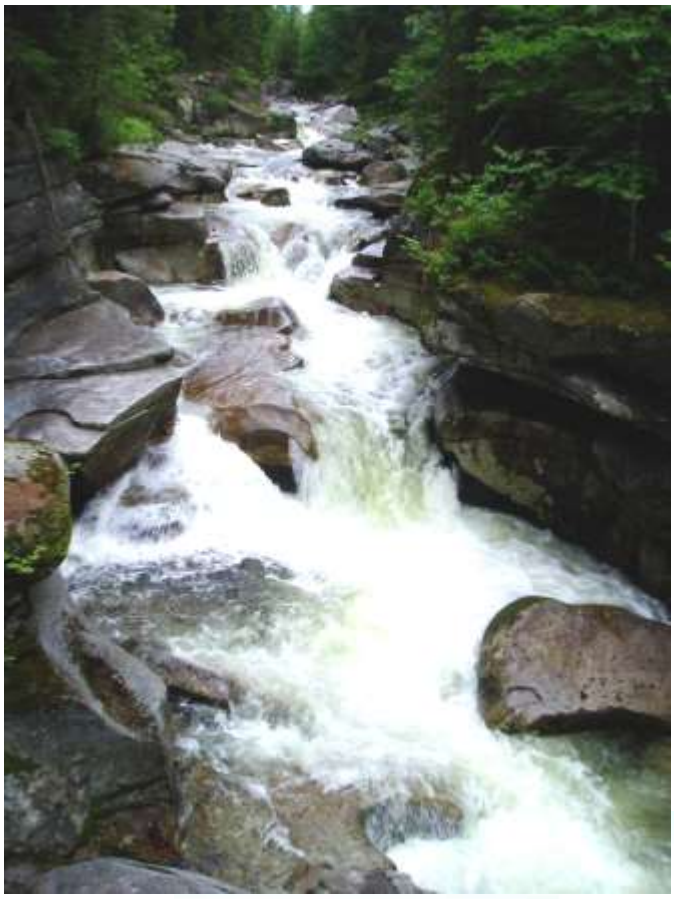

AMMONOOSUC RIVER LOCAL ADVISORY COMMITTEE

CORRIDOR MANAGEMENT PLAN

JUNE 2013

WITH ASSISTANCE FROM
NORTH COUNTRY COUNCIL
AND THE UPPER CONNECTICUT RIVER MITIGATION AND ENHANCEMENT FUND

Cover Photos:
Field Geology Services, 2009

Founded in 1973, North Country Council (NCC) is a nonprofit regional planning agency serving 51 communities and 25 unincorporated places in the northern third of New Hampshire.

It is the mission of North Country Council to encourage effective community and regional planning for the development of economic opportunity and the conservation of natural, cultural and economic resources. This is accomplished by providing information, regional advocacy, technical assistance, community education, and direct service to the region, its organizations, and political subdivisions.

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Ammonoosuc River
Corridor Management Plan

Adopted by the Ammonoosuc River Local Advisory Committee
June 5, 2013

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on the Ammonoosuc River Local Advisory Committee
at time of adoption:

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Developed by
Ammonoosuc River Local Advisory Committee
with assistance from
North Country Council
and the Upper Connecticut River Mitigation and Enhancement Fund

ACKNOWLEDGEMENTS

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Tracie Sales, Jacquie Colburn, Amy Spagula and Ted Walsh, NH Department of Environmental Services

Violet Hopkins, Curator, Littleton Area Historical Society

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APPENDICES TO THE CORRIDOR PLAN

Ammonoosuc River Geomorphic Assessment, Floodplain Conservation, and River Corridor Planning, Dr. John Field, Field Geology Services, October 2011

Ammonoosuc River Geomorphology Based River Corridor Planning Guide, Dr. John Field, Field Geology Services, October 2011

These reports can be downloaded from North Country Council's Ammonoosuc Corridor Plan page (www.nccouncil.org/ncc.php?page=33) or click on title above.

SECTION 1. INTRODUCTION

1.1. Designation of the Ammonoosuc River to N.H. Rivers Management and Protection Program

The 2013 Ammonoosuc River Corridor Management Plan represents a major milestone in a nine year journey undertaken by the residents of the seven corridor towns together to identify, prioritize and plan for the management of the river and its resources. The first corridor-wide project was the Ammonoosuc River Corridor Study undertaken by Lobdell Associates under the direction of an advisory committee with appointees from each of the seven towns. One of the outcomes of the Study was the recommendation to nominate the river to the New Hampshire Rivers Management and Protection Program pursuant to N.H. Rev. Stat. Ann. Chapter 483 (Ammonoosuc River Corridor Study, Phase 1 Report, October 2004). The Study also provided much of the information required for the nomination application. With Ray Lobdell of Lobdell Associates again in the lead, the nomination for the 49.6 miles of the river from the White Mountain National Forest property line at Lower Falls to the confluence with the Connecticut River was compiled and submitted to NH Department of Environmental Services (NHDES) in 2006. The designation was supported by all seven towns and approved by the Legislature in 2007.

Under the Rivers Management and Protection Program, the NHDES Commissioner appoints a local river management advisory committee comprised of nominees submitted by the selectboards of each river corridor community. In early 2008, the first major decision made by the Ammonoosuc River Local Advisory Committee (LAC) after getting organized was to nominate the remainder of the Ammonoosuc River mainstem, the “Upper Reach,” from the Lake of the Clouds to Lower Falls, to the Program as well. The designation of this final segment was approved by the Legislature in 2009.

Lake of the Clouds
Photo by Leslie Bergum, 2008

1.2. Development of the Plan

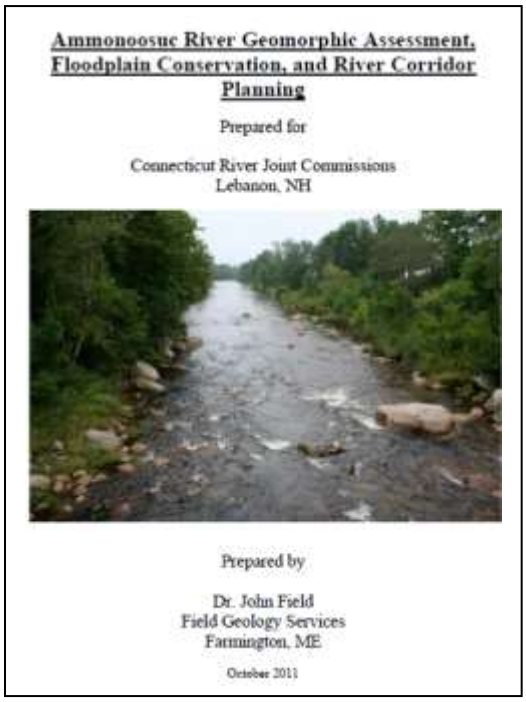
State law (N.H. Rev. Stat. Ann. 483:8-a) assigns four duties to the local river management advisory committees:

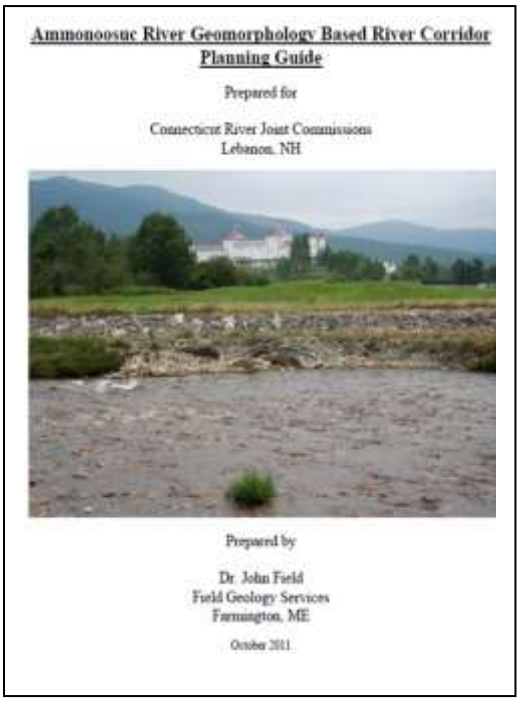
> (a) To advise the commissioner, the advisory committee, the municipalities through which the designated river or segment flows, and municipalities within tributary drainage areas on matters pertaining to the management of the river or segment and tributary drainage areas. Municipal officials, boards, and agencies shall inform such committees of actions which they are considering in managing and regulating activities within designated river corridors.
> (b) To consider and comment on any federal, state, or local governmental plans to approve, license, fund or construct facilities that would alter the resource values and characteristics for which the river or segment is designated.
> (c) To develop or assist in the development and adoption of local river corridor management plans under RSA 483:10. The local planning board, or, in the absence of a planning board, the local governing body, may adopt such plans pursuant to RSA 675:6 as an adjunct to the local master plan adopted under RSA 674:4. No such plan shall have any regulatory effect unless implemented through properly adopted ordinances.
> (d) To report biennially to the advisory committee and the commissioner, and annually to municipalities on the status of compliance with federal and state laws and regulations, local ordinances, and plans relevant to the designated river or segment, its corridor, and tributary drainage areas.

To obtain the resources needed to develop a local river corridor management plan, the Ammonoosuc River LAC took the following steps in 2008 and 2009:

- Collaborated with NHDES and the Connecticut River Joint Commissions to arrange for a fluvial geomorphology study of the Ammonoosuc River.
- Arranged for North Country Council to apply for an Upper Connecticut River Mitigation and Enhancement Fund grant to facilitate the planning process and assist with development of the plan document.
- Appointed a Corridor Management Plan Subcommittee.

Connecticut River Joint Commissions contracted with Field Geology Services of Farmington, Maine to conduct the fluvial geomorphology assessment of the river. The purpose of the assessment was to identify flood erosion hazards and areas of channel instability, as well as the causes for channel adjustments. The field work was conducted by Dr. John Field and Nicholas Miller over the summer of 2009. A series of informational meetings was organized by the Ammonoosuc River LAC, both a regional meeting and one in each corridor town, at the beginning of the project to exchange information with the public and local officials, and again at the end to report on results. The Ammonoosuc River Geomorphic Assessment, Floodplain Conservation, and River Corridor Planning, and accompanying Ammonoosuc River Geomorphology Based River Corridor Planning Guide, both by Dr. John Field, Field Geology Services, October 2011, provide an important foundation of the Local Advisory Committee's recommendations and are an integral part of this plan.





The Corridor Management Plan Subcommittee also began work in the summer of 2009. With the assistance of North Country Council staff, the Subcommittee guided the development of goal statements and identification of priority issues to be addressed in this first plan for the Ammonoosuc River corridor. Next, Subcommittee members volunteered to individually research several of the priority issues according to their individual interest/and or knowledge, summarize pertinent background information and related issues, and develop draft recommendations for discussion purposes. The following individuals contributed material for "issue papers" for the draft Plan:

Leslie Bergum
Marilyn Johnson
Joan Karpf
Connie McDade
Rick Walling
Jessica Willis
Tara Bamford (NCC)

This information was then compiled into the plan document by Tara Bamford, North Country Council, edited as needed and formatted.

It is recognized that each issue is related to several others, however the Subcommittee felt that this topical organization of the plan would provide the user easy access to the Local Advisory Committee's guidance on a particular topic. Like the various reaches of the river, the reader will note varying styles in different sections of the plan as a result of this collaborative approach.

After obtaining input from the public, local officials, and state experts on the management of river resources, the plan was revised accordingly and adopted by the Ammonoosuc River LAC on June 5, 2013.

The Ammonoosuc River LAC views this plan as a “living document,” meaning it will be reviewed and revised on an ongoing basis as feedback is received, circumstances change, and more is learned. Riparian landowners, recreational enthusiasts and citizens have invaluable first-hand knowledge of the river and its resources which is crucial to the River’s Local Advisory Committee. Ongoing educational and outreach programs will provide the opportunity for dialog, regarding mutual interests and concerns.

This Plan will provide guidance for the future activities of the Ammonoosuc River LAC and for the LAC review of proposed activities of others which may affect the river and its resources. It is hoped that the plan will also be of assistance to local officials, businesses, residents and visitors with an interest in learning how to be good stewards of the Ammonoosuc River and its economic, natural, scenic, and recreational values. Maintaining the high quality of its water and abundant natural and recreational resources will take the care and attention of each community along the river, education of residents and visitors, and cooperation of many agencies and partners.

SECTION 2. GOALS

The Ammonoosuc River Local Advisory Committee's Corridor Management Plan aims to balance land use with river protection, and provides recommendations for ways to ensure growth and development can continue to occur in each corridor community without degradation to this shared asset. The Local Advisory Committee has identified protection of the water quality and quantity, the aquatic life zone, the wildlife habitat, and the shoreline natural plant communities to be high priorities. The development of this Plan was guided by the premise that keeping the river healthy depends, not only on stewardship of the river corridor, but also on being mindful about the impact the watershed has on the river.

The goals below are not listed in priority order, nor is each associated with any one specific section of the plan. Like the river ecosystem itself, most plan elements are interrelated in some way.

Specific Goals:

1. Monitor and improve water quality as necessary to support healthy aquatic habitat.

2. Establish and maintain the instream flow volume necessary for drinking water supply, recreation and habitat.

3. Ensure that the natural resource base is maintained for future generations.

4. Protect and restore vegetated buffers to the river and its wetlands and tributaries.

5. Manage growth and development in the watershed in a manner that will maintain and improve the water quality in the river.

6. Ensure a vibrant economy by maintaining the unique character of the river corridor and its communities.

7. Support agriculture and forestry utilizing best management practices.

8. Plan future land use to be compatible with the flooding and movement of the river.

Floodplain hayfield
Photo by Field Geology Services, 2009

9. Enhance recreational opportunities on the river while minimizing the adverse impacts of recreation.

10. Strive for improved enforcement of regulations.

11. Consider other local and regional resource protection objectives when prioritizing river protection initiatives.

12. Educate the public on the value of stewardship of the river and its resources.

Snowmobile bridge over the Ammonoosuc River
Photo by Field Geology Services, 2009

13. Partner with other organizations, agencies and local boards to pool resources (e.g., grant opportunities, data, manpower, knowledge).

14. Incorporate the corridor management plan into each town's master plan.

15. Monitor the implementation of the corridor management plan on an ongoing basis and respond as appropriate.

16. Strive to keep the corridor management plan up-to-date regarding emerging issues.

SECTION 3. PRIORITY ISSUES AND OPPORTUNITIES

3.1 Population Growth and Development

Background

The Ammonoosuc River valley is a desirable area to live in, both year-round and seasonally, and can be expected to continue to grow in terms of developed area, year-round and seasonal populations, and visitors.

According to U.S. Census population change data for 1980 to 2010, during that thirty-year period the towns of Littleton and Lisbon experienced population increases of 6.7% and 5.1% respectively. The towns of Haverhill, Bethlehem, Bath and Landaff experienced much higher rates with 36.3%, 41.6% and 41.5% and 56% respectively. Bretton Woods and Twin Mountain, villages of the town of Carroll, tend to be populated mostly by second homeowners; the 17.9% increase in year-round population from 1980 to 2010 does not reflect the impacts associated with visitors to the over five hundred seasonal dwelling units in that community.

According to the NH Department of Environmental Services (NHDES), population growth in the Ammonoosuc River valley has been exceeding projections (The Ammonoosuc River, NHDES Fact Sheet WD-R&L-20, 2009). A rough build-out analysis estimated there to be 3,500 possible lots (average lot size of 6.7 acres) along the river available for development. According to existing regulations, future subdivision was estimated to have the potential to double the developed area in the river corridor (The Ammonoosuc River, NHDES Fact Sheet WD-R&L-20, 2009).

Issues

- As in the rest of northern New England, development in the Ammonoosuc River watershed has concentrated on the level well drained floodplain soils, and grown from colonial settlements adjacent to the water-power provided by the region's brooks. However, human activity in the buffer zone and the floodplain of a river can have a detrimental effect on the

river's health, function and aesthetic value, as well as consequences for plant and wildlife species that depend on the river. Human activity can deliver both point and nonpoint pollution into the river. In addition, the impact of light and noise on aquatic species is a growing concern and not yet well understood.

- The Ammonoosuc River corridor runs through seven separate municipalities, each with its own authority to plan for future growth and development, and to adopt and administer ordinances and regulations to implement those plans. Most of the land in the Ammonoosuc River corridor is privately owned, meaning that within this array of local land use plans, thousands of individual land use decisions will ultimately shape the character of the river corridor.

Recommendations

- ☐ Work closely with local planning boards and developers to identify the areas most appropriate for population growth and development, and the best practices for protecting water resources from negative impacts associated with that development.

- ☐ Hold developers accountable to current and future protection standards and sustainable building practices (enabling the river to meander in order to remain in equilibrium and avoid erosion hazards for example). Development can happen with the protection of the river as a priority.

- ☐ Assist developers, homeowners and towns to work with NHDES and others to benefit from preventive planning/maintenance by avoiding costly mitigation efforts.

3.2 Water Supply

Background

Photo by Field Geology Services, 2009

Several community water systems depend upon the Ammonoosuc for water supply, either through direct withdrawal from the river or from nearby wells:

- Woodsville Water & Light serves approximately 2,000 users with a direct withdrawal from the river.
- Lisbon Water Department's Caswell Wellfield serves approximately 1050 individuals. The wellhead protection area extends to both sides of the river.
- Carroll Water Works serves approximately 875 individuals from wells adjacent to the river – the wellhead protection area is adjacent to the river and encompasses a portion of the river.
- Rosebrook Water serves approximately 1050 individuals with wells adjacent to the river – the wellhead protection area lies on both sides of the river.

In addition, Littleton Water and Light's Brickyard Road well is used as a back-up source for the town.

Several businesses and residential and tourist facilities also depend upon wells that are adjacent to the mainstem and so interact with the river via groundwater, including:

Twin Rivers Campground, Bath
Ammonoosuc Inn, Lisbon
Lisbon Village Country Club
The New Whistle Stop, Lisbon
Evergreen Sports Center, Lisbon
Littleton-Lisbon KOA
Redimix Concrete, Littleton
Zealand Campground, Carroll

Many private wells at homes and businesses are also near the river.

Unlike some parts of southern New Hampshire where some communities are beginning to face water quantity challenges due to population growth, adequate quantities of clean water for drinking and other uses continue to be available for residents and businesses in most areas of the Ammonoosuc River watershed. With ongoing water quality protection and infrastructure maintenance and improvements, it is expected that this will be true for many years to come.

Issues

- NH Department of Environmental Services (NHDES) produced drinking water source assessments for each public water supply. These identify potential contamination threats, susceptibility to contamination threats, and recommended protection measures. Some of the land uses of concern noted in 2002 relative to the use of the Ammonoosuc River as a water supply, due to their proximity to the river, were:
  - highways
  - areas where pesticides are applied
  - agriculture land cover
  - livestock
  - septic systems
  - wastewater facilities
  - combined sewer overflows

- In addition, numerous potential contamination sources such as underground storage tanks, hazardous waste generators, salt piles, and junkyards, were identified.

- Many potential contamination sources have yet to be identified, e.g., buried junk cars in gullies.

- Most public water supplies do not have adequate protection in place. Several regulatory and nonregulatory tools are available. A Source Protection Plan is the process for identifying, prioritizing and addressing contamination threats; however, due to lack of funding, many of these are out-of-date and/or incomplete.

Oil sheen on the Ammonoosuc
Photo by Field Geology Services, 2009

- Tannins, although not a health threat, are of concern due to the yellow/brown tint they give the water. Local water supply managers have observed tannins increasing in the river as clearcutting has increased and undesired material is left to rot.

Tannins in the Ammonoosuc
Photo by Bill Harris

- Water suppliers are not consistently being alerted to potential contamination events in a timely manner. In some cases protocols are not in place and in others they are not being followed. For example, there was an unacceptable delay between the time when the storage building containing golf course chemicals at Bretton Woods was flooded in 2011 as a result of an ice jam and when Woodsville Water & Light was notified. A similar situation occurs when the Littleton WWTF overflows.

- Inadequate vegetated buffers between farm fields and the river lead to increased nitrate levels in the water following a rain. Manure also continues to be stockpiled in the floodplain. Pesticides are utilized in many of these floodplain fields as well.

- State road crews are sometimes seen not following best management practices when working near the river.

Recommendations

- ☐ The Ammonoosuc River LAC, towns, water suppliers, and NHDES should work together to:
  - Update the inventory of potential contamination sources throughout the watershed.
  - Promote best management practices for agriculture, logging, and handling of potentially hazardous materials.
  - Explore regulatory and nonregulatory tools for water supply protection.
- ☐ Improve state agency communication and cooperation on water quality protection issues, e.g., provide NHDES training to NHDOT road crews.

- ☐ Facilitate review of communications protocol following potential contamination event, strengthen where needed, and conduct periodic exercises.

- ☐ Educate homeowners on the importance of keeping contaminants out of the groundwater that feeds their own and their neighbor's wells.

For More Information

- "Protection of Groundwater and Surface Water Resources," Innovative Land Use Planning Techniques Handbook, NHDES, NH Association of Regional Planning Commissions, NHOEP, and NHMA, October 2008.

3.3 Water Quality

Background

The importance of water quality protection cannot be underestimated. James R. Jackson's 1905 History of Littleton, New Hampshire, Vol. II Topical History, reports on the 1901-1902 typhoid fever epidemic in Littleton. After years of amended legislation to control the increasing degradation of water quality in the United States, the Clean Water Act became law in 1972 providing protection for all surface waters. These mandates specified technological controls for industry and municipalities to mitigate impacts from their waste streams, required states to identify areas affected by nonpoint pollution sources, mandated adoption of various land use planning processes, addressed the issue of ocean dumping, divided pollutants into various classes, and set standards. As a result, states adopted programs to fulfill the various requirements of the Clean Water Act and monitor the states' waters. The Act requires each state to submit two surface water quality reports every two years to the US Environmental Protection Agency. The first report, commonly called the "305(b) Report," describes the quality of its surface waters; the second report, called the "303(d) List," identifies those surface waters that are impaired or threatened, not expected to meet water quality standards within a reasonable time, or require the development or implementation of a study. These reports can be found on the NH Department of Environmental Services (NHDES) website.

The New Hampshire Water Quality Standards are specific provisions established to ensure that the physical, chemical and biological integrity of the state's waters are maintained and protected. The standards provide for the protection and propagation of all aquatic wildlife and ensure the level of water quality necessary to protect the existing recreational activities on state waters. The state compares existing water quality to the standards through their monitoring programs including the Volunteer River Assessment Program (VRAP) and the Ambient and Biomonitoring Program.

The Ammonoosuc River has been designated as a Class B water by the New Hampshire General Court. Class B water is of the second highest quality. These waters are considered acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies. Since the 1971 implementation of the Clean Water Act, money from the federal and state governments was spent to upgrade the sewage treatment plants and other points of pollution along the Ammonoosuc River.

Except for low pH, with only isolated instances, monitoring on the Ammonoosuc River has shown that the river meets the standards for "fishable and swimmable." Low pH tends to occur in the state's mountain headwater streams where the granite bedrock provides little buffering capacity for acid rain.

Issues

In 2012, the NHDES released its most recent assessment of water quality of the river (combined 305(b) Report and 303(d) List). Overall the Ammonoosuc River is very high quality.

- Several sampling locations on the Ammonoosuc River show lower than accepted EPA pH levels which is most likely due to acid rain combined with local geology.
- High pH of unknown cause exceeding the water quality standard have been recorded at Streeter Pond Road Bridge.
- E. coli was detected in Littleton along with high aluminum levels. (In areas where buffering capability is low, acid rain releases aluminum from the soil to the river.)
- In addition, low dissolved oxygen was noted behind the Woodsville Dam in Bath.

It should be noted that the List only represents known impairments and threats. Waters presented on the List may also be threatened or impaired by other pollutants or non-pollutants. Also, at this time in New Hampshire, fish/shellfish consumption advisories due to mercury contamination are in effect for all surface waters.

Since 2006, the VRAP has been testing the water quality of the Ammonoosuc River. Tests include pH, turbidity, temperature, conductivity and dissolved oxygen. In recent years testing was expanded to include phosphorus, E. coli, chloride and total nitrogen. Although most areas along the river show pH levels below N.H. surface water quality standards, with the exception of dissolved oxygen at one headwater site, all other tests fell within recommended Class B standards in 2012.

- Water quality can change dramatically based on river flow, storm frequency, dilution and channel characteristics.

Historically, the overall health of the river has improved, however, the limited periodic testing may not accurately reflect the quality trends of the river. Repeated testing over time will create a picture of the fluctuating conditions and help determine where improvements, restoration or preservation may benefit the river and the communities it supports. In addition, coordination with NHDES has enabled the use of some submersible multiparameter dataloggers in recent years which can capture readings of, e.g., dissolved oxygen, every 15 minutes over a period of days to gain an understanding of fluctuations.

Recommendations

- ☐ Continue and expand the existing water quality monitoring and stream assessment programs and purchase additional testing equipment when needed.

- ☐ Towns should continue to support the water quality monitoring program through the Ammonoosuc River LAC.

Sampling Stations for the Ammonoosuc River, NHDES VRAP, 2010

Station ID & AUID	Class	Waterbody Name	Location	Town	Elevation *(Rounded to the Nearest 100 Feet)*
29-AMM NHRIV801030401-01	**B**	**Ammonoosuc River**	Jefferson/Clinton Road & Base Road	Crawfords Purchase	2000
01-DRT NHRIV801030402-04	**B**	**Dartmouth Brook**	Base Road	Carroll	1600
27-AMM NHRIV801030402-04	**B**	**Ammonoosuc River**	Mt. Washington Hotel Historic Marker	Carroll	1600
26-AMM NHRIV801030402-04	**B**	**Ammonoosuc River**	Route 302 Bridge - Fabyan/Base Station Road	Carroll	1600
25-AMM NHRIV801030402-04	**B**	**Ammonoosuc River**	Route 302 Bridge Lower Falls	Carroll	1500
24-AMM NHRIV801030402-07-01	**B**	**Ammonoosuc River**	Route 3 Bridge Twin Mountain	Carroll	1400
22-AMM NHRIV801030403-01	**B**	**Ammonoosuc River**	Route 302 Bridge Pierce Bridge	Bethlehem	1200
20-AMM NHRIV801030403-03	**B**	**Ammonoosuc River**	Prospect Street Bridge	Bethlehem	1000
16D-AMM NHRIV801030403-07	**B**	**Ammonoosuc River**	End of Railroad Street	Littleton	1100
15J-AMM NHRIV801030403-11	**B**	**Ammonoosuc River**	Cottage St Bridge/Veterans Memorial Bridge	Littleton	900
15-DEL NHRIV801030403-13	**B**	**Dells Brook**	Dells Brook Upstream of Dells Pond	Littleton	900
13-AMM NHRIV801030403-16	**B**	**Ammonoosuc River**	Streeter Pond Road Bridge	Lisbon	700
10-AMM NHIMP801030503-02	**B**	**Ammonoosuc River**	School Street Bridge	Lisbon	600
07-AMM NHRIV801030506-04	**B**	**Ammonoosuc River**	Railroad Bridge	Bath	600
04-AMM NHIMP801030506-02	**B**	**Ammonoosuc River**	Bath Covered Bridge	Bath	500
03-AMM NHRIV801030506-10	**B**	**Ammonoosuc River**	Railroad Bridge off Route 302	Bath	500

Notes: 1. Not all of these sites are sampled each year.

2. 22-AMM and 03-AMM are trend stations that have been established by NHDES.

(Source: NH Department of Environmental Services, New Hampshire Volunteer River Assessment Program, 2010 Ammonoosuc River Water Quality Report, February 2011)

- ☐ Recruit new volunteers by developing outreach materials and opportunities.
- ☐ Provide training for new volunteers.
- ☐ Identify additional sampling sites and data needs to better locate unknown sources of contaminants.
- ☐ Implement the recommendations from the VRAP annual reports to improve the program.
- ☐ Expand the biological monitoring of the river.
- ☐ Increase outreach on the program to residents; make the water quality reports widely available.
- ☐ Continue to work with NHDES to expand the use of submersible multiparameter dataloggers in the VRAP monitoring.

For More Information

For additional information on water quality in the Ammonoosuc River, see:

- NHDES Volunteer River Assessment Program at des.nh.gov/organization/divisions/water/wmb/vrap/ammonoosuc/index.htm
- NHDES Surface Water Quality Assessment Program reports at des.nh.gov/organization/divisions/water/wmb/swqa/index.htm

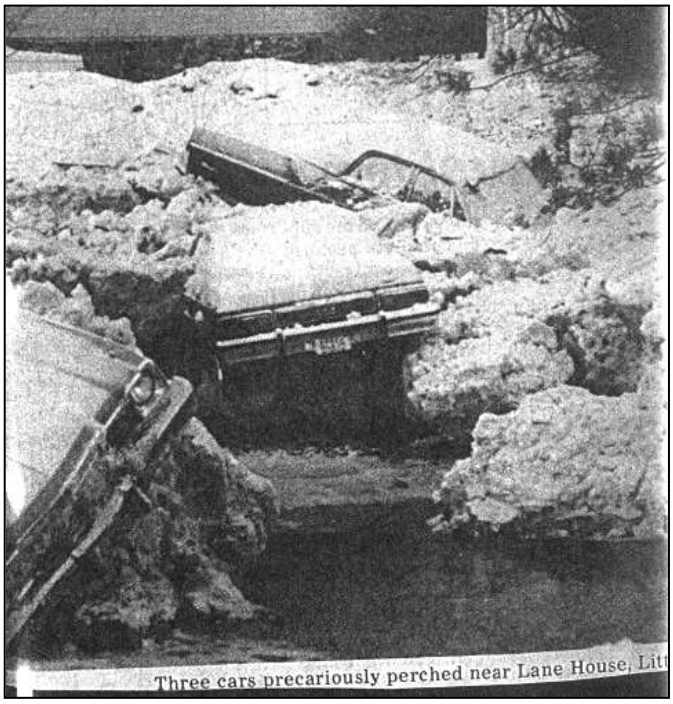
3.4 Floodplains and Fluvial Erosion Hazards

Background

Historically, flooding has been one of the most common natural hazards in New Hampshire. Floodplains in their natural undisturbed state have the capacity to store floodwater, reduce the rate of flow, and prevent channel instability. Over the course of time, straightening stretches of the river, filling wetlands, constructing bridges, installing inadequate culverts for drainage, and putting developments with impervious surfaces in floodplain areas have resulted in water rising to higher levels during heavy rainfall.

The federal government began purchasing land for stream flow protection following passage of the Weeks Act of 1911. The Act allowed lands acquired for this purpose to be preserved and maintained as national forests. Subsequently, the White Mountain National Forest in New Hampshire was established in 1918 to protect the watershed.

The Ammonoosuc River at annual ice out has had the tendency to flood downstream in Lisbon, Landaff, Bath, and Woodsville. In one such flooding event ice blocks carried automobiles downstream from the Lane House in Littleton. Following passage of the 1960 Flood Control Act, the U.S. Army Corps of Engineers in conjunction with the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, N.H., started providing guidance to communities with ice jam problems.



Flooding in Downtown Littleton, 1981
Courtesy of Littleton Area Historical Society

Management of the floodplain at the community level was implemented by adoption of zoning ordinances, subdivision regulations, and building codes. The National Flood Insurance Program was established in 1968 to enable property owners to buy flood insurance in participating communities that adopted floodplain ordinances. In the 1970s, the Federal Emergency Management Agency (FEMA) started developing and maintaining floodplain mapping. Current maps for New Hampshire, known as “DFIRMs” or Digital Flood Insurance Rate Maps are available through UNH Complex Systems Research Center’s GRANIT. The maps show “100 year” floodplains, where modelling shows that floods have a 1 in 100 (1%) probability of occurring in a given year, “500 year” floodplains, where the probability is 1 in 500 (0.2%), and floodways, which

are the river channels themselves. The National Flood Insurance Program restricts activity in the floodway, and requires floodproofing or elevation above the 100 year flood.

Dr. John Field conducted a fluvial geomorphology study to map features of the entire Ammonoosuc River in 2009, funded by the New Hampshire Department of Environmental Services. His study, done in geomorphic "reach" stretches, assessed the stream channel and associated floodplain in the river. The information regarding channel migration and stream bank erosion was provided to the Ammonoosuc River Local Advisory Committee. The recurring theme expressed in Dr. John Field's report, Ammonoosuc River Geomorphology Based River Corridor Planning Guide , October 2011, is that the river channel is always trying to return to equilibrium. His study showed that the river deals best with stressors such as climate change and impacts of development when it is in a balanced state. Some of humans' past activities along the river have been associated with unwanted consequences. Dr. Field identified activities that should be avoided. Straightening the river, deforestation and denudation of ground cover along the shoreland, and loss of floodplain storage areas were identified as forerunners of bank erosion. As expected, the subsequent increase in flow velocity, in turn, increases the capacity of the river to transport sediment load. Unintended and unanticipated consequences occur, including loss of aquatic and shoreland habitats, flooding events, and occurrence of ice jams in shallow and/or constricted stretches of the river. Dr. Field's report provides in-depth information about the vertical and lateral constraints that affect the river's ability to make adjustments. His report offers practical measures to be undertaken to alleviate problems, including a comprehensive list of elective restoration projects on a town-by-town basis. Dr. Field urged protection of some of the still existing undeveloped shorelands that are located adjacent to highly developed areas to offset the floodplain problems that have been created by past activities. A series of public meetings/discussions was held for riparian corridor landowners, town government planners, and other interested parties. The erosion hazard mitigation mapping will be used as a basis for planning as well as for aquatic habitat and stream restoration projects.

Issues

Courtesy of Littleton Area Historical Society

- There has been a gradual loss of open space due to increased development, during a time when New Hampshire has been experiencing greater climate variability. This trend has been accompanied by a net loss of wetlands to absorb the sudden increases in water flow, and decreases in storage areas for the overflow. Deforestation in critical areas, losses of vegetative buffers, and changes in land use have subjected the watershed to increases in erosion and sedimentation.

- Flooding and bank erosion are contributing to the spread of some invasive plant species. In addition, invasive plants are contributing to bank erosion in some areas where they have outcompeted native species better suited for bank stabilization.

- Hazard mitigation and emergency operations plans addressing, e.g., downbursts, hurricanes, dam failure, and transport of hazardous materials, should be kept up to date and implemented. Risk assessment, planning, pre-emptive corrective measures, and restoration projects should be done at the community level throughout the watershed to offset flooding and other hazards, locally and downstream. Timing of action is key to human safety, to the prevention of property damage, to the protection of community infrastructure, and to budgetary cost containment. It is better to deal with problems at the outset than wait.

Tropical Storm Irene floodwaters at Mount Washington Hotel entrance, 8/29/2011 Photo by Linda Dowling

Recommendations

- ☐ Floodplain and fluvial erosion hazard areas should be a key part of multihazard mitigation planning and implemented through land use planning.

- ☐ The results of Dr. John Field's studies of the Ammonoosuc River should be incorporated in local land use planning and implemented through both public and private activities. Some examples:
  - Implement pre-emptive mitigation.
  - Conduct restoration projects to protect the river corridor: plant stream buffers, stabilize stream banks, restore areas of sediment accumulation (aggradation) and areas of incised channel reaches.
  - Encourage meander of the river in remaining open areas.
  - Remove floodplain constraints and/or replace structures.
  - Use erosion and sediment controls.

- ☐ The Ammonoosuc River LAC should continue to work toward river restoration and separation of human activities from flood and erosion hazards through such activities as:
  - Listing important floodplain areas for possible land conservation.
  - Identifying floodplain areas of concern adjacent to major highways.
  - Reviewing floodplain zoning regulations in the river corridor towns.
  - Encouraging use of Best Management Practices in all activities.
  - Identifying new areas in need of floodbank restoration projects.
  - Inventorying invasive shoreline and aquatic plants for the NH Department of Environmental Services (NHDES).
  - Setting up educational programs for riparian landowners and recreational land users.

For More Information

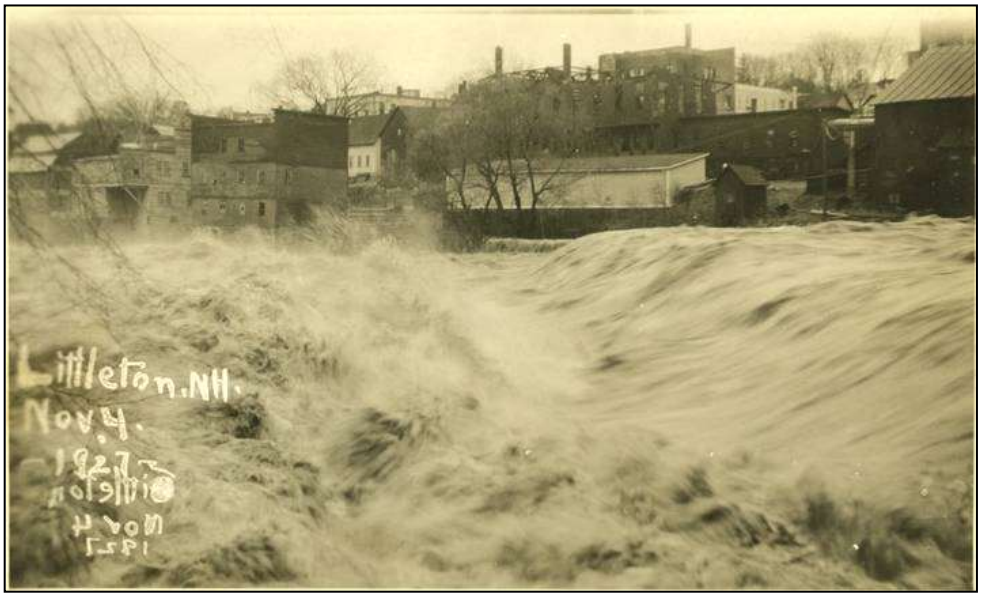
- "Flood Hazard Area Zoning," Innovative Land Use Planning Techniques Handbook, NHDES, NH Association of Regional Planning Commissions, NHOEP, and NHMA, October 2008.

- For one approach to incorporating fluvial erosion hazard area information into town planning and zoning see Fluvial Erosion Hazard Area Zoning, NHDES, September 2010.

- For another approach from our neighbors in Vermont, see VANR's Municipal Guide to Fluvial Erosion Hazard Mitigation, May 2010.

3.5 Stormwater Management

Background



1927 Floods in Downtown Littleton
Courtesy of Littleton Area Historical Society

The Ammonoosuc River watershed, as a network of water interconnectivity, is important to life zones and ultimately to the well-being of people living in the communities along the river. Locations that have extensive impervious surfaces, bank erosion, high-density development, and agricultural areas devoid of vegetative buffers warrant extra surveillance to determine if there are stormwater problems in-the-making that would be amenable to restoration programs. Experience has shown that being proactive in looking after water quality in the Ammonoosuc River is more effective and less costly than after-the-fact remedial actions. Stormwater Management Plans and Best Management Practices (BMP) are standards expected of developers.

Littleton Meadows, Google Earth

Oversight of projects from inception to completion by a qualified person and enforcement of infractions are measures of equal importance. A recent trend has been to set up stormwater upkeep maintenance plans for businesses prior to construction. In 2003 the N.H. Department of Environmental Services (NHDES) funded the business community of Littleton to do the Ammonoosuc River Drainage System Mapping and Modelling Project for box store development along the river in *The Meadows*. It was a prototype endeavour to do mapping of the watershed, matching the data to contingency planning for protection of the water from everyday hazards and unforseen hazardous materials threat. It was a cooperative effort by community leaders, educators, Antioch's COSEED (Community-based School Environmental Education),

the Appalachian Mountain Club and Littleton High School students, using GPS and GIS technology. This cooperative effort provides a great example for addressing issues on other sites in the corridor through collaboration.

Issues

- The quality of water for human consumption (i.e. drinking water in Woodsville, Lisbon, and private wells) is dependent on protection of water at its source (the Ammonoosuc River and the aquifer) and on having effective stormwater management.

Photo by Connie McDade

- Wetlands act like a sponge, soaking up stormwater and releasing it more slowly. The loss of wetlands can result in reduction of infiltration, increased pollution of surface and groundwater from polluted runoff, and peak flood levels and velocity. Additional impacts to the hydrologic cycle occur when the groundwater is not recharged.

- Lack of vegetated buffers along some agricultural lands and runoff from impervious surfaces has opened up the river to erosion and sedimentation.

- The conclusion by scientists is that we need to change the way water is managed. Water conservation needs to be partnered with stormwater management to reduce humans' overall disruption of the water cycle and reduce the amount of wastewater in the waters receiving the stormwater.

Recommendations

- ☐ Opportunities for municipalities to improve stormwater management include:

- building smaller roads with no curbs and gutters outside the urban area; using swales for road runoff, pervious pavement, and detention ponds in problem areas; urban tree planting
- locate snow storage areas away from the river
- installation of oil traps in parking areas for box stores and on tarmacs where autos for sale are lined up
- use and store hazardous substances in covered impervious areas away from the river

☐ Continue monitoring of water quality by Volunteer River Assessment Program team (VRAP)

☐ Towns should ensure that subdivision and site plan regulations require stormwater best management practices during construction and post construction, and that approvals are followed up with enforcement to ensure that stormwater infrastructure is properly maintained.

☐ To ensure that projects are in compliance with the terms and conditions of state and local permits, Planning Boards should require developers to provide funds to be put in an escrow account to enable assigning a qualified professional to do project oversight from inception to finish.

☐ Towns should periodically review community maintenance practices, e.g., street sweeping, erosion control, drainage, snow removal and storage.

☐ Towns should adopt local wetland and shoreland ordinances.

☐ Continue educational programs for developers, builders, and landowners about the Shoreland Water Quality Protection Act, including impervious surface limits, waterfront buffer rules, stormwater management within 250’ of the river.

☐ Workshops are needed for town officials and farmers about N.H. Rivers Management and Protection Program regulations within 1/4 mile of the river that deal with new solid waste treatment plants, new landfills, sludge and fertilizer application.

☐ Identify remaining combined sewer overflows where stormwater enters sewage treatment plants along the river during heavy precipitation.

☐ Reduce stormwater runoff by using water conservation measures such as:
- retention of water on home sites by storing and/or delaying runoff with green roof garden, back yard harvesting of roof water by rain barrel and roof diverters, rain gardens
- avoiding watering lawns, replacing extent of traditional lawns with natural surrounds, adding natural surrounds to golf courses

- low-flush toilets, efficient water tank design
- use of permeable products in the yard, increase moisture absorption into the water table by addition of one foot of topsoil on top of cleared land for development; plant native trees and shrubbery

☐ Continue to learn about low impact development (LID) techniques and new technologies and assist with outreach to towns and developers.

For More Information

- "Permanent (Post Construction) Stormwater Management," Innovative Land Use Planning Techniques Handbook, NHDES, NH Association of Regional Planning Commissions, NHOEP, and NHMA, October 2008.

- NHDES Fact Sheet WD-WMB-17 Low Impact Development and Stormwater Management http://des.nh.gov/organization/commissioner/pip/factsheets/wmb/index.htm

3.6 Erosion and Sedimentation from Human Activities

Background

It is a goal of the Ammonoosuc River LAC to promote activities which will reduce erosion and sedimentation on the banks of the Ammonoosuc caused by earlier human activities, mitigate the resultant flooding, and prevent erosion caused by future human activities.

Tropical Storm Irene floodwaters carrying silt
Photo by Leslie Bergum, 2011

Erosion is the loss of soil by the actions of water, ice, gravity or wind through the detachment and transportation of soil particles. Sedimentation, the end product of erosion, is the settling of the detached soil particles transported by water. The organic and mineral particles carried in the runoff from riverbanks cause turbidity which can slow stream flow and affect water quality by raising the temperature of the water and lowering its dissolved oxygen. When these particles, which carry pollutants as well as nutrients, settle in the streambed, they can change the river's aquatic habitat.

Nature, since the glacial age, and humans during the past two centuries, have influenced riverbank erosion and sedimentation in the Ammonoosuc. " Human development in the watershed has created restraints in some locations" not allowing the river to adjust back to equilibrium. "If constraints can be avoided in remaining areas of the undeveloped flood plain," adjustment will allow the river to re-establish equilibrium (from Dr. John Field). Dr. Field also shared the following information during his work with the Ammonoosuc River LAC: "The percentage of floodplain that is blocked and storage area lost determines impact to the river channel." The increase in flow velocity during heavy precipitation events is associated with bank erosion, especially in areas that lack a vegetated buffer. Wetlands and forested surrounds aid in absorption of drainage runoff. A buffer zone of vegetative cover protects the river from aggregates of soil, waste, nitrate fertilizer and other chemicals of agricultural land use. The effects of this increased bank erosion can be seen in a few landslides at the river's edge, and one particularly large landslide at a bend in the river. The resulting sedimentation can be seen where it has accumulated at constricted areas, at river bends, and at tributary confluences.

Sediments hilling in the dam area cause problems for Woodsville's water plant operators. Photo by Bill Harris.

Natural causes are stormwater runoff, tributary inflows, ice build-up and wind-induced wave activity. Human activities have been deforestation, farming, dam building and straightening the river's natural meandering channels to accommodate log drives, road and railroad construction. More recent activities have been increased development activities along the river and in the floodplain, excavation in adjacent gravel and clay pits, and recreational dredging for gold. In addition, some attempts to stop erosion in one locality have caused erosion and flooding farther down the river.

Ice on the Lisbon Soccer Field, Photo by Tara Bamford, NCC

Riverbank erosion is a serious problem that we must consider in this era of changing weather patterns and increasing human activity along the Ammonoosuc. Dr. John Field, who conducted a geomorphic assessment of the Ammonoosuc in 2009/10, stated: "It's clear that most of the Ammonoosuc River offers excellent habitat and is in beautiful condition, with little severe erosion."

He did, however, note that there are problems where serious erosion and flooding occur. These are illustrated on the fluvial erosion hazard maps indicating areas of low, moderate, high and very high zones of erosion. The highest zones are where the river runs along Route 302 and near centers of development. These increase as the Ammonoosuc nears its confluence with the Connecticut River. The most extensive erosion and flooding occur in the Bath/Haverhill area.

Riverbank erosion on the Ammonoosuc
Photo by Field Geology Services, 2009

Issues

- Water quality fit for human consumption and recreation, an adequate stream flow, a good aquatic and wildlife habitat, and protection of valuable land from further erosion and flooding are the goals. Slowing the process of erosion and sedimentation, if not eliminating it completely, is essential to maintaining each of these. Dr. Field's geomorphic study of the Ammonoosuc, which describes how the river has attempted to reach its equilibrium in the watershed by changing its channels, provides knowledge for this, as well as for remediation of present problems. The study will provide a basis for area organizations to work with landowners to help the river find its equilibrium and reduce property damage.

Bank erosion at the Lisbon Soccer Field
Photo by Tara Bamford, NCC, June 2010

- Vegetated riparian buffers are essential to controlling erosion. They stabilize the riverbank soil, filter sediments and provide shade to maintain the cooler temperatures critical to aquatic life. New Hampshire's Shoreland Water Quality Protection Act (RSA 483-B) establishes a protected zone of 250 feet from the river reference line in which certain restrictions apply to impervious surfaces. Other restrictions apply to types of business, septic system setbacks, lot sizes, dwelling units and alteration of terrain. This protected zone contains a waterfront buffer and a natural woodland buffer from the river reference line. No primary structures are allowed in the 50 foot waterfront buffer and tree coverage is managed with a grid and point system. Within these buffer zones proscriptions and restrictions apply to vegetated areas.

Recommendations

- ☐ Although RSA 483-B is periodically amended by the Legislature, planning and zoning boards in communities along the Ammonoosuc should be familiar with it and include its provisions in their master plans and ordinances. Information and publications such as an illustrated *Summary of the Standards* are available from the NH Department of Environmental Services (NHDES), the responsible agency. The Connecticut River Joint Commissions also has an excellent series of brochures, including *River Dynamics and Erosion, Introduction to Riparian Buffers, Buffers for Habitat, Backyard Buffers, Planting Riparian Buffers* and a detailed list of native ground covers which could be included in a packet for distribution to riparian landowners by the Ammonoosuc River LAC, conservation commissions and to planning boards for developers. Also available and applicable to the Ammonoosuc is the Coos and Grafton Counties Conservation Districts' informative brochure, *Living With The River: A Landowner's Guide to Erosion Control on the Connecticut River.*

- ☐ The Ammonoosuc River LAC and conservation commissions should work with towns to ensure that road agents, developers, construction companies, gravel and sand pit owners, and loggers observe best management practices published by various organizations, including the University of New Hampshire's Cooperative Extension Service, as well as to understand state laws and the NHDES permit regulations relative to their activities.

- ☐ Working with the Ammonoosuc Conservation Trust and other conservation organizations, the Ammonoosuc River LAC and conservation commissions should encourage landowners to consider the benefits of conservation easements on riparian lands.

- ☐ Conservation commissions should check with their planning and zoning boards to see if they are aware of and using the publication *Innovative Land Use Planning Techniques: A Handbook For Sustainable Development* (October 2008) compiled by New Hampshire's regional planning commissions for NHDES.

For More Information

- "Erosion and Sediment Control During Construction." Innovative Land Use Planning Techniques Handbook, NHDES, NH Association of Regional Planning Commissions, NHOEP, and NHMA, October 2008.

- My Healthy Stream – A Handbook for Streamside Owners, Jack E. Williams, Michael P. Dombeck, and Christopher A. Wood, Trout Unlimited and Aldo Leopold Foundation, 2012.

3.7 Pollution from Human Activities and Special Land Uses

Background

Point and nonpoint sources of pollution can have a major effect on the health of the river. Point source pollution is defined as specific pollutant or discharge points that can be identified and physically located. Since the Clean Water Act of 1971, most discharges require a permit and have to be treated prior to discharge. No discharges are allowed into Class A waters and no new discharges that contain phosphorus are allowed into lakes and ponds. There are four active permits for discharges to the Ammonoosuc River: Bethlehem Village District, Pinetree Power, Littleton Wastewater Treatment Facility, and Lisbon Wastewater Treatment Facility.

Issues

- The major source of pollution today comes from nonpoint sources, such as runoff from roads, parking lots, golf courses and other impervious surfaces; short-term land uses that disturb the soil such as construction sites; logging and farming; and seepage from landfills, auto salvage yards and hazardous waste storage areas.

- Farming is not a significant source of nonpoint pollution in the corridor since less than 8% of corridor land is in agricultural use. Logging operations are more likely to impact water quality, e.g., through sedimentation and tannins, as close to 70% of the corridor is forested area. Timber harvesting operations must file a Notice of Intent to Cut with the town, and a Forestry Notification with NHDES if impacting surface waters or wetlands. NHDES regulations requiring best management practices, and DRED basal area and slash laws are in place to protect surface waters, but harvesting may sometimes fall out of compliance due to lack of funding for inspections leaving erosion and sediment problems unchecked.

Pigtails containing contaminants seeping from the bank along the Ammonoosuc
Photo by Field Geology Services, 2009

- Construction projects of over 100,000 square feet of contiguous land require a site specific permit from the NH Department of Environmental Services (NHDES) which ensures that measures are being taken to provide erosion control and prevent sedimentation of surface waters. Site preparation and the construction of roads, driveways and parking lots are short-lived impacts but may cause severe erosion or sedimentation if preventive measures are not established or maintained during the project. Although land development has slowed during the recent recession, the Towns of Bethlehem, Carroll and Littleton have still had significant building growth over the past few years.

- Seepage from junkyards and landfills can also be sources of nonpoint pollution. Landfills in proximity to an aquifer and/or the river are being phased out due to health concerns that seepage from the liner may leach out salts, dissolved organic carbon and nitrogen, and heavy metals, which may drain into the aquifer and eventually into the river. Although there are four towns within the corridor with solid waste sites, Bethlehem is the only town with a facility that is open. NHDES lists one junkyard within the river corridor located in Littleton.

- Highway maintenance may also be a source of surface water pollution, specifically the salt and sand mixture used to de-ice the roadways. Although the state has started a road salt reduction initiative program, it has no laws to regulate the use of salt. To protect groundwater, NHDES recommends putting snow dumps near flowing surface waters (at least 25 feet from the high water mark to keep debris out of the water). Snow dumping sites may create concentrated salts and other pollutants that may seep into nearby surface waters.

- NHDES has an inventoried hazardous waste generators which may be potential sites of pollution if not maintained properly. These sites include underground storage tanks, above ground storage tanks, remediation sites and businesses such as gas stations, auto repair shops and industries. All tanks greater than 1,100 gallons are regulated by NHDES. As of January 1, 1999 all tanks greater than 20 years old were required to be removed. Although underground tanks of less than 1,100 gallons and residential fuel oil tanks located in the basement present a potential threat to water quality, they are not regulated by NHDES. Remediation sites are locations of known contamination or leakage of hazardous waste.

- Stormwater runoff from impermeable surfaces can be the most serious source of pollution because it carries high levels and a broad range of contaminants, and is generally discharged directly into surface waters without treatment. As towns grow along the river corridor, impermeable surfaces and stormwater drainage systems increase bringing a greater potential for surface water contamination.

- There has been a recent concern regarding pharmaceuticals being detected in groundwater, streams, rivers and lakes at very low concentrations. The sources of these pollutants are both improperly disposed of medicines and human waste. There is concern about potential impacts on human health and other species. Most water and wastewater utilities do not

specifically test for pharmaceuticals in the water supply at this time. Over the next few years, the EPA is requiring that all water systems serving more than 10,000 people and a representative sample of water systems serving fewer than 10,000 people collect water samples from their water sources and analyze them for ten common pharmaceuticals. Although pharmaceuticals are not regulated under drinking water regulations, EPA continues to evaluate the occurrence of these compounds in the environment and associated human and aquatic life health effects.

Recommendations

- ☐ Address existing contamination sources.
  - Update the NCC/NHDES inventory of potential contamination sources along the river. These include failing septic systems, underground fuel storage tanks, uses associated with hazardous waste, large impervious surfaces, storm water runoff, and agricultural activities without adequate vegetated buffers.
  - Target hot spots that need attention presently and prioritize protection area.
  - Monitor known and potential contamination sources.
  - Review building permits as one source of information on land use changes in the corridor.

- ☐ Educate municipalities and residents on pollution prevention.
  - Educate the public about the importance of a healthy septic system and provide them with guidance on proper maintenance.
  - Educate homeowners, businesses and local officials about the importance of proper disposal of hazardous wastes.
  - Encourage towns to establish comprehensive hazardous materials management programs to prevent contamination along the river.
  - Educate local land use boards on the importance of effective storm water management and provide them with guidance in BMPs and establishing regulations.
  - Educate the public about everyday hazards and contaminants: advise discretionary use of herbicides and pesticides; abstain from discharge of household chemicals and medications into sewer/septic system.
  - Provide educational programs for winter and summer maintenance crews of towns, including private contractors.
  - Include information on the importance of vegetative buffers in farm newsletters.
  - Publicize Shoreland Act provisions, e.g., no sludge applied to fields within 1, 320 feet of the river, no pesticides within 50 feet unless applied by a licensed applicator.

- ☐ Assist towns in updating and implementing land use regulations.
  - Review existing town regulations and ordinances to see if there are protective measures in place, e.g., requirements for vegetated buffers and stormwater management.

- Compile model ordinances that may be suggested to towns that would improve the protection in their section of the river.
- Attend local land use meetings that are addressing applications for development along the river to make recommendations regarding protective measures and BMPs.

☐ Support periodic hazardous waste and medication collections for proper removal.

☐ Investigate funding options for implementing protection strategies.

☐ Continue ongoing monitoring and reporting to the NHDES by the VRAP water quality testing team.

For More Information

- Innovative Land Use Planning Techniques Handbook, NHDES, NH Association of Regional Planning Commissions, NHOEP, and NHMA, October 2008.
- Other NHDES Publications available on the NHDES website des.nh.gov/organization/divisions/water/publications.htm.

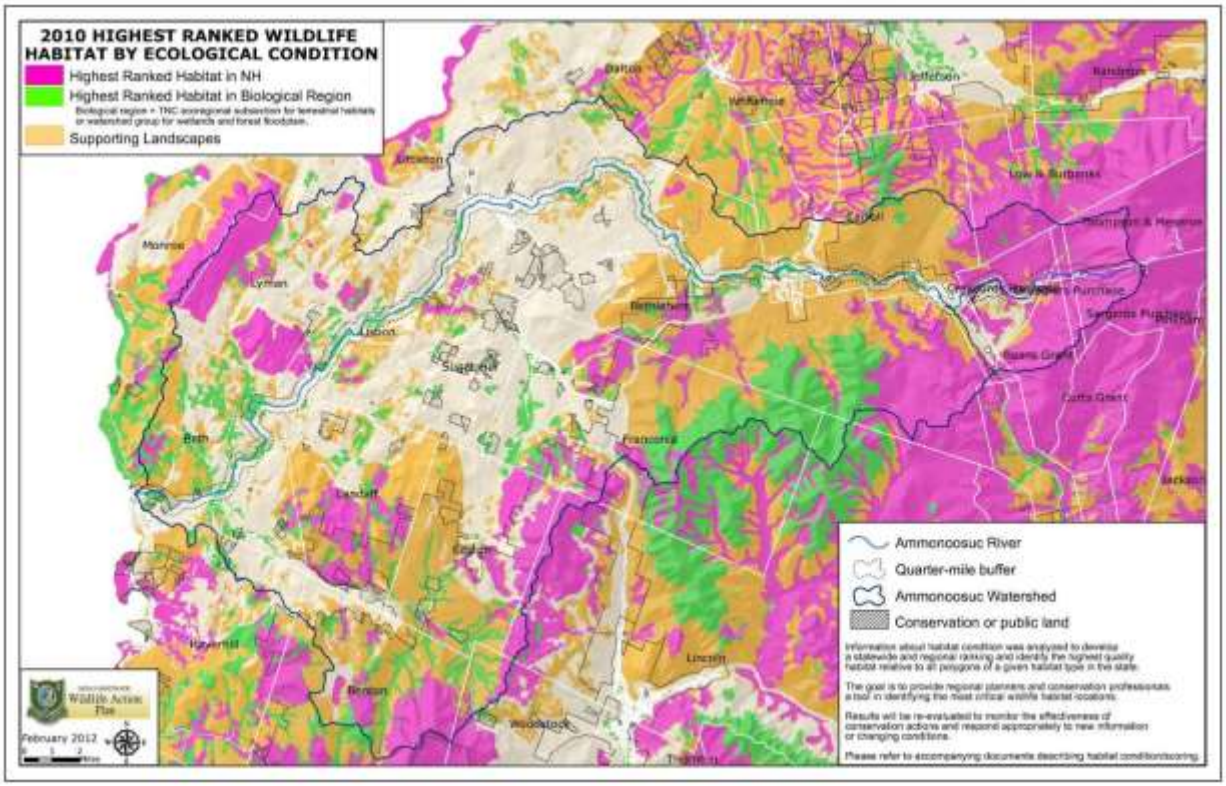
3.8 Wildlife and Fish

Background

Photo by Nancy McCarthy

Wildlife

The Ammonoosuc River supports an extremely diverse habitat comprised of forest, wetlands, and open space that is home to a variety of wildlife. Its floodplains, wetlands, and large sections of unfragmented lands are critical habitat areas that offer important and often irreplaceable wildlife benefits. The Ammonoosuc River was listed as a high priority area in the Connecticut River watershed for contiguous habitat (Silvio O. Conte National Fish and Wildlife Refuge Final Action Plan and Environmental Impact Statement). The NH Fish and Game Wildlife Action Plan indicates this rich area of the river corridor as some of the highest ranked wildlife habitat in the state.



The NH Fish and Game has identified several deer wintering areas and over 140 bird species within the Ammonoosuc corridor. Some of these bird species, such as the bald eagle, osprey and hawks, can be seen in the spring and fall as they migrate to and from their breeding grounds. Bald eagles are occasionally seen throughout the winter months utilizing the large river corridors with open water in search of food. According to Chris Martin, Senior Biologist with N.H. Audubon, an osprey nest was reported adjacent to the river in Bath. Each year for several years now the nest has produced two young.

Osprey nest in the Ammonoosuc corridor
Photo by: Robert Landry, 2009

Large sections of unfragmented land in the Upper Reach section of the river are especially important for moose, black bear, bobcat, state-threatened American pine marten, and federally threatened/state endangered Canada lynx. Recent sightings of the lynx have been documented in Coos County in upper areas of the Connecticut River watershed. The NH Natural Heritage Bureau reports the presence of five threatened or endangered wildlife species in the Ammonoosuc River watershed. The northern bog lemming (NH's rarest mammal) is specifically associated with the Upper Reach segment of the river. Other species on NH Natural Heritage Bureau's Rare Animal List for New Hamspshire that are present in the watershed include the bald eagle (state threatened species), peregrine falcon (state threatened species), and osprey (special concern).

The Ammonoosuc River originates in the alpine habitat at an elevation of 5,018 feet above sea level. In this habitat type, unique plant communities' extreme climate and isolation lead to rare, sometimes site-specific, species, such as the White Mountain fritillary butterfly.

In the spring of 2010 an early emergence of bats was present in the headwater drainage areas of the Ammonoosuc River. Many bats were observed flying during the day in the Mount Washington Cog Railway and Bretton Woods Resort area. Bats were found dead and specimens (little brown bat species) collected confirmed the presence of White Nosed Syndrome. The USFS White Mountain National Forest conducted bat survey work in August and September of 2010 to try and identify the presence of an unknown hibernaculum in the Ammonoosuc Ravine area. Various natural resource agencies are collaborating on continued bat surveys in the Ammonoosuc headwaters area to monitor bat populations.

Fish

The Ammonoosuc River provides habitat for at least 17 resident cold and warm water fish species: Atlantic salmon, blacknose dace, brook trout, brown trout, burbot, common shiner, creek chub,

common white sucker, eastern chain pickerel, fallfish, longnose dace, longnose sucker, northern brown bullhead, rainbow trout, slimy sculpin, tessellated darter and yellow perch.

The Ammonoosuc River has been identified by the US Fish and Wildlife Service as an important cold water fishery. Atlantic salmon fry had been stocked into this river as part of the federal Atlantic Salmon Restoration Program from the mid-1990s to 2011. The program was a major cooperative effort between USF&W, National Marine Fisheries Service, US Forest Service, Atlantic Salmon Commission, N.H. Fish & Game, private organizations, and many volunteers. The termination of the Connecticut River Salmon Program was primarily due to low adult return rates, as well as the destruction of the White River National Fish Hatchery by Tropical Storm Irene. This facility was the sole provider of Atlantic salmon for the Connecticut River Restoration Program.

Studying trout populations in the Ammonoosuc watershed
Photo by Rick Walling, 2011

The Ammonoosuc River is stocked annually with rainbow, brook and brown trout of varied age cohorts. According to the NH Fish & Game, the Ammonoosuc River is suitable for wild, self-sustaining populations of brook trout. Brook trout is one of the most highly sought fish in New Hampshire and is included in the NH Wildlife Action Plan as a "Species of Greatest Conservation Need." Critical habitat found within the corridor includes deep pools, such as Lower Falls in Carroll and the ledges in Bath; smaller pocket pools and spring seeps are scattered throughout the system, which provide cool water refuge necessary for summer survival of cold water species. Additionally, the many tributaries of the Ammonoosuc River provide critical habitat for cool water refuge and spawning for trout and salmon which very often takes place in the tributaries to larger rivers. The Eastern Brook Trout Joint Venture (EBTJV) is a Fish Habitat Partner under the National Fish Habitat Partnership. It is made up of a diverse group of partners, including state fish and wildlife agencies, federal resource agencies, academic institutions and private sector conservation organizations that are all working toward conserving Eastern brook trout and their habitats across their native range. This group reviewed available brook trout habitat and population data from Georgia to Maine and developed a preliminary presence/absence model using various

habitat parameters and conservation strategies by state that would protect, enhance, and restore the brook trout populations that resided there. NH Fish & Game has documented naturally reproducing populations of wild brook trout in this watershed and the EBTJV model classifies the Upper Reach and many tributaries throughout the Ammonoosuc River Watershed as intact, which makes them high priority waters.

A multi-year biological assessment project on the Ammonoosuc River tributaries began in the summer of 2011. It is a collaborative effort between NH Fish & Game, Trout Unlimited, EBTJV, and many volunteers. The project includes habitat, fish, and macro-invertebrate surveys on both the mainstem and its tributaries. The data, once collected and analyzed, will serve as a tremendous resource to the Ammonoosuc River Local Advisory Committee, local municipalities, groups, and anyone interested in the health of the Ammonoosuc River Watershed. This data will be utilized collaboratively by NH Fish & Game and the EBTJV to document brook trout presence within their entire native range, as well as prioritize areas for protection, enhancement and restoration of Eastern brook trout habitat.

Issues

- New Hampshire's Wildlife Action Plan (2005) identified several issues affecting habitats within the Ammonoosuc River watershed including:
  - climate change
  - acid deposition
  - recreational activities
  - human development
  - transportation infrastructure
  - land fragmentation
  - nonpoint source pollution

(See Wildlife Action Plan Critical Habitats and Threats, Appendix 3.8.)

- Continued development in the river corridor with increases in commercial and residential use presents potential issues for both wildlife and aquatic resources. There is growing concern about the impact these changes will have on wildlife and aquatic life. Poor water quality, habitat loss and fragmentation will have the greatest impact on wildlife that require large areas for movement and have specific travel corridors. It is a fundamental tenet of conservation biology that organisms need to move around to some extent. Some organisms need to move vast distances, while others need not move much at all. Studies conducted on brook trout in New Hampshire and elsewhere have clearly demonstrated that some individual trout move very long distances to find cool water and to spawn. For this species, it is absolutely vital that they can access their required habitats. They tend to spawn in tributaries to large rivers (although they also spawn in the large rivers), so migratory barriers such as culverts and dams can impact wild brook trout populations.

- Undeveloped corridors of land that connect habitat areas allow wildlife movement. Riparian areas also offer some of the most reliable sources of early and late season food sources for wildlife. Loss of this critical resource could result in competition for food and adequate cover. The impact of human activity on wildlife extends beyond the area of actual development. It can affect an entire area where habitat value has been meaningfully reduced.

- Development also affects the quality and quantity of aquatic resources. Roads may be the single most destructive element of habitat fragmentation. Culverts can present issues for fish passage and movement of aquatic life. Additionally, undersized culverts are more likely to be damaged during floods, often leading to the deposition of road fill into the streams; this can be one of the greatest impacts to aquatic habitats. Impervious surfaces have been shown to lead to direct and indirect impacts to aquatic ecosystems. The more impervious surfaces in a watershed, the more stormwater runoff there is from developed areas, and traditional peak flood flows occur faster and higher than what would naturally occur. Runoff typically is warmer, and can be polluted with oil and grease, fertilizers, pathogens, household chemicals, and trash; all of which can have negative effects on water quality and therefore can have an impact on all aquatic life forms. Because the peak flows can be higher due to impervious surfaces, sediment transport in streams and rivers can be altered such that there is greater bank erosion than naturally occurs.

- When vegetative buffers along rivers and tributaries are lost, sunlight can further warm water beyond a threshold at which native species, especially coldwater ones like brook trout, can survive and reproduce. Riparian buffers serve a number of important functions. First, they tend to be travel corridors for terrestrial wildlife. Second, decades of research have shown that riparian buffers help filter out contaminants before they can get to the stream/river. The value of this cannot be overstated. Third, they provide shade to the stream/river such that water temperatures are

High water on the Ammonoosuc carrying heavy silt load after Tropical Storm Irene
Photo by Rick Walling, 2011

cooler when a solid riparian buffer is present. Fourth, they provide a critical food source to the stream/river in the form of insects and spiders, especially in mid-summer when macroinvertebrates in the stream/river tend to be hard for fish to obtain. Fifth, they provide organic matter to the stream/river. Large trees, and even small sticks, are part of a healthy stream/river, and are especially important to brook trout, which utilize instream wood directly by hiding under it or within wood jams. Large instream wood helps form pools, a habitat that is vital to brook trout and other fish species, and also allows for the accumulations of leaves, especially in wood jams. The leaves that fall into the stream/river in autumn form the basis of the food web in flowing waters. The leaves are colonized by bacteria and fungi, which obtain nutrients directly from the water, and are in turn eaten by macroinvertebrates that shred leaves (specifically to eat the bacteria and fungi), which are then eaten by fish and then other animals such as mink and people. Sixth, they provide the base for stream bank stability. Intact buffers slow erosion rates by reducing direct runoff through their diverse plant/root composition.

- Water quantity can also affect aquatic species on both ends of the spectrum, drought and low flow conditions, as well as flood and high water conditions. Manmade dams and even dams created by beavers can affect water quantity and natural flow rates. Aquatic organisms are well adapted to natural flows, including severe floods and droughts. They are not, however, adapted to withstand flows heavily altered by human activities. In heavily developed watersheds, it is common for peak flood flows to be higher and occur more frequently than under natural conditions, and droughts tend to be much more severe in duration and flow. A large amount of research has documented these problems and also that fish species respond negatively to altered flows, with certain species, such as brook trout, being very sensitive to flow alteration. Species that are specifically adapted for riverine conditions are also very sensitive to flow alteration and many examples exist in which entire populations of fish species have been extirpated from streams with severely altered flows.

- Unintended spread of invasive species is a more recent problem in the Ammonoosuc watershed and has the potential to greatly impact aquatic habitat by impairing water quality and crowding out species needed by wildlife. The Upper Reach has remained free of Japanese Knotweed; the mainstem south from Littleton has notable areas of spread to Lisbon and Bath. Purple loosestrife continues to spread along road way ditches adjacent to the Ammonoosuc River.

- Poorly designed culverts and unmaintained culverts can prohibit free movement of aquatic life (fish, amphibians, invertebrates) and stream substrate.

Recommendations

- ☐ Encourage towns to develop natural resource inventories to collect and compile existing information on local resources into one document and map set, and natural resource

protection plans to identify approach to resource protection most appropriate for the community.

- ☐ Include wildlife, fish and habitat in conservation planning efforts, using existing resources such as natural resource inventories, open-space plans, conservation plans, etc.
- ☐ Encourage landowners and conservation groups to consider connectivity relative to the various habitat needs of aquatic species when protecting, maintaining and restoring habitat.
- ☐ Encourage landowners to work with NH Fish and Game Department and UNH Cooperative Extension County Foresters to conduct habitat management on lands to maintain habitat diversity.
- ☐ Protect, restore and maintain vegetative buffers along river and stream corridors to help maintain water quality.
- ☐ Public and private landowners, road crews, utilities and recreationists should be encouraged to follow best management practices for invasive species management.
- ☐ Provide education to residents within Ammonoosuc River watershed about the importance of maintaining habitat for terrestrial and aquatic species.
- ☐ Strive to reduce human alteration of natural flows; consider the impacts of proposed flow alterations on a wide range of aquatic organisms.
- ☐ Replace existing culverts with bottomless archway culverts or bridge design to facilitate free upstream and downstream movement. Develop maintenance schedules to monitor culverts before they become a problem.

For More Information

- NH Wildlife Action Plan, NH Fish and Game, http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm
- NH Natural Heritage Bureau, http://www.nhdfl.org/about-forests-and-lands/bureaus/natural-heritage-bureau/
- Trout Unlimited, http://www.tu.org
- Ammonoosuc Chapter of Trout Unlimited, http://www.ammotu.org
- Eastern Brook Trout Joint Venture, http://www.easternbrooktrout.org

3.9 Plant Habitat

Background

The species present along the Ammonoosuc River corridor are the result of climate, elevation, hydrology, soils, and human impacts. The entire corridor is within the humid temperate ecosystem but the corridor is within two separate ecological subunits along its length, according to the US Geological Survey. The lower section is in the New Hampshire Upland subsection and the northern (upper) portion in the White Mountain subsection. While most species are found in both sections, the White Mountains area is dominated by large areas of spruce-fir forests and northern hardwood forests while the lower portion of the corridor is a transitional area of coniferous and hardwoods forests. For example, coniferous forests in Bath consist primarily of white pine while those in Carroll are comprised of balsam fir and red spruce. Hardwoods in the northern section may have a predominance of yellow birch while in the lower end the northern extent of red oak can be seen in Landaff and Bath. Wetland plant communities in both sections are dominated by palustrine forested communities.

Mountain Avens (Geum peckii)
Photo by Leslie Bergum

Literally hundreds of plant species may be found in the corridor. Representative species include: balsam fir, white spruce, red spruce, black spruce, arbor vitae, white pine, eastern hemlock, tamarack, red oak, red maple, sugar maple, yellow birch, beech, moosewood, white birch, aspens, shadbush, ash, poplar, white cedar, along with alder, willows, dogwoods, elderberry, winterberry, blueberry, cherry, and large and varied number of herbaceous weed, grass, and wildflowers.

Wetlands, including river and stream banks, provide a unique habitat that is suitable for hundreds of species of sedges, rushes, grasses, ferns, and woody species. Wetlands offer a diversity of species not found elsewhere in the corridor.

The alpine zone which occurs above treeline at approximately 4,900 feet elevation, is an area that due to its extreme climate and isolation leads to many rare species. High winds, precipitation, cloud cover and fog result in low annual temperatures and a short growing season. This area where the river arises is a special habitat with some species that are unique to this location.

Moss Plant, also known as Moss Heather (Harrimanella hypnoides) Photo by David Govatski

Endangered or Threatened Species

The following tables indicate state-listed endangered or threatened plant species that are supported by the river and river corridor environment. The species location and species status in New Hampshire are listed and noted as follows: endangered [E], threatened [T] species. The Plant Habitat Tables in Appendix 3.9 list the type of habitat in which each plant species might be found in the watershed.

Plant Species	Location	Threatened/ Endangered
Dwarf Birch	Chandlers Purchase, Thompson & Meserve	E
Harsh Bluepoint	Sargents Purchase	E
Pickering's Bluepoint	Sargents Purchase	T
Black Sedge	Sargents, Crawfords, Chandlers, and Beans Purchase, Thompson and Meserve, Carroll	E
Bigelow's Sedge	Sargents, Beans and Chandlers Purchase, Thompson and Meserve	T
Diapensia	Sargents, Beans and Chandlers Purchase, Thompson and Meserve	T
Hornemann's Willowherb	Sargents Purchase, Beans Purchase, Thompson and Meserve	T

Mountain Avens	Sargents Purchase, Beans Purchase, Thompson and Meserve	T
Moss Plant	Sargents Purchase, Thompson and Meserve	E
Plant Species	**Location**	**Threatened/ Endangered**
Sweet Alpine Grass	Sargents Purchase, Thompson and Meserve	T
Lily-leaved Twayblade	Sargents Purchase, Carroll	T
Heart-leaved Twayblade	Sargents Purchase, Beans Purchase, Carroll, Thompson and Meserve	T
Alpine Azalea	Sargents Purchase, Chandlers Purchase, Thompson and Meserve	T
Spiked Woodrush	Sargents Purchase, Thompson and Meserve	T
Boott's Rattlesnake Root	Sargents Purchase, Chandlers Purchase, Thompson and Meserve	E
Mountain Heath	Sargents Purchase, Thompson and Meserve	T
Wavy Bluegrass	Sargents Purchase, Thompson and Meserve	E
Lapland Rosebay	Sargents Purchase, Chandlers Purchase, Thompson and Meserve	T
Baked Appleberry	Sargents Purchase, Chandlers Purchase	T
Silver Willow	Sargents Purchase	E
Tea-leaved Willow	Sargents Purchase, Thompson and Meserve	T
Bearberry Willow	Sargents Purchase, Chandlers Purchase, Thompson and Meserve	T
Alpine Brook Saxifrage	Sargents Purchase, Thompson and Meserve	E
Peat Moss	Sargents Purchase, Crawford Purchase	T

Alpine Blueberry	Sargents Purchase, Beans Purchase, Thompson and Meserve	T
Mountain Hairgrass	Sargents Purchase, Thompson and Meserve	T
Plant Species	**Location**	**Threatened/ Endangered**
Alpine Marsh Violet	Sargents Purchase, Chandlers Purchase, Thompson and Meserve	E
Hidden Sedge	Carroll, Bethlehem	E
Meadow Horsetail	Carroll	T
Millet Grass	Carroll	T
Thin-leaved Alpine Pondweed	Carroll	T
Wapato	Carroll	T
White Bluegrass	Carroll	T
Kidney-leaved Violet	Carroll, Bethlehem	T
Jack Pine	Bethlehem	T
Goldies Fern	Bethlehem	T
Green Adders-mouth	Carroll, Bethlehem, Landaff	T
Cileated Aster	Bethlehem, Littleton	T
Cileated Willow-herb	Bethlehem, Littleton, Bath	T
Bailey's Sedge	Littleton	T
Garber's Sedge	Littleton	E
Grass of Parnassus	Littleton	T
Pursh's Goldenrod	Littleton	T
Three-leaved Black Snakeroot	Littleton	T
Golden-fruited Sedge	Littleton, Landaff	T
Bebb's Sedge	Littleton, Haverhill	T
Large Yellow Lady Slipper	Landaff	T
Chestnut Sedge	Lisbon	E
Kalm's Lobelia	Bath, Haverhill	T
Climbing Fumitory	Bath	T
Dwarf Ragwort	Bath	T
Great St. John's-wort	Bath	T
Gregarious Black Snakeroot	Bath	T
Hairy Rock	Bath	E
Houghton's Umbrella-sedge	Bath	T
Incurved Umbrella-sedge	Bath	T

Loesel Twayblade	Bath	T
Siberian Chives	Bath	T
Hackberry	Haverhill	T
Bosc's Pigweed	Haverhill	T
Green Dragon	Haverhill	E

Natural Communities

The following table indicates vegetative communities supported by the river and the river corridor environment which have been identified as "exemplary natural ecological communities" by the New Hampshire Natural Heritage Inventory, and their respective locations. An “exemplary” natural community means a viable occurrence of a rare natural community type or a high quality example of a more common natural community type as designated by the Natural Heritage Bureau based on community size, ecological condition, and landscape context. See the Plant Habitat Tables in Appendix 3.9 for a list of plant species associated with each community.

Exemplary Natural Ecological Community	**Location**
Wet Alpine/subalpine bog	Chandlers Purchase, Thompson & Meserve, Sargents Purchase
Acidic Riverside seep	Carroll, Bretton Woods area at Lower Falls
Moderate-gradient sandy-cobbly riverbank system	Carroll
Sugar Maple-ironwood-short husk floodplain forest	Carroll
Sugar Maple/false nettle-sensitive fern floodplain	Carroll
Red spruce swamp	Bethlehem, Landaff
Poor level fen/bog system	Bethlehem
Northern medium sedge meadow marsh	Bethlehem
Northern hardwood-black ash-conifer swamp	Bethlehem
Montane sloping fen system	Bethlehem
Montane heath woodland	Bethlehem
Medium level fen system	Bethlehem
Sugar Maple-beech-yellow birch forest	Bethlehem
Spruce-birch-mountain maple wooded talus	Bethlehem
Red spruce-heath-cinquefoil rocky ridge	Bethlehem
Montane lichen talus barren	Bethlehem
Montane acidic cliff	Bethlehem
Lowland spruce-fir forest	Bethlehem

Black spruce-larch swamp	Bethlehem, Landaff
Rich mesic forest	Littleton, Landaff
Northern white cedar-balsam fir swamp	Littleton, Bath
Rich slopping fern system	Littleton
Hemlock-spruce northern hardwood forest	Landaff, Bath
High gradient rocky riverbank system	Landaff, Bath
Herbaceous riverbank/floodplain	Landaff
Exemplary Natural Ecological Community	**Location**
Red maple -black ash -swamp saxifrage swamp	Landaff
acidic riverbank outcrop	Bath, Haverhill
Red pine rocky ridge	Haverhill
Rich maple-oak-hickory terrace forest	Haverhill
Silver maple-wood nettle-ostrich fern floodplain forest	Haverhill

The information listed above was obtained from the NH Natural Heritage Bureau. More information on the NH Natural Heritage Bureau can be found in Appendix 3.9.

Issues

- Much of the area has not been surveyed for rare species.
- Identification and protection of rare species are dependent upon awareness and stewardship by private landowners and those working on the land.
- Invasives are becoming an increasing concern as these are plants that outcompete native species and in most cases do not provide the same habitat benefits of those they replace.
- Increasing development and growth leads to increasing impacts on natural communities, not only due to the development itself, but also due to increasing numbers of people recreating in the outdoors.
- Human impacts on the climate are expected by many to reduce the habitat available for alpine species.

Recommendations

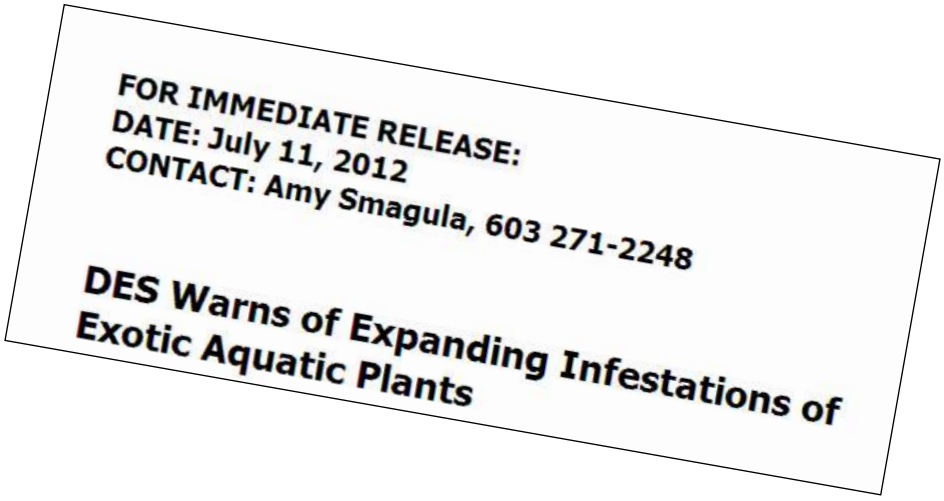
- ☐ Increase landowner education - promote surveys to identify rare species and important natural communities, and stewardship of important habitat areas.

- ☐ Promote consideration of rare species in forest management plans.
- ☐ Increase the identification and eradication of invasive species.
- ☐ Support increased education of recreationists by public agencies and nonprofits on topics such as the age and fragility of alpine plants and the importance of leashing dogs when near important plant and wildlife habitat.

For More Information

- ➢ Natural Heritage Bureau, DRED Division of Forests and Lands, http://www.nhdfl.org/natural-heritage-and-habitats/

3.10 Invasive Plants


FOR IMMEDIATE RELEASE:
DATE: July 11, 2012
CONTACT: Amy Smagula, 603 271-2248

DES Warns of Expanding Infestations of Exotic Aquatic Plants

Background

Invasive species are species that are not native to the ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, February 3, 1999). Invasive species typically possess certain traits that give them an advantage over many native species. The most common traits include:

- production of many offspring
- early and rapid development
- adaptability and tolerance of a broad range of environmental conditions
- absence of natural controls to keep them in check

(NH Department of Agriculture Invasive Species Committee on-line fact sheet)

These traits allow invasive species to be highly competitive and, in many cases, suppress native species. Studies have shown that invasives can reduce natural diversity, impact endangered or threatened species, reduce wildlife habitat, create water quality impacts, stress and reduce forest and agricultural crop production, damage personal property, and cause health problems (NH Department of Agriculture Invasive Species Committee on-line fact sheet). Some invasive plant species can also reduce or alter flow and cause bank erosion.

Terrestrial Invasives

Terrestrial invasives are those found along riverbanks, in the moist soils of forests, wetlands, seeps, floodplains and at the edges of woods and trails. Two invasive species that have taken hold in colonies throughout the Ammonoosuc River corridor are Japanese knotweed (*Polygonum cuspidatum*) and purple loosestrife (*Lythrum salicaria)*. Both grow in a variety of soils and habitats, including stream and river shores. Other invasive species which grow in streams and riverbanks, floodplain forests and marshes are: yellow flag iris (*Iris pseudacorus*), coltsfoot (*Tussilago farfara)*, ornamental jewelweed (*Impatiens glandulifera*), common reed (*Phragmites australis*) Japanese stiltgrass *(Microstegium vinimeum), c*yprus spurge (*Euphorbia cyparissias),* true forget-me-not (*Myosotis scorpioides*), garlic mustard (*Alliaria petiolata*), goutweed or bishop's weed (*Aegopodium podagraria*) and celandine (*Chelidonium majus*). Poison ivy, while not considered an exotic invasive, is spreading rapidly in and around riverside recreation areas.

Aquatic Invasives

The four sub-categories of aquatic invasives are :

- Emergent
- Submergent
- Floating
- Algae

Like terrestrial invasives, exotic aquatic plants threaten native vegetation. They can also impact recreation and lower property values. By changing the chemistry of a river's water and thus its ecology, trout streams may be altered so that they no longer attract May and Caddis flies which provide food for trout. By choking surface waters they can impede personal water craft, deprive the water of oxygen, and affect the aesthetic and economic value of riverside properties.

Issues

- As of this writing, the NH Department of Environmental Services (NHDES) Limnologist/Exotic Species Program Coordinator states that to her knowledge there are no invasive aquatic plants or algae within the Ammonoosuc River. But because some of the more dangerous have been identified in neighboring states and in some other New Hampshire rivers and lakes, it is essential to be on the lookout for evidence of their invasion. Didymo (Didymosphenia geminata), commonly known as "rock snot", is the only form of algae threatening the Ammonoosuc. A low-nutrient diatom which anchors itself to rocks and spreads rapidly by its secretions, Didymo is especially dangerous because the Ammonoosuc offers its classic habitat of a cold, flowing stream with a pH lower than 7.5. Although introduced only in 2006 and noticed in 2007, it is now already widespread in New Hampshire. By clinging to fishermen's waders, other footwear, clothing, canoes and kayaks, as well as anything else that has been in infected water, it is easily introduced elsewhere.

- Three emergent aquatic invasives considered to be of most danger to the Ammonoosuc are: Purple Loosestrife, Common Reed, and Yellow Iris. Although these have roots in the river bank, clumps may break off with erosion and take root in the stream. The Common Reed has also been documented to grow from the banks out into river systems, forming peninsulas and small island areas.

Purple Loosestrife, Photo by Amy Spagula NHDES

Phragmites or Common Reed, Photo by Amy Spagula NHDES

Yellow Iris
Photo by Amy Spagula NHDES

- Among submerged invasives the two most threatening to the Ammonoosuc are Eurasian water-milfoil (*Myriophyllum spicatum*) and variable milfoil (*Myriophyllum heterophyllum*). They spread quickly, out-producing native species and are coming into New Hampshire, mainly on boat bottoms from Maine and Vermont. Others, already in some southern rivers and lakes, are hydrilla (*Hydrilla verticillata*), Brazilian elodea (*Egeria densa*), fanwort (*Cabomba caroliniana*).

Eurasian Water Milfoil
Photo by Amy Spagula NHDES

Variable Milfoil, Photo by Amy Spagula NHDES

Others, already in some southern rivers and lakes, are hydrilla (*Hydrilla verticillata*), Brazilian elodea (*Egeria densa*), fanwort (*Cabomba caroliniana*).

Fanwort, Photo by Amy Spagula NHDES

Hydrilla, Photo by Any Spagula NHDES

- The most dangerous floating invasive is water chestnut (*Trapa natans*), introduced from Massachusetts forty years ago and already in the Connecticut River. The plant can anchor to the bottom with a seed and thin stem, but most of the biomass of the plant floats at the water's surface. The seeds are very spiny and harmful if stepped on. They can also persist in the sediment and remain viable for 10-12 years.

Water Chestnut, Photo by Amy Spagula NHDES

- Terrestrial invasive plants are already a problem along much of the Ammonoosuc River. Since they are by definition opportunistic and able to outcompete native plants when an area is disturbed, they often replace native vegetation on the riverbank after an event causing bank erosion. Since they do not tend to stabilize the soil as well as a mix of native species, the result is often an increase in riverbank erosion. An example of this is shown on the photo below of knotweed along the Ammonoosuc River.

Photo by Field Geology Services, 2009

Recommendations

- ☐ Inventory and monitoring of native and nonnative plant species found in the river corridor to enable timely identification of new occurrences of invasive plants. Enlisting volunteers to receive training from and work with experts from NHDES Exotic Species Program, NH Rivers Council or other specialists could serve to increase public education as well. Training of the VRAP volunteers to identify aquatic invasives would provide the opportunity for them to note new infestation when collecting water quality samples.

- ☐ Rapid response to aquatic invasives through a program of early detection by teams of volunteers followed by control/eradication efforts coordinated and led by state agency professionals or contractors.

- ☐ Education to riparian landowners and school children through talks and distribution of publications on invasive species available from NHDES.

- ☐ Outreach education for fishermen, boaters and swimmers to teach and remind them before entering the Ammonoosuc to check their equipment for any materials from invasive species and, if found, how to properly clean their equipment and dispose of the invasive material.

- ☐ Public education regarding the fact that if recreationists have been in a contaminated watershed, it is necessary to properly clean everything regardless of a visual inspection as a contaminant can be microscopic.

For More Information

- The USDA National Invasive Species Information Center provides a clearinghouse for information about invasive species at www.invasivespeciesinfo.gov/unitedstates/nh.shtml .
- Information specific to New Hampshire's exotic aquatic species can also be found at des.nh.gov/organization/divisions/water/wmb/exoticspecies/index.htm
- NH Department of Environmental Services Fact Sheet WD-BB-61 FAQs about Rock Snot in New Hampshire http://des.nh.gov/organization/commissioner/pip/factsheets/bb/index.htm

3.11 Water Quantity

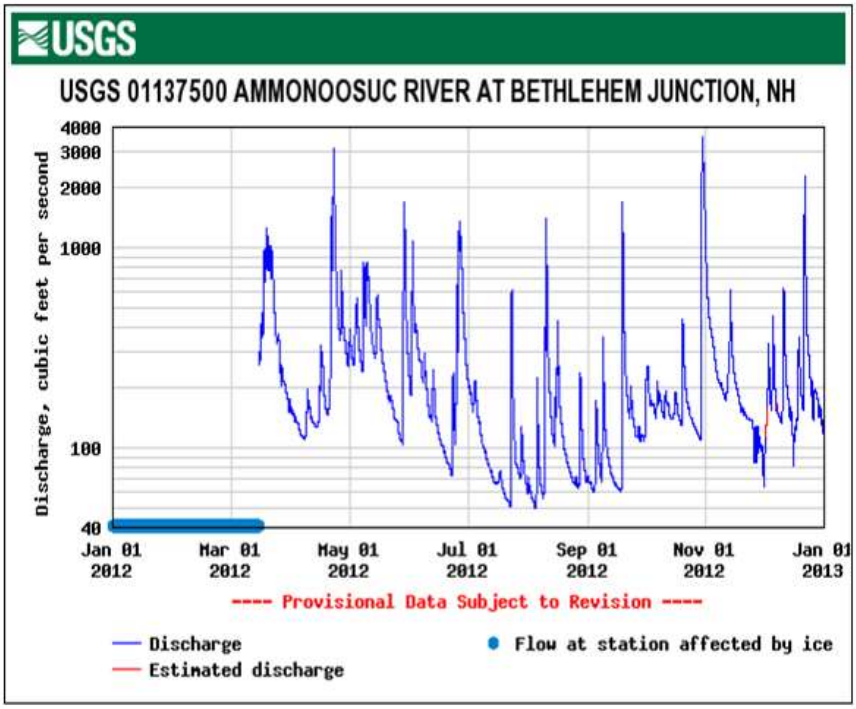
Background

Stream flow varies dramatically on the Ammonoosuc due to climate, precipitation patterns, and watershed characteristics. Currently, the USGS maintains a stream flow gauging station on the Ammonoosuc River at one location in Bethlehem. Another station was operated in Bath between 1936 and 1970. River flow data from each USGS gauge are shown below.

Ammonoosuc River Flow Data

Location	***Bath***	***Bethlehem***
Years of Data	1936-1970	1939-2002
Drainage Area (sq.miles)	395	88
Annual Mean (cfs)	639	207
Highest Annual Mean (cfs)	1,004	323
Lowest Annual Mean (cfs)	413	131
Minimum Daily Dis. (cfs)	-	16
Highest Daily Mean (cfs)	-	6,300
Maximum Peak Flow (cfs)	27,900	11,300

As shown, recorded flows vary greatly from year to year and between peak flows and mean flows. Spring is the normal period of high mean river flows due to snowmelt and rainfall.



In New Hampshire, all facilities that use more than 20,000 gallons of water per day, averaged over a seven-day period, must register with NH Department of Environmental Services (NHDES). There are several registered facilities that withdraw water directly from the Ammonoosuc mainstem:

Woodsville Water & Light, Municipal Water Supply	Haverhill
CHI Operations, Inc., Woodsville Hydroelectric Power	Haverhill
Bath Electric Power Co., Hydroelectric Power	Bath
Lisbon Wastewater Treatment Facility	Lisbon
Littleton Wastewater Treatment Facility	Littleton
Pine Tree Power Co. Biomass Electric Generation	Bethlehem
Bretton Woods Ski Area	Carroll
Mt. Washington Hotel golf course	Carroll

Several other facilities withdraw water from nearby wells and from wells or tributaries throughout the watershed.

Issues

- Aquatic species require certain volumes and patterns of flow.
- River-based recreation, aesthetics/property values, and tourism are dependent on a certain minimum flow volume.
- Aging infrastructure is making leak detection and metering important tools for reducing waste.
- Additional education is needed to address water waste such as single-family swimming pools, daily laundering of towels for multi-night guests, sprinklers that go off on a timer rather than as needed.
- Funding to maintain stream gages is often threatened when federal budgets are cut.

Policies and Recommendations

- ☐ State and federal agencies should work to maintain and restore stream gages in key points throughout the watershed.
- ☐ The Ammonoosuc LAC should, whenever possible, inform the corridor towns and residents about the stream gages and the value they have for monitoring water levels and flooding events.

- ☐ Proposed large withdrawals in the watershed which have the potential to impact the volume and/or pattern of flow in the river need to be carefully evaluated for their impacts on aquatic species, recreation, aesthetics/property values and the tourism economy.

- ☐ Collaborate with state efforts to increase awareness of areas where both residential and nonresidential water usage can be reduced; use the area's scenic beauty as an awareness campaign tool.

- ☐ Regulators should incorporate more flexibility to utilize new technology and approaches, e.g., appropriate uses for grey water, stormwater credits for rain gardens and rain barrels.

- ☐ Water conservation technology should be required for large users such as irrigation and snow-making.

For More Information

- ➢ The US Geological Survey data regarding flows on the Ammonoosuc River can be found at http://waterdata.usgs.gov/usa/nwis/uv?site_no=01137500 **.**

3.12 Dams

Lisbon Dam Powerhouse and canal
Photo by Field Geology Services, 2009

Background

Most of the Ammonoosuc River is free flowing. Of the fourteen dams that have been documented on the Ammonoosuc River, only five remain intact. The remainder are in ruins with most having been old stone and timber dams used for generating power for early mills.

Four of the remaining dams are being managed for hydroelectric power – Woodsville Dam, Ammonoosuc River Dam (in Bath), Lower Lisbon Dam, and Apthorp Dam in Littleton. Removal of the fifth remaining dam - Bethlehem - has been considered by NH Fish & Game to have potential benefits to fish habitat, but it is privately owned.

Two dams – Woodsville and Apthorp – are classified by NHDES Dam Bureau as “Significant Hazard” structures, meaning that, due to their location and size, failure or misoperation would result in one or more of the following: major economic loss to structures or property, structural damage to a state highway, or major environmental or public health impacts. The other three dams are classified as “Low Hazard” structures. Inspection frequency is based on these classifications to ensure that repairs needed to maintain safe operation are identified.

Issues

- These dams do not act as flood control structures; however, there are small impacts to flow characteristics since water is diverted for short distances at these hydro sites. Additionally, the dams' old impoundments are shallow and contain sediment. This undoubtedly causes a slight warming of the waters in the summer months behind the dams.

- Energy costs and the desire to reduce dependency on foreign sources and on fossil fuels has led to increased interest in hydropower.

- Without proper consideration for fish passage, dams can disrupt the connectivity between essential components of habitat.

Recommendations

- ☐ Carefully consider the impacts of new and existing hydropower projects on aquatic life and the geomorphology of the river.

- ☐ Ensure that adequate provisions are made for fish passage.

- ☐ Evaluate the benefits and impacts of removing inactive dams.

3.13 Recreation

Background

Photo by Leslie Bergum

The Ammonoosuc River arises in the pristine setting of Lakes of the Clouds on Mt. Washington. It descends through the White Mountain National Forest, flowing alongside the Ammonoosuc Ravine Trail, a drop of 2,500 feet from its source to the Cog Railway Base Station. It cascades over the Upper Falls, famous for high rocks and whirlpools. Young people get drawn there by the natural features and by stories about the deaths at the falls. The area is well marked with warnings that there is no safe way to jump off the 25' high rocks into the pools below due to unseen projectiles and unpredictable deadly forces, arising from the dark depths below. The river drops 30’ at Lower Falls, a less dangerous area frequented mainly by families, who are also forewarned by signs that caution is needed.

The upper stretch is too steep and rocky to navigate by boat. Navigation of the river can only be done in stretches with portages to get around impassable falls and four dams encountered along the course of the river. It is one of the finest whitewater rivers in New Hampshire; enthusiasts come to take it on in the spring. The river flows downstream in a series of very strong rapids; large boulders in the channel become giant boulders in the difficult pitches. It goes through a gorge as Class IV rapids. By Alder Brook the river is steep and comes to a series of drops, called the Railroad Rapids. After passing under the Railroad Bridge, the river loops around the end of the former Littleton Airport. The whitewater experience is only recommended for those with the skills and experience required. Novices and intermediately skilled people can put in at the quiet stretches, where the water is smooth and easy paddling. Recreational

use requires being informed about the extent of the river so as not to put in at a quiet stretch that in short order becomes a series of rapids and drops.

Over the summer, except after heavy rainfall associated with storms, the water level is low and navigation is restricted to kayaking. A canoe can be paddled in more placid sections of the river, before the water level goes down.

Photo by Leslie Bergum

Native brook trout, as well as stocked rainbow trout and brown trout, make the river a popular destination for fisherman.

The Ammonoosuc River flows through natural, rural, community, and rural-community areas. By the time it reaches downstream, it passes by agricultural lands, where the river is mostly quiet with riffles. Gold panning is done in the lower Ammonoosuc River by the confluence with the Wild Ammonoosuc River. Bird watching and photography are popular pastimes with delight to those who happen to see a Great Blue Heron, Osprey, or Bald Eagle. There are three picturesque covered bridges along the river. The Ammonoosuc Rail Trail, popular with ATVers, mountain bikers, and snowmobilers, is 19 miles long and goes next to the river between Littleton and Woodsville. There are limited public access areas to the river but visitors are allowed to park at any suitable place along the way that will accommodate their vehicle. There are town trails and picnic areas including the publicly owned recreation areas of the White Mt. National Forest Zealand Trails in Carroll, Bretzfelder Park and Town Forest in Bethlehem, Dells Park, Kilburn Crags, and Pine Hill in Littleton, Bath Covered Bridge Picnic area and many state and federal snowmobile trails in towns. The Ammonoosuc River watershed offers a playground for all seasons of economic benefit to the state. Licensing of sportsmen engaged in fishing and hunting, gear for outdoor enthusiasts, and accommodations and meals for visitors all contribute to the local and state economy.

Ammonoosuc Rail Trail in Lisbon, Photo by Tara Bamford, NCC, 2012

Swimming at the Ledges in Littleton, Photo by Connie McDade

Issues

Outdoor recreation is fundamental to life in New Hampshire for residents and visitors alike. Public access to the river is limited for swimming, fishing and boating. Established trails adjacent to the river, such as Littleton's Riverwalk, are popular for walking and bird watching. Biking, ATV riding, and snowmobiling make use of the old railroad bed that parallels the river between some of the river corridor towns. Pros and cons have been discussed about proposals for the rails to trails initiative. Stewardship coalition between volunteers, landowners and people, who engage in recreation on established trails by the river, is essential to maintaining the existing recreational opportunities. The following factors need to be taken into account:

- Boating and swimming safety
- Illegal camping
- Public access
- Inadvertent transfer of invasive species "Rock Snot" Didymo present on a wet item that has not been properly treated from a body of water where it is present into a Didymo-free body of water, including but not limited to fishing gear, felt-bottom wader shoes, life preservers, water toys, bathing suit, canoe and kayak bottom, and even the hair of a dog
- Fishermen cleaning their fish in a swimming area
- Habitat impacts from motorized gold dredging and enforcement of permits
- Power equipment for gold dredging causes turbidity, undermines the riverbank, and gets fuel in the water.
- Gold dredging regulations – permit is issued to the person rather than being site specific
- Trash, oil, fuel along riparian trail stopping points
- Erosion from ATVs and mountain bikes
- Erosion observed by river bend's proximity to highway
- Fluctuation in water release from dams, water levels affecting recreation
- Salt from winter snow plowing and snow storage; nitrate from fertilizers used by farmers
- Absence of vegetative buffer next to some agricultural soils

Current NH Department of Environmental Services (NHDES) permits for motorized gold dredging are not site specific but instead go with the person. This makes it difficult for local officials and others to assist NHDES staff with enforcement since there is no way to know if an individual has a permit or not. This continues to be an area of concern in the region as some undercutting of banks and unpermitted activity has been known to occur. Landowner permission is required for both motorized dredging and nonmotorized extraction (panning). Signs at access points noting landowner permission and permit requirements would assist landowners.

Recommendations

- ☐ Identify and map public access and parking locations.

- ☐ Increase compliance with NHDES gold dredging regulations, including:
  - Signage in gold dredging areas to alert participants that NHDES Wetland Bureau permitting (Recreational Mineral Dredging Application) is required for motorized activity. The applicant has to get written permission from the landowner before the application is submitted for the permit. The permit is issued specific to the name of the person applying.
  - Closely monitor and regulate motorized activities.
  - Keep a log book on hot spots where mechanized dredging is done.

- ☐ Increase public education, through such means as:
  - Flyers about the river made widely available, including through business groups and places with tourist brochures.
  - Hold summer program series for landowners and tourists
  - Work with partners to post and maintain signs for fishermen and boaters at access points about precautions to prevent spread of Didymo (wash items with soap and water at home; rinse well. Dry items for 48 hours before going into another river or lake.)
  - Publicize information on the economic importance of recreation to the State.
  - Identify areas containing old trash and tires for a clean-up day.

- ☐ Vegetative buffers should be restored and maintained between trails and the river.
  - Identify roadside areas of erosion in need of bank stabilization
  - Inventory areas with inadequate vegetated buffers.

- ☐ Ensure that the importance of flow management to recreational use is considered when dam permits are sought, renewed and enforced.

3.14 Historic and Cultural Resources

Bath Covered Bridge, Photo by Field Geology Services, 2009

The Ammonoosuc River corridor has played a major role in the history of the area. Before the first white settlers, the Abenaki Indians fished and camped along the river, netting fish in the narrow river bends, such as Salmon Hole. Ammonoosuc is an Abenaki word for 'fish place,' a very appropriate designation even today. With an abundance of fertile soils and varied landscapes The Ammonoosuc Valley has provided a welcoming environment for millennia, providing more than the simple necessities of life. At the close of the Ice Age, the waters of proglacial Lake Hitchcock covered much of what is now the lower part of the valley. In this area the lake may have persisted only between 15000 and 13000 BP, probably preceding human entrance into the area. With the draining of Lake Hitchcock, the area began the process of taking on the appearance as we know it today.

Relatively few prehistoric Native American sites are officially recorded within the corridor; however, this is almost certainly a result of limited investigation rather than a lack of use of the area prehistorically. The earliest inhabitants of North American are referred to as Paleoindians and entered this area with the end of the last ice age. No Paleoindian sites are recorded in corridor. However, several Paleoindian sites have been reported on the Israel River drainage to the north, indicating that the region was occupied as early as about 11,000 years ago. Throughout this period the region was utilized by a low density, dispersed and highly mobile population. Through the later stages of prehistoric times populations increased and became more regionalized. Stone tool technology and gathering and hunting continued to provide sustenance but groups were less wide ranging. The first pottery appears in the area a little over 3000 years ago. Horticultural produce did not become an important part of the diet until late in prehistoric times. Early historic accounts document the presence of Native Americans within the corridor.

The first European settlers to the valley found their way via the Connecticut River in the mid-eighteenth century. Frontiersman and settlers made their way up the Ammonoosuc River from its confluence with the Connecticut and also came overland to the Littleton area from 15 Mile Falls on the Connecticut River. The first hunters began moving up the valley around 1750. The area saw no major engagements directly associated with the French and Indian War, although Rogers Rangers stopped at the mouth of the Ammonoosuc on their way back from the destruction of St. Francis, Quebec in 1759 before proceeding down the Connecticut. Following the end of the French and Indian War charters for many of the towns were granted by the King of England in the 1760's. In 1792, Timothy Nash, a moose hunter, crossed the great mountain gap known today as Crawford Notch and opened an invaluable trade route between the Atlantic coast and the upper Ammonoosuc valley.

The greater part of the pioneers were people of limited means and made their living as hunters, blacksmiths, farmers and lumbermen. The early economy grew, industries were developed to support farming and lumbering. In the late eighteenth century, dams were built on the Ammonoosuc in Bath, Lisbon, and Littleton to power gristmills, sawmills, and shingle mills. Later starch mills, tanneries, smelting mills, bobbin mills, and peg mills were constructed, all relying on water power either on the Ammonoosuc or its larger tributaries. Historic documents mention large charcoal kilns erected in the area which gave employment to about 300 men.

As early as 1803, room and board was offered to travelers at the site now called Fabyan's in the Town of Carroll. This heralded the later development with the opening of the summer hotels through the nineteenth and into the twentieth centuries. The last of the grand hotels constructed in the area, the Mount Washington Hotel built in 1902, is located on the Ammonoosuc River and in front of the mountain from which it takes its name, still attracts visitors to the area.

The coming of the railroad in the mid nineteenth century caused an increase in the variety and types of mills along the river, including shoe and boot factories, piano parts, leather, board, and bobbin/peg mills with ties to the textile industry in southern New England. Subsistence agriculture was replaced by commercial farming with a variety of produce being shipped south. With increasing technology, the dams and mills increased in size and capacity along the river, using it for power and as an available resource for disposing of domestic and industrial waste. In 1870, at the now abandoned Willowdale Village in Littleton (at the Lisbon/Littleton town line), a waterwheel was constructed that produced 92 horsepower and powered 2 lumber mills.

Old mill foundation by the river
Photo by Field Geology Services, 2009

The railroad brought ever increasing numbers of tourists to the upper Ammonoosuc area and changed growth patterns and population migration. However, soon after the Civil War, many New Englanders migrated to the fertile soils in Ohio and beyond, abandoning the stony hill farms above the river valley. The beginning of the twentieth century again saw changes in economic and land use patterns. Trains came to depend on an ever increasing number of tourists from Boston and New York, who came to spend summers in the large hotels throughout the White Mountains.

The Ammonoosuc River offers many cultural resources of local and statewide importance representing all of the important historic periods, from the early settlers to the rise of tourism in the twentieth century. The river corridor has 8 known archeological sites (prehistoric and historic), 8 structures on or formerly on the National Historic Register, 6 historic bridges, 15 historic sites, and many additional identified locally important resources. Each of the 6 historic villages along the river is different and reflects a variety of historic periods, from the colonial Upper Bath Village to downtown Littleton with its nineteenth century water-powered factories built right on the river's banks, to Bethlehem and Carroll's old hotels catering to nineteenth and twentieth century tourists. Several historic markers identify sites including a site used by Rogers Rangers during the French and Indian Wars, an eighteenth century coal kiln which can still be seen and was used by colonists in the making of local pig iron, the ruins of Willowdale Village which burned and was never rebuilt, Woodsville, a railroad junction with over 30 passenger trains a day at its peak, the Crawford Family marker, the family for which the notch was named, The Mount Washington Hotel marker, and the Bretton Woods Monetary Conference.

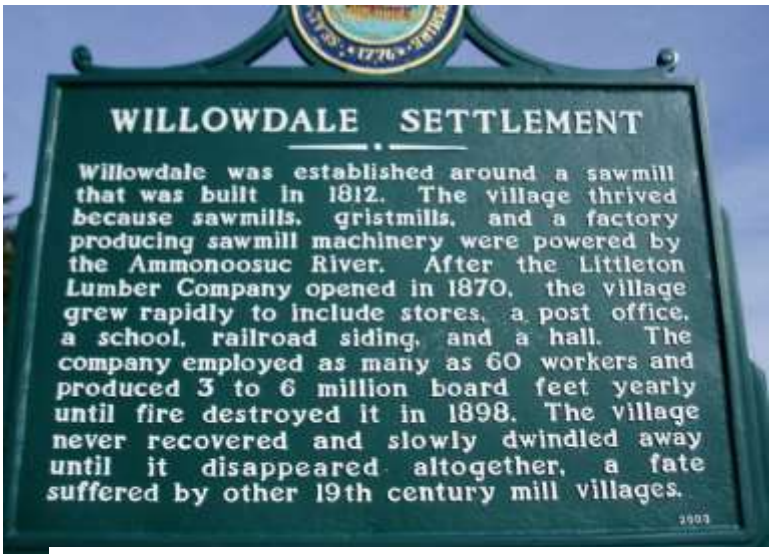


Photo by Field Geology Services, 2009

The villages along the river are making efforts to preserve and enhance their unique historic past by restoring covered bridges, railroad stations, and mills and other historic buildings. Factories thrived along the river and electric turbines were installed to produce electricity for the villages of Woodsville, Bath, Lisbon, and Littleton. Factories along the river began a slow decline as electricity replaced water power, trucks replaced the need to be near a railroad line, competition from the south increased, and laws were passed at both the state and federal level to improve water quality.

Modernization included road improvements to accommodate the automobile and tractor trailers. Routes 302 and 3 brought traffic to and from the area from all directions, as the railroads began to lose popularity. In the 1980's and 90's the interstate highway system reached the North Country with I-93 passing through Littleton and I-91 in Vermont, running parallel to the Connecticut River.

Historic Sites and Resources

While no detailed inventory of historic or archeological sites has been done along the entire corridor, the following is based on a review of local histories, field observation, and various state and federal resources.

National Register of Historic Places

Woodsville - Woodsville Opera Building (listed 1980)
Woodsville - Haverhill--Bath Covered Bridge (listed 1977)
Bath - Brick Store (listed 1976)
Bath - Bath Covered Bridge (listed 1976)
Bath - Goodall-Woods Law Office (listed 1985)
Bath - Jeremiah Hutchins Tavern (listed 1980)
Bath - Swiftwater Covered Bridge (listed 1976)
Lisbon - Lisbon Inn (listed 1980)
Littleton - Lane House (listed 1980)
Littleton - Littleton Opera House (listed 1973)
Littleton -Thayer's Hotel (listed 1982)
Littleton - US Post Office and Courthouse (listed 1986)
Bethlehem - Felsengarten (listed 1973)
Bethlehem - Burt--Cheney Farm (listed 1982)
Bethlehem - The Rocks Estate (listed 1984)
Carroll - Crawford House Artist's Studio (listed 1985)
Carroll (Bretton Woods) - Mount Washington Hotel (listed 1978)
Sargent's Purchase - Tip -Top House (listed 1982)

New Hampshire Register of Historic Places

Lisbon, Lisbon Station (listed 2008)
Littleton, Littleton Community House and Annex (listed 2007)
Bethlehem, Colonial Theater (listed 2002)
Bethlehem, Burch House (listed 2002)
Bethlehem, Mt. Washington Cemetery (listed 2006)

State & Federal Historic Districts

Haverhill, Commercial/Railroad Area (Woodsville HD) (1997)
Haverhill, Connecticut Street Historic Area (1997)
Haverhill, Woodsville-Bath Covered Bridge Neighborhood (1994)
Haverhill, Bath, Haverhill-Bath Project Area (n/a)
Bath, Bath Lower Village Historic District (1992)
Bath, Bath Upper Village Historic District (2006
Bath, Simmonds Brook Agricultural Historic District (1992)
Lisbon, Landaff Road Rural Historic Area (1993)
Lisbon, Lisbon Village Historic District (1992)
Lisbon, Route 302 Agricultural Historic Area (1992)
Lisbon, Savageville Historic Area (1993)

Littleton, Beacon Street Bridge Project Area (1992)
Bethlehem, Pierce Bridge Area (1998)
Carroll, Twin Mountain Project Area (1998)

Historic Bridges Over the Ammonoosuc River

Haverhill/Bath, Haverhill-Bath Covered Bridge
Bath, Bath Covered Bridge
Bath, Bath Railroad Bridge
Bethlehem, Pierce Bridge
Bethlehem, Prospect Street Bridge

Haverhill-Bath Covered Bridge
Photo by Field Geology Services, 2009

Historic Sites, Markers, & Memorials

Haverhill, Veteran Memorial VFW Woodsville
Haverhill, Haverhill/Bath Covered Bridge
Bath, Lone Elm Tea Room
Bath, Bath Village Covered Bridge
Bath, Mercy's Rock*
Bath, Bath Village War Memorial
Bath, Bath Upper Village
Bath, Simonds Brook Agricultural Area
Landaff, The Acre Residential Area
Lisbon, Young-Cobleigh Tavern
Lisbon, Lisbon Village Area
Lisbon, Original Village Marker
Lisbon, The Old Coal Kiln*
Littleton, Soldiers Memorial
Littleton, Willowdale Settlement *
Carroll, Bretton Woods, Mount Washington Hotel*
Carroll, Bretton Woods, Monetary Conference*
Carroll, Crawford Family*
* NH Historic Marker

A review of the State of New Hampshire site files found no prehistoric archeological sites listed within the corridor. Prehistoric sites are known to occur in this area and a number of areas have been identified as sensitive for prehistoric site location. In addition, towns have identified other locally important cultural and historic structures and sites near the river, some of which are listed below.

Examples of Locally Identified Historic Sites

Bath Church
Bath, Route 302 cemetery
Bath, Mercy's Rock
Bath, Payson Mansion (Colonial Inn)
Bath, The Narrows
Bath Town Building
Lisbon Town Hall/Opera House

Lisbon Village Dam
Lisbon, Parker Block
Lisbon Railroad Station
Lisbon Library
Littleton, Main Street Buildings
Littleton, Kilburn House
Littleton, Railroad Station
Littleton, Edson Berry House
Littleton, Meadow Street Cemetery
Carroll, St. Patrick's Church
Carroll, Twin River Farm and Bobbin Mill
Carroll, Bretton Woods Choir Camp
Carroll, Old Farm Site
Carroll, Brown Co. Logging RR Spur
Carroll, Charcoal Kilns
Carroll, Crawford Cemetery off Base Road
Carroll, Fabyan's Cabin
Carroll, Stickney Memorial Chapel

Crawford Cemetery, Photo by Leslie Bergum

Sources: Ammonoosuc River Nominations; Town Master Plans

Notes:
1. This is not intended to be an exhaustive list of local historic sites.
2. Sites previously mentioned not repeated.

Issues

- Lack of professional investigation, identification and evaluation of local cultural resources, especially prehistoric resources
- Lack of oversight and monitoring regulated activities
- Destruction of cultural resources through farming, development, and natural processes
- Underutilization of historic structures and settings

Recommendations

- ☐ Explore opportunities for heritage tourism.
- ☐ State agencies and regulated activities should consider impacts on community character, and take steps to protect stonewalls, historic bridges, naturally vegetated riverbanks, and scenic roads.

- ☐ Towns should maintain the vitality of historically compact village and town centers.
- ☐ Initiate efforts to identify, record, and protect significant cultural resources for listing in the National Register of Historic Places.
- ☐ Identify and target local historic structures and inform/educate owners of tax advantages of preservation.
- ☐ Identify and stabilize cultural resources in danger of bank erosion.
- ☐ Landowners should be encouraged to voluntarily protect cultural resources.
- ☐ Provide educational outreach touting the importance of cultural resources.

3.15 Existing Regulations

State Regulations

NH Department of Environmental Services (NHDES) issues permits for activities in the shoreland or affecting wetlands or streams. These include:

- Wetlands permits
- Shoreland permits
- Alteration of terrain permits

Wetlands

The Wetland Rules describe the purpose of the state's wetland permit program as:

> The purpose of this chapter is to protect the public trust and other interests of the state of New Hampshire, by:
> (a) Establishing requirements for the design and construction of structures in order to prevent unreasonable encroachment on surface waters of the State;
> (b) Preserving the integrity of the surface waters of the state by requiring all structures to be constructed so as to insure safe navigation, minimize alterations in prevailing currents, minimize the reduction of water area available for public use, avoid impacts that would be deleterious to fish and wildlife habitat, and avoid impacts that might cause erosion to abutting properties; and
> (c) Ensuring that all projects are constructed using the least impacting alternatives, in a manner that meets the requirements of RSA 483-B and shoreline and bank alteration or stabilization requirements. (Env-Wt 401.1)

Requirements vary according to the location and size of the proposed project. It is important to note that New Hampshire's wetland program does not prohibit filling wetlands, i.e., it is not a "no net loss" program.

Shoreland

In addition to the Ammonoosuc River itself, all lakes, ponds and impoundments greater than 10 acres, and all 4th order and greater tributary streams and rivers are subject to the Shoreland Water Quality Protection Act. Permits are required for new construction or expansion of impervious surfaces and for excavation or filling. The requirements vary according to the location and size of the project.

Alteration of Terrain

From the NHDES website:

> New Hampshire Alteration of Terrain permits are issued by the DES Alteration of Terrain (AoT) Bureau. This permit protects New Hampshire surface waters, drinking water supplies and groundwater by controlling soil erosion and managing stormwater runoff from developed areas. An AoT permit is required whenever a project proposes to disturb more than 100,000 square feet of contiguous terrain (50,000 square feet, if any portion of the project is within the protected shoreland), or disturbs an area having a grade of 25 percent or greater within 50 feet of any surface water. In addition to these larger disturbances, the AoT Permit by Rule applies to smaller sites.
>
> This permitting program applies to earth-moving operations, such as industrial, commercial, and residential developments as well as sand pits, gravel pits, and rock quarries. Permits are issued by DES after a technical review of the application, which includes the project plans and supporting documents.

Local Land Use Regulations

Land use and land use density are primarily regulated at the local level by municipal ordinances and regulations discussed below. Since they often govern the patterns of development in a river corridor, they can have a tremendous impact. The table on pages 78-79 summarizes the land use regulations for the towns along the river and includes a breakdown of some of the regulatory components that impact the corridor.

Local land use regulations in New Hampshire are of three types: Zoning Ordinances, Subdivision Regulations, and Site Plan Review Regulations, as discussed below.

Zoning

All of the towns in the corridor have zoning ordinances which were adopted by town meeting vote and administered by a zoning officer and a Board of Adjustment. Zoning ordinances typically regulate land use, e.g. residential, commercial, industrial; density; setbacks; building height, etc., but they vary a great deal in the uses and densities allowed. Instead of a single zoning ordinance, Haverhill*** has a series of special purpose zoning ordinances: floodplain, wetland and aquifer, personal wireless, and airport. Minimum lot sizes range from no minimum in Haverhill and many

Littleton zones to 3 acres in most towns, with smaller lot sizes only where municipal sewer and water are available.

***Two of Haverhill's villages have their own zoning ordinances.

While all towns except Haverhill and Littleton have road frontage requirements, only Bath has river shoreline minimum requirements. Other than Haverhill, only Bath has conservation overlay districts that have special regulations for protecting critical natural resources such as wetlands, aquifers, steep slopes, and floodplains. In fact, although all seven towns have flood hazard ordinances, only Bath's ordinance prohibits development in the floodplain. The other town's ordinances are primarily to comply with the federal flood insurance regulations which focus on flood-proofing and reducing flood damages. They do not prohibit development or loss of flood storage capacity.

The town of Littleton has a vegetative buffer ordinance which is 100 feet wide, but it only applies to a very short section of the riverbank on one side of the river (the west side, from the I-93 bridge to a point 3600 feet up from the Lisbon town line). No other towns have any buffer protection.

Cluster developments are mentioned in all ordinances but are generally applicable to only certain districts or by special exception and generally allow the same overall density as a conventional subdivision but on smaller lots to allow for the creation of open space. Overall, cluster is not popular with either the communities or the developers and is little used.

Subdivision Regulations

Subdivision regulations are adopted and administered by the planning board and govern the process of dividing land. While overall building density is based on zoning requirements, the inability to construct roads to town standards and have sufficient area on a lot for a state-approved septic system often reduces density from that allowed by the zoning ordinance. Road standards include such things as road width, maximum grades, and surface materials.

Each of the seven towns has subdivision regulations and they are similar. Only two of the towns address erosion and sediment control or other environmental issues in great detail.

Site Plan Review Regulations

Site plan regulations are also adopted and administered by the planning board and allow for the review of multi-family and non-residential uses, such as industrial and commercial, for such things as traffic, parking, lighting, impermeable surfaces, stormwater drainage, erosion control, and safety. Haverhill does not have site plan regulations and Littleton abolished site plan review regulations in 1989. Thus the towns with the most commercial and industrial growth have no site development regulations for such things as drainage, parking, impermeable surfaces, erosion and sediment control. Only one town has any limits on the amount of impermeable surface allowed on lots within the corridor and most towns do not have stormwater regulations that deal either with increased runoff from development or non-point pollution prevention.

Excavations, a specific type of commercial use, are regulated under a separate state statute and five towns have adopted local regulations, although enforcement of required restoration is limited.

Local Land Management Tools in Effect

Municipal Tools	**Unincorp. Places**	**Carroll**	**Bethlehem**	**Littleton**	**Lisbon**	**Landaff**	**Bath**	**Haverhill**
1. Master Plan is in effect	Yes (2006)	Yes (1986)	Yes (2004)	Yes (2004)	Yes (2005)	Yes (2007)	Yes (2007)	Yes (2008)
2. River is mentioned in master plan	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Scenic/ historic resources mention in master plan/ zoning	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Zoning is in effect	Yes (1991)	Yes (2010)	Yes (2011)	Yes (2011)	Yes (2002)	Yes (2006)	Yes (2007)	Partial
5. Subdivision regulations are in effect	Yes	Yes (1995)	Yes (1995)	Yes (2010)	Yes (2002)	Yes (2002)	Yes (2004)	Yes (2008)
6. Site plan review is in effect		Yes	Yes	Voluntary	Yes	No	No	No
7. Excavation regulations are in effect	Yes	Yes	Yes	No	No	Yes	Yes	Yes
8. Shoreland protection regulations	Yes	No	No	No	No	No	Yes	No
8.a. Building setback required from waterways (50’ setback - state law)	Yes - 100'	No	No	No	No	No	Yes - 120'	No
8.b. Development prohibited in flood hazard area? (100 year floodplain)	No	No	No	No	No	No	Yes	No
8.c. Riparian buffer protected?		No	No	Partial	No	No	No	No

Municipal Tools	Unincorp. Places	Carroll	Bethlehem	Littleton	Lisbon	Landaff	Bath	Haverhill
8.d. Overlay district for rivers & streams?		No	No	Yes *	Yes	No	No	No
8.e. Minimum frontage required for shore lots? (150' min. if no sewer-state law)	Yes - 200'	No	No	No	No		Yes - 150'	No
9. Wetlands Regulations	Partial	No	No	No	No	No	Yes	Yes
9.a. Uses regulated in wetlands?	Partial	No	No	No	No	No	Yes	Yes
9.b. Uses regulated in buffer around wetlands?	Partial	No	No	No	No		No	Yes - 75'
10. Groundwater protection regulations	Yes	No	Yes	Yes	No		Yes	Yes
10.a. Uses regulated over aquifers?	Yes	Yes	Yes	No	No	No	Yes	Yes
10.b. Well-head protection area regulations?	No	Yes	No	No	Yes		Yes	No
10.c. On-site sewage disposal buffer for , water supplies?	Yes	No	No	No	No		Yes - 200'	No
11. Ag. soils protection regulations		No	No	No	No	No	No	No
12. Natural Resources Inventory	No	Yes	Yes	Yes	No	Yes	Yes	No

Adapted from Appendix G. Connecticut River Management Plan: Water Resources, Riverbend Region, 2009

**Littleton overlay district for rivers and streams:* Conservation of water, plants, & wildlife; Emergency procedures necessary for safety or protection of property (erosion or safety threat); Usual & necessary maintenance; Recreation & nature trails; Overhead or underground utility crossings; Wetland mitigation measures; Storm water drainage practices.

Issues

- Inconsistent regulations at the local level make it difficult to manage the river in a coordinated way
- Inconsistent regulations can result in development being concentrated in locations where regulations are the weakest without regard for suitability of site in terms of water resource impacts.
- Enforcement of state and federal regulations is underfunded.
- Enforcement of local regulations is often uncomfortable for local officials who need the support of the community to keep their jobs or to be reelected, and can also be costly for the community.
- Communities often do not have the staff for inspection of sites to ensure required water quality protection infrastructure is being properly maintained. In some cases development approvals are silent on long term maintenance and upkeep.

Recommendations

- ☐ Town should inform residents about possible applicable state regulations as early in the project planning process as possible, e.g., by providing information with applications for local approvals in person and on town websites.
- ☐ Both the state and municipalities should enforce existing regulations, fairly and consistently.
- ☐ To ensure that permit conditions are implemented, the state should fund NHDES permitting programs at a level which will enable inspections to be performed after projects are completed.
- ☐ Penalties should be increased substantially for repeat offenses.
- ☐ Responsible agencies should ensure that funding is sufficient to monitor maintenance plans that are included in a permit.
- ☐ Responsible agencies should ensure that BMPs are followed during permitted activities, and monitor ongoing actions that require BMPs to be followed.
- ☐ DRED should be encouraged to establish contact with local advisory groups.

3.16 Local Advisory Committee Role in Permit Reviews

Background

The Ammonoosuc River Local Advisory Committee (LAC) has the responsibility to review and advise the NH Department of Environmental Services (NHDES) on permit applications for proposed activities within 1/4 mile of the Ammonoosuc River under RSA 483:12-a (I-a) as follows:

Programs Established Under the Following Statutes

- Groundwater Protection Act (RSA485-C)
- Water Pollution and Waste Disposal (RSA 485-A)
- Dams, Mills and Flowage (RSA 482)
- Hazardous Waste Management (RSA 147-A)
- Solid Waste Management (RSA 149-M)

Types of Permit Applications Reviewed by Ammonoosuc River LAC

- Alteration of Terrain (AoT) Permit (RSA 485-A:17)
- Shoreland Permit (RSA 483-B)
- Wetland Bureau Permits (RSA 482-A:3)
- 401 Water Quality Programs

In February 2010 the LAC worked with state officials to expedite approval to remove this tree from the river to protect the Haverhill-Bath Covered Bridge. Photo by Rick Walling

Course of Action for Standard Review of Applications

Ammonoosuc River LAC members are required to review the application material and consider the characteristics of the site such as wetlands, slope gradient, geological features, vegetation and forest type. A site visit, with the owner's permission if appropriate, is advisable. Each application is unique and not all of the factors listed below apply to each one, however the

following are some of the factors that may be considered, along with any questions provided by NHDES:

Water Resources

- Proximity to aquifer, surface water- groundwater relationship
- Public and private water supplies
- Wetlands, vernal pools, stream crossings
- Flood hazard and erosion hazard areas
- Shoreland Water Quality Protection Act (SWQPA) Requirements
- Presence or Absence of Riparian Vegetative Buffer Areas by Agricultural Lands
- Best Management Practices (BMP) for oversight of project during construction and post construction to protect water resources.
- Stormwater management plans, including river bank stabilization measures to prevent erosion, and surface runoffs into the river, culvert type and placement
- Local wastewater requirements
- Impervious surface for access and parking and proximity to water resources, consideration of permeable materials
- Plan for winter maintenance and snow removal
- Large water withdrawals
- Water temperature impacts
- Known existing water quality or quantity issues

Other River-Related Resources of Interest

- Fisheries and important wildlife habitat areas, e.g., known deeryards and crossings, bird nesting and resting places, rare plants and animals
- Established recreation areas, informal and formal public access
- Locally identified priorities, e.g., identified in local Natural Resources Inventory
- Historic/Archaeological Sites, scenic views, and designated scenic roads

Additional information may be requested. If there are any remaining questions, Ammonoosuc River LAC has the option to invite the applicant to provide further information at their next meeting. Mitigation of potential impacts is suggested where appropriate.

Issues

- Reviewing an application is a multi-step process that requires due diligence. The timeframe to comment on applications for state permits is often not always adequate for the task. The application is sometimes not received in a timely fashion and has to be requested. There is no guarantee that request for an extension of time to comment will be granted. Several factors make it especially important for the Ammonoosuc River LAC to provide comments to the NHDES reviewer before the deadline:

- In many cases, although towns can require it, there is no oversight of the project by an outside knowledgeable professional, during construction and post construction.
- There is a lack of enforcement of infractions at both the local and state level.

➢ Legislative pressure to diminish the Shoreland Act has led to an even shorter timeline as well as a requirement for landowner permission for site visits.

Recommendations

☐ Ammonoosuc River LAC members should review proposed projects as early in the planning stages as possible so that applicants will have the benefit of LAC suggestions for reducing or mitigating impacts prior to developing final applications for local and state approvals. Towns can help facilitate this by:
- Providing planning and zoning board agendas to their local Ammonoosuc River LAC liaison.
- Including parcel map and lot or street address on planning and zoning board agendas.
- Inform applicants of the Ammonoosuc River LAC's role and the LAC availability to review and/or discuss preliminary plans.

☐ DES must assist in the timely delivery of information relevant to permitted actions, including encouraging applicants to meet with, or at least provide information to, LACs as early in the permitting process as possible.

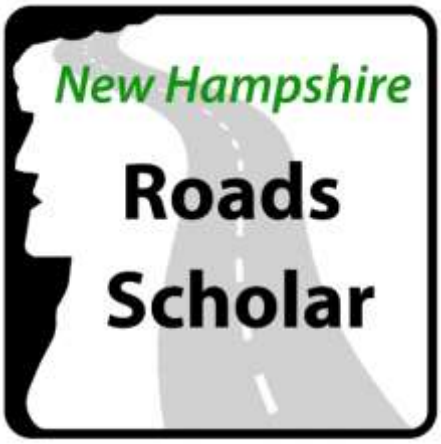
☐ There is currently a move to consolidate and streamline the DES permitting process. Local groups, such as the LACs and Conservation Commissions, should be included in the process in the pre-permitting stage to ensure that there is sufficient time to incorporate input from these groups in the project design.

3.17 Public Education

Education is one of the fundamental keys to ensuring the implementation of this River Corridor Management Plan. Communities that understand the importance of the watershed ecosystem as it relates to their basic needs, their economy and the environment are more willing to advocate for the restoration, maintenance and protection of its resources. Providing educational and stewardship programs and increasing public awareness of the Ammonoosuc River and its resources will ensure the success of this Plan.

The focus groups for this educational outreach should include but not be limited to:

- ☐ Landowners
- ☐ Residents
- ☐ Visitors
- ☐ Developers
- ☐ Students
- ☐ DOT/town road crews and utilities
- ☐ Business
- ☐ Land use boards



Methods of establishing public awareness should include but not be limited to:

- ☐ Create a website.
- ☐ Print and distribute brochures on different topics.
- ☐ Film a video of the river highlighting historical landmarks and recreational areas.
- ☐ Design a curriculum for use by students that is age appropriate aimed to inform students of the river resources and the importance of their protection.
- ☐ Build a portable display of river information that can easily be transported to local events.
- ☐ Conduct informational workshops.
- ☐ Construct informational kiosks along the river to highlight important natural and historic areas.
- ☐ Post signs along the river informing the public of its designation into the Rivers Management and Protection Program.
- ☐ Partner with various organizations such as snowmobile clubs, the Appalachian Mountain Club, historical societies, schools, libraries, and UNH Extension to combine efforts to teach the public about the river.
- ☐ Organize activities involving river maintenance including clean-ups and invasive species identification and eradication programs.
- ☐ Use local newspapers to publicize and promote issues and activities surrounding the river.
- ☐ Create a scrapbook of local news clippings that cover events that relate to the river to be used as an educational tool.

- ☐ Attend local land use board meetings to keep officials abreast of the applicable federal, state and local regulations that protect the corridor.
- ☐ Utilize existing brochures and fact sheets from NH Department of Environmental Services (NHDES).

Educational topics should be age appropriate and directed to the interest and relevance of the audience. Suggested topics, according to groups, should include but not be limited to:

Residents

- ☐ Water Quality: protecting surface water and the aquifer.
- ☐ Care and Maintenance of Septic Systems
- ☐ Proper application of fertilizers and pesticides
- ☐ Riparian Buffers : what to plant to keep it healthy
- ☐ Invasive species: what to look for and how to stop the spread.
- ☐ Proper disposal of pharmaceuticals.
- ☐ Maintenance of large woody material in streams and rivers.
- ☐ Regulations applicable to landowners.

Visitors

- ☐ Historical Resources along the corridor.
- ☐ “Leave No Trace” principles.
- ☐ Erosion Prevention , Stay on the Trail.
- ☐ Recreational highlights
- ☐ Invasive Species: transportation on fishing gear.
- ☐ Wildlife Habitats

Businesses

- ☐ Natural Resources and the economy
- ☐ Water Quantity
- ☐ Invasive Species: Transportation on equipment
- ☐ Fertilizer and pesticide runoff from farms and golf courses.

Students

- ☐ History within the corridor
- ☐ Wildlife Habitats
- ☐ Invasive species
- ☐ Water Quality testing

Developers/ Land Use Boards

- ☐ Shoreland Water Quality Protection Act
- ☐ NHDES Alteration of Terrain Program
- ☐ EPA Storm water Regulations
- ☐ Floodplains and Fluvial Erosion Hazards
- ☐ Development Management
- ☐ Water Quantity
- ☐ Non- point source pollution affects on water quality and habit

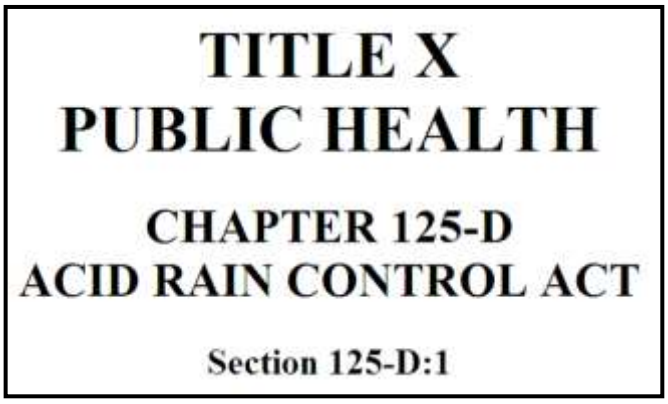
DOT/Town Road Crews & Utilities

- ☐ Storm water management
- ☐ Culverts: size matters
- ☐ Road Salts and Non Point Pollution.
- ☐ Bridge Erosion
- ☐ Ice Jams and Roads flooding
- ☐ Invasive species

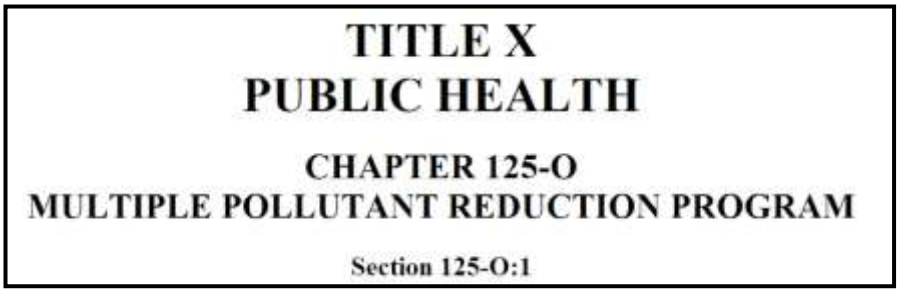
3.18 Influences from Outside the Watershed

In addition to local activities affecting the river, there are many outside factors not under the influence of the Ammonoosuc River LAC, the state, or municipalities. Nevertheless, it remains important to know about these forces as well, and, once they are identified, to keep track of them. For example, acid rain, mercury contamination, and climate changes each takes a toll on the riparian ecosystem and are expected to continue to do so in the foreseeable future.

In 1985 the General Court of New Hampshire found that acid deposition of sulfur and nitrogen containing compounds, commonly referred to as "acid rain" was occurring in the state and was posing a significant adverse threat to the natural environment by degrading natural ecosystems, including fish and wildlife (RSA 125-D:1). Through burning, fossil fuels enter into the atmosphere and cause rain, snow and fog to be more acidic. This acidic precipitation reaches the surface water either directly or through runoff and snow melt. Both the increased acidity and the associated increase in the concentration of metals in the water can reduce species diversity and the abundance of aquatic life. Results of VRAP water testing of the Ammonoosuc show a majority of acidic ph measurements. Continued testing will further determine the source of these results.



Under RSA 125-O:1, the New Hampshire General Court specifically found mercury to be an airborne pollutant that is a significant cause of negative environmental impacts. This heavy metal reaches the surface water and accumulates in the tissues of animals and fish. Mercury contamination in freshwater fish is widespread and significant enough to warrant fish consumption advisories in N.H. Exposure in humans can lead to a variety of negative health effects, especially to women of child bearing years, young children and infants. In addition, fish-consuming wildlife such as loons, eagles and otters are also at risk. Fishing is a popular recreation activity along the Ammonoosuc River for both residents and visitors.



Climate records from the Northeast reveal an increase in average annual temperatures over the past decade. This change in climate has been associated with more intense rain and snow events and fewer extremely low minimum temperature events. These changes are predicted to have

potentially serious effects on the habitat of New Hampshire's cold water fish such as brook, brown, and rainbow trout. Climate change can potentially change the temperature and level of the water, both important factors for fish survival. Although adult fish may be able to tolerate warmer water temperatures, their ability to reproduce will decline. Data indicate that, along with higher water temperatures, climate change may bring about lower water levels and reduced stream flows leading to reduced food availability. In addition, lower water levels reduce the availability of winter habitat as well as suffocate and desiccate fish eggs. Survival of cold water fish is not only important to the species, but also the fishing economy in New Hampshire. There would be a significant loss in revenue from the loss of cold water fishing.

Appendix to Section 3.8 Wildlife and Fish

WILDLIFE ACTION PLAN CRITICAL HABITATS AND THREATS
Source: NH Wildlife Action Plan Chapter 3 (New Hampshire's Wildlife Habitat Conditions)

WAP CRITICAL HABITATS	THREATS
Small Scale Habitats	
Alpine	Climate change and acid deposition
Caves and Mines	Recreational activities such as spelunking and geochaching
Cliffs	Recreational activities such as hiking and rock climbing
Floodplain Forest	Human development and Transportation infrastructure
Grasslands	Development and certain agricultural practices, such as mowing during breeding seasons
Lakes	Acid deposition and non-point source pollution are likely to become more problematic over time.
Marsh & Shrub Wetlands	Land fragmentation, transportation infrastructure, development of surrounding uplands and invasive species
Peatlands	Development, altered hydrology, non-point source pollutants, and unsustainable forest harvesting.
Riverine	No critical threats to Southern Upland Watersheds have been identified. However, acid deposition and non-point source pollution are likely to become more problematic over time.
Rocky Ridge and Talus Slope	Hiking and climbing
Vernal Pools	Human development and transportation infrastructure, wetland filling, altered hydrology, and loss or degradation of surrounding upland habitats.
Forest block habitats (matrix forests)	
Hemlock-Hardwood-Pine	Hemlock-hardwood-pine forests are one of New Hampshire's most at-risk habitats. The most challenging issues facing hemlock-hardwood-pine forests are human development, introduced species and altered natural disturbance.
High Elevation Spruce-Fir	Acid deposition
Lowland Spruce-Fir	Development, timber harvest, non-point source pollutants and altered natural disturbance regimes.
Northern Hardwood-Conifer	Development and acid deposition.

Recommendations: For each critical habitat, use the NH WAP Chapter 3, Habitat Condition and WAP Species and Habitat Appendices (A & B) to identify conservation and management recommendations.

Appendix to Section 3.9 Plant Habitat

THE NATURAL HERITAGE BUREAU

The Natural Heritage Bureau is mandated by the Native Plant Protection Act of 1987 (NH RSA 217-A) to determine protective measures and requirements necessary for the survival of native plant species in the state, to investigate the condition and degree of rarity of plant species, and to distribute information regarding the condition and protection of these species and their habitats.

The Natural Heritage Bureau provides information to facilitate informed land use decision making. It is not a regulatory agency; instead, it works with landowners and land managers to help protect the State's natural heritage and to meet their land use needs.

The NH Natural Heritage Bureau is a bureau in the Division of Forests & Lands. Its mission is to find, track, and facilitate the protection of New Hampshire's rare plants and exemplary natural communities (which are essentially different types of forests, wetlands, grasslands, etc.). They currently study more than 630 plant and animal species and 190 natural communities. The database contains information about more than 6,000 plant, animal, and natural community occurrences throughout the state.

Most of New Hampshire's rare plants are listed as Endangered (in danger of extinction in the state) or Threatened (likely to become Endangered) under the NH Native Plant Protection Act of 1987 (NH RSA 217-A). The most recent revision of the list came into effect on June 25, 2005. A subset of these species is also listed under the federal Endangered Species Act of 1973 (42 USCA 4321-4370c). State and federal listing represents a political recognition of rarity, so some species that are biologically rare (as indicated by the State and Global Ranks) may not be listed as Threatened or Endangered.

[The most recent version of the Natural Heritage Bureau's lists of rare plant species that occur in New Hampshire, grouped by habitat types in which they may be found, can be downloaded from http://www.nccouncil.org/images/NCC/Planthabitatlists_2008_web.pdf .]

Known Sites

There has not been a comprehensive search of the state for rare species, so the Natural Heritage Bureau is frequently finding or learning about previously unknown populations. Further, many populations have not been checked since they were originally found, sometimes more than 50 years ago, so they do not know the status of these populations. In the more extensive data, they have therefore separated known sites into two sub-categories: those last seen more than 20 years ago, and those reported within the last 20 years. This distinction helps show the state of our knowledge about a given species and the need for additional research. Those additional data are available through the NH Natural Heritage Bureau.