a shift to less fossil fuel-intensive industries and the introduction of clean and resource-efficient technologies. Emissions of greenhouse gases peak around mid-century and then decline. Atmospheric carbon dioxide levels reach 550 parts per million by 2100, about double pre-industrial levels. Associated global temperature changes by end-of-century range from 4 to 9°F based on the best estimate of climate sensitivity.

As diverse as they are, the SRES scenarios do not cover the entire range of possible futures. Since 2000,

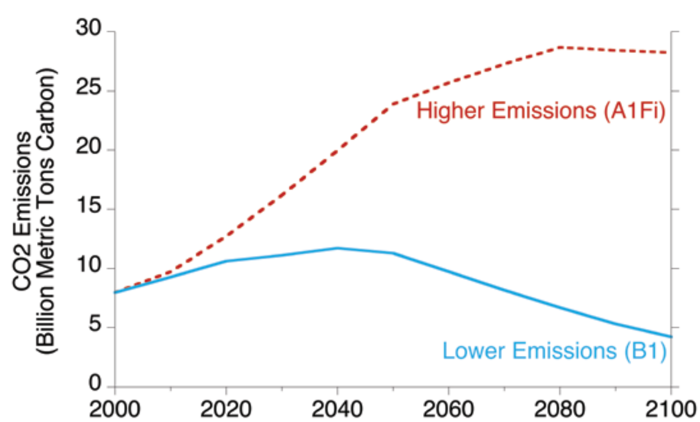


FIGURE A1. Projected future global emissions of carbon dioxide from fossil fuel burning for the "high emissions" (A1fi, red) and "low emissions" (B1, blue) scenarios. Data from Nakicenvoic, et al. (2000).

CO_2 emissions have already been increasing at an average rate of 3 percent per year. If they continue at this rate, emissions will eventually outpace even the highest of the SRES scenarios.[109] On the other hand, significant investments in renewable energy and energy efficiency could reduce CO_2 emissions below the lower B1 emission scenario within a few decades.[110] Nonetheless, the substantial difference between the high- versus the low-emission scenarios used here provides a good illustration of the potential range of changes that could be expected, and how much these depend on future emissions and human choices.

Global Climate Models (GCMs)

Future emission scenarios are used as input to GCMs, complex, three-dimensional coupled models that continually evolve to incorporate the latest scientific understanding of the atmosphere, oceans, and Earth's surface. As output, GCMs produce geographic grid-based projections of temperature, precipitation, and other climate variables at daily and monthly scales. These physical models were originally known as atmosphere-ocean general circulation models (AO-GCMs). However, many of the newest generation of models are now more accurately described as GCMs as they incorporate additional aspects of the Earth's climate system beyond atmospheric and oceanic dynamics.

Because of their complexity, GCMs are constantly being enhanced as scientific understanding of climate improves and as computer computational power increases. Some models are more successful than others at reproducing observed climate and trends over the past century.[111] However, all future simulations agree that both global and regional temperatures will increase over the coming century in response to increasing emissions of heat-trapping gases from human activities.[112]

Historical GCM simulations are initialized in the late 1800s, externally "forced" by the human emissions, volcanic eruptions, and solar variations represented by the historical 20C3M scenario described above. They are also allowed to develop their own pattern of natural chaotic variability over time. This means that, although the climatological means of historical simulations should correspond to observations at the continental to global scale, no temporal correspondence between model simulations and observations should be expected on a day-to-day or even year-to-year basis. For example, while a strong El Niño event occurred from 1997 to 1998 in the real world, it may not occur in a model simulation in that year. Over several decades, however, the average number of simulated El Niño events should be similar to those observed. Similarly, although the central United States suffered the effects of an unusually intense heat wave during the summer of 1995, model simulations for 1995 might show that year as average or even cooler-than-average. However, a similarly intense heat wave should be simulated some time during the climatological period centered around 1995.

In this study, we used GCM simulations archived by the Program for Climate Model Diagnosis and Intercomparison (PCMDI). This collection of climate model simulations, assembled between 2005 and 2006, consists of models that contributed to phase three of the Coupled Model Intercomparison Project (CMIP3)[113] and were the basis for results presented in the 2007 IPCC Fourth Assessment Reports.[114] The CMIP3 GCM simulations used in this project consist of all model outputs archived by PCMDI with daily maximum and minimum temperature and precipitation available for the SRES A1fi and B1 scenarios. Additional simulations were obtained from the archives of the Geophysical Fluid Dynamics Laboratory, the National Center for Atmospheric Research, and the U.K. Meteorological Office. The list of GCMs used, their origin, the scenarios available for each, and their equilibrium climate sensitivity are provided in Table A1.[115]

We chose the GCMs used in this study based on several criteria. First, only well-established models were considered—those already extensively described and evaluated in the peer-reviewed scientific literature. Models had to be evaluated and shown to adequately reproduce key features of the atmosphere and ocean system. Second, the models had to include the greater part of the IPCC range in climate sensitivity. Climate sensitivity is defined as the temperature change resulting from a doubling of atmospheric carbon dioxide concentrations relative to pre-industrial times, after the atmosphere has had decades to adjust to the change. In other words, climate sensitivity determines the extent to which temperatures rise under a given increase in atmospheric concentrations of greenhouse gases.[116] The third and final criterion is that the models chosen must have continuous daily time series of temperature and precipitation archived for the global emisison scenarios used here (SRES A1fi and B1). The GCMs selected for this analysis are the only models that meet these criteria.

For some regions of the world (including the Arctic, but not the continental United States), there is evidence that models better able to reproduce regional climate features may produce different future projections.[117] Such characteristics include large-scale circulation features or feedback processes that can be resolved at the scale of a global model. However, it is not valid to evaluate a global model on its ability to reproduce local features, such as the bias in temperature over a given city or region. Such limitations are to be expected in any GCM, as they are primarily the result of a lack of spatial resolution rather than any inherent shortcoming in the physics of the model. Here, no attempt was made to select a sub-set of GCMs that performed better than others, as previous literature has shown that it is difficult, if not impossible, to identify such a sub-set for the continental United States.[118]

Origin	Model	Scenarios	Equilibrium Climate Sensitivity (°C)*
National Center for Atmospheric Research, USA	CCSM3	A1fi, B1	2.7
National Center for Atmospheric Research, USA	PCM	A1fi, B1	2.1
Geophysical Fluid Dynamics Laboratory, USA	GFDL CM2.1	A1fi, B1	3.4
UK Meteorological Office Hadley Centre	HadCM3	A1fi, B1	3.3

**data from IPCC 2007 Fourth Assessment Report, Chapter 8.*

TABLE A1. Coupled Model Intercomparison Project 3 (CMIP3) global climate modeling groups and their Global Climate Models (GCMs) used in this analysis for generating projections of future climate change. The HaDCM3 model only has 360 days per year. All other models archived full daily time series from 1960 to 2099.

Statistical Downscaling Model

Global climate models (GCMs) cannot accurately capture the fine-scale changes experienced at the regional to local scale. GCM simulations require months of computing time, effectively limiting the typical grid cell sizes of the models to one or more degrees per side. And, although the models are precise to this scale, they are actually skillful, or accurate, to an even coarser scale.[119]

Dynamical and statistical downscaling represent two complimentary ways to incorporate higher-resolution information into GCM simulations in order to obtain local- to regional-scale climate projections. Dynamical downscaling, often referred to as regional climate modeling, uses a limited-area, high-resolution model to simulate physical climate processes at the regional scale, with grid cells typically ranging from 4 to 50 km per side. Statistical downscaling models capture historical relationships between large-scale weather features and local climate, and they use these to translate future projections down to the scale of any observations—here, to individual weather stations.

Statistical models are generally flexible and less computationally demanding compared to regional climate models and are able to use a broad range of GCM inputs to simulate future changes in temperature and precipitation for a continuous period covering more than a century. Hence, statistical downscaling models are best suited for analyses that require a range of future projections reflecting the uncertainty in future emissions scenarios and climate sensitivity, at the scale of observations that may already be used for planning purposes. If the study is more of a sensitivity analysis, where using only one or two future simulations is not a limitation, or if it requires multiple surface and upper-air climate variables as input and has ample financial resources to support multi-year analyses, then regional climate modeling may be more appropriate.

In this project, we used a relatively new statistical downscaling model, the Asynchronous Regional Regression Model (ARRM).[120] Our analysis expands on original applications with modifications specifically aimed at improving the ability of the model to simulate the shape of the distribution including the tails, the use of a piecewise rather than linear regression to accurately capture the often non-linear relationship between modeled and observed quantiles, and bias correction at the tails of the distribution. It is a flexible and computationally efficient statistical model that can downscale station-based or gridded daily values of any variable that can be transformed into an approximately symmetric distribution and for which a large-scale predictor exists. A quantile regression model is derived for each individual weather station that transforms historical model simulations into a probability distribution that closely resembles historical observations (Figure A2a). This model can then be used to transform future model simulations into distributions similar to those observed (Figure A2b).

Both statistical and dynamical downscaling models are based on a number of assumptions, some shared, some unique to each method. Two important shared assumptions are the following: first, that the inputs received from GCMs are reasonable (that is, they adequately capture the large-scale circulation of the atmosphere and ocean at the skillful scale of the

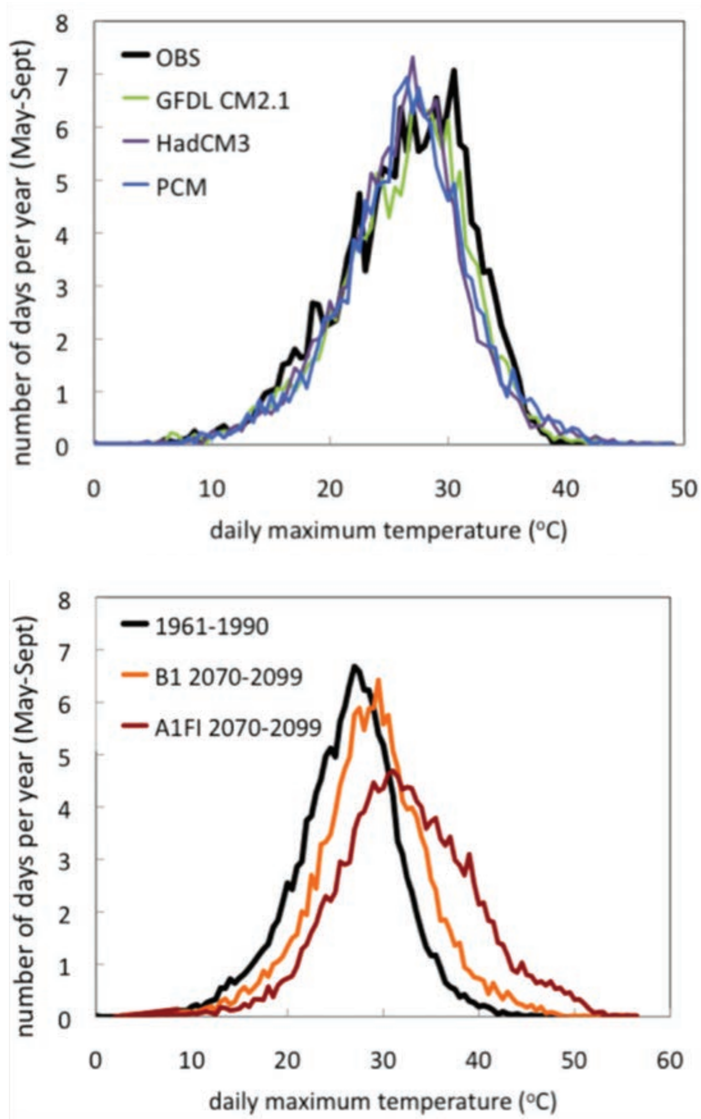


FIGURE A2. (a) Observed (black) and historical simulated distribution of daily maximum summer temperatures by three Global Climate Models for a weather station in Chicago for evaluation period 1980–1999 (top); (b) historical simulated (black) and future projected daily maximum summer temperature under the A1Fi higher (red) and B1 lower (orange) emission scenarios (bottom).

global model); and second, that the information from the GCM fully incorporates the climate change signal over that region. In addition, all statistical models are based on a crucial assumption often referred to as stationarity. Stationarity assumes that the relationship between large-scale weather systems and local climate will remain constant over time. This assumption may be valid for lesser amounts of change, but could lead to biases under larger amounts of climate change.[121]

In a separate project, we are currently evaluating the stationarity of three downscaling methods, including the ARRM method used here. Preliminary analyses show that the assumption of stationarity holds true over much of the world for the lower and middle of the distribution. The only location where ARRM performance is systematically non-stationary is at high temperatures (at and above the 99.9th quantile) along coastal areas, with warm biases up to 6°C. (This bias is therefore only important for days hotter than the 1-in-1000 historical day, so in other words days that historically occur no more than one day every 2.7 years.) This may be due to the statistical model's inability to capture dynamical changes in the strength of the land-sea breeze as the temperature differences between land and ocean are exacerbated under climate change; the origins of this feature are currently under investigation. For precipitation, the ARRM method is characterized by a spatially variable bias at all quantiles that is generally not systematic, and varies from approximately -30 to +30 percent for higher quantiles of precipitation (above the 90th percentile) depending on location.

The methods used to statistically downscale GCM simulation using asynchronous quantile regression are described in detail in a published paper.[122] In terms of training the downscaling model using meteorological data from New Hampshire weather stations, the observed record must have an adequate length and quality of data. A minimum of twenty consecutive years of daily observations with less than 5 percent missing data is commonly required in order to appropriately sample from the range of natural climate variability at most of the station locations examined. Here, downscaling was conducted using the entire record from 1960 to 2012 to include as broad a range of observed variability as possible. Downscaling was conducted and tested using observed daily minimum and maximum temperature for twenty-five GHCN-Daily stations in southern New Hampshire (south of latitude 43.9 N; Table 7; Figure 10) and observed 24-hour cumulative precipitation for forty-one GHCN-Daily stations in southern New Hampshire (Table 8; Figure 11). Although GHCN-Daily station data have already undergone a standardized quality control,[123] before using the station data for downscaling, they were filtered using a quality control algorithm to identify and remove erroneous values previously identified in the GHCN database. This additional quality control step included three tests for errors, removing 1) data on any days where the daily reported minimum temperature exceeded the reported maximum, 2) any temperature values above (below) the highest (lowest) recorded values for North America, or with precipitation below zero or above the highest recorded value for the state of New Hampshire, and 3) repeated values of more than five consecutive days with identical temperature or non-zero precipitation values to the first decimal.

Addressing Uncertainty

The primary challenge of a climate assessment is the reliability of information concerning future climate. A common axiom warns that the only aspect of the future that can be predicted with any certainty is the fact that it is impossible to do so. However, although it is not possible to predict the future, it is possible to project it. Projections can describe what is likely to occur under a set of consistent and clearly articulated assumptions. For climate change, these assumptions should encompass a broad variety of the ways in which energy, population, development, and technology might change in the future.

There is always some degree of uncertainty inherent in any future projections. In order to accurately interpret and apply future projections for planning purposes, it is essential to quantify both the magnitude of the uncertainty as well as the reasons for its existence. Each of the steps involved in generating projections—future scenarios, global modeling, and downscaling—introduces a degree of uncertainty into future projections; how to address this uncertainty is the focus of this section.

"A common axiom warns that the only aspect of the future that can be predicted with any certainty is the fact that it is impossible to do so. However, although it is not possible to predict the future, it is possible to project it."

Another well-used axiom states that all models are wrong, but some models are useful. The Earth's climate is a complex system. It is only possible to simulate those processes that have been observed and documented. Clearly, there are other feedbacks and forcing factors at work that are challenging to capture or have yet to be documented. Hence, it is a common tendency to assign most of the range in future projections to model, or scientific, uncertainty.

Future projections will always be limited by scientific understanding of the system being predicted. However, there are other important sources of uncertainty that must be considered—some that even outweigh model uncertainty for certain variables and time scales. Uncertainty in climate change at the global to regional scale arises primarily due to three different causes: (1) natural variability in the climate system, (2) scientific uncertainty in predicting the response of the Earth's climate system to human-induced change, and (3) socio-economic or scenario uncertainty in predicting future energy choices and hence emissions of heat-trapping gases.[124]

Scenario uncertainty is very different, and entirely distinct, from scientific uncertainty in at least two important ways. First, while scientific uncertainty can be reduced through coordinated observational programs and improved physical modeling, scenario uncertainty arises due to the fundamental inability to predict future changes in human behavior. It can only be reduced by the passing of time, as certain choices (such as depletion of a non-renewable resource) can eliminate or render certain options less likely. Second, scientific uncertainty is often characterized by a normal distribution, where the mean value is more likely than the outliers. Scenario uncertainty, however, hinges primarily on whether or not the primary emitters of heat-trapping gases, including traditionally large emitters such as the United States and nations with rapidly-growing contributions such as India and China, will enact binding legislation to reduce their emissions. If they do enact legislation, then the lower emission scenarios become more probable. If they do not, then the higher emission scenarios become more probable. The longer such action is delayed, the less likely it becomes to achieve a lower emissions scenario because of the emissions that continue to accumulate in the atmosphere. Consequently, scenario uncertainty cannot be considered to be a normal distribution. Rather, the consequences of a lower versus a higher emissions scenario must be considered independently, in order to isolate the role that human choices are likely to play in determining future impacts.

Over timescales of years to several decades, natural chaotic variability is the most important source of uncertainty (Figure A3). By mid-century, scientific or model uncertainty is the largest contributor to the range in projected temperature and precipitation change. By the end of the century, scenario uncertainty is most important for temperature projections, while model uncertainty continues as the dominant source of uncertainty in precipitation. This is consistent with the results of the projections discussed in this report, where there is a significant difference between the changes projected under high versus low emission scenarios for temperature-based and heavy precipitation indicators, but little difference for mean precipitation-based indicators.

The first source of uncertainty can be addressed by always averaging or otherwise sampling from the statistical distribution of future projections over a climatological period—typically, twenty to thirty years. In other words, the average winter temperature should be averaged over several decades, as should the coldest day of the year. No time stamp more precise than twenty to thirty years should ever be assigned to any future projection. In this report and accompanying data files, simulations are always averaged over four thirty-year climatological time periods: historical (1980–2009), near-term (2010–2039), mid-century (2040–2069), and end-of-century (2070–2099).

The second source of uncertainty, model or scientific uncertainty, can be addressed by using multiple global climate models to simulate the response of the climate system to human-induced change. As noted above, the climate models used here cover a range of climate sensitivity (Table A1); they also cover an even wider range of precipitation projections, particularly at the local to regional scale. Only models that demonstratively fail to reproduce the basic features of large-scale climate dynamics (for example, the Jet Stream or El Niño) should be eliminated from consideration. Multiple studies have convincingly demonstrated that the average of an ensemble of simulations from a range of climate models (even ones of varied ability) is generally closer to reality than the simulations from one individual model, even one deemed "good" when evaluated on its performance over a given region.[125] Hence, wherever possible, impacts should be summarized in terms of the values resulting from multiple climate models, while uncertainty estimates can be derived from the range or variance in model projections. This is why all plots and tables in this report show multi-model mean values.

The third and final primary source of uncertainty in future projections can be addressed through generating climate projections for multiple futures: for example, a "higher emissions" future where the world continues to depend on fossil fuels as the primary energy source (SRES A1fi), as compared to a "lower emissions" future focusing on sustainability and conservation (SRES B1).

Over the next two-to-three decades, projections can be averaged across emission scenarios as there is no significant difference between scenarios over that time frame due to the inertia of the climate system in responding to changes in heat-trapping gas levels in the atmosphere.[126] Past mid-century, however, projections should never be averaged across scenarios; rather, the difference in impacts resulting from a higher as compared to a lower scenario should always be clearly delineated. That is why, in this report, future projections are always summarized in terms of what is expected for each scenario individually.

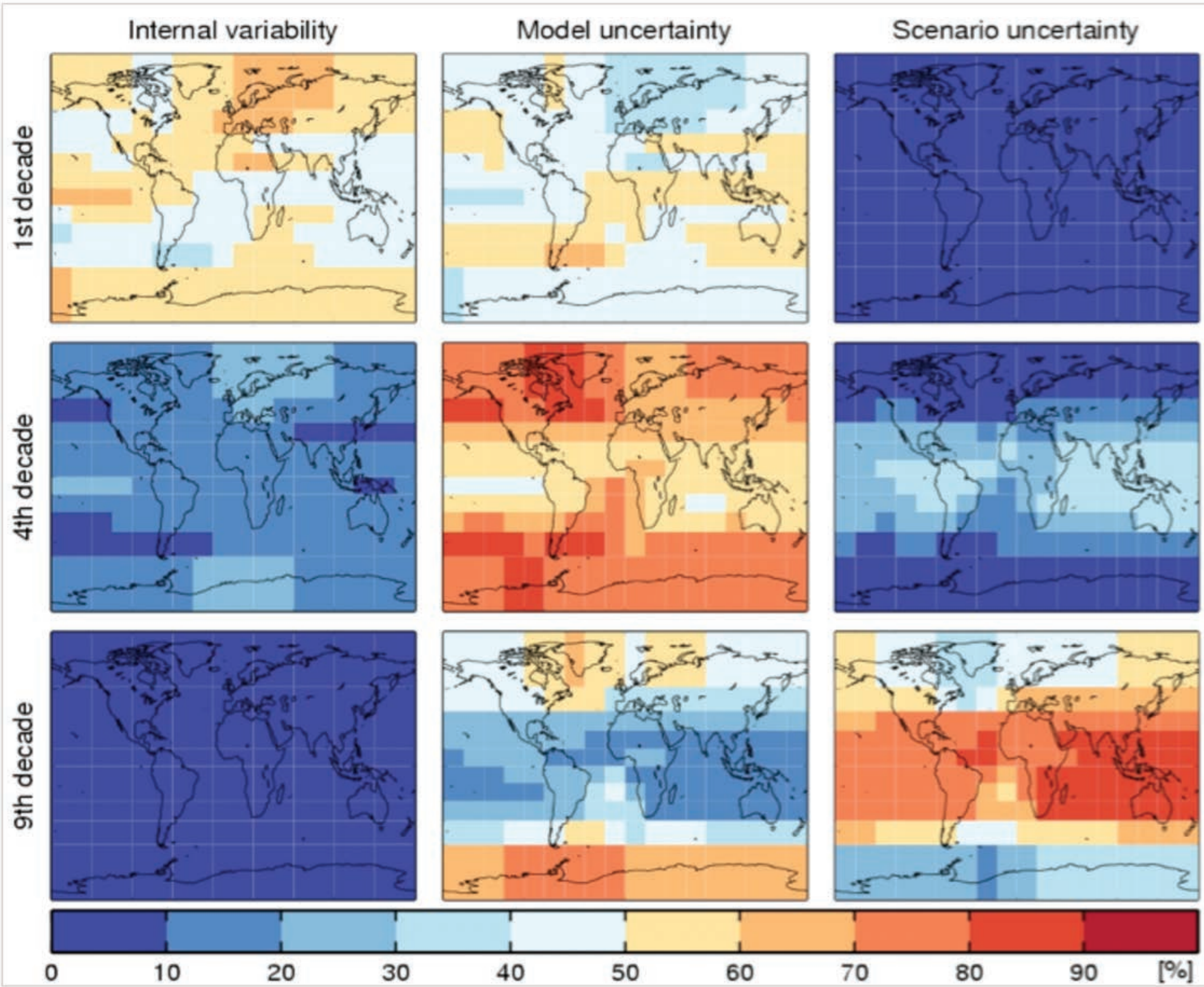


FIGURE A3. Percentage of uncertainty in future temperature projections one decade in the future (top row), four decades in the future (middle row), and nine decades in the future (bottom row) that can be attributed to natural variability (left column), model uncertainty (center column), and scenario uncertainty (right column). Figure from Hawkins & Sutton (endnote reference 124).

APPENDIX B.

CLIMATE GRIDS FOR TWENTY-FIVE STATIONS IN SOUTHERN NEW HAMPSHIRE

This Appendix contains climate grids with historical and projected future thirty-year climatologies for twenty-five Global Historical Climatology Network-Daily (GHCN-Daily) meteorological stations (Table B1) in southern New Hampshire (that is, south of 43.9° north latitude) for the historical period [1980–2009] and the future (near-term [2010–2039], medium-term [2040–2069] and long-term [2070–2099]). The projected values represent the average of daily simulations four Global Climate Models (GCMs) (see Table A1 in the report for more information on the GCMs). Each average was first calculated for each individual GCM, then the results of all four GCMs were averaged.

The climate grids include thirty-year averages of daily measures for minimum and maximum temperature (annual, seasonal, extremes), length of the growing season (number of days between the last hard freeze in the spring and first hard freeze in the fall, using a threshold of 28°F), precipitation (annual, seasonal, extremes), and snow-covered days. There were significant gaps in the daily data from some NH GHCN-Daily stations for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output. The climate grids are arranged in alphabetical order based on the station name.

Station Name	Latitude (N)	Longitude	Elevation (ft)	StationID
Blackwater Dam	43.32	-71.72	183	270741
Deering	43.09	-71.87	325	271950
Durham	43.14	-70.95	23	272174
East Deering	43.07	-71.82	241	272284
Epping	43.03	-71.08	49	272800
Franklin	43.45	-71.67	119	273177
Franklin Falls	43.47	-71.67	131	273182
Grafton	43.57	-71.95	253	273530
Greenland	43.02	-70.83	26	273626
Hanover	43.71	-72.29	178	273850
Hudson	42.78	-71.41	56	274234
Keene	42.94	-72.32	156	274399
Lakeport	43.55	-71.46	152	274480
Lakeport2	43.55	-71.47	171	274475
Manchester	43.03	-71.48	64	275072
Massabesic Lake	42.99	-71.39	77	275211
Mt. Sunapee	43.33	-72.08	387	275629
Nashua	42.77	-71.45	27	275702
Nashua2	42.79	-71.47	41	275712
Newport	43.38	-72.18	235	275868
Peterboro	42.85	-71.95	311	276697
Plymouth	43.78	-71.65	201	276945
Surry Mtn	43.00	-72.31	171	278539
Tamworth	43.90	-71.30	241	278612
Windham	42.82	-71.33	67	279740

TABLE B1. List and location of 25 GHCN-Daily stations in southern New Hampshire for which climate grids are provided.

Blackwater Dam, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	33.6	1.6	1.9	2.7	5.0	3.6	8.4
Winter TMIN	11.2	2.3	2.7	3.6	5.7	4.9	9.4
Spring TMIN	32.2	2.9	1.3	4.5	3.9	5.6	7.0
Summer TMIN	54.3	1.5	2.1	2.7	5.4	3.3	9.1
Fall TMIN	36.1	0.0	1.8	0.3	5.1	0.8	8.4
Maximum Temperature (°F)							
Annual TMAX	56.3	1.7	1.7	3.0	4.9	4.0	8.3
Winter TMAX	32.0	1.8	1.7	2.6	3.7	3.7	6.3
Spring TMAX	54.6	2.6	1.5	5.1	4.7	7.0	8.7
Summer TMAX	79.2	1.7	2.1	3.3	5.7	4.1	9.4
Fall TMAX	58.8	0.8	1.9	1.2	5.6	1.4	8.9
Temperature Extreme (days per year)							
<32°F	169	-8	-11	-15	-24	-18	-42
<0°F	18	-5	-5	-8	-12	-10	-16
>90°F	5	4	5	10	20	16	45
>95°F	0	1	1	3	5	6	18
TMAX on hottest day of year	92.5	2.2	1.2	3.8	4.3	5.6	8.3
TMIN on coldest day of year	-17.1	3.7	4.4	5.9	10.1	7.8	17.3
Growing Season (days)	162	12	13	17	29	20	47
Precipitation (inches)							
Annual mean	44.0	4.5	2.6	5.6	5.9	7.4	8.9
Winter mean	10.3	1.3	0.9	1.5	1.5	2.2	3.2
Spring mean	10.8	1.4	1.1	2.2	1.8	2.2	2.8
Summer mean	11.6	1.8	0.7	1.3	1.8	2.6	1.5
Fall mean	11.3	0.1	0.0	0.5	0.6	0.6	1.4
Extreme Precipitation (events per year)							
1” in 24 hrs	11.0	1.8	1.3	2.3	2.8	2.8	4.1
2” in 48 hours	4.9	1.6	0.9	1.7	2.2	2.5	4.2
Extreme Precipitation (events per decade)							
4” in 48 hours	4.3	2.3	1.1	4.3	5.4	7.0	8.8
Snow-Covered Days	96	-14	-15	-20	-36	-29	-51

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Deering, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	37.3	1.7	1.9	2.8	4.9	3.6	8.3
Winter TMIN	16.5	2.1	2.3	3.4	5.1	4.6	8.6
Spring TMIN	35.1	2.9	1.5	4.6	4.0	5.7	7.2
Summer TMIN	57.2	1.4	1.9	2.6	5.2	3.2	9.0
Fall TMIN	40.1	0.2	1.8	0.4	5.1	0.9	8.5
Maximum Temperature (°F)							
Annual TMAX	56.1	1.6	1.7	2.8	4.6	3.7	7.9
Winter TMAX	32.9	1.8	1.5	2.6	3.5	3.7	6.1
Spring TMAX	55.9	2.4	1.6	4.7	4.5	6.3	8.2
Summer TMAX	77.7	1.4	1.9	2.8	5.1	3.5	8.6
Fall TMAX	57.6	0.8	1.6	1.2	5.2	1.4	8.5
Temperature Extreme (days per year)							
<32°F	143	-10	-11	-16	-25	-20	-43
<0°F	8	-3	-4	-5	-6	-6	-8
>90°F	2	1	2	4	12	8	32
>95°F	0	0	0	0	2	2	10
TMAX on hottest day of year	89.5	1.5	1.3	2.8	4.7	4.7	8.4
TMIN on coldest day of year	-9.4	3.3	3.5	5.4	9.0	6.7	15.3
Growing Season (days)	186	13	14	18	30	22	48
Precipitation (inches)							
Annual mean	47.7	5.8	3.3	9.1	7.8	11.0	11.6
Winter mean	11.6	1.4	0.9	2.7	2.9	3.5	5.9
Spring mean	12.0	1.6	1.0	2.5	1.0	2.8	2.4
Summer mean	11.2	1.8	0.8	1.4	1.7	2.5	0.9
Fall mean	12.9	1.1	0.6	2.5	2.2	2.2	2.5
Extreme Precipitation (events per year)							
1” in 24 hrs	11.6	2.2	1.5	2.9	2.2	3.8	3.5
2” in 48 hours	5.6	2.2	1.3	2.8	2.4	3.7	4.3
Extreme Precipitation (events per decade)							
4” in 48 hours	7.8	5.4	0.7	9.8	6.1	10.7	12.6
Snow-Covered Days	81	-13	-13	-17	-33	-25	-44

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Durham, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.9	1.8	2.0	3.0	5.3	3.9	9.2
Winter TMIN	15.6	2.3	2.6	3.6	5.6	4.9	9.3
Spring TMIN	33.4	2.9	1.6	4.6	4.3	5.9	7.7
Summer TMIN	55.5	1.7	2.3	3.1	6.1	3.8	10.8
Fall TMIN	38.7	0.3	1.8	0.7	5.4	1.2	9.0
Maximum Temperature (°F)							
Annual TMAX	59.3	1.7	1.7	3.0	4.9	4.0	8.3
Winter TMAX	36.2	1.7	1.5	2.4	3.4	3.5	6.0
Spring TMAX	57.4	2.5	1.6	4.8	4.8	6.6	8.8
Summer TMAX	81.2	1.8	2.2	3.4	5.9	4.3	9.8
Fall TMAX	62.0	0.9	1.7	1.3	5.3	1.6	8.5
Temperature Extreme (days per year)							
<32°F	154	-11	-11	-18	-28	-22	-48
<0°F	10	-3	-4	-6	-7	-6	-10
>90°F	10	6	7	15	28	21	57
>95°F	2	1	1	4	11	8	32
TMAX on hottest day of year	94.8	1.8	1.4	3.0	4.5	5.0	7.9
TMIN on coldest day of year	-13.5	4.1	5.0	6.6	11.0	8.5	18.6
Growing Season (days)	164	14	15	20	31	24	54
Precipitation (inches)							
Annual mean	43.7	4.2	3.8	5.2	6.8	7.1	10.4
Winter mean	9.6	1.1	0.8	1.4	1.3	2.1	2.8
Spring mean	11.2	1.2	2.0	1.4	2.4	2.1	3.9
Summer mean	10.6	1.4	0.8	1.3	2.2	2.1	2.5
Fall mean	12.4	0.5	0.1	1.0	0.8	0.8	1.2
Extreme Precipitation (events per year)							
1” in 24 hrs	10.8	1.2	2.0	1.8	3.3	2.2	4.6
2” in 48 hours	5.1	1.3	1.4	1.8	2.6	2.7	4.4
Extreme Precipitation (events per decade)							
4” in 48 hours	6.6	3.2	0.2	4.8	5.4	7.4	10.3
Snow-Covered Days	77	-15	-16	-20	-34	-27	-45

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

East Deering, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	33.4	1.8	2.2	2.9	5.4	3.9	9.1
Winter TMIN	12.1	2.2	2.7	3.6	5.7	4.9	9.4
Spring TMIN	31.1	3.3	1.4	5.0	4.2	6.2	7.6
Summer TMIN	53.7	1.6	2.3	2.8	5.8	3.5	10.0
Fall TMIN	36.5	-0.1	2.1	0.2	5.6	0.7	9.1
Maximum Temperature (°F)							
Annual TMAX	56.2	1.6	1.7	2.9	4.7	3.8	8.1
Winter TMAX	32.8	1.6	1.6	2.3	3.4	3.4	5.8
Spring TMAX	54.3	2.6	1.4	5.0	4.5	6.7	8.3
Summer TMAX	78.3	1.7	1.9	3.1	5.3	3.9	9.1
Fall TMAX	59.1	0.7	2.0	1.1	5.5	1.3	8.7
Temperature Extreme (days per year)							
<32°F	174	-8	-12	-15	-26	-18	-44
<0°F	17	-5	-5	-8	-12	-10	-16
>90°F	3	3	2	7	13	12	35
>95°F	0	1	1	2	3	4	14
TMAX on hottest day of year	91.4	2.1	1.7	3.4	5.8	5.5	10.4
TMIN on coldest day of year	-17.9	4.2	5.1	6.6	11.1	8.4	18.6
Growing Season (days)	150	8	12	16	30	19	53
Precipitation (inches)							
Annual mean	44.9	4.2	3.1	5.0	5.5	6.9	8.4
Winter mean	10.5	1.2	1.1	1.3	1.4	1.9	3.1
Spring mean	10.8	1.1	0.9	1.9	1.6	2.0	2.9
Summer mean	11.5	1.6	1.2	0.9	2.3	2.0	1.9
Fall mean	12.0	0.5	0.1	1.0	0.1	1.0	0.6
Extreme Precipitation (events per year)							
1” in 24 hrs	10.9	1.8	1.6	2.0	2.6	2.7	4.2
2” in 48 hours	4.8	2.0	1.3	2.2	2.1	2.9	4.2
Extreme Precipitation (events per decade)							
4” in 48 hours	5.5	2.1	-0.9	4.0	3.8	6.5	6.0
Snow-Covered Days	81	-13	-13	-17	-33	-25	-44

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Epping, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.9	1.8	2.1	3.0	5.3	3.9	9.2
Winter TMIN	15.7	2.3	2.5	3.6	5.4	4.9	9.1
Spring TMIN	33.6	2.9	1.6	4.6	4.3	5.8	7.6
Summer TMIN	55.8	1.7	2.2	3.0	6.0	3.7	11.0
Fall TMIN	38.3	0.4	1.8	0.7	5.3	1.2	8.9
Maximum Temperature (°F)							
Annual TMAX	58.6	1.7	1.7	3.0	4.9	4.0	8.3
Winter TMAX	35.5	1.7	1.6	2.5	3.6	3.7	6.3
Spring TMAX	56.7	2.6	1.7	5.0	4.9	6.7	9.0
Summer TMAX	80.5	1.8	2.2	3.4	5.8	4.2	9.5
Fall TMAX	61.1	1.0	1.7	1.4	5.3	1.6	8.6
Temperature Extreme (days per year)							
<32°F	157	-11	-12	-17	-28	-22	-48
<0°F	10	-4	-4	-6	-7	-7	-9
>90°F	8	5	6	13	25	18	54
>95°F	1	1	1	2	8	4	24
TMAX on hottest day of year	93.5	1.5	1.4	2.4	4.2	3.7	7.7
TMIN on coldest day of year	-12.9	4.0	4.5	6.5	10.5	8.3	17.9
Growing Season (days)	164	13	12	20	30	21	52
Precipitation (inches)							
Annual mean	45.7	4.7	2.8	6.4	6.0	8.7	9.2
Winter mean	10.6	1.2	0.9	1.5	1.2	2.4	2.9
Spring mean	12.1	1.3	1.3	2.1	1.9	2.8	3.7
Summer mean	10.7	1.9	0.4	1.6	1.3	2.5	0.7
Fall mean	12.3	0.4	0.3	1.2	1.4	1.0	2.0
Extreme Precipitation (events per year)							
1” in 24 hrs	11.1	1.7	1.6	2.4	2.9	3.1	4.2
2” in 48 hours	5.2	1.6	1.4	2.4	2.4	3.1	4.5
Extreme Precipitation (events per decade)							
4” in 48 hours	5.6	3.7	-0.4	6.9	6.4	8.3	11.8
Snow-Covered Days	77	-15	-17	-20	-34	-26	-44

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Franklin, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.2	1.7	2.1	2.9	5.2	3.8	8.8
Winter TMIN	11.5	2.3	2.8	3.7	5.9	5.1	9.7
Spring TMIN	31.7	3.2	1.3	4.9	4.1	6.2	7.5
Summer TMIN	54.9	1.5	2.1	2.7	5.5	3.3	9.4
Fall TMIN	38.4	-0.1	2.1	0.2	5.4	0.7	8.7
Maximum Temperature (°F)							
Annual TMAX	58.8	1.7	1.7	2.9	4.7	3.9	8.1
Winter TMAX	32.9	1.6	1.6	2.2	3.3	3.2	5.6
Spring TMAX	57.5	2.7	1.3	5.2	4.4	7.0	8.3
Summer TMAX	82.6	1.7	1.9	3.1	5.4	3.9	9.2
Fall TMAX	61.9	0.7	2.0	1.1	5.7	1.4	9.0
Temperature Extreme (days per year)							
<32°F	164	-9	-11	-15	-25	-18	-43
<0°F	18	-5	-5	-9	-12	-10	-16
>90°F	14	7	7	17	29	24	57
>95°F	2	3	2	7	12	12	32
TMAX on hottest day of year	95.8	2.2	1.4	3.2	5.4	5.6	9.8
TMIN on coldest day of year	-20.2	5.0	5.8	7.4	12.6	9.9	20.6
Growing Season (days)	160	12	15	17	31	19	52
Precipitation (inches)							
Annual mean	38.5	3.4	1.7	3.7	3.5	5.4	5.1
Winter mean	8.6	0.9	0.9	1.1	1.2	1.6	2.6
Spring mean	9.6	0.5	0.4	0.7	0.6	1.1	1.2
Summer mean	9.5	1.5	0.2	1.1	0.8	1.8	-0.1
Fall mean	10.9	0.4	0.2	0.8	0.7	0.8	1.2
Extreme Precipitation (events per year)							
1” in 24 hrs	7.7	1.7	1.2	1.8	2.0	2.3	3.2
2” in 48 hours	3.3	1.1	0.6	1.4	1.4	1.9	2.9
Extreme Precipitation (events per decade)							
4” in 48 hours	3.3	1.3	-0.2	1.1	2.5	3.1	3.6
Snow-Covered Days	105	-14	-14	-20	-37	-30	-54

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Franklin Falls, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	32.3	1.8	2.1	2.9	5.3	3.8	8.9
Winter TMIN	9.6	2.3	2.8	3.7	5.9	5.0	9.8
Spring TMIN	31.0	2.9	1.5	4.6	4.3	5.8	7.5
Summer TMIN	53.7	1.5	2.2	2.7	5.7	3.4	9.7
Fall TMIN	34.6	0.2	1.8	0.5	5.1	1.0	8.5
Maximum Temperature (°F)							
Annual TMAX	57.1	1.8	1.9	3.1	5.1	4.1	8.6
Winter TMAX	33.2	1.8	1.8	2.6	3.7	3.7	6.4
Spring TMAX	55.8	2.6	1.7	5.0	4.9	6.7	8.9
Summer TMAX	79.9	1.8	2.3	3.5	6.2	4.3	10.3
Fall TMAX	59.1	0.9	1.8	1.3	5.4	1.5	8.7
Temperature Extreme (days per year)							
<32°F	178	-9	-11	-15	-25	-18	-43
<0°F	23	-6	-6	-10	-14	-11	-19
>90°F	8	5	6	12	24	17	50
>95°F	1	1	2	3	10	6	27
TMAX on hottest day of year	94.2	1.9	1.8	3.1	5.8	5.1	10.6
TMIN on coldest day of year	-18.6	3.6	3.7	5.6	9.3	7.3	16.6
Growing Season (days)	148	9	10	17	28	20	50
Precipitation (inches)							
Annual mean	43.0	4.4	2.6	5.6	6.4	8.6	9.8
Winter mean	9.7	1.2	1.0	1.2	1.4	2.1	3.0
Spring mean	10.4	1.3	0.9	2.1	1.6	2.4	2.8
Summer mean	11.6	1.6	1.1	1.1	2.6	2.3	2.3
Fall mean	11.2	0.5	-0.3	1.2	0.8	1.8	1.7
Extreme Precipitation (events per year)							
1” in 24 hrs	9.7	1.9	1.5	2.6	2.9	3.2	4.6
2” in 48 hours	4.2	1.4	0.9	1.8	2.3	2.7	4.3
Extreme Precipitation (events per decade)							
4” in 48 hours	3.9	2.8	-1.1	2.4	3.9	6.4	7.1
Snow-Covered Days	105	-14	-14	-20	-37	-30	-54

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Grafton, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	30.4	2.0	2.3	3.3	5.7	4.3	9.7
Winter TMIN	8.2	2.7	3.1	4.3	6.5	5.9	10.9
Spring TMIN	28.5	3.3	1.6	5.2	4.7	6.4	8.2
Summer TMIN	50.9	1.8	2.4	3.2	6.2	3.9	10.6
Fall TMIN	33.7	0.2	1.9	0.5	5.4	1.0	9.0
Maximum Temperature (°F)							
Annual TMAX	55.4	1.7	1.7	3.0	4.8	4.0	8.3
Winter TMAX	31.0	1.9	1.7	2.7	3.7	3.9	6.4
Spring TMAX	54.1	2.5	1.6	4.9	4.8	6.6	8.7
Summer TMAX	78.2	1.7	2.1	3.3	5.7	4.1	9.4
Fall TMAX	57.7	0.9	1.7	1.3	5.4	1.5	8.7
Temperature Extreme (days per year)							
<32°F	189	-10	-12	-18	-28	-21	-48
<0°F	29	-8	-7	-11	-16	-14	-24
>90°F	4	2	3	8	16	13	40
>95°F	0	1	1	2	4	4	15
TMAX on hottest day of year	91.6	1.9	1.4	3.0	4.4	4.1	7.4
TMIN on coldest day of year	-24.6	4.6	5.0	7.1	11.6	9.2	20.2
Growing Season (days)	128	8	11	17	31	21	53
Precipitation (inches)							
Annual mean	39.2	3.5	3.2	4.2	5.6	6.2	8.3
Winter mean	8.3	1.2	0.8	1.1	1.2	1.7	2.4
Spring mean	9.7	0.5	1.0	1.3	1.3	1.7	2.5
Summer mean	10.8	1.5	1.0	0.8	2.4	2.0	2.1
Fall mean	10.4	0.4	0.4	0.9	0.6	0.9	1.4
Extreme Precipitation (events per year)							
1” in 24 hrs	8.8	1.3	1.8	1.9	2.7	2.2	4.4
2” in 48 hours	3.4	1.1	1.1	1.2	2.0	1.9	3.6
Extreme Precipitation (events per decade)							
4” in 48 hours	2.2	2.9	1.0	1.4	2.9	4.8	5.7
Snow-Covered Days	112	-13	-13	-19	-36	-28	-53

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Greenland, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	37.5	1.8	2.0	3.0	5.2	3.9	8.9
Winter TMIN	18.1	2.2	2.3	3.4	5.1	4.6	8.7
Spring TMIN	34.9	2.8	1.6	4.4	4.3	5.6	7.5
Summer TMIN	56.4	1.8	2.3	3.1	6.0	3.8	10.5
Fall TMIN	40.3	0.5	1.6	0.8	5.2	1.3	8.7
Maximum Temperature (°F)							
Annual TMAX	59.0	1.7	1.7	3.1	5.0	4.1	8.7
Winter TMAX	37.0	1.8	1.5	2.6	3.5	3.7	6.2
Spring TMAX	56.6	2.5	1.7	4.9	5.0	6.7	9.2
Summer TMAX	80.2	1.9	2.4	3.6	6.4	4.6	10.7
Fall TMAX	61.6	1.0	1.5	1.4	5.2	1.7	8.6
Temperature Extreme (days per year)							
<32°F	142	-12	-12	-18	-29	-24	-50
<0°F	6	-3	-3	-4	-5	-5	-6
>90°F	9	5	7	14	28	19	57
>95°F	1	2	2	4	12	8	33
TMAX on hottest day of year	94.7	1.7	1.8	3.1	5.6	5.0	10.8
TMIN on coldest day of year	-8.8	3.7	4.4	5.9	9.8	7.7	16.7
Growing Season (days)	177	14	14	22	33	28	54
Precipitation (inches)							
Annual mean	49.7	4.7	3.9	6.5	8.3	8.0	12.0
Winter mean	11.9	1.4	1.2	1.8	1.9	2.4	3.7
Spring mean	13.4	1.0	1.0	1.5	2.0	2.2	3.3
Summer mean	11.0	1.4	1.1	1.3	2.2	2.1	2.6
Fall mean							
Extreme Precipitation (events per year)							
1" in 24 hrs	13.5	1.6	1.6	2.5	3.1	3.1	4.5
2" in 48 hours	7.1	1.6	1.7	2.6	3.8	3.1	5.8
Extreme Precipitation (events per decade)							
4" in 48 hours	9.6	2.8	0.5	5.9	9.3	7.6	17.5
Snow-Covered Days	92	-13	-12	-18	-30	-27	-45

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Hanover, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -) Short Term 2010–2039 Low Emissions	Short Term 2010–2039 High Emissions	Medium Term 2040–2069 Low Emissions	Medium Term 2040–2069 High Emissions	Long Term 2070–2099 Low Emissions	Long Term 2070–2099 High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.2	1.8	2.0	2.9	5.1	3.9	8.8
Winter TMIN	12.3	2.5	2.9	4.0	6.2	5.5	10.3
Spring TMIN	32.9	3.0	1.6	4.7	4.4	5.9	7.7
Summer TMIN	56.2	1.5	2.0	2.6	5.2	3.2	9.0
Fall TMIN	38.9	0.2	1.6	0.5	4.9	1.0	8.1
Maximum Temperature (°F)							
Annual TMAX	56.7	1.8	1.8	3.1	4.9	4.0	8.3
Winter TMAX	31.5	1.8	1.7	2.7	3.6	3.9	6.3
Spring TMAX	56.0	2.5	1.6	4.9	4.8	6.6	8.7
Summer TMAX	80.3	1.8	2.1	3.3	5.8	4.2	9.6
Fall TMAX	58.7	0.9	1.6	1.3	5.3	1.5	8.5
Temperature Extreme (days per year)							
<32°F	156	-10	-10	-16	-26	-20	-44
<0°F	18	-5	-5	-9	-12	-10	-16
>90°F	8	5	6	13	24	18	50
>95°F	1	1	2	4	10	6	27
TMAX on hottest day of year	94.2	1.8	1.3	2.9	4.6	4.0	8.3
TMIN on coldest day of year	-18.0	4.0	4.4	6.1	10.7	8.1	18.6
Growing Season (days)	168	14	14	20	31	23	51
Precipitation (inches)							
Annual mean	38.5	3.7	2.9	4.5	6.2	6.4	9.1
Winter mean	8.2	0.9	0.6	0.9	1.1	1.5	2.2
Spring mean	9.3	0.8	1.0	1.6	1.7	1.7	3.0
Summer mean	10.7	1.4	0.7	0.9	1.9	2.1	1.4
Fall mean							
Extreme Precipitation (events per year)							
1” in 24 hrs	8.2	1.6	1.6	2.1	2.8	3.0	4.9
2” in 48 hours	3.1	1.2	0.8	1.1	2.2	2.2	3.5
Extreme Precipitation (events per decade)							
4” in 48 hours	1.0	1.6	0.7	1.4	2.7	4.3	4.9
Snow-Covered Days	117	-10	-11	-17	-33	-25	-50

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Hudson, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.3	1.8	1.9	3.0	5.1	3.9	8.8
Winter TMIN	14.0	2.3	2.3	3.6	5.1	4.8	8.7
Spring TMIN	32.8	2.8	1.7	4.5	4.5	5.7	7.8
Summer TMIN	56.4	1.7	2.2	2.9	5.7	3.6	9.8
Fall TMIN	37.7	0.6	1.5	0.9	5.0	1.3	8.7
Maximum Temperature (°F)							
Annual TMAX	58.8	1.8	1.7	3.2	5.0	4.1	8.5
Winter TMAX	36.1	1.9	1.5	2.7	3.5	3.8	6.1
Spring TMAX	56.7	2.6	1.8	5.1	5.1	6.8	9.3
Summer TMAX	80.6	1.8	2.3	3.5	6.2	4.4	10.3
Fall TMAX	61.3	1.1	1.4	1.5	5.1	1.6	8.3
Temperature Extreme (days per year)							
<32°F	163	-11	-10	-17	-25	-21	-43
<0°F	12	-5	-4	-7	-8	-8	-11
>90°F	11	5	7	14	27	20	56
>95°F	2	1	2	4	13	6	33
TMAX on hottest day of year	95.0	1.5	1.6	2.6	5.2	4.1	9.5
TMIN on coldest day of year	-12.9	3.6	3.7	5.9	9.1	7.6	15.8
Growing Season (days)	163	12	11	16	26	20	45
Precipitation (inches)							
Annual mean	45.8	2.8	4.2	3.9	5.9	6.0	7.9
Winter mean	10.4	1.1	0.7	1.3	1.1	1.9	2.5
Spring mean	12.3	0.9	1.5	1.1	1.9	2.1	2.2
Summer mean	10.3	0.6	1.4	0.6	2.2	1.2	2.0
Fall mean							
Extreme Precipitation (events per year)							
1” in 24 hrs	11.2	1.1	2.0	1.4	2.8	2.0	3.3
2” in 48 hours	5.3	1.1	1.5	1.4	2.3	2.5	3.8
Extreme Precipitation (events per decade)							
4” in 48 hours	7.7	2.6	1.8	4.3	3.5	7.7	7.0
Snow-Covered Days	77	-14	-15	-19	-34	-27	-45

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Keene, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.8	1.8	2.1	3.0	5.3	4.0	9.1
Winter TMIN	13.5	2.4	2.7	3.8	5.9	5.3	9.8
Spring TMIN	32.4	3.1	1.7	4.9	4.5	6.1	7.9
Summer TMIN	55.1	1.6	2.2	2.9	5.8	3.5	9.9
Fall TMIN	37.7	0.3	1.8	0.6	5.3	1.1	8.8
Maximum Temperature (°F)							
Annual TMAX	58.8	1.6	1.7	2.9	4.7	3.8	7.9
Winter TMAX	34.5	1.7	1.6	2.5	3.4	3.6	5.9
Spring TMAX	57.6	2.6	1.6	5.0	4.8	6.6	8.6
Summer TMAX	81.4	1.6	1.9	3.0	5.3	3.8	8.7
Fall TMAX	61.2	0.9	1.7	1.3	5.2	1.5	8.4
Temperature Extreme (days per year)							
<32°F	163	-10	-13	-17	-28	-22	-48
<0°F	16	-5	-5	-8	-11	-9	-15
>90°F	9	5	6	13	26	19	53
>95°F	1	1	2	3	9	6	26
TMAX on hottest day of year	94.0	1.3	1.1	2.2	4.1	3.1	7.3
TMIN on coldest day of year	-17.1	3.9	4.5	6.4	10.7	8.5	18.4
Growing Season (days)	156	12	12	18	29	19	51
Precipitation (inches)							
Annual mean	41.6	4.6	3.4	5.4	6.4	6.9	9.2
Winter mean	9.0	0.9	0.7	1.0	1.0	1.6	2.3
Spring mean	10.1	1.4	1.1	1.9	1.8	2.1	2.6
Summer mean	11.4	1.7	1.5	1.3	2.4	2.1	2.1
Fall mean							
Extreme Precipitation (events per year)							
1” in 24 hrs	9.2	2.3	1.6	2.5	3.2	3.1	4.4
2” in 48 hours	3.4	1.3	0.9	1.8	1.9	1.9	3.6
Extreme Precipitation (events per decade)							
4” in 48 hours	1.5	2.2	0.4	3.2	2.8	5.0	6.0
Snow-Covered Days	94	-11	-11	-17	-33	-24	-46

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Lakeport (1), New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	36.4	1.6	1.9	2.6	4.7	3.5	8.1
Winter TMIN	13.5	2.1	2.5	3.3	5.4	4.6	8.9
Spring TMIN	33.4	3.0	1.3	4.5	3.9	5.7	7.0
Summer TMIN	57.8	1.4	1.9	2.5	4.9	3.0	8.5
Fall TMIN	40.4	0.0	1.8	0.3	4.8	0.8	7.9
Maximum Temperature (°F)							
Annual TMAX	55.4	1.7	1.7	3.0	4.9	3.9	8.3
Winter TMAX	30.4	1.7	1.6	2.5	3.6	3.6	6.1
Spring TMAX	54.4	2.7	1.5	5.2	4.7	6.8	8.7
Summer TMAX	79.0	1.8	2.0	3.3	5.6	4.1	9.3
Fall TMAX	57.3	0.8	1.9	1.2	5.7	1.4	9.1
Temperature Extreme (days per year)							
<32°F	152	-9	-10	-15	-23	-18	-38
<0°F	12	-4	-4	-6	-9	-7	-11
>90°F	5	3	4	9	18	15	43
>95°F	0	1	1	2	4	3	16
TMAX on hottest day of year	92.2	1.8	1.1	3.0	4.7	4.3	9.0
TMIN on coldest day of year	-13.2	3.6	4.2	5.6	9.6	7.4	16.5
Growing Season (days)	188	10	11	14	26	21	40
Precipitation (inches)							
Annual mean	41.5	3.8	2.5	4.8	5.5	6.8	8.5
Winter mean	9.6	0.9	0.7	1.0	1.1	1.8	2.6
Spring mean	9.9	1.1	0.8	1.8	1.7	1.8	3.0
Summer mean	11.3	1.3	1.0	0.8	2.1	1.9	1.9
Fall mean							
Extreme Precipitation (events per year)							
1” in 24 hrs	9.1	1.5	1.2	2.0	2.5	2.7	4.1
2” in 48 hours	3.7	1.4	0.8	1.7	1.8	2.4	3.8
Extreme Precipitation (events per decade)							
4” in 48 hours	3.9	1.5	0.3	2.4	2.8	4.1	4.9
Snow-Covered Days	112	-14	-16	-21	-39	-32	-58

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Lakeport (2), New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	36.7	1.7	1.8	2.7	4.6	3.6	8.0
Winter TMIN	14.8	2.1	2.2	3.4	5.0	4.6	8.4
Spring TMIN	33.4	2.7	1.6	4.2	4.2	5.4	7.2
Summer TMIN	57.8	1.4	1.8	2.5	4.9	3.1	8.9
Fall TMIN	40.5	0.4	1.2	0.7	4.2	1.1	7.1
Maximum Temperature (°F)							
Annual TMAX	56.9	1.8	1.8	3.1	4.9	4.1	8.4
Winter TMAX	32.9	1.9	1.6	2.7	3.5	3.8	6.1
Spring TMAX	55.0	2.5	1.8	4.9	5.0	6.5	9.0
Summer TMAX	79.6	1.8	2.2	3.5	6.1	4.3	10.1
Fall TMAX	59.7	1.0	1.4	1.4	5.0	1.6	8.2
Temperature Extreme (days per year)							
<32°F	148	-10	-10	-16	-23	-19	-40
<0°F	10	-4	-4	-6	-7	-7	-9
>90°F	7	5	6	12	24	17	50
>95°F	1	1	2	3	10	4	27
TMAX on hottest day of year	93.8	1.5	1.8	2.5	5.5	3.6	10.2
TMIN on coldest day of year	-11.2	3.7	3.8	5.6	8.9	7.6	15.5
Growing Season (days)	191	12	12	15	27	23	43
Precipitation (inches)							
Annual mean	40.7	4.3	2.7	5.5	5.0	7.2	7.4
Winter mean	8.5	0.9	0.6	1.1	1.0	1.5	1.9
Spring mean	9.8	1.1	1.1	1.9	1.8	2.1	2.9
Summer mean	11.3	1.9	0.7	1.2	1.9	2.4	1.5
Fall mean							
Extreme Precipitation (events per year)							
1” in 24 hrs	9.2	1.7	1.4	2.3	2.5	3.0	4.1
2” in 48 hours	3.7	1.3	0.7	1.7	1.7	2.5	3.4
Extreme Precipitation (events per decade)							
4” in 48 hours	3.2	2.6	-0.4	4.1	1.8	4.6	4.4
Snow-Covered Days	112	-14	-16	-21	-39	-32	-58

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Manchester, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.5	1.5	1.9	2.6	4.9	3.5	8.3
Winter TMIN	11.8	2.2	2.6	3.4	5.5	4.7	9.0
Spring TMIN	32.1	2.9	1.2	4.4	3.7	5.6	6.7
Summer TMIN	55.1	1.4	2.0	2.5	5.2	3.1	9.0
Fall TMIN	38.4	0.0	1.9	0.3	5.2	0.7	8.5
Maximum Temperature (°F)							
Annual TMAX	58.8	1.7	1.8	3.1	5.0	4.1	8.5
Winter TMAX	33.7	1.6	1.6	2.3	3.5	3.4	5.9
Spring TMAX	56.5	2.9	1.5	5.5	4.8	7.4	8.9
Summer TMAX	81.9	1.8	2.1	3.5	5.9	4.4	9.9
Fall TMAX	62.5	0.8	2.1	1.2	5.9	1.4	9.5
Temperature Extreme (days per year)							
<32°F	160	-8	-10	-13	-22	-16	-38
<0°F	15	-4	-5	-7	-10	-9	-14
>90°F	14	7	7	18	30	24	59
>95°F	3	2	2	7	13	12	36
TMAX on hottest day of year	96.4	2.8	1.4	5.1	5.5	7.2	10.0
TMIN on coldest day of year	-16.2	4.0	4.8	6.2	10.6	8.3	17.5
Growing Season (days)	175	11	13	16	27	16	43
Precipitation (inches)							
Annual mean	38.4	4.1	3.2	4.6	5.3	6.4	7.5
Winter mean	8.6	1.2	0.9	1.6	1.4	2.0	3.1
Spring mean	9.4	0.8	1.1	0.8	1.4	1.0	2.0
Summer mean	10.4	1.8	0.7	1.5	1.6	2.5	1.0
Fall mean	9.9	0.5	0.6	0.8	0.9	1.0	1.5
Extreme Precipitation (events per year)							
1” in 24 hrs	8.3	1.9	1.4	2.3	2.6	2.6	4.3
2” in 48 hours	3.4	1.2	0.9	1.5	1.7	1.9	2.6
Extreme Precipitation (events per decade)							
4” in 48 hours	1.8	3.0	1.0	2.9	2.5	5.9	5.9
Snow-Covered Days	91	-14	-14	-19	-36	-29	-49

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Massabesic Lake, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.4	1.7	2.0	2.9	5.1	3.8	8.8
Winter TMIN	13.5	2.2	2.5	3.5	5.3	4.7	8.8
Spring TMIN	33.1	2.9	1.6	4.6	4.3	5.8	7.5
Summer TMIN	56.1	1.7	2.2	2.9	5.8	3.6	10.0
Fall TMIN	38.4	0.3	1.8	0.6	5.2	1.1	8.6
Maximum Temperature (°F)							
Annual TMAX	58.4	1.7	1.7	3.1	4.9	4.0	8.4
Winter TMAX	35.2	1.7	1.6	2.5	3.5	3.6	6.1
Spring TMAX	56.3	2.6	1.7	5.0	4.9	6.8	8.9
Summer TMAX	80.3	1.8	2.1	3.4	5.8	4.3	9.9
Fall TMAX	61.4	1.0	1.6	1.3	5.2	1.5	8.4
Temperature Extreme (days per year)							
<32°F	158	-9	-10	-15	-24	-19	-42
<0°F	13	-5	-5	-7	-9	-8	-12
>90°F	8	5	7	13	26	19	53
>95°F	1	1	2	4	9	7	27
TMAX on hottest day of year	94.2	1.9	1.3	3.3	4.8	5.3	10.8
TMIN on coldest day of year	-14.2	4.1	4.4	6.4	10.1	8.2	17.0
Growing Season (days)	164	14	14	19	30	22	50
Precipitation (inches)							
Annual mean	41.3	3.6	3.2	4.8	5.7	7.0	8.8
Winter mean	8.7	0.9	0.9	1.1	1.1	1.6	2.7
Spring mean	10.2	0.9	1.1	1.4	1.6	1.9	3.0
Summer mean	11.0	1.7	1.1	1.3	2.0	2.5	1.9
Fall mean	11.3	0.3	0.2	1.0	1.0	1.1	1.4
Extreme Precipitation (events per year)							
1” in 24 hrs	9.3	1.2	1.6	1.7	2.6	2.5	4.4
2” in 48 hours	3.9	1.1	1.2	1.4	1.9	2.0	3.9
Extreme Precipitation (events per decade)							
4” in 48 hours	5.1	0.7	-1.3	2.7	3.2	4.1	5.3
Snow-Covered Days	85	-14	-15	-18	-34	-27	-47

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Mount Sunapee, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	35.8	1.7	2.0	2.8	5.1	3.7	8.8
Winter TMIN	14.6	2.2	2.5	3.5	5.4	4.7	8.9
Spring TMIN	33.1	2.8	1.5	4.5	4.2	5.7	7.5
Summer TMIN	56.1	1.6	2.1	2.8	5.7	3.5	10.3
Fall TMIN	39.0	0.3	1.7	0.6	5.0	1.1	8.3
Maximum Temperature (°F)							
Annual TMAX	55.1	1.6	1.6	2.9	4.6	3.8	7.8
Winter TMAX	31.4	1.8	1.7	2.6	3.6	3.8	6.3
Spring TMAX	53.7	2.4	1.5	4.7	4.6	6.3	8.4
Summer TMAX	77.2	1.6	1.9	3.0	5.2	3.7	8.5
Fall TMAX	57.5	0.9	1.7	1.3	5.1	1.4	8.2
Temperature Extreme (days per year)							
<32°F	155	-10	-11	-16	-25	-20	-43
<0°F	11	-4	-4	-7	-8	-7	-10
>90°F	1	1	2	4	11	6	29
>95°F	0	0	0	0	1	1	4
TMAX on hottest day of year	89.3	1.4	1.3	2.3	4.4	3.5	7.7
TMIN on coldest day of year	-11.9	3.7	4.0	5.7	9.4	7.3	16.1
Growing Season (days)	173	14	12	17	30	21	47
Precipitation (inches)							
Annual mean	44.8	4.2	3.0	4.8	5.8	7.3	8.3
Winter mean	9.3	1.2	0.9	1.3	1.4	1.9	3.0
Spring mean	11.1	1.1	0.8	1.6	0.8	2.3	1.4
Summer mean	12.1	1.7	1.1	1.1	2.3	2.3	1.9
Fall mean	12.4	0.1	0.2	0.6	1.1	0.7	2.0
Extreme Precipitation (events per year)							
1” in 24 hrs	11.2	1.6	1.6	2.3	3.1	2.9	4.1
2” in 48 hours	5.4	1.6	1.2	1.6	2.3	2.7	4.2
Extreme Precipitation (events per decade)							
4” in 48 hours	3.4	2.9	0.4	2.1	3.8	5.3	6.4
Snow-Covered Days	93	-13	-13	-19	-34	-27	-48

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Nashua (1), New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	36.0	1.6	1.9	2.8	5.1	3.6	8.8
Winter TMIN	14.9	2.1	2.5	3.4	5.3	4.6	8.7
Spring TMIN	33.9	2.9	1.3	4.6	3.9	5.8	7.1
Summer TMIN	56.3	1.6	2.2	2.8	5.8	3.5	10.5
Fall TMIN	38.4	0.0	1.9	0.3	5.3	0.8	8.9
Maximum Temperature (°F)							
Annual TMAX	59.0	1.7	1.8	3.0	4.9	3.9	8.3
Winter TMAX	35.8	1.6	1.6	2.4	3.5	3.4	6.0
Spring TMAX	57.5	2.6	1.5	5.0	4.7	6.7	8.6
Summer TMAX	81.0	1.7	2.1	3.3	5.7	4.1	9.5
Fall TMAX	61.4	0.8	1.8	1.2	5.5	1.4	8.8
Temperature Extreme (days per year)							
<32°F	158	-9	-11	-15	-25	-19	-43
<0°F	11	-4	-5	-6	-8	-7	-10
>90°F	9	5	7	14	26	19	55
>95°F	1	2	2	5	10	9	29
TMAX on hottest day of year	94.4	2.0	1.3	3.6	5.1	5.4	8.9
TMIN on coldest day of year	-12.6	3.7	4.4	6.0	9.9	7.6	16.8
Growing Season (days)	167	13	14	17	29	19	49
Precipitation (inches)							
Annual mean	44.8	4.3	2.6	5.5	4.3	7.3	6.2
Winter mean	10.9	1.1	0.9	1.4	1.1	2.0	2.5
Spring mean	11.2	1.0	0.9	1.6	1.1	2.1	1.7
Summer mean	11.0	1.7	0.6	1.3	1.3	2.1	0.9
Fall mean	11.8	0.5	0.1	1.0	0.6	1.1	1.1
Extreme Precipitation (events per year)							
1” in 24 hrs	11.7	1.9	1.3	2.6	2.3	3.1	3.1
2” in 48 hours	4.6	1.4	0.8	2.0	1.6	2.3	3.0
Extreme Precipitation (events per decade)							
4” in 48 hours	3.7	2.1	0.3	3.7	1.8	5.6	6.9
Snow-Covered Days	77	-14	-15	-19	-34	-27	-45

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Nashua (2), New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	36.2	1.7	1.9	2.8	5.0	3.6	8.6
Winter TMIN	15.3	2.1	2.3	3.4	5.1	4.6	8.5
Spring TMIN	33.8	2.8	1.5	4.4	4.1	5.6	7.2
Summer TMIN	56.5	1.6	2.1	2.8	5.7	3.5	10.4
Fall TMIN	38.7	0.3	1.7	0.6	5.1	1.0	8.5
Maximum Temperature (°F)							
Annual TMAX	59.0	1.7	1.7	3.0	4.8	4.0	8.2
Winter TMAX	36.0	1.7	1.5	2.5	3.5	3.6	6.1
Spring TMAX	57.1	2.6	1.6	5.0	4.8	6.7	8.8
Summer TMAX	80.8	1.7	2.1	3.3	5.8	4.2	9.6
Fall TMAX	61.6	0.9	1.6	1.3	5.3	1.5	8.5
Temperature Extreme (days per year)							
<32°F	157	-10	-11	-16	-25	-19	-43
<0°F	10	-4	-4	-6	-7	-7	-10
>90°F	9	5	7	14	26	19	54
>95°F	1	1	2	4	10	7	29
TMAX on hottest day of year	94.2	1.7	1.3	2.8	4.3	4.4	7.9
TMIN on coldest day of year	-11.9	3.8	4.3	6.1	9.7	7.7	16.4
Growing Season (days)	168	14	14	18	29	21	48
Precipitation (inches)							
Annual mean	46.3	4.3	3.3	4.3	4.9	6.9	7.3
Winter mean	10.8	1.3	0.9	1.6	1.2	2.2	2.8
Spring mean	12.2	0.6	1.1	0.4	1.3	1.2	1.9
Summer mean	11.2	1.8	1.1	1.2	2.1	2.0	2.1
Fall mean	12.2	0.5	0.2	1.1	0.2	1.3	0.4
Extreme Precipitation (events per year)							
1” in 24 hrs	12.3	1.5	1.5	1.5	2.3	2.4	3.4
2” in 48 hours	5.4	1.5	0.9	1.5	1.7	2.7	3.6
Extreme Precipitation (events per decade)							
4” in 48 hours	5.3	1.6	-0.1	4.5	3.0	6.0	6.4
Snow-Covered Days	77	-14	-15	-19	-34	-27	-45

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Newport, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	30.8	1.9	2.0	3.1	5.3	4.1	9.1
Winter TMIN	8.7	2.6	2.7	4.1	6.0	5.7	10.1
Spring TMIN	28.1	2.9	2.0	4.7	4.9	6.0	8.4
Summer TMIN	51.5	1.6	2.1	2.8	5.6	3.5	9.8
Fall TMIN	34.3	0.6	1.3	0.9	4.6	1.3	8.0
Maximum Temperature (°F)							
Annual TMAX	55.8	1.8	1.7	3.1	4.9	4.1	8.4
Winter TMAX	32.1	2.0	1.6	2.9	3.7	4.1	6.5
Spring TMAX	53.8	2.4	1.8	4.9	5.1	6.5	9.1
Summer TMAX	78.1	1.7	2.1	3.4	6.0	4.3	10.0
Fall TMAX	58.6	1.2	1.4	1.6	5.0	1.7	8.2
Temperature Extreme (days per year)							
<32°F	187	-9	-11	-15	-25	-18	-44
<0°F	27	-7	-6	-11	-15	-13	-22
>90°F	4	3	5	9	20	13	45
>95°F	0	1	1	1	5	2	17
TMAX on hottest day of year	92.2	1.2	1.8	2.2	5.2	3.6	9.8
TMIN on coldest day of year	-23.7	5.2	5.2	7.8	11.8	10.5	19.6
Growing Season (days)	139	7	10	17	27	20	46
Precipitation (inches)							
Annual mean	39.9	3.4	3.3	4.2	5.9	6.0	8.3
Winter mean	8.3	1.0	0.7	0.9	1.1	1.5	2.5
Spring mean	9.6	1.0	1.5	1.8	1.7	1.8	2.6
Summer mean	11.3	1.5	0.9	1.0	1.9	2.1	1.5
Fall mean	10.7	0.0	0.3	0.4	1.0	0.6	1.7
Extreme Precipitation (events per year)							
1” in 24 hrs	8.5	1.2	1.5	1.7	2.5	2.2	4.1
2” in 48 hours	3.1	1.0	0.9	0.8	1.6	1.8	3.1
Extreme Precipitation (events per decade)							
4” in 48 hours	1.9	3.0	1.3	2.4	3.4	5.4	6.1
Snow-Covered Days	104	-12	-13	-18	-34	-26	-49

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Peterboro, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.8	1.7	2.1	2.9	5.3	3.9	9.1
Winter TMIN	14.1	2.1	2.6	3.4	5.4	4.7	9.0
Spring TMIN	32.6	3.1	1.4	4.9	4.2	6.2	7.7
Summer TMIN	54.5	1.7	2.4	3.1	6.1	3.8	10.5
Fall TMIN	37.7	0.0	2.0	0.3	5.5	0.7	9.0
Maximum Temperature (°F)							
Annual TMAX	56.8	1.5	1.6	2.7	4.5	3.6	7.7
Winter TMAX	33.5	1.6	1.6	2.3	3.4	3.4	6.0
Spring TMAX	55.7	2.5	1.5	4.8	4.5	6.5	8.2
Summer TMAX	78.2	1.5	1.8	2.9	4.9	3.6	8.3
Fall TMAX	59.2	0.8	1.8	1.1	5.3	1.3	8.4
Temperature Extreme (days per year)							
<32°F	161	-9	-11	-16	-27	-20	-46
<0°F	12	-4	-4	-6	-9	-7	-11
>90°F	2	2	2	6	12	10	32
>95°F	0	0	0	1	1	3	8
TMAX on hottest day of year	90.1	2.1	1.2	3.6	4.7	5.2	8.8
TMIN on coldest day of year	-13.0	3.3	3.9	5.5	9.2	7.1	16.1
Growing Season (days)	158	13	13	17	31	20	54
Precipitation (inches)							
Annual mean	43.6	4.4	3.2	5.5	4.8	6.6	7.7
Winter mean	10.0	1.2	1.2	1.4	1.5	1.9	3.0
Spring mean	10.8	1.0	1.2	1.4	1.2	1.6	2.3
Summer mean	11.8	2.3	0.7	2.0	1.4	2.4	1.3
Fall mean	11.1	0.0	0.1	0.6	0.4	0.5	1.1
Extreme Precipitation (events per year)							
1” in 24 hrs	11.3	1.9	1.4	2.2	2.5	3.0	3.9
2” in 48 hours	5.5	1.7	1.4	2.2	2.0	2.7	4.4
Extreme Precipitation (events per decade)							
4” in 48 hours	3.5	0.8	0.3	3.7	2.5	3.9	3.2
Snow-Covered Days	104	-12	-12	-19	-37	-28	-52

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Plymouth, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	30.7	1.8	2.0	2.9	5.1	3.9	8.8
Winter TMIN	8.5	2.4	2.7	3.8	5.9	5.2	9.8
Spring TMIN	28.8	3.0	1.5	4.6	4.3	5.8	7.5
Summer TMIN	51.3	1.6	2.1	2.8	5.5	3.4	9.4
Fall TMIN	33.8	0.3	1.7	0.6	5.0	1.1	8.3
Maximum Temperature (°F)							
Annual TMAX	55.1	1.8	1.8	3.1	4.9	4.1	8.4
Winter TMAX	30.6	1.9	1.7	2.7	3.6	3.8	6.3
Spring TMAX	53.5	2.6	1.7	5.0	4.8	6.7	8.8
Summer TMAX	78.3	1.8	2.0	3.4	5.7	4.3	9.6
Fall TMAX	57.7	1.0	1.6	1.4	5.3	1.6	8.7
Temperature Extreme (days per year)							
<32°F	187	-9	-11	-16	-25	-19	-45
<0°F	26	-7	-7	-11	-15	-13	-22
>90°F	4	4	4	10	18	15	43
>95°F	0	1	1	2	4	3	15
TMAX on hottest day of year	92.1	1.8	1.4	3.0	4.5	4.0	8.8
TMIN on coldest day of year	-19.7	4.1	4.4	6.0	10.0	7.8	17.1
Growing Season (days)	140	7	11	16	29	20	49
Precipitation (inches)							
Annual mean	43.1	4.2	2.4	4.9	4.9	6.9	7.4
Winter mean	9.8	1.1	0.7	1.1	1.2	1.7	2.5
Spring mean	10.5	1.1	0.8	1.5	1.4	1.7	2.8
Summer mean	11.6	1.5	0.4	0.9	1.2	2.3	0.5
Fall mean	11.3	0.5	0.4	1.2	0.9	1.1	1.6
Extreme Precipitation (events per year)							
1” in 24 hrs	9.9	1.3	1.5	1.9	2.5	2.6	3.9
2” in 48 hours	3.9	1.4	1.0	1.4	1.8	2.4	3.5
Extreme Precipitation (events per decade)							
4” in 48 hours	2.2	3.5	1.4	2.1	2.6	6.6	5.9
Snow-Covered Days	144	-10	-12	-16	-31	-26	-55

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Surry Mountain, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	32.8	1.8	2.1	2.9	5.3	3.9	9.0
Winter TMIN	9.9	2.4	2.9	3.8	6.1	5.2	10.0
Spring TMIN	31.1	3.1	1.5	4.8	4.3	6.0	7.6
Summer TMIN	53.9	1.6	2.2	2.8	5.6	3.4	9.5
Fall TMIN	35.9	0.0	1.8	0.3	5.2	0.8	8.6
Maximum Temperature (°F)							
Annual TMAX	56.3	1.7	1.7	2.9	4.7	3.9	8.1
Winter TMAX	32.4	1.7	1.7	2.5	3.6	3.6	6.1
Spring TMAX	54.8	2.6	1.6	5.0	4.7	6.7	8.6
Summer TMAX	78.4	1.7	2.0	3.1	5.5	3.9	9.0
Fall TMAX	59.2	0.8	1.8	1.2	5.2	1.3	8.4
Temperature Extreme (days per year)							
<32°F	174	-9	-11	-15	-25	-18	-43
<0°F	23	-6	-6	-10	-14	-12	-20
>90°F	4	2	3	7	17	12	41
>95°F	0	0	1	1	2	2	11
TMAX on hottest day of year	91.5	1.5	1.1	2.4	3.8	3.9	7.2
TMIN on coldest day of year	-19.7	3.4	3.9	5.6	9.7	7.5	17.2
Growing Season (days)	154	9	10	15	26	17	46
Precipitation (inches)							
Annual mean	41.4	4.3	2.6	5.2	4.6	7.1	6.3
Winter mean	8.9	0.9	0.7	1.1	1.0	1.6	2.2
Spring mean	9.8	1.1	0.4	1.8	0.6	2.2	1.0
Summer mean	12.5	1.7	1.4	1.3	2.5	2.2	2.2
Fall mean	10.3	0.5	0.0	0.8	0.3	1.0	0.8
Extreme Precipitation (events per year)							
1” in 24 hrs	8.7	2.0	1.4	2.3	2.5	3.0	3.3
2” in 48 hours	3.8	1.1	0.7	1.2	1.5	2.3	3.0
Extreme Precipitation (events per decade)							
4” in 48 hours	1.5	0.9	0.8	1.5	2.8	4.7	5.0
Snow-Covered Days	94	-11	-11	-17	-33	-24	-46

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Tamworth, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	30.8	1.9	2.1	3.1	5.4	4.0	9.2
Winter TMIN	9.1	2.5	2.8	4.0	6.1	5.5	10.3
Spring TMIN	29.6	3.1	1.5	4.7	4.3	5.9	7.5
Summer TMIN	51.0	1.6	2.2	2.9	5.8	3.6	10.1
Fall TMIN	33.3	0.2	1.7	0.5	5.0	1.0	8.5
Maximum Temperature (°F)							
Annual TMAX	55.3	1.7	1.7	3.0	4.8	3.9	8.2
Winter TMAX	31.6	1.8	1.5	2.5	3.4	3.6	6.0
Spring TMAX	54.0	2.4	1.6	4.7	4.6	6.3	8.4
Summer TMAX	78.3	1.8	2.1	3.4	6.0	4.3	10.2
Fall TMAX	56.9	0.9	1.5	1.3	5.1	1.5	8.2
Temperature Extreme (days per year)							
<32°F	189	-9	-12	-17	-29	-20	-49
<0°F	26	-7	-7	-11	-15	-13	-22
>90°F	4	4	5	10	19	14	43
>95°F	1	0	0	1	5	3	18
TMAX on hottest day of year	92.4	1.8	1.7	3.2	5.6	5.2	11.1
TMIN on coldest day of year	-20.0	3.8	3.9	5.7	9.9	7.4	17.3
Growing Season (days)	138	8	9	17	27	20	48
Precipitation (inches)							
Annual mean	51.2	5.7	3.0	7.2	7.8	9.7	10.8
Winter mean	11.6	1.3	0.9	1.5	1.4	2.4	2.7
Spring mean	12.7	1.7	1.3	2.5	2.5	2.4	3.4
Summer mean	13.6	1.9	0.6	1.0	2.3	3.0	2.0
Fall mean	13.2	0.9	0.4	2.1	1.6	1.9	2.8
Extreme Precipitation (events per year)							
1” in 24 hrs	13.3	2.1	1.2	3.2	3.3	4.1	5.0
2” in 48 hours	6.6	2.2	1.3	3.0	3.4	3.6	5.2
Extreme Precipitation (events per decade)							
4” in 48 hours	5.4	4.5	1.4	5.2	5.7	8.4	9.5
Snow-Covered Days	134	-13	-14	-18	-36	-30	-60

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

Windham, New Hampshire

Indicators	Historical* 1980–2009	Change from historical (+ or -)					
		Short Term 2010–2039		Medium Term 2040–2069		Long Term 2070–2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions
Minimum Temperature (°F)							
Annual TMIN	34.9	1.8	2.2	3.0	5.5	3.9	9.2
Winter TMIN	14.3	2.2	2.7	3.6	5.7	4.9	9.3
Spring TMIN	32.4	3.2	1.4	4.9	4.1	6.1	7.4
Summer TMIN	55.0	1.7	2.4	3.0	6.2	3.8	10.6
Fall TMIN	37.7	0.0	2.2	0.3	5.8	0.8	9.4
Maximum Temperature (°F)							
Annual TMAX	60.1	1.6	1.7	2.9	4.8	3.9	8.2
Winter TMAX	36.6	1.6	1.6	2.3	3.5	3.4	5.9
Spring TMAX	58.3	2.7	1.4	5.0	4.6	6.8	8.6
Summer TMAX	82.0	1.7	1.9	3.2	5.4	4.0	9.4
Fall TMAX	63.0	0.8	2.0	1.2	5.8	1.5	9.1
Temperature Extreme (days per year)							
<32°F	164	-9	-12	-16	-27	-20	-46
<0°F	13	-4	-5	-7	-9	-8	-12
>90°F	11	7	8	17	30	23	61
>95°F	2	2	1	5	10	10	31
TMAX on hottest day of year	95.3	2.3	1.5	3.7	5.6	5.3	10.5
TMIN on coldest day of year	-18.8	5.4	6.7	8.2	13.8	10.4	21.7
Growing Season (days)	157	11	11	17	30	19	53
Precipitation (inches)							
Annual mean	44.4	4.4	3.5	5.7	6.0	7.0	9.3
Winter mean	10.4	1.2	0.8	1.4	1.2	1.6	2.7
Spring mean	10.7	1.1	1.5	1.7	2.0	2.0	3.3
Summer mean	10.8	1.8	1.1	1.6	2.1	2.3	2.1
Fall mean	12.5	0.4	0.1	0.9	0.6	1.1	1.2
Extreme Precipitation (events per year)							
1” in 24 hrs	9.8	1.6	1.3	1.9	2.8	2.7	4.2
2” in 48 hours	5.0	1.7	1.2	2.2	2.4	2.9	3.8
Extreme Precipitation (events per decade)							
4” in 48 hours	6.6	1.7	0.8	4.7	3.5	3.4	7.1
Snow-Covered Days	72	-14	-15	-19	-33	-27	-43

*There were significant gaps in the daily data from some New Hampshire sites for the period 1980–2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

ENDNOTES

1 National Research Council (2011) America's Climate Choices. Washington, DC: The National Academies Press. http://www.nap.edu/catalog.php?record_id=12781

2 There are several good books written over the past decade on the science of climate change, including (in reverse chronological order):

Archer, D. (2011) Global Warming: Understanding the Forecast. 2nd Edition. David Wiley-Blackwell. 212 p.

Schmidt, G., and J. Wolfe (2009) Climate Change: Picturing the Science. W.W. Norton.

Ruddiman, W. F. (2008) Earth's Climate: Past and Future (2nd Edition). New York: WH Freeman and Company. 388 p.

Weart, S. (2008) The Discovery of Global Warming: Revised and Expanded Edition. Cambridge, MA: Harvard University Press. 240 p. http://www.aip.org/history/climate/index.htm

Kump, L.R., et al. (2004) The Earth System (2nd edition). New Jersey: Pearson-Prentice Hall. 420 p.

Steffen, W., et al. (2003) Global Change and the Earth System: A Planet Under Pressure. Springer, 336 p.

3 Intergovernmental Panel on Climate Change (IPCC) (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. T. F. Stocker, et al. (eds.). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. http://www.ipcc.ch/report/ar5/wg1/

Intergovernmental Panel on Climate Change (IPCC) (2007a) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, et al. (eds). Cambridge, UK: Cambridge University Press. 996 p. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

National Academy of Sciences and The Royal Society (2014) Climate Change: Evidence & Causes. An Overview from the Royal Society and the US National Academy of Sciences. http://dels.nas.edu/resources/static-assets/exec-office-other/climate-change-full.pdf

4 National Climate Assessment and Development Advisory Committee (NCADAC) (2013) DRAFT Climate Assessment Report. Washington, DC: U.S. Global Change Research Program. http://ncadac.globalchange.gov/

National Research Council (2010) Advancing the science of climate change: America's climate choices. Washington, DC: National Academy Press. http://books.nap.edu/catalog.php?record_id=12782

Karl, T. R., J. M. Melillo, and T. C. Peterson (eds.) (2009) Global Climate Change Impacts in the United States. Cambridge University Press. http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf

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climate solutions new england

Climate Solutions New England (CSNE) promotes regional collaboration toward the goal of greater energy self-reliance and weather resilience that contribute to healthy, prosperous, and sustainable communities across New England. CSNE is an initiative of and led by faculty and staff from the Sustainability Institute and the University of New Hampshire.

Learn more at www.climatesolutionsne.org.

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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

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UVLSRPC Regional Plan 2015

Chapter 10

Implementation

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10.1 OVERVIEW

How to Read the Implementation Tables

Level of Action	Functional Areas	Notes
● Primary level of action	● Primary Functional Area Affected	This field can contain information on potential funding sources, fiscal impact (cost neutral, minimal investment, significant investment), and other relevant factors.
○ Secondary level of action	○ Secondary Functional Area(s) Affected	

List of Acronyms

CDBG	Community Development Block Grant
CRJC	Connecticut River Joint Commissions
DRED	NH Department of Resources and Economic Development
EDA	Economic Development Administration
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GCEDC	Grafton County Economic Development
GMEDC	Green Mountain Economic Development Corporation
GRANIT	Geographically Referenced Analysis and Information Transfer System
HUD	US Department of Housing and Urban Development
LSPA	Lake Sunapee Protective Association
NHBEM	NH Bureau of Emergency Management
NHCF	NH Charitable Foundation
NHDES	NH Department of Environmental Services
NHDOT	NH Department of Transportation
NHHFA	New Hampshire Housing
NHOEP	NH Office of Energy and Planning
NHPA	NH Preservation Alliance
NHSHPO	NH State Historic Preservation Office
USDA	US Department of Agriculture
UVHHWC	Upper Valley Household Hazardous Waste Committee
UVHC	Upper Valley Housing Coalition
UVLSRPC	Upper Valley Lake Sunapee Regional Planning Commission
UVLT	Upper Valley Land Trust

10.2 HOUSING NEEDS AND FAIR HOUSING EQUITY

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Ensure that communities in the region are educated on New Hampshire's Workforce Housing Statute.	● Local ● Region ○ State	○	●						○	Municipalities; UVLSRPC; NH OEP; UVHC	Municipalities with Master Plans and and regulations including workforce housing language.
Promote adaptive reuse of existing housing stock.	● Local ○ Region ○ State	●	●		○			○		Municipalities; UVHC; Habitat; NHHFA	Residential properties rehabilitated by organizations engaged in adaptive reuse programs.
Utilize affordable housing covenants.	● Local ○ Region ○ State		●		○					Municipalities; NHHFA	Municipalities with regulations addressing affordable housing covenants.
Coordinate with local housing authorities.	● Local ● Region ○ State		●						○	Municipalities; UVLSRPC; NHHFA; Housing Authorities	Outreach efforts by housing authorities.
Utilize the Low Income Housing Tax Credit (LIHTC) Program.	○ Local ○ Region ○ State		●		○					NHHFA	Residential properties purchased using LIHTC Program.
Participate in the Community Development Block Grant (CDBG) Program.	○ Local ○ Region ○ State		●		○					Municipalities; NHCDFA	Total funds awarded through CDBG Program toward residential projects.
Consider municipal contributions to housing development.	● Local ○ Region ○ State		●							Municipalities; NH OEP; NHMA	Total municipal contributions to housing development in the form of cash or cash equivalent of real estate, services, or other non-monetary contributions.
Consider inclusionary and density incentives in zoning ordinances	● Local ○ Region ○ State	●	●	○	○	○	○	○		Municipalities; UVLSRPC; NH OEP; Land Trusts	Municipalities with regulations including inclusionary and density incentives.
Consider jobs-housing linkage contributions.	● Local ○ Region ○ State	○	●	○	○		○	○		Municipalities; NH OEP; UVHC; Businesses	Municipal regulations and policies addressing jobs-housing linkage fees.
Require housing impact statements for large-scale non-residential developments.	● Local ○ Region ○ State	○	●	○	○					Municipalities; UVLSRPC; UVHC	Municipalities with regulations requiring housing impact statements for large non-residential developments.

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Promote employer-assisted housing initiatives.	● Local ● Region ○ State	○	●	○	○					Municipalities; NHHFA; NH OEP; UVHC; Businesses	The number of regional employers committed to creating new initiatives.
Support affordable housing trusts and community-based housing non-profits.	● Local ○ Region ○ State		●							Municipalities; UVHC; Housing Commissions	Total donations to the affordable housing trusts.
Coordinate public education efforts to support affordable and workforce housing.	● Local ● Region ● State		●							Municipalities; NHHFA; NH OEP; UVHC; UVLSRPC	Public outreach and education events.
Consider inter-municipal tax base sharing and regionalized services.	● Local ○ Region ○ State		●		○					Municipalities; NHMA; NHHFA; NH OEP; UVHC; UVLSRPC	Number of agreements among municipalities.
Promote utilization of the Downtown Tax Incentive, RSA 79-E.	● Local ● Region ○ State		●		○					Municipalities; NHMA; NH OEP; UVLSRPC	Municipalities adopting downtown development districts per RSA 79-E.
Encourage additional utilization of the Housing Futures Fund.	● Local ● Region ○ State	●	●	○	○	○	○	○		Municipalities; UVHC; Housing Commissions	Establishment of Housing Futures Funds.
Consider creating a Municipal Affordable Housing Revolving Fund—RSA 31:95(h).	● Local ○ Region ○ State		●							Municipalities; UVHC; Housing Commissions	Establishment of Municipal Affordable Housing Revolving Funds per RSA 31:95(h).

10.3 TRANSPORTATION

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Advocate at the state, local, and federal level for adequate and consistent funding sources highway and bridge maintenance activities.	● Local ● Region ● State			●						NHDOT, Municipalities, Regional Planning Commissions	Pavement Condition, Number of Red-Listed Bridges
Support an expansion of the NHDOT State Aid Bridge program.	● Local ● Region ● State			●						NHDOT, Municipalities, Regional Planning Commissions	Number of Red-Listed Bridges
Support an expansion of the NHDOT Betterment program for pavement maintenance efforts administered by NHDOT Maintenance District offices.	● Local ● Region ● State			●						NHDOT, Municipalities, Regional Planning Commissions	Pavement Condition
Assist communities in the region in developing Road Surface Management Systems (RSMS).	○ Local ● Region ○ State			●						NHDOT, Municipalities	Pavement Condition
Place high priority on red list bridge replacement and/or rehabilitation projects during the Ten-Year Transportation Improvement Plan project prioritization process.	● Local ● Region ○ State			●						NHDOT, Municipalities, Regional Planning Commissions	Number of Red-Listed Bridges
Develop a corridor study for Interstate 89 to determine improvement priorities and concurrence between development and roadway capacity.	○ Local ● Region ● State	○		●						NHDOT, Municipalities	Operational Level of Service
Assist communities in the UVLSRPC Region in developing local Capital Improvement Programs that comprehensively address local highway and bridge infrastructure needs.	○ Local ● Region ○ State			●						NHDOT, Municipalities	Pavement Condition, Number of Red-Listed Bridges, Airport Runway Condition
Coordinate Road Safety Audits (RSA) at all locations in the UVLSRPC Region that appear on the statewide "Five Percent" Report developed annually by the NHDOT Bureau of Highway Design.	○ Local ● Region ● State			●						NHDOT, Municipalities	Number of Highway Fatalities

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Collaborate with State and Local partners to ensure that locations with completed RSAs have safety improvements implemented with Highway Safety Improvement Program funding.	● Local ● Region ● State			●						NHDOT, Municipalities	Number of Highway Fatalities
Continue assisting municipalities with the implementation of the NH PASS (Pass All bicyclists Slowly and Safely) safety campaign to promote awareness of NH RSA 265:143-a.	● Local ● Region ○ State			●					○	NHDOT, Municipalities, Local Bicycle/Pedestrian Advocacy Groups	Number of Highway Fatalities
Continue UVLSRPC participation on the NHDOT Highway Safety Improvement Program Committee.	○ Local ● Region ○ State			●						NHDOT	Number of Highway Fatalities
Continue UVLSRPC participation on the NH Driving Toward Zero Deaths Coalition.	○ Local ● Region ○ State			●						NHDOT, NH Driving Toward Zero Coalition	Number of Highway Fatalities
Continue UVLSRPC participation on the NHDOT Bicycle/Pedestrian Safety Signage Subcommittee.	○ Local ● Region ○ State			●						NHDOT	Number of Highway Fatalities
Oppose discretionary transfers of New Hampshire's Highway Safety Improvement Program funding.	● Local ● Region ● State			●						NHDOT, Municipalities, Regional Planning Commissions	Number of Highway Fatalities
Support local and statewide campaigns to educate the public about the risks and consequences of impaired driving.	● Local ● Region ● State			●					○	NHDOT, Municipalities, NH Driving Toward Zero Coalition	Number of Highway Fatalities
Support local and statewide campaigns to educate the public about the safety benefits of wearing seat belts.	● Local ● Region ● State			●					○	NHDOT, Municipalities, NH Driving Toward Zero Coalition	Number of Highway Fatalities
Coordinate with NHDOT to develop a statewide training to ensure that the unique needs of older drivers are considered in the planning, design, construction, and maintenance of the state's highway network.	○ Local ● Region ● State			●						NHDOT	Number of Highway Fatalities

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Analyze key regional corridors for run-off-road crashes and review the potential to install shoulder and centerline rumble strips on those roads.	○ Local ● Region ● State			●						NHDOT, Municipalities	Number of Highway Fatalities
Collect additional speed data as part of the region's traffic data collection program to inform local and statewide speed enforcement efforts.	○ Local ● Region ○ State			●						NHDOT, Municipalities	Number of Highway Fatalities
Advocate at the state, local, and federal level for adequate and consistent funding sources for transit operations and capital costs.	● Local ● Region ● State			●						NHDOT, Municipalities, Regional Planning Commissions	Transit Ridership, Mode Share
Continue to serve on the Advance Transit Board of Directors and Planning and Operations Committee.	○ Local ● Region ○ State			●						Advance Transit	Transit Ridership, Transit Fleet Condition
Continue to serve on the CATS Advisory Committee.	○ Local ● Region ○ State			●						CATS	Transit Ridership, Transit Fleet Condition
Provide technical assistance to Advance Transit and CATS in developing applications for FTA Section 5311 capital and operating funding.	○ Local ● Region ○ State			●						NHDOT, Advance Transit, CATS	Transit Ridership, Transit Fleet Condition, Mode Share
Assist Advance Transit and CATS in applying for FTA Section 5304 funding to update their five-year transit development plans.	○ Local ● Region ○ State			●						NHDOT, Advance Transit, CATS	Transit Ridership, Mode Share
Assist Advance Transit and CATS in updating their air quality impact analyses biennially.	○ Local ● Region ○ State			●						NHDES, Advance Transit, CATS	
Apply for and administer transit feasibility studies using FTA Section 5304 funds to study new services along the I-89 Corridor, NH Route 12A Corridor, and in the Lake Sunapee communities of Sunapee, New London, and Newbury.	● Local ● Region ● State			●						NHDOT, Municipalities, Advance Transit, CATS	Transit Ridership
Advocate for statewide eligibility of Congestion Mitigation and Air Quality (CMAQ) funding in New Hampshire.	● Local ● Region ● State			●						NHDOT, FHWA	Transit Ridership, Transit Fleet Condition, Mode Share

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Advocate for the creation of a dedicated, competitive funding program for statewide park-and-ride facility development and expansion.	● Local ● Region ● State			●						NHDOT, State Legislators	Transit Ridership, Transit Fleet Condition, Mode Share
Provide technical assistance to communities in the Upper Valley Lake Sunapee Region developing transit capital improvements under the NHDOT's Local Public Agency (LPA) project administration process.	○ Local ● Region ○ State			●						NHDOT, Municipalities	Transit Ridership, Mode Share
Support the continued development of philanthropic programs to benefit Advance Transit and CATS.	○ Local ● Region ○ State			●						Advance Transit, CATS	Transit Ridership, Transit Fleet Condition, Mode Share
Pursue federal and state grants to improve the energy efficiency and reduce greenhouse gas emissions of the region's transit fleet.	○ Local ● Region ○ State			●		○	○	○		NHDOT, Municipalities, Advance Transit, CATS	Transit Fleet Condition
Engage state, county, and local governments in the national policymaking to address the remaining barriers to coordinated public and human service transportation.	● Local ● Region ● State			●						NHDOT, NHDHHS, Municipalities, State Legislators	ADA Transit Ridership, Elderly/Disabled Transit Ridership, Volunteer Driver Program Ridership
Conduct a Health Impact Analysis to determine indicators found to influence health resulting from the expansion of public transit.	○ Local ● Region ○ State			●						Municipalities	ADA Transit Ridership, Elderly/Disabled Transit Ridership, Volunteer Driver Program Ridership
Encourage municipalities and counties to plan for the spectrum of long-term-care support services, including accessible transportation that will help the population age-in-place.	● Local ● Region ● State			●						NHDHHS, Municipalities	ADA Transit Ridership, Elderly/Disabled Transit Ridership, Volunteer Driver Program Ridership
Encourage municipalities and counties to budget for matching funds to leverage available federal grant funding.	● Local ● Region ○ State			●						Municipalities	ADA Transit Ridership, Elderly/Disabled Transit Ridership, Volunteer Driver Program Ridership
Encourage the development of local land use ordinances that encourage compact, mixed-use, pedestrian-oriented, and handicap- accessible communities.	● Local ● Region ○ State	○		●						Municipalities	Transit Ridership

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Encourage communities to require public transportation access to reduce traffic impacts and further accessibility goals.	● Local ● Region ○ State			●						Municipalities	Transit Ridership, Operational Level of Service
Advocate for a stop in the City of Claremont during the Northern New England Intercity Rail Initiative feasibility study process.	● Local ● Region ● State			●						NHDOT, City of Claremont	Passenger Rail Ridership
Coordinate with the City of Claremont to plan and implement station improvements, parking improvements, and multi-modal connections at the Claremont Junction passenger rail station.	● Local ● Region ○ State			●						NHDOT, City of Claremont	Passenger Rail Ridership
Coordinate with the City of Claremont, City of Lebanon, and short-line rail owners to improve the condition of short-line railroads in the region.	● Local ● Region ○ State			●						NHDOT Bureau of Rail and Transit, City of Claremont, City of Lebanon, Claremont-Concord Railroad	Freight Movement
Advocate for a state-level contribution to Amtrak's Vermonter operation to help ensure continued service to the City of Claremont.	● Local ● Region ● State			●						NHDOT, State Legislators	Passenger Rail Ridership
Develop and adopt a regional Complete Streets Policy, and provide technical assistance to communities in the region developing local Complete Streets policies.	● Local ● Region ○ State			●						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Continue to provide technical assistance to communities in bicycle and pedestrian project planning and implementation.	○ Local ● Region ○ State			●						Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Establish a regional bicycle/pedestrian counting program to evaluate existing infrastructure usage and future needs.	○ Local ● Region ○ State			●						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Coordinate with the CNHRPC to form an inter-regional rail trail connection by expanding the Sugar River Rail Trail to points east.	● Local ● Region ○ State			●						CNHRPC, NHDOT, Municipalities, Local Bicycle/Pedestrian Advocacy Groups	Pedestrian Level of Service, Bicycle Level of Service

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Coordinate with municipalities and state agencies to acquire right-of-way during reconstruction projects to accommodate future bicycle and pedestrian transportation infrastructure needs.	• Local • Region • State			•						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Improve marked crosswalks to Rectangular Rapid Flashing Beacons (RRFBs) or Pedestrian Hybrid signals where appropriate.	• Local • Region • State			•						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Coordinate with NHDOT and municipalities to ensure that new developments construct appropriate bicycle and pedestrian infrastructure and integrate that infrastructure into the state or local network.	• Local • Region • State			•						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Install countdown timers at all signalized pedestrian crossings in the region.	• Local • Region • State			•						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Coordinate with the NHDOT and municipalities to develop bicycle and pedestrian connections to all local bus stops, intercity bus stations, passenger rail stations, and park-and-ride facilities in the region.	• Local • Region • State			•						NHDOT, Municipalities	Pedestrian Level of Service, Bicycle Level of Service
Encourage the NHDOT to allow multiple uses on rail corridors where appropriate (e.g. rail with trail).	• Local • Region • State			•						NHDOT	Pedestrian Level of Service, Bicycle Level of Service
Coordinate with NHDOT to evaluate narrowing travel lane widths during resurfacing projects to improve shoulders and/or bicycle lanes.	• Local • Region • State			•						NHDOT	Pedestrian Level of Service, Bicycle Level of Service

10.4 ECONOMIC DEVELOPMENT

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Reconvene the Sullivan County Comprehensive Economic Development Strategy (CEDS) Committee and develop an updated CEDS for the County through the inclusion of diverse public and private stakeholders	● Local ● Region ○ State				●					Municipalities, Sullivan County, EDA, Regional Economic Development Authorities	TBD in consultation with local and statewide partners.
Investigate the feasibility of adding Sullivan County to the Northern New Hampshire Economic Development District.	● Local ● Region ○ State				●					Municipalities, Sullivan County, EDA, Regional Economic Development Authorities	TBD in consultation with local and statewide partners.
Engage in CEDS planning in both East Central Vermont and Northern New Hampshire to ensure that both the UVLSRPC region's interests and inter-regional projects are considered.	● Local ● Region ○ State				●					NCC, TRORC, Regional Economic Development Authorities	TBD in consultation with local and statewide partners.
Develop a Regional Brownfields Assessment Program.	● Local ● Region ○ State				●	●				NH DES; US EPA; municipal planning departments	Assessment sites completed by using information from NH DES.
Develop specialized regional business incubators focused on value-added products in the *Agriculture*; *Arts, Entertainment, and Recreation*; and *Manufacturing*.sectors.	● Local ○ Region ○ State				●					NH DRED; UNH Carsey Institute; Small Business Adm.; Regional Economic Development Authorities; NH Business Incubator Network; Dartmouth College; Women's Rural Entrepreneurial Network	Number of businesses created and successfully leaving the incubators

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Coordinate with local and statewide partners to implement the recommendations of the UVLSRPC Regional Broadband Plan.	● Local ● Region ● State				●					Broadband Tech, DRED/DED	TBD in consultation with local and statewide partners.
Complete an inventory of existing providers of workforce training within the UVLSRPC region (and in neighboring communities in Vermont) to identify training gaps.	● Local ● Region ○ State				●				○	NH DRED; NH Dept of Ed; local high schools and colleges; Regional Economic Development Authorities	Private/institutional partnerships
Coordinate with local and statewide partners to develop targeted workforce/vocational training opportunities specific to the unique needs of the region's large employers (e.g. Sturm Ruger).	● Local ● Region ● State				●				○	NH DRED; NH Dept of Ed; local high schools and colleges; Regional Economic Development Authorities	Private/institutional partnerships; schools altering curricula based upon partnerships with business/industry
Ensure that the strategies identified in Chapter 2 (Housing) of this plan to promote and encourage the construction of an affordable housing stock in the region are implemented.	● Local ○ Region ○ State				●					NH Housing; municipal planning departments	TBD in consultation with local and statewide partners.
Develop and maintain a "Regional Dashboard" of key economic indicators to guide the formation of local and regional economic development policies.	● Local ○ Region ○ State				●				●	NH DRED, UNH Carsey Institute, Small Business Adm.; NH Industrial Dev Authority; Private Investors	Number of municipalities adopting economic development policies using the dashboard.
Provide technical assistance to UVLSRPC communities in streamlining local land use permitting process to ensure that the local regulatory environment is equitable and efficient for all applicants.	● Local ○ Region ○ State				●					Municipal planning departments	Number of municipalities performing local land use permit evaluations

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Provide technical assistance to rural UVLSRPC communities wishing to expand their economic base through cottage industries and home-based businesses.	● Local ○ Region ○ State				●					Municipal planning departments	Number of municipalities amending regulations and ordinances to be user friendly to new business
Ensure that infrastructure programs prioritized at the regional level (e.g. Ten-Year Transportation Improvement Plan) place priority on infrastructure projects at direct growth towards the region's existing village and city centers.	● Local ○ Region ○ State				●					Municipal planning departments and DPWs	TBD in consultation with local and statewide partners.
Promote the tourism economy within the region and provide technical assistance to the Connecticut River Scenic Byway and Lake Sunapee Scenic Byway Councils.	● Local ○ Region ○ State				●					Scenic Byway Councils	TBD in consultation with local and statewide partners.

10.5 NATURAL RESOURCES

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Implement policies to eliminate unnecessary vehicle idling while parked	● Local ○ State					●	●	●		NH DES & NH School Transportation Assoc.	Policies adopted by municipalities; enforcement
Increase public transportation and promote carpooling (TRANSPORTATION)	● Local ○ Region ● State			●		●	●	●		Advance Transit	Number of riders
Increase public outreach to teach about indoor air quality and toxic cleaning products	● Local ● Region ○ State					●	●			Municipalities and RPC	Number of outreach events; change in behavior (difficult to measure)
Encourage EPA to designate upwind states to join the Ozone Transport Region	● State					●	●	○		Northeast and Mid-Atlantic states	Number of upwind states required to join Ozone Transport Region
Promote efficient wood stoves and their efficient use	● Local ○ Region ● State					●	●	●		Municipalities, Fire Departments, RPC, NH DES	Distribution of information; development of media campaign
Promote southern NH reduction in pollution to allow funding to be evenly distributed in state	● State					●	●	●		NH DES	Amount of money available to other parts of the state
Promote municipal regulatory protection of aquifers.	● Local ○ Region ○ State					●				Municipalities, RPC, NH DES; NH Office of Energy & Planning	Number of aquifer protection ordinances adopted
Promote municipal regulatory protection of flood plains.	● Local ○ Region		●			●	○			Municipalities, NH DES; NH Office of Energy & Planning	Number of flood plain protection ordinances adopted banning new construction in floodplain

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Promote municipal regulatory protection of wetlands	● Local ○ Region ○ State					●	○			Municipalities, NH DES; NH Office of Energy & Planning	Number of wetland protection ordinances adopted to provide wetland buffers
Promote municipal regulatory protection of drinking water sources.	● Local ○ Region ○ State					●				Municipalities, NH DES; NH Office of Energy & Planning	Number of municipalities evaluating their drinking supplies and adopting protective ordinances
Inventory priority agricultural soils	● Local ○ Region ○ State					●				NH Department of Agriculture; NRCS	Number of municipalities incorporating agricultural soil inventories into their NRIs and Master Plans
Promote municipal protection of agricultural soils	● Local ○ Region ○ State					●				NH Department of Agriculture; NRCS	Number of municipalities adopting ordinances to protect agricultural soils
Inventory priority forestlands	● Local ○ Region ○ State					●				NH Division of Forests and Lands; SPNHF	Number of municipalities incorporating forest land soil and blocks of forest inventories into their NRIs and Master Plans
Promote municipal protection of high value forestlands	● Local ○ Region ○ State					●				NH Division of Forests and Lands, SPNHF	Number of municipalities implementing protection in their ordinances and regulations
Promote development of municipal excavation regulations	● Local ○ Region ○ State					●				Municipal Planning Boards; RPC, NH Dept of Revenue	Number of municipalities that implement excavation regulations
Inventory large blocks of undeveloped land	● Local ○ Region ○ State					●				Conservation commissions, RPC, NH Fish & Game	Number of municipalities incorporating large land block inventories into their NRIs and Master Plans
Promote municipal protection of high value wildlife habitats	● Local ○ Region ○ State					●				Conservation commissions, RPC, NH DES & Fish & Game	Number of municipalities implementing protection in their ordinances and regulations
Inventory invasive species	● Local ○ Region ○ State					●				Conservation commissions, RPC, NH DES & Fish & Game	Number of municipalities incorporating invasive species inventories into their NRIs and Master Plans
Develop and enhance programs for invasive species control	● Local ○ Region ○ State					●				Conservation commissions, lake associations, RPC, NH DES & Fish & Game	Municipalities, organizations, or state agencies with invasive control programs in region.

10.6 HISTORIC, CULTURAL, AND RECREATIONAL RESOURCES

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Provide technical assistance to communities developing nominations for National Historic Register recognition.	○ Local ● Region ○ State	●			○					Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.
Encourage additional utilization of federal tax credits for buildings on the National Historic Register that are adaptively rehabilitated.	● Local ○ Region ○ State	●			○					Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.
Promote municipal participation in the NH Division of Historic Resources Certified Local Government (CLG) Program.	● Local ● Region ○ State	●			○					Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.
Provide technical assistance to municipalities in establishing local Historic Districts, Demolition Review Ordinances, or other historic preservation regulatory measures.	○ Local ● Region ○ State	●								Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.
Collaborate with municipalities to designate and Promote Scenic Roads & Byways (e.g. Lake Sunapee Scenic Byway and Connecticut River Scenic Byway).	● Local ● Region ○ State	○		●						Municipalities, NHDOT	TBD in consultation with local and statewide partners.
Encourage municipal utilization of conservation easements as a tool for protecting significant historic properties.	● Local ● Region ○ State	●								Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.
Work with municipalities to ensure that stone wall protections become part of subdivision and site review regulations, and that maintenance of municipally-owned stone walls be included in the local Capital Improvement Program (CIP).	● Local ● Region ○ State	●								Municipalities, NHPA, NHSHPO	TBD in consultation with local and statewide partners.

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Develop a Regional Safe Routes to Play plan.	○ Local ● Region ○ State	○		●						Municipalities, NHDOT, Private Foundations	TBD in consultation with local and statewide partners.
Support the development of the "Quabbin to Cardigan" trail network.	○ Local ● Region ○ State			●						Municipalities, DRED	TBD in consultation with local and statewide partners.
Coordinate with municipalities, the Central New Hampshire Regional Planning Commission, and statewide partners to develop a feasibility study evaluating the potential for extending the Sugar River Rail Trail to points east.	● Local ● Region ● State			●						Municipalities, NHDOT, CNHRPC	TBD in consultation with local and statewide partners.
Assist the City of Claremont in implementing the Bobby Woodman Rail Trail Action Plan.	● Local ● Region ○ State			●						Claremont, NHDOT, DRED	TBD in consultation with local and statewide partners.
Implement the water quality improvement strategies detailed in Chapter 5 (Natural Resources) of this Plan to ensure that swimming, boating, and fishing opportunities remain abundant in the region.	● Local ● Region ● State					●				Municipalities, NHDES	TBD in consultation with local and statewide partners.
Implement the forest lands improvement strategies detailed in Chapter 5 (Natural Resources) of this Plan to ensure that hunting opportunities remain abundant in the region.	● Local ● Region ● State					●				Municipalities, NHDES	TBD in consultation with local and statewide partners.

10.7 UTILITIES, INFRASTRUCTURE, AND PUBLIC SERVICES

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Develop and/or regularly update source water protection and water resource ordinances to minimize risk of surface and groundwater contamination.	● Local ○ Region					●				Municipalities, NH OEP, NHDES	TBD in consultation with local and statewide partners.
Encourage municipal water and sewer districts to conduct thorough network inventories to identify location, age, and condition of connections and main lines. Maintain and execute capital improvement programs based on inventories.	● Local ○ Region	●								Water and Sewer Districts, Municipalities	TBD in consultation with local and statewide partners.
Maintain water, sewer, and stormwater networks to minimize operational costs and reduce likelihood of water resource pollution.	● Local ○ Region ○ State	●				●				Water and Sewer Districts, Municipalities	TBD in consultation with local and statewide partners.
Encourage operators of municipal water and sewer districts to conduct regular equipment maintenance and seek new technologies that increase energy and operational efficiency in treatment stations and pump stations.	● Local ○ Region ○ State					●		●		Water and Sewer Districts, Municipalities	TBD in consultation with local and statewide partners.
Provide funding sources to help municipal water and sewer districts defray capital improvement and maintenance costs to meet state and federal water quality standards for both water supply and wastewater discharge.	○ Local ○ Region ● State				●					Water and Sewer Districts, Municipalities	TBD in consultation with local and statewide partners.
Assist water and sewer districts with public education about the importance of capital improvements to existing water infrastructure.	● Local ● Region ● State				●	●			●	Water and Sewer Districts, Municipalities	TBD in consultation with local and statewide partners.

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Assist communities in revising local land use regulations to incorporate water, wastewater, and stormwater management techniques to increase water conservation and green infrastructure practices in commercial and residential development.	● Local ○ Region ○ State	●			●				●	Municipalities	TBD in consultation with local and statewide partners.
Develop regional, watershed-based source water and water quality studies to identify common goals for municipalities sharing water supply resources or affected by impaired water resources.	● Local ○ Region ○ State	●			●	●			●	NHDES, Municipalities	TBD in consultation with local and statewide partners.
Encourage regular private well testing and private septic system inspections to ensure reliable and safe water supplies and replace failed septic systems.	● Local ○ Region ○ State	●				●			●	Private landowners	TBD in consultation with local and statewide partners.
Assist communities with impact studies associated with major water or sewer system expansions.	● Local ○ Region ○ State	●			●				●	Municipalities	TBD in consultation with local and statewide partners.
Encourage communities with high-value water resources to develop septic system monitoring and replacement standards.	● Local ○ Region ○ State	●			●					NHDES, Municipalities	TBD in consultation with local and statewide partners.
Support reform of the federal Connect America Fund to allow more money to be available to New Hampshire companies for broadband expansion.	○ State ● Nation				●					NH federal delegation, NH Telecom Advisory Board (TAB)	TBD in consultation with local and statewide partners.
Pass state legislation that permits or promotes broadband financing.	○ Local ○ Region ● State	●			●					NH Legislature, NH CDFA, Municipalities, Service Providers	TBD in consultation with local and statewide partners.
Share case studies and information on innovative financing strategies at the community level.	○ Local ○ Region ● State				●				●	UNH Center for Broadband Excellence, UNH Cooperative Extension, RPCs	TBD in consultation with local and statewide partners.
Continue to inventory broadband availability statewide, so decision-makers have up-to-date information on where funding should be targeted.	● State ● Nation	●			●				●	UNH, NH DRED, NH TAB, FCC, NTIA, NH federal delegation	TBD in consultation with local and statewide partners.

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way.	● State	●			●					NH Public Utilities Commission, NH Legislature, NHMA	TBD in consultation with local and statewide partners.
Create a statewide inventory of utility poles and pole attachments.	○ Local ● State	●								NH Public Utilities Commission, Municipalities	TBD in consultation with local and statewide partners.
Study the state cable franchise law (RSA 53-C) to determine whether barriers exist for the entry of more than one cable provider into a municipality.	○ Local ● State				●					NH Legislature, Municipalities	TBD in consultation with local and statewide partners.
Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.	○ Region ● State	●			●	●				NH Office of Energy and Planning, NH Municipal Association, RPCs	TBD in consultation with local and statewide partners.
Facilitate research, development and deployment of emerging broadband technologies, such as TV white space.	○ State ● Nation				●					UNH Broadband Center for Excellence, FCC	TBD in consultation with local and statewide partners.
Encourage municipalities to establish telecommunications or broadband committees' provide technical assistance.	○ Local ● Region ● State				●				●	NH Office of Energy and Planning, NH Municipal Association, RPCs	TBD in consultation with local and statewide partners.
Encourage municipalities to develop a broadband chapter in the master plan; provide technical.	○ Local ● Region ● State	●			●				●	NH Office of Energy and Planning, NH Municipal Association, RPCs	TBD in consultation with local and statewide partners.
Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.	○ Local ● Region ○ State				●				●	Regional Economic Development Councils, RPCs	TBD in consultation with local and statewide partners.
Consider inter-municipal agreements for shared specialized attorney services for cable franchise agreement negotiation.	● Local				●					Municipalities	TBD in consultation with local and statewide partners.
Create and fund a State Broadband Authority.	● State				●					NH Legislature, Governor's Office, NH Telecom Advisory Board	TBD in consultation with local and statewide partners.

Strategy	Level of Action*	Functional Areas* Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Provide sufficient funding to enable state agency staff to participate in or liaison with industry-specific broadband consortia and initiatives.	● State				●					NH Dept of Education, NH Dept of Safety, NH DRED, NH Legislature, Governor's Office	TBD in consultation with local and statewide partners.
Encourage the utilization of Comcast's Internet Essentials program for low-income households with school-aged children.	● Local				●				●	Schools, libraries	TBD in consultation with local and statewide partners.
Continue digital literacy education and public computer access initiatives to assist people with using the Internet to access information and services online.	● Local ● Region ● State ● Nation				●				●	Schools, UNH Cooperative Extension, continuing education programs, libraries, community centers	TBD in consultation with local and statewide partners.
Encourage other providers to offer similar low-cost programs for low-income households.	● State ● Nation				●				●	NH Telecom Advisory Board, Service Providers	TBD in consultation with local and statewide partners.
Educate the public about landfill ban items, universal waste collection programs, household hazardous waste collection programs, and unwanted medicine proper disposal and collection programs.	● Local ● Region ○ State					●			●	Municipalities; Dartmouth-Hitchcock Hospital; Upper Valley Substance Misuse Prevention Partnership; Greater Sullivan County Regional Prevention Network; pharmacies	Number of outreach events and media programs
Educate municipal leaders and transfer station workers about proper waste management and available programs to assist them in providing opportunities for responsible waste management.	● Local ● Region ● State					●			●	Private waste haulers; NH DES; NRRA; NERC	Increase in recycling rates and universal waste programs
Partner with waste haulers to provide adequate recycling and composting opportunities.	● Local ○ Region					●				Municipalities; private waste haulers	Increase is recycling and composting rates

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Create a culture of waste reduction and hazardous waste reduction by increasing communication between the public and the municipal waste management programs; promote Yankee frugality.	● Local ○ Region ● State					●			●	Municipalities; waste facilities; waste haulers	Reduction in disposal rates; increase in recycling and composting rates
Work with NH DES to amend the food waste composting regulations to more readily allow meat and dairy composting	● Local ● Region ● State					●				Municipalities; legislators; NH DES	Increase in food waste composting programs
Encourage schools to increase their recycling programs and develop a food waste composting program.	● Local ○ Region					●			●	Municipalities; schools; NH DES	Increase in school recycling and composting programs; increase in quantities recycled and composted
Encourage cooperation between municipalities to share resources and combine marketing efforts.	● Local ● Region					●			●	Municipalities; NRRA; NERC; NH DES	Number of meetings to discuss opportunities; number of shared programs

10.8 ENERGY EFFICIENT COMMUNITIES

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
Develop a vision for community energy efficiency to guide local long- term planning and policy. This vision and action steps should be articulated in the respective Master Plans.	● Local ○ Region	●					●	●	●	Municipalities, NH OEP, RPCs, Municipal Association	TBD in consultation with local and statewide partners.
Conduct energy audits on existing municipal buildings and facilities and track energy consumption to identify effective energy efficiency upgrades and track energy and cost savings after upgrades are in place.	● Local ○ Region						●	●		Municipalities, US EPA	TBD in consultation with local and statewide partners.
Incorporate energy efficiency guidelines in municipal capital spending, including purchasing policies, equipment replacement, and Capital Improvement Programs.	● Local						●	●		Municipalities, Municipal Association	TBD in consultation with local and statewide partners.
Encourage governmental agencies to lead by example and conduct building renovation and new building construction projects using green building siting and construction principles.	● Local ● Region ● State	●					●	●		Municipalities, State Agencies, Counties	TBD in consultation with local and statewide partners.
Encourage energy efficient building construction and on-site renewable energy facilities and support innovations in the field.	● Local ○ Region ● State	●			●		●	●		NH Legislature, Governor's Office, Municipalities, NH OEP, NH PUC	TBD in consultation with local and statewide partners.
Encourage in-fill development in existing village centers and downtowns and energy efficient site layout for all new projects.	● Local ○ Region ○ State	●	●				●	●		Municipalities, NH OEP	TBD in consultation with local and statewide partners.
All levels of government should encourage weatherization and energy efficient renovation of existing buildings through public education, grants and loans, tax incentives, removing regulatory barriers, and public-private partnerships with commercial and non-profit groups.	● Local ○ Region ○ State		●		●		●	●	●	NH Legislature, Governor's Office, Municipalities, NH OEP, NH PUC, US EPA, Municipal Association	TBD in consultation with local and statewide partners.

10.9 HAZARDS AND ADAPTATION

Strategy	Level of Action*	Functional Areas*								Potential Partners	Performance Measure
		Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement		
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..	● Local ○ Region ● State			●		●				Municipal DPW, NH DOT	Municipalities with completed evaluations and replacement programs.
Incorporate fluvial erosion into hazard mitigation plans to evaluate the community's susceptibility to riverine erosion and to identify homes and infrastructure at greatest risk from eroding or weakening stream banks.	● Local ○ Region ● State	●	●			●	●			NH HSEM, NH DES	Municipalities with fluvial erosion assessments incorporated into their hazard mitigation plans
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).	● Local ○ Region	●		●		●	●			Municipal Planning Boards	Municipalities with completed evaluations and changes made to master plan and regulations to protect hazard areas from development
Advocate for federal re-evaluation of flood plain mapping to make them more accurate for planning and development purposes. Consider other methods of accurate floodplain delineation.	● State	●				●				NH DES; NH HSEM, NH OEP	Communication with FEMA and any resulting changes or planned changes
Provide on-going educational opportunities for the public 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.	● Local ○ Region ○ State						●		●	Red Cross of NH; Red Cross of VT and the Upper Valley; Upper Valley Strong; municipal emergency response	Municipalities providing outreach and how often

Strategy	Level of Action*	Functional Areas*: Settlement Patterns	Housing	Transportation	Economic	Natural Resources	Climate	Energy	Engagement	Potential Partners	Performance Measure
Encourage municipalities to participate in the National Flood Insurance Program and have up-to-date Hazard Mitigation Plans and Emergency Operations Plans.	● Local ○ Region ● State		●							NH OEP; FEMA	Number of municipalities participating
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.	● Local ○ Region						●			Municipalities; NH HSEM; FEMA	Number of municipalities which include hazard mitigation and emergency management improvement in their CIPs
Enforce 911 numbering system to assist emergency responders in locating properties.	● Local		●						●	Municipal Police Departments	Number of municipalities that can report the 911 numbering system is completed
Work with schools as a team in emergency preparedness.	● Local ○ Region ● State								●	Municipalities; schools	Number of municipalities that report cooperation with schools in developing emergency preparedness