

Upper Merrimack Management and Implementation Plan

prepared for the

Upper Merrimack River Local Advisory Committee



prepared by

Central NH Regional Planning Commission
Concord, NH

with assistance from

Vanasse Hangen Brustlin, Inc
Bedford, NH

for the

Upper Merrimack River Local Advisory Committee
merrimackriver.org

September 2007

Message from the Chair

I have always lived in the Merrimack River watershed. I was born in Manchester, less than a mile from the river and the huge mills that line its banks. Within a couple of years, we moved to a house near Lake Massabesic. As an adult, I moved to Penacook, a few hundred yards from the confluence of the Contoocook and Merrimack Rivers. Now I live in Boscawen where my house overlooks the woods that line the shore shared with Canterbury.

Growing up, I didn't really have a sense of a watershed, although my father worked for the Manchester Water Works and traveled daily in the city and surrounding towns. When I asked him where he worked that day, he would simply reply, "In the watershed." In my mind, I pictured a little wooden building by the side of the lake—a water "shed."

The Merrimack River and its watershed are a significant part of all of our lives. From those who look at it as they cross a bridge while stopped in traffic, to parents and grandparents who settled in the area to work in the mills, to anglers from near and far who recognize it as a superior fishing area, to canoeists who appreciate the quiet waters flowing along beautiful farm and forest land. We all connect to the river in our different ways.

In 1990, I was asked to serve as a charter representative to the Upper Merrimack River Local Advisory Committee (UMRLAC). Although I was a committed member of my town's conservation commission, I had no idea how important the UMRLAC and its work would become to me. The river to which I had been so close all my life had now become a conscious and defined part of my life. Each month, I look forward to UMRLAC meetings and seeing its other committed representatives.

During these past seventeen years there has been much fruit from the Management Plan. Nearly 500 volunteers have participated in the river corridor planning process; study and recommendation of scenic and recreational designation; legislative leadership and activism; and significant efforts in water quality monitoring, education, and outreach with the Upper Merrimack Monitoring Program (UMMP). Many partners including nonprofit organizations, government agencies, and Adopt-a-River Site Sponsors have provided financial and in-kind support.

With this *Plan's* focus broadened to include watershed resources, the potential for more success and the involvement of more partners increases. The watershed focus is key to best conserving—for this and future generations—the unique and rich resources of the upper Merrimack River. The success of this *Plan* will be measured by achieving the desired goals and meeting the objectives for each of the resources. This *Plan* outlines the steps required to meet the objectives and achieve the goals. This work will rest on the efforts of the many volunteers who graciously serve on the local boards and committees. The challenge will be to continue to foster the cooperative relationship and interests with the six cities and towns and promote a unified effort to protect our valuable resources and the heritage of this unique region that we call home.

Of course, none of the work accomplished to date by UMRLAC and UMMP would be possible without the participation, collaboration, cooperation, and assistance of these committed partners, supporters, and volunteers. Their interests have enhanced this work—and returned the advantages both to them and the entire watershed community. I am proud to work with the UMRLAC and all of its partners. Thank you to everyone who participated—your continued support is essential as we work together to implement this *Plan*.

Michele L. Tremblay
Chair, UMRLAC and Program Director, UMMP
September 2007

Upper Merrimack Management and Implementation Plan Acknowledgements

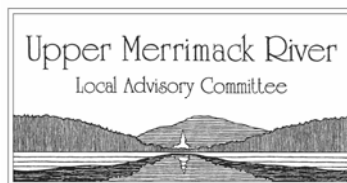
The UMLAC expresses its sincerest gratitude to the NH Department of Environmental Services, who provided financial and staff support in developing this Plan. Financial assistance was provided through a water quality planning grant authorized under Section 604(b) of the Clean Water Act. We would also like to thank the Central NH Region Planning Commission and its subcontractor, Vanasse Hangen Brustlin, Inc. of Bedford, NH for their efforts, technical expertise and report preparation assistance.

Our heartfelt thanks to Bill Arcieri, VHB, Inc., who worked with us and the many agency contacts and other stakeholders to complete this *Plan*.

The Chair expresses her deepest appreciation to the UMLAC representatives for their devotion and endless efforts. Without them, this Plan update would not have been completed.

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Upper Merrimack Management and Implementation Plan Purpose Statement

In updating this Management and Implementation Plan, the Upper Merrimack River Local Advisory Committee recognizes the following statement of purpose:

The newly revised goals, objectives, and recommended activities contained in this management plan will help protect and manage the unique characteristics and resources of the upper Merrimack while recognizing these concerns:

- Preserve and enhance the water quality and natural, scenic, cultural and recreational values of the river corridor;
- Maintain local control;
- Increase public involvement and education;
- Respect the rights of private landowners;
- Recognize the need for balanced use; and
- Recognize present and future generations' use of the river.



Merrimack River viewed from the Route 4 Bridge looking upstream (photo provided by UMLAC)

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Upper Merrimack Management and Implementation Plan

Executive Summary

This Plan is the first update to the original *Upper Merrimack River Management and Implementation Plan* prepared by the Upper Merrimack River Local Advisory Committee (UMRLAC) in 1994. The section of the upper Merrimack River designated for additional protection under the New Hampshire Rivers Management and Protection Act (RSA 483) consists of 30 miles starting from the confluence of the Winnepesaukee and Pemigewasset Rivers in the City of Franklin to Garvins Falls in the Town of Bow. UMRLAC is comprised of representatives from six communities including Boscawen, Bow, Canterbury, Concord, Franklin, and Northfield.

This Management and Implementation Plan update was developed as result of many working meetings with the UMRLAC members over the course of eighteen months with technical and report preparation assistance from both the Central NH Region Planning Commission and its subcontractor, Vanasse Hangen Brustlin, Inc. of Bedford, NH. Funding for the development of this Plan was provided through a water quality planning grant administered through the NH Department of Environmental Services (NHDES), Rivers Management and Protection Program.

Since the original Plan was completed 1994, land use conditions within the river corridor have changed. Each community has experienced population growth and an increase in both residential and commercial land uses. Land use changes can affect both water quality conditions through increased pollutant loading as well change stream flow conditions by altering the existing runoff/recharge dynamics. In addition to changes in land use, the scientific knowledge and our understanding of complex resource protection issues as well as the tools available to enhance resource protection have changed dramatically. At the time the original Plan was produced, the use of Geographic Information Systems (GIS) and the availability of geo-referenced data layers were still in its infancy. Today, the use of GIS has become a highly useful tool to create detailed mapping of the various resources and to conduct spatial temporal analyses as to how land use changes and other human activities may affect these resources.

Our understanding of the existing water quality and aquatic life conditions has been greatly enhanced due to the extensive data collection activities in the river corridor over the last decade or so. Most notably, the UMRLAC's Upper Merrimack Monitoring Program (UMMP) has collected macroinvertebrate data at multiple river locations for more than twelve years since 1994. The UMMP has not only developed a long term database of macroinvertebrate data, which can be used to assess changes in water quality conditions over time, but has also been very successful in attracting and recruiting hundreds of volunteers, which helps to inform the public and awareness of values and issues associated with preserving the integrity of the upper Merrimack River. The public education and awareness component of the UMMP is particularly important in building consensus and generating local involvement in the protection efforts in each of the upper Merrimack communities. Each community has their own unique concerns and issues with respect to land development, natural resources protection, pollution sources, and historic and cultural heritage. The momentum of public involvement generated by the UMMP can be used to solidify a general consensus among the upper Merrimack communities to help them identify the priorities for future implementation measures. These measures will help improve the current protection measures to insure the unique characteristics and resources of the upper Merrimack can be preserved for generations to come.

Since the first Plan was published, there have been several proposed and recently adopted state regulatory and environmental policy changes. This Plan incorporates many of the new and anticipated provisions of these regulatory and policy changes including the proposed updates to the Comprehensive Shoreline Protection Act (RSA 483-B), changes to Alteration of Terrain Program regulation, and the still pending draft instream flow regulations. NHDES is working towards completing two instream flow pilot studies in the Souhegan and Lamprey Rivers to establish methods in developing flow thresholds to protect instream flow and designated uses during low flow conditions. The results of these pilot studies will be used to finalize rules and regulations for adoption to protect instream flow conditions in the other designated river reaches. In the interim, NHDES has compiled data on existing water user facilities, withdrawal volumes and discharges within the upper Merrimack River reach that will potentially affected by instream flow regulations. Starting in 1998, NHDES has also maintained a list of "impaired" water bodies, which identifies water bodies that are known to have a water quality impairment of one or more of the designated uses due to pollutant contributions, flow alterations, or an invasion of exotic species. For water bodies that are impaired due to point or nonpoint pollutant source(s), a Total Maximum Daily Load (TMDL) study must be conducted to determine the pollutant load reduction needed to eliminate the impairment and protect all designated uses of

the water body. Building on this program, the NHDES Watershed Management Bureau has recently developed Interim Guidance documents for conducting Pollutant Loading Analyses and Stormwater BMP design standards for newly proposed large development projects within watersheds of impaired water bodies. This interim guidance is intended to become part of the proposed Alteration of Terrain (AoT) permit requirements once the proposed new rules are adopted (tentatively planned for early 2008).

The NH Fish and Game Department has recently released a comprehensive, statewide *Wildlife Action Plan* that identifies critical wildlife habitat locations and includes recommended actions needed to protect these areas. The NH Fish and Game Department also has prepared guidance on proper culvert installation methods to improve fish passage at road crossings, has also established. In February 2007, NHDES published a guidance document providing details on improving natural stream channel design and stream bank stabilization techniques. The information contained in these recent publications will be included in the assessment and restoration activities outlined in this Plan.

This Plan describes the goals, objectives, and the recommended activities needed to enhance protection for thirteen (13) different resource areas that are considered critical and relatively unique to the designated river corridors throughout this state. The resources are grouped into three main categories including water resource management, outstanding resource management, and riparian lands management. There are seventeen (17) different protection goals identified and included in this Plan with several resources areas having more than one goal. Based on the desired goals, one or more measurable and time bound objectives were then established for each resource to help accomplish these goals. The objectives focused on both short and long-term data collection, restoration and funding needs, updating local ordinances to be consistent with recent regulatory and policy changes, and developing partnerships with other agencies to help implement Best Management Practices. For each objective, the Plan lists a number of specific activities that should be followed to meet each of the objectives. The general timeframe to complete the goals, objectives, and activities of this Plan was considered to be by end of 2012. To this end, successful implementation will depend on close and frequent collaboration with local municipal officials, planning board and conservation commission members, state resource agency personnel, and available funding assistance.

Upper Merrimack Management and Implementation Plan

Introduction

In 1988, the New Hampshire River Management and Protection Program (RMPP) was enacted with the passage of RSA 483 to protect the State's most significant rivers or river segments, generally referred to as **designated rivers**. These designated rivers or river segments are recognized for their outstanding natural and cultural resources. The program is administered by the New Hampshire Department of Environmental Services (NHDES).

For a river to be designated, an interested individual, organization, or municipality must submit a **nomination** that outlines why the river's unique values and characteristics warrant further protection. The nomination must be sufficiently supported by local officials and residents of the riverfront communities in order for the nomination to move forward to the NHDES Commissioner for consideration and approval. Once approved by the Commissioner, the nomination moves for consideration and approval by the State Legislature and then the Governor. Once all parties have approved the nomination, the RSA 483 is amended to include the designation of the nominated river or river segment to be protected under the Program.

After designation, a management plan must then be prepared and implemented so to protect the outstanding qualities of the river for future generations. This Plan is to be developed and implemented by a volunteer local river advisory committee that can monitor and advise on various activities that affect the river on a regional basis. A typical plan identifies management goals and recommends actions that may be taken to protect the resources identified in the nomination. NHDES often assists in the development and implementation of the management plan and also maintains authority to enforce state regulations concerning the quality and quantity of flow in protected river segments.

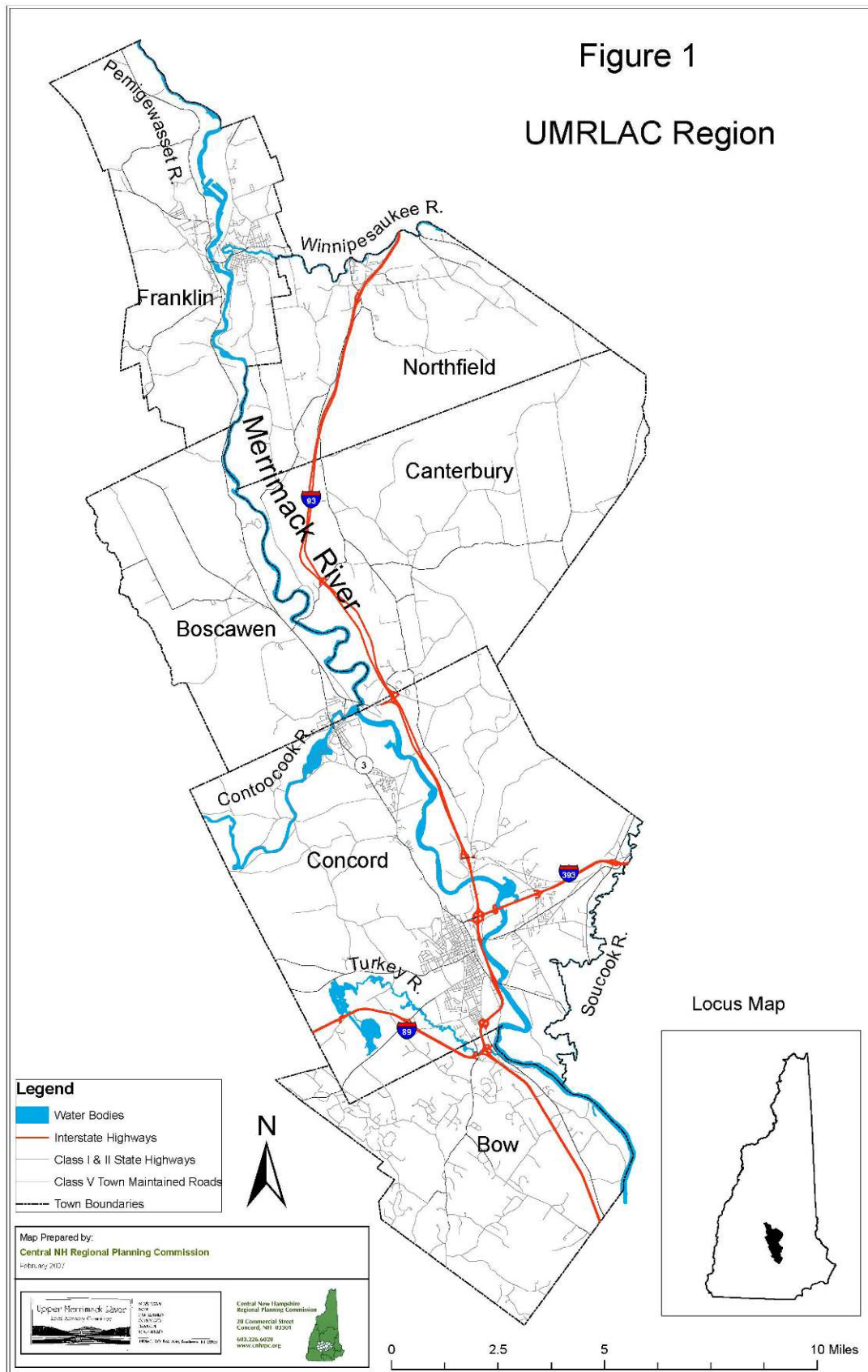
The designated upper Merrimack River segment begins at the confluence of the Pemigewasset and Winnepesaukee Rivers in the City of Franklin and flows for approximately 30 miles to Garvins Falls in the Town of Bow (see Figure 1). This river segment is one of ten river segments that were originally designated for protection when the RMPP was first established in 1988.

Background of UMRAC

The Upper Merrimack River Local Advisory Committee (UMRLAC) was founded in 1990 following the establishment of the Rivers Management and Protection Program (RSA 483). As shown in Figure 1, the UMRAC region encompasses and represented by six communities including Boscaawen, Bow, Canterbury, Concord, Franklin, and Northfield. The representatives are nominated by their municipalities and appointed to three-year terms by the Commissioner of the NH Department of Environmental Services. The UMRAC completed its first Management and Implementation Plan in 1994. One of the first major actions that spawned from the initial Plan was the formation of a volunteer water quality monitoring program called the Upper Merrimack Monitoring Program (UMMP). The volunteer program came together in 1995 through a cooperative agreement with NHDES and the Merrimack River Watershed Council. Since then, the UMMP has monitored water quality conditions through field sampling and testing of *E. coli* bacteria, temperature, and other field chemistry measurements as well as benthic macroinvertebrates at eleven sites on the upper Merrimack, Pemigewasset, Winnepesaukee and Contoocook Rivers. The Program has grown from seven sampling sites during its first year to eleven sampling sites in its second. It has become one of the most long-running successful volunteer monitoring programs in the region and has been nationally recognized. The UMMP has been supported by various funding sources including the New England Water Pollution Control Commission, NHDES, its municipalities, and corporate sponsors as part of its "Adopt-a-River-Site" Program. In addition to the data collected, UMMP has been an equally successful program for Outreach and Education and public participation as well. Over the years, hundreds of volunteers including river conservationists, teachers, students, anglers, municipal officials, and many others have assisted in the field efforts and data analysis.

With UMMP now over ten years old, there is an extensive database that provides a historical basis to evaluate how the river quality may have changed over the years. The UMMP is still going strong with many veteran volunteers continuing to return and assist in the sampling and analysis. UMRAC will continue to maintain and support the UMMP as a principal resource to monitor water quality and for its education and public awareness benefits in promoting and protecting the resource values of the upper Merrimack River and its watershed. Other accomplishments, goals, objectives, and activities are discussed in each of the individual resource sections.

Figure 1
UMRLAC Region



WATER RESOURCE MANAGEMENT

Background

The science behind current water resource management principles is ever-changing and constantly being refined as new research is being completed. The ongoing research leads to a better understanding and the development of new methods or tools to assess how land-use practices and human activities might affect water quality and quantity within a watershed. As a result, the existing policies, regulations, and practices used to protect our water resources are frequently updated. The most recent examples include the current draft regulation changes to the Alteration of Terrain (AoT) Program, Instream Flow and Shoreland Protection Act (adopted in July 2007 and will become effective April 2008). As practitioners, advocates, and educators, it is important for UMR LAC to continually monitor new research findings and participate in the development of proposed regulatory changes and the tools used to measure impacts on water quality and quantity.

The goal of protecting water quality and quantity will continually be met new challenges as the population grows and the demand for land development increases within the watershed. The conversion of land to impervious surfaces (e.g., roads, roofs, parking lots, sidewalks) in developing areas has rapidly become one of the largest threats to stream water quality and integrity. As impervious areas increase through land development, so does the volume and rate of runoff entering nearby waterbodies. Studies have shown that there can be notable adverse effects on the biological, chemical, and physical characteristics of streams and rivers as the imperviousness of a watershed area increases above 10 percent (Booth and Reinelt, 1993, Schueler, 1994, Deacon et. al., 2005). As mentioned above, many new local, state, and federal regulations have recently been adopted or in the process being updated in response to these findings. The general regulatory approaches used to minimize and reduce these impacts include the use of both structural and non-structural Best Management Practices (BMPs). Non-structural BMPs focus on reducing the generation of runoff through Low Impact Development strategies (e.g., porous pavement, green roofs, disconnected impervious areas), pursuing conservation land easements, and open space acquisitions as well as the various zoning restrictions related to development density, lot imperviousness, buffers, and setbacks. Structural measures or BMPs rely on more traditional end-of-pipe treatment measures such as oil and grease traps, detention basins, wet ponds, grassed swales, and gravel wetlands. The Draft revisions to the AoT regulations include a provision to require a pre and post-construction pollutant loading assessment for all major projects subject to the AoT regulations.

Equally as important, will be the development of restoration plans for river segments that are already considered impaired or degraded due to previous development, other land use activities or hydrologic flow alterations. Recently, NHDES has targeted available grant funding and research to restore water bodies impaired by excessive algal growth, channel modifications, diminished water quality or flow alterations.

WATER QUALITY

GOAL 1: The upper Merrimack River and its tributaries maintain or exceed their statutory designated uses so that its citizens and visitors can enjoy swimming, fishing, boating, and its communities can depend on reliable clean water sources.

OBJECTIVE: WQ-1 - The UMR LAC will monitor and prioritize state and federal legislation and rules that affect watershed management in the upper Merrimack region and draft comment letters and provide testimony to support water quality.

Activities

- Seek opportunities to participate in NHDES rule development committees (e.g., Alteration of Terrain and Shoreland Protection Act committees).
- Designate an UMR LAC member to monitor key state and federal web sites or contact key personnel on pending rule changes and update full committee at regular meetings.
- Monitor legislative review documents to identify upcoming proposed legislation.

OBJECTIVE: WQ-2 - By end of 2008, all upper Merrimack River public and local officials will be aware of the UMR LAC and the resources that it provides for improving water quality through a meeting with each community at least once per year or by convening training and other events.

Activities

- Contact local Planning Boards in UMR communities to attend one of their meetings for informational purposes to discuss and share UMMP results, Management Plan recommendations, and survey results comparing zoning ordinances, subdivision, and site plan requirements in each of the communities.
- Schedule a follow-up meeting in 2009 or 2010 to share results of additional data gathering efforts conducted as part of this management plan.

OBJECTIVE: WQ-3 - Encourage consistency in the water quality protection measures and requirements included in local ordinances within the upper Merrimack communities, so that they all have strong, enforceable watershed protection and water quality ordinances in place by 2010.

Activities

- Coordinate and work with Planning Boards in UMR communities to encourage the inclusion and adoption of NHDES's recent Draft Stormwater Model Ordinance on Stormwater Management (April 2007; see listing in Appendix C) in local ordinances and site plan and subdivision regulations to enhance water quality protection measures for future development.
- By the end of 2008, compile and make available on merrimackriver.org, a simple guide or other reference documents regarding Best Management Practices targeted to the upper Merrimack communities with particular emphasis on any new NHDES regulations (e.g., AoT Rules, Comprehensive Shoreland Protection Act).
- By mid-2009, update and distribute a new State of UMR River Quality Report summarizing recent findings and other relevant information (e.g., water quality, macroinvertebrate data, impervious area estimates) to educate local officials on current conditions and needs for new protection measures.

GOAL 2: Restore those portions of the upper Merrimack River and its tributaries that are not meeting their statutory designated uses so that its citizens and visitors can enjoy swimming, fishing, boating, and its communities can depend on reliable clean water sources.

OBJECTIVE: WQ-4 - By mid-2008, all stream reaches or other waterbodies in the upper Merrimack watershed that are listed as impaired on the NH Department of Environmental Services 303(d) list are prioritized for restoration and specific corrective measures identified.

Activities

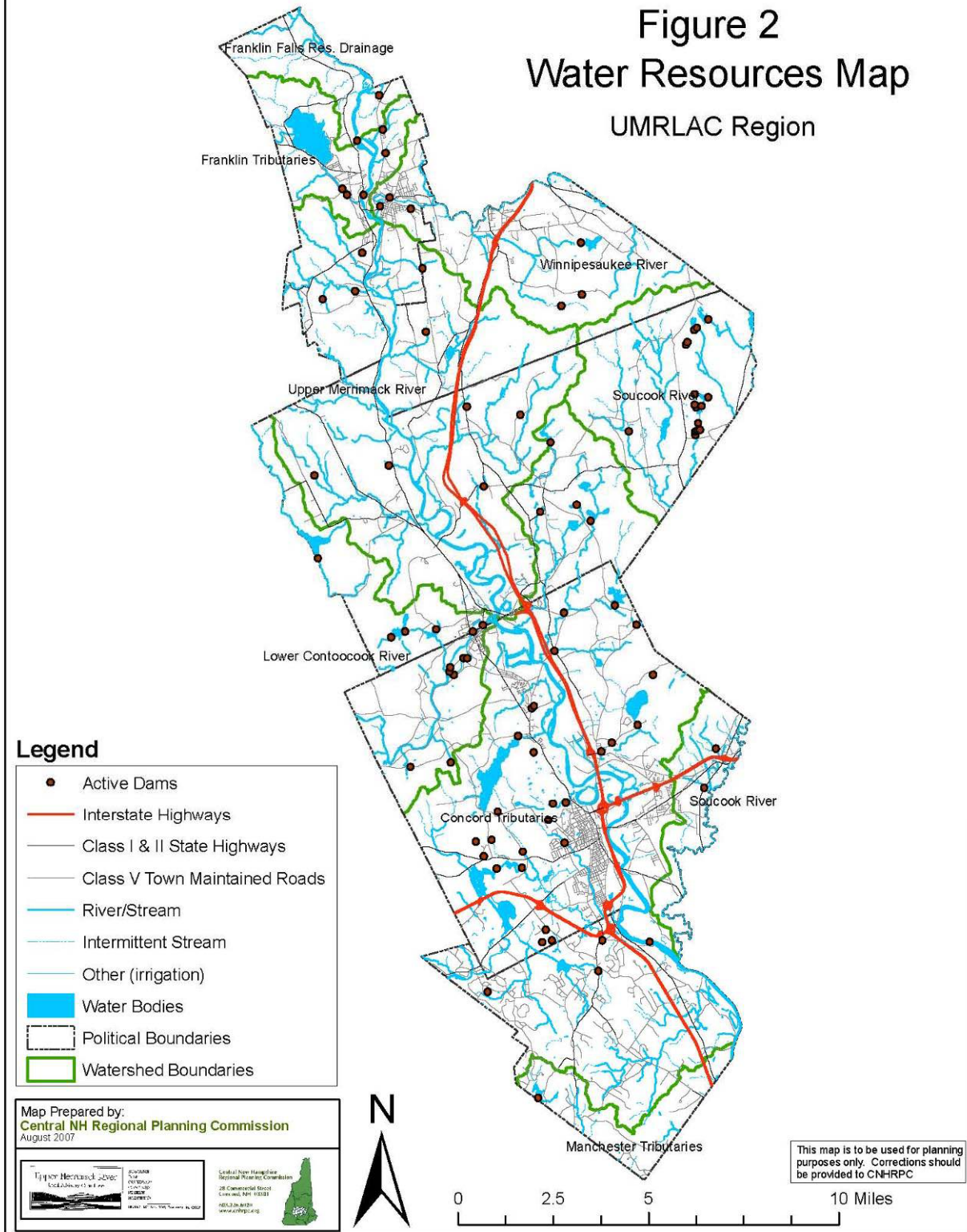
- Encourage the development or obtain existing higher resolution aerial photography to identify potential sources of runoff, especially in reaches identified as not supporting their designated uses.
- Work with NHDES to generate a map and data tables containing assessment information and impairments for the upper Merrimack River and its tributaries.
- Coordinate and participate in the review of the planned upper Merrimack River and Pemigewasset River Study to be directed by NHDES over the next three years from 2007 to 2009, which includes dry and wet weather sampling and modeling pollutant loading along various reaches.
- Expand UMMP to increase number of parameter and/or include smaller tributaries to bracket known "hot spots" or verify suspected source areas in reaches not supporting their designated uses especially due to elevated bacteria levels.
- Create a map delineating and quantifying the extent of impervious surfaces within each sub-watershed based on GRANIT land use data layer information. Identify watersheds having the largest percent imperviousness and those nearing thresholds that have been found to lead to water quality impacts.
- Conduct a baseline annual pollutant loading analysis on a sub-watershed basis using the Center for Watershed Protection "Simple Method" procedure
- Investigate continuation of "dry" and "wet weather" sampling conducted in (UM & PR) Study in key locations.
- Using existing GIS data layers, identify and provide relative ranking of key areas that have the highest development potential based on road access, development trends, soils, slopes, and other conditions.
- Coordinate with CNHRPC and LRRPC to evaluate results of recent or pending build-out analyses.

OBJECTIVE: WQ-5 - By early 2010, create a restoration plan that identifies, prioritizes, and list sources for funding to implement additional planning, monitoring, and restoration studies or measures to protect water quality and/or aquatic habitat conditions.

Activities

- Identify and evaluate any similar ongoing or completed restoration plan approaches in other regions of the state.
- Identify principal goals and objectives of a restoration plan based on the most recent understanding of the sources, listed impairments and extent of the problem.
- Align UMMP sampling, analytical and reporting procedures with NHDES's Consolidated Assessment Listing Methodology (CALM) for common parameters (e.g., dissolved oxygen, bacteria).
- Identify potential sources of funding and in technical assistance in developing and completing the Plan.
- Identify areas in local regulations that could be strengthened and improved to assist restoration and preserve future stream integrity conditions.

Figure 2
Water Resources Map
UMRLAC Region



WATER QUANTITY

Background

The NH Department of Environmental Services has been trying to adopt instream flow rules for over fifteen years. Similar to those in other states, these rules would be geared toward protecting existing instream water uses and insuring that sufficient aquatic habitat conditions are maintained throughout the range of seasonal flow conditions. As an interim measure, in 2002, the NH Legislature authorized and provided funding for NHDES to conduct Pilot Studies on the Souhegan and Lamprey Rivers to assess how the proposed methodology and study results would affect the existing water users. These studies are ongoing and are anticipated to be completed in 2009.

Instream flow generally pertains to the volume of water within a specific river segment or channel cross-section at any given time and has components of frequency of occurrence and duration. Stream flow is generally composed of groundwater inflow also known as base flow and surface runoff from adjacent land areas produced during storm events and snow melt. Stream flow is measured and expressed as a rate of flow in terms of cubic feet per second. Stream flow can be reduced by indirect and direct water withdrawals, altered by flow controls such as dams and by changes in the land uses within the watershed. Studies have shown that as the imperviousness of the watershed increases, more water enters the stream as direct runoff during or immediately after a rain event and less water infiltrates to the groundwater, which ultimately reduces the base flow that occurs between storm events. As a result, streams in urbanizing areas tend to be more “flashy” with much greater, short-term peak flows during storm events and lower base flows during dry weather. This shift to higher peak flows and lower base flows can result in dramatic changes in channel geometry, increase the flooding potential downstream and reduce the availability of water for other uses during dry weather conditions. Recent regulatory approaches (e.g., proposed AoT rule changes) are seeking to promote greater infiltration of site runoff for development projects to counter this effect.

Maintaining stream flow as close to its naturally occurring conditions is vitally important for maintaining healthy aquatic habitat conditions with respect to the depth of water, flow velocity, and width of stream channel that is inundated with water. Stream flow supports other public uses as well including navigation, recreation, fishing, conservation, wildlife habitat, protection of water quality and public health, pollution abatement, aesthetic beauty, public water supply, and hydropower production. Typically, a reduction in stream flow in terms of the rate of flow and duration has the greatest adverse affect on these uses. A reduction in stream flow can result from increased water withdrawals, dam modifications or less groundwater inflow or base flow due to increased runoff and less ground water infiltration (DES has prepared a Water Use Report for the Upper Merrimack River that is available via their web site in the instream flow rule section). Lower stream flow can diminish water quality conditions by causing higher water temperatures, reduced dissolved oxygen levels and a lower assimilative capacity for wastewater treatment. Lower stream flow volumes results in less dilution, causing higher concentrations of contaminants. Declining water quality and water depths can affect uses and the availability of water for public water supply, swimming, fishing, aquatic habitat as well as boating activities.

GOAL 3: Instream flows in the upper Merrimack River that support the public uses and the outstanding resources for which the river was designated such as habitat, recreation, wildlife, agriculture, wastewater treatment discharges, and drinking water.

OBJECTIVE: SF-1 - By end of 2008, identify all instream protected uses and outstanding characteristics and resources (IPUOCRs), as described in RSA 483 such as wastewater allocation flow, aquatic habitat, water supply, recreation needs, irrigation, and withdrawal will be identified.

Activities

- Review draft documents from Souhegan and Lamprey River to evaluate methodology for determining the flow needs to support flow-dependent instream public uses, outstanding resources, and characteristics.
- Identify existing water supply and irrigation withdrawals and quantify usage amounts.
- Conduct visual surveys along corridor to identify, verify, and report any large (>140,000 gallons per week) water withdrawals.
- Identify existing dams within entire watershed and determine their flow maintenance operations.
- Evaluate the affects of maintaining summer water levels in major lakes and impoundments on downstream flow.
- Identify wastewater discharge points and any flow allocation (i.e. 7Q10) contained in permits.
- Identify available USGS gauging stations in the region and assess availability of historical flow records to develop flow duration curves similar to Souhegan and Lamprey studies.

- Conduct a random citizen and/or stakeholder survey to obtain public feedback on the important issues and concerns in the river corridor (a similar survey was conducted for the Lamprey River by a UNH graduate student specializing in resource economics).

OBJECTIVE: SF-2 - By mid-2009, conduct a preliminary assessment of the flow volume needs to preserve and/or maintain the protected uses and outstanding characteristics and resources. Identify any possible flow management measures needed to address data gaps and/or estimated flow deficiencies (this objective is newly created to separate the hydrologic modeling or flow determination needs for each of the IPUOCRS as opposed to the simple identification of IPUOCR in the previous objective since the flow modeling efforts will require much more time (as was found in the Souhegan and Lamprey River studies).

Activities

- Conduct in-stream surveys at key locations to evaluate habitat flow needs based on Pilot Study methodology.
- Develop seasonal flow duration curves for key multi-use river segments using historical flow records.
- Identify any data gaps in historical flow records and measures to bridge or fill-in gaps.
- Quantify flow volume needs for each of the IPUOCRs including future water supply and waste water flow planning estimates and compare flow needs to the historical seasonal flow duration curves to identify flow deficiencies.
- Determine amount of flow need to overcome estimated flow deficiencies.
- Consult with NHDES Drinking Water and Ground Water Bureau to acquire future planning estimates of water supply and wastewater flow needs developed as part of the larger Merrimack River Watershed Project.
- Continue to monitor and review re-licensing applications for dams in the upper Merrimack River corridor and participate as interveners with the Federal Energy Regulatory Commission (FERC) process.

OBJECTIVE: SF-3 - By end of 2009, create a plan that identifies and prioritizes existing flow alterations and water consumption issues and identifies sources of funding to study or implement corrective measures to reduce effects of water consumption and improve flows in the upper Merrimack River watershed.

Activities

- Review proposed corrective actions, if any, in draft Souhegan and Lamprey River Plans and assess applicability for use in the upper Merrimack River reach.
- Research and promote alternatives to water conservation practices for commercial and residential uses.
- Evaluate water usage from local withdrawal sources on an average daily and seasonal demand basis as well as possible future demand and expansion plans and any conservation practices and/or policies that may be included in their operations.
- Educate community residents and key stakeholders about the benefits of water conservation measures through educational mailings or presentations at local events.
- Work with NHDES to identify funding sources needed to complete field efforts, promote education or implement corrective actions.
- Coordinate and provide recommendations to NHDES on measures to improve flow management or reduce consumptive uses for the existing potentially affected stake holders as well as those for any future proposed uses or operational changes.

STREAM CHANNEL INTEGRITY

Background

Stream channel integrity is most often threatened by increases in peak flows due to increased impervious surfaces and in sediment loads due to erosion and land disturbances within the watershed. Increases in peak flow rates during storm events alter the channel geometry by scouring the stream bed and eroding the stream bank, which results in wider and deeply incised stream channels. These channel modifications diminish the aquatic habitat conditions by slowing flow velocities and reducing the water depth during low flow periods. The bank erosion may also increase the sediment load downstream, which ultimately is re-deposited causing channel filling in lower velocity sections. Additional sediment contained in runoff due to erosion of disturbed soils along the shoreline or within the watershed may also alter the stream substrate by embedding cobble, gravel and rocks with a covering of silt and fine sediment. As stream beds become covered with fine sediment, the macroinvertebrate communities that once inhabited the stream bed are altered and become much less diverse, which, in turn, causes a ripple effect of change to the entire food web interactions of the aquatic ecosystem. Streams exposed to excessive sediment inputs are often impaired and support only a limited number of the most tolerant species of fish and aquatic life. These tolerant species are generally less desirable than the diverse aquatic communities sustained in non-impaired streams.

The primary means to minimizing these threats is by requiring proper erosion controls for terrain altering activities and requiring peak flow control for the smaller (e.g. two-year design storms) and larger storm events as development projects create more impervious surfaces. These requirements can be enforced both at the state and local levels. At the state level, erosion control and peak runoff control issues are addressed through the Alteration of Terrain (AoT) Program that is required for projects disturbing more 100,000 square feet (2.5 acres) or 50,000 square feet (1.1 acres) within a Shoreland Protection Zone. The existing AoT regulations and permit requirements are currently in the process of being updated and strengthened based on new information and recent policies adopted in other states. Timber harvesting and agricultural activities are not subject to the same permit requirements and are handled in a Permit-by-Rule process where general BMPs are required but are not reviewed on a project-by-project basis. One of the shortcomings of this Program is that NHDES does not have sufficient staff resources to adequately conduct follow-up site inspections and enforcement subsequent to issuance of permits. For this reason and the fact that many smaller projects fall below the permit requirement threshold, it is important for local communities to establish similar, if not more stringent, erosion and peak runoff control requirements as part of their zoning ordinances and subdivision and site plan review regulations. For local requirements to be truly effective in protecting stream resources, all communities within the watershed should have consistent regulations.

GOAL 4: The upper Merrimack River and its tributaries exhibit channels that are stable, self-sustaining, and capable of supporting diverse biological communities or biota.

OBJECTIVE: SC-1 - By end of 2009, through the use of existing data and visual observations compiled as part of the stream bank survey, develop a draft River Restoration Master Plan that identifies corrective measures to address identified stream channel integrity problems, and integrate these restoration objectives into the Management Plan.

Activities

- Conduct a visual survey of the entire designated river corridor using the White River Standard Operating Procedures to identify, photo-document, assess severity, and map existing stream bank erosion areas and areas with extensive streambed embeddedness.
- Use the regional river channel geometry equilibrium curves to assess and prioritize the most problematic areas and identify likely sources and causes.
- Compare and evaluate existing local subdivision and site plan regulations in UMR communities with respect to erosion and stormwater management. Develop a set of recommendations to update and improve local regulations in each community based on most current NHDES guidance and regulations.
- Develop a draft river restoration master plan that includes stream channel restoration design concepts and recommends measures and actions needed to reduce future channel degradation.
- Review methods and cost estimates for other river restoration projects in the region.

OBJECTIVE: SC-2 - By 2010, develop conceptual restoration plans for the three most significantly damaged stream channel sites, based on natural channel design principles.

Activities

- Finalize a river restoration master plan that includes concept designs, a description of the restoration action, and an estimate of funding needs to restore the three most significant and/or degraded stream channel sites.
- Coordinate with NHDES and other interested organizations such as Trout Unlimited to develop consensus on restoration design concept and to identify potential funding sources.

OBJECTIVE: SC-3 - By the end of 2010, secure sufficient public and private funding to restore the priority stream sites such that the restoration construction/implementation is accomplished by the end of 2011.

Activities

- Pursue and submit grant application forms to acquire necessary funds to accomplish restoration.
- Prepare construction design bid plans for contractor bid and selection.



Merrimack River confluence with Stirrup Iron Brook in Boscawen (photo provided by UMR LAC)

OUTSTANDING RESOURCES MANAGEMENT

AGRICULTURE

Background

Agriculture is one of our more important social and economic assets in maintaining a viable, self-sufficient community and preserving our local heritage for future generations. The upper Merrimack River is historically rich in agricultural heritage and production. In the early 1700s, the early settlers of the region recognized the value of the highly enriched soils along the Merrimack River floodplain for agricultural production. Today, much of the same floodplain within Boscawen, Canterbury, Concord, and Franklin is still in agricultural production. These local farm fields provide a source of quality vegetables and feed stock for dairy farms. They also provide valuable scenic buffers, greenbelts, and a connection to our historical heritage in rapidly developing land areas. Keeping floodplains in agriculture or forested land uses preserves the natural flood storage capacity that would otherwise be lost if houses and businesses were allowed to be built in these areas. The development of homes and commercial buildings not only eliminates flood storage but also generates additional runoff from impervious surfaces, which increases the risk of downstream losses of property and human life. These local farmlands are increasingly threatened by development, as the state's population continues to shift northward, bringing with it increased land values and development pressures.. One of the principal means to preserving of our existing farms is through the use of conservation easements (discussed further under the Riparian Land Management section).

From a statewide perspective and based on fiscal year 2005 economic data, the state's agriculture industry was valued at nearly \$935 million with approximately \$554 million in direct sales in of agricultural and other horticultural products and services and \$381 million associated with direct spending agricultural related tourist events such as fairs and scenic travel². New Hampshire farmers maintain about 450,000 acres of crop fields, pasture areas, and tree farms throughout the state.

Proper nutrient management and the use of Best Management Practices is essential in applying fertilizers and especially manure to active field areas to prevent offsite losses of nutrients and sediment into the upper Merrimack River and other nearby water bodies. Contributions of *E. coli* bacteria from livestock manure can be a major pollutant concern. For most agricultural activities, there are no permit requirements or a permit review process. However, education and outreach is provided through many cooperative agencies, including the NH Department of Agriculture, Markets & Food (NHDAMF), the Natural Resources Conservation Service, and the University of NH and County Cooperative Extension , to assist and educate farmers on proper Best Management Practices that minimize potential water quality impacts. The NHDAMF has developed an Agricultural BMP Manual that provides details for proper storage, handling, and application of agricultural compost, manure, and fertilizer.

GOAL 5: Communities of the upper Merrimack River watershed value, support, and foster the working landscapes of agriculture and forestry.

OBJECTIVE: AG-1 - By 2008, all agricultural lands along the upper Merrimack River will be inventoried.

Activities

- Using GIS data layers, develop a land use cover map showing existing agricultural lands in the watershed.
- Inventory the type, amount of area, and location of various activities within the watershed.
- Consult with NRCS and the NH Department of Agriculture, Markets & Food to review and acquire information on any known issues with regard to Nutrient Management Plans for farms within the region.

OBJECTIVE: AG-2 - By 2012, river levels will be managed so that there is adequate support for irrigation.

Activities:

- Identify farms and the amount of area utilizing irrigation withdrawals from streams and rivers.
- Quantify irrigation volume needs for various stream reaches based on known water withdrawal locations, areas being irrigated, and historical climatic conditions to determine needs during drought conditions.
- Coordinate findings with the Instream flow analyses conducted under the Water Quantity section of the Plan.

RECREATION

Background

Our lakes and streams throughout the river corridor have long played a central role in our water-based and land-based recreational activities. Residents of the region enjoy both the many recreational opportunities available such as swimming, boating, and fishing that are essential to our quality of life as well as the economic benefits of increased tax revenue, business, and employment opportunities that are generated by tourism and recreation visits that are linked to our water resources. The upper Merrimack River Region has some of the best river reaches in the state for recreational canoeing and kayaking. During the summer months, it is not unusual to see canoeing and kayaking activity in every section of the upper Merrimack River with paddlers able to navigate both upstream and down at ease. Numerous secluded sandy beaches and sand bars along the upper Merrimack River allow for relaxing respites, picnic lunches, and refreshing swims to those who come upon these sites (see Figure 3). During seasonal high-flow periods there are some stretches of river, particularly in the northern reaches, that are highly regarded for whitewater kayaking. The upper Merrimack River boasts some of the best fishing spots in the state for both cold water and warm water fisheries. The region also contains several large lakes and ponds that attract both seasonal and year-round lake boating and fishing enthusiasts. The demand and value of waterfront homes and cottages have steadily increased over the years as this central region of the state becomes more attractive as the state population continues to shift northward. The future value and availability of our recreation opportunities associated with our water resources will depend greatly on how well the water quality and the natural conditions along the river corridor and shoreline areas can be preserved and protected for future generations.

A recent economic study conducted in NH estimated that approximately \$400 million or 26% of summer spending in New Hampshire is associated with fishing, swimming and boating activity. The study also found that about half to two-thirds of visitors to a particular water body would decrease or cease their visiting days if they perceived a decline in water quality or purity at a particular site. Statewide, this reduction in visiting days would result in about \$51 million in lost sales, \$18 million in lost income and more than 800 lost jobs associated with fishing, swimming and boating (Nordstrom 2007).

GOAL 6: The upper Merrimack River watershed supports recreation opportunities that connect people to the river while conserving and maintaining its natural resources.

OBJECTIVE: RC-1 - By October 2008, all public access locations will be evaluated as to their usage, effectiveness, and appropriateness and whether their current conditions should be improved to promote greater access and reduce potential environmental impacts to the river.

Activities

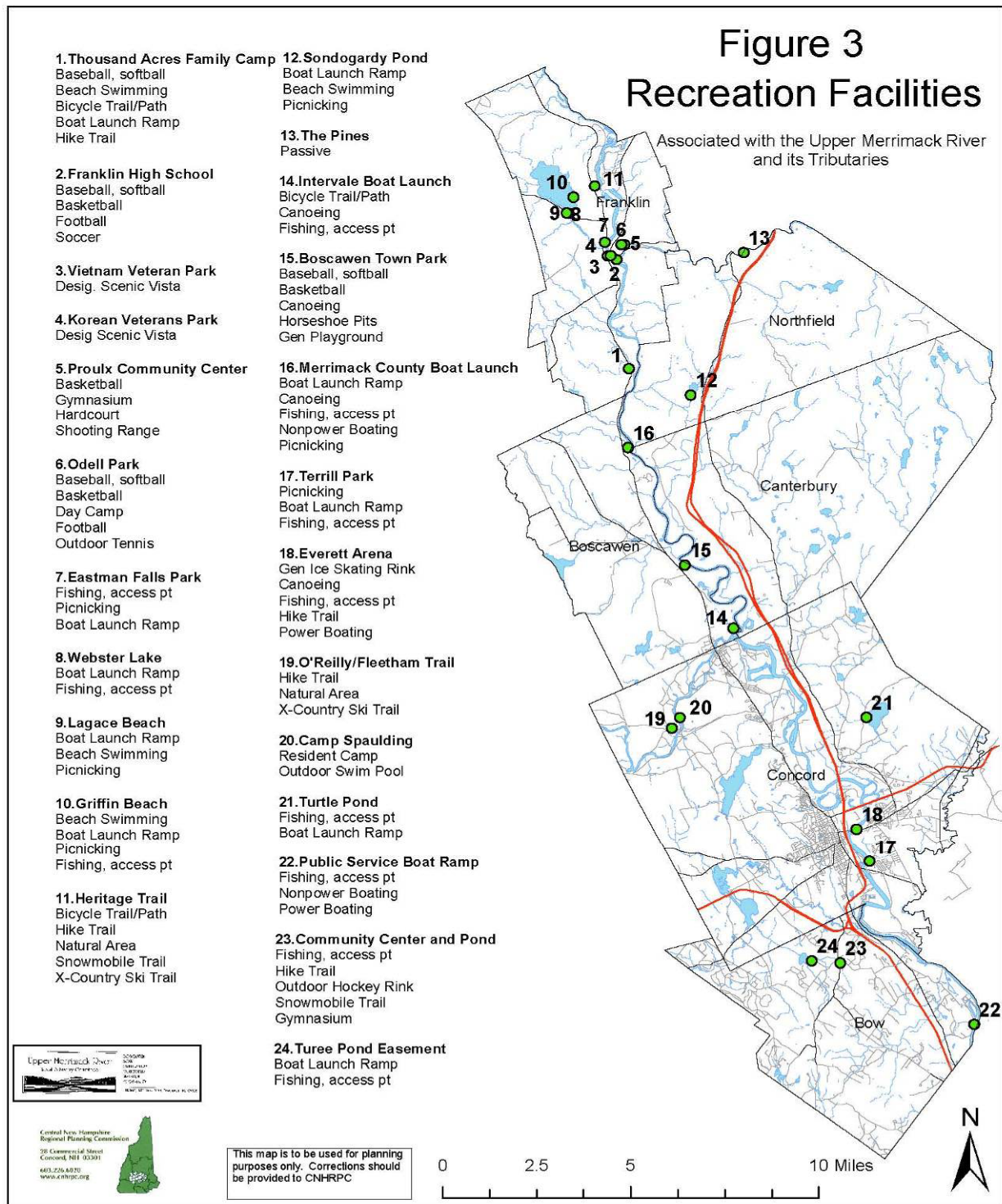
- Conduct a visual survey to identify and map all public access locations and inventory the type and extent of recreational uses within the river corridor.
- Identify and assess the critical viewsheds that support or encourage land-based activities within the river corridor.
- Identify areas that are experiencing environmental damage from overuse or inappropriate access points.
- Identify areas where additional stabilization and other protection measures are needed or where additional parking and public facilities may be needed.
- Identify areas where public access may be lacking and/or where new public access points may be appropriate for boat launches, swimming, and fishing.
- Identify/evaluate how flow management operations at existing dams affect both upstream and downstream recreational uses.

OBJECTIVE: RC-2 - By end of 2008, a long-range recreation plan will be developed that provides an inventory of existing recreational opportunities and outlines goals and actions to address future needs and possibilities for land-based and water related recreation activities, and identifies funding sources.

Activities

- Develop a general estimate of the economic benefits and revenue generated by the various water dependent recreational activities within the watershed.
- Identify measures that can improve the recreational usage and economic benefits within the region.
- Identify measures and structural needs to reduce any existing or future environmental impact that may be caused by recreational activities. Incorporate findings and measures into the overall watershed restoration plan with a draft scheduled to be completed by mid-2009.

- Create and distribute brochure-type materials and/or signage at access points to promote “Leave No Trace” principles and address barriers/objectives to following these principles.
- Develop an online virtual “tour” of the River.



WILDLIFE

Background

The NH Fish and Game Department's recently completed *Wildlife Action Plan* (WAP) represents the most comprehensive statewide assessment of aquatic and terrestrial habitat conditions. The WAP describes the status of habitat conditions and identifies the areas and species that are of greatest risk of habitat loss, the critical factors that contribute most to further habitat degradation or loss, and provides recommendations for conservation measures needed to maintain or enhance habitat conditions. The preservation of our wildlife and aquatic species is important not only to protect our enjoyment of our natural heritage but is imperative to preserve the ecological balance of the complex ecosystems. Conservation also protects the economic benefits of hunting and fishing activities within the region. As cited in the WAP, the findings of the 2001 US Fish and Wildlife Service's National Survey indicate that fishing generated \$165 million in economic benefits in New Hampshire, hunting brought in \$71 million per year, and wildlife watching accounted for another \$343 million per year statewide. A separate independent study, conducted by Southwick Associates, suggested that hunting and fishing activities results in more 4,500 jobs throughout the state. As an important region of the State, the upper Merrimack River is both a significant contributor and beneficiary of these economic benefits generated by hunting and fishing. The findings and recommendations of WAP for the upper Merrimack region should be incorporated into this Plan and ultimately into the local communities' regulations and planning goals (See highest ranked wildlife habitat areas in the region as shown in Figure 4).

GOAL 7: The upper Merrimack River watershed habitats maintain ecological integrity and diversity that support healthy wildlife communities.

OBJECTIVE: WF-1 - By mid-2009, the recommendations from the NH Fish and Game Department's *Wildlife Action Plan* will be analyzed along with local maps, shoreland protection provisions in local ordinances, and other information.

Activities

- Develop GIS mapping that shows WAP data, priorities, and recommendations for key habitat areas throughout the watershed.
- Prepare a summary memorandum outlining the WAP priorities and recommendations for the upper Merrimack River communities.
- Incorporate findings and measures into the overall watershed restoration plan with a draft scheduled to be completed by mid-2009.

OBJECTIVE: WF-2 - By mid-2011, a plan will be developed to implement appropriate *Wildlife Action Plan* recommendations in the upper Merrimack River watershed.

Activities

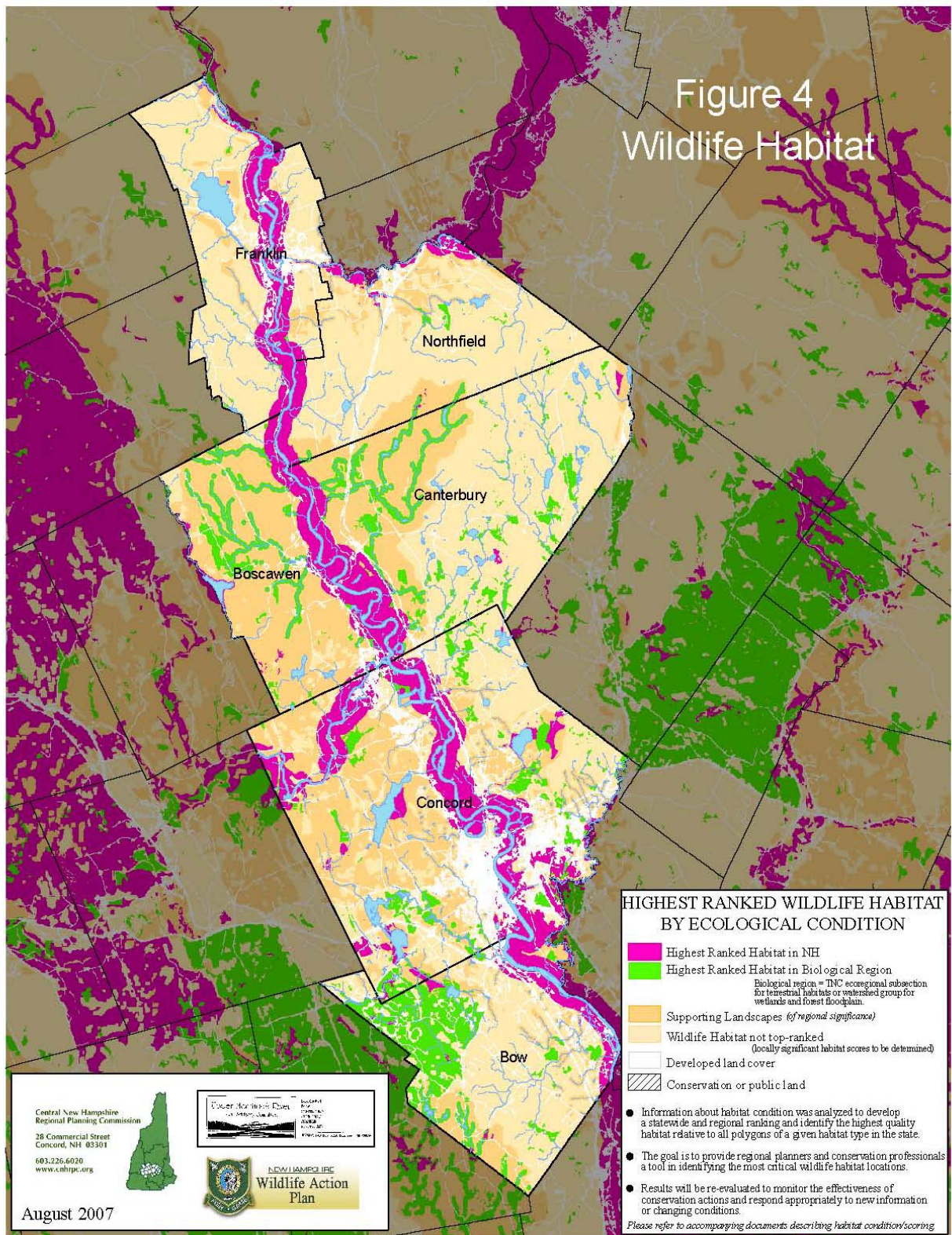
- Coordinate with NH Fish and Game Department, nonprofit conservation agencies, and local municipal officials to develop a plan of key activities needed to implement the WAP recommendations for the region to protect existing viable and important habitat areas.

GOAL 8: Those areas of the upper Merrimack River watershed that are not supporting healthy wildlife communities are restored.

OBJECTIVE: WF-3 - By mid-2011, a wildlife restoration plan will be developed that identifies, prioritizes, and provides recommendations to restore degraded or threatened wildlife habitat areas, and funding sources to support restoration.

Activities

- Identify funding sources to implement measures to enhance habitat conditions in degraded areas.
- Develop and prioritize a list of measures that should be implemented over the next ten years to improve heavily impacted and degraded terrestrial and aquatic habitat areas in the upper Merrimack based on the WAP recommendations.



Historical and Archaeological

Background

From the Abenaki meaning, “swift water place” the waters of the Merrimack River have given sustenance, provided transportation, and pleasure to native Americans, our early settlers and the diversity of cultures and communities that settle its banks today. Local historical societies and heritage commissions continue to remind us through exhibits and preservation of precious artifacts and historical places of where we have been and how far we have come as individuals and as communities and that our heritage is intimately entwined with the Merrimack River. The sense of pride and unity we carry with in our hearts is reflected in the windows of the small shops and restored fabric mills that line our Main Street communities. The physical local, layout, and social fabric of our existing communities cannot be separated from the historical connection to the River. The River brought trade and commerce to the Abenaki and Merrimack tribes as well as provided power for the businesses and industry that built the unique mill towns, small cities, and large metropolitans that continue to rejoice in its natural splendor, rich heritage, and economical prosperity.

GOAL 9: Historical and archaeological sites within the upper Merrimack River watershed are identified, recognized, and appreciated by watershed communities for their value to the landscape and local culture and are preserved for future generations.

OBJECTIVE: HA-1 - By mid-2008, in consultation with the NH Division of Historical Resources and the local historical societies in each corridor community, an inventory of at least 50% of the historical and archaeological sites within the communities will be compiled using existing sources prepared at the state or local level.

Activities

- Identify areas of significant historical importance for protection and preservation
- Identify areas of significant archeological importance for excavation and protection and preservation.
- Assist with the development of legislation governing the establishment and declaration of protected historical and archeological sites/areas.

OBJECTIVE: HA-2 - By early-2009, historical and archaeological sites inventory data will be incorporated into a map that will be distributed to communities and the public to promote better stewardship of historic resources in the community.

Activities

- Compile historical site and structure data for each community an incorporate into a GIS map for distribution to local and state historical commissions, archeological organizations, regional and local planning commissions, as well as local zoning boards.
- Coordinate with watershed communities’ city and town clerks to make maps are available to the general public through their town halls and parks and recreation departments.

OBJECTIVE: HA-3 - By 2010, historical and archeological sites that are unique and relevant to the River and vulnerable to potential loss or destruction and are in need of restoration will be documented and the information provided to the communities.

Activities

- Provide support to state and local authorities through local advisory committees concerning law enforcement of areas and sites declared to be of historical or archeological significance along the corridor.
- Promote public awareness and appreciation of areas/sites declared to be historically and archeologically valuable through UMLAC publications and fundraisers.

Geologic and Natural Features

Background

The upper Merrimack River corridor contains many natural and geologic features that are unique to the area including the large bluffs along the river bank in Concord and Canterbury, floodplain forests, sandy beaches, large boulders, and the isolated oxbow ponds in the lower broad valley through Concord. These geological and natural features have developed over millions of years and tell a story of how the River conditions about the dynamic changes over time and how the ecological communities have adapted to these changes. These features attract many curious visitors and are the subject of many natural, geologic, and historical publications.

GOAL 10: Communities along the upper Merrimack River and its tributaries recognize and protect the unique geologic and natural features associated with the river including glacial deposits, sand dunes and bluffs, rare plant communities, floodplain forests, oxbow ponds, and beaches.

OBJECTIVE: GNF-1 - On an on-going basis, work with the State Geologist's Office, the NH Natural Heritage Bureau, and others to continue efforts to locate, identify, and document important geologic and natural features of the river area.

Activities

- Develop a GIS Map illustrating the various unique natural and geologic features working with State Geologists and Natural Heritage Bureau.
- Coordinate with each community, NHDES, and regional planning commissions to identify existing measures to protect these resources as well as identify any long-term and short-term threats to their integrity.

OBJECTIVE: GNF-2 - On an on-going basis, assist with efforts to educate the public and local officials about the presence of the unique geological and natural features in their communities.

Activities:

- Develop a fact sheet or brochure highlighting the particular natural features of the area that can be distributed to each community.



Sand Bluffs along the Merrimack River in Canterbury (photo provided by UMRAC)

FISH AND AQUATIC

Background

The upper Merrimack supports a highly diverse and, for the most part, very healthy fish and aquatic ecosystem throughout its rivers, streams, and lakes. Recreational fishing is a very popular and cherished activity in many locations along the river corridor as well as lakes and ponds. The region supports high quality, cold water fisheries in the fast-moving rivers of the upper headwaters as well as excellent warm water fisheries in the many lakes and ponds and the slower-moving sections of the river. The abundance and access to various water bodies, the general high water quality, and diverse habitat conditions in most locations provides excellent year-round fishing opportunities. The abundantly available, high-quality fishing is an important contributor to the economic activity for many businesses within the region including marinas, bait and tackle shops, convenience stores, restaurants, and hotels.

GOAL 11: The upper Merrimack River watershed habitats maintain ecological integrity and diversity that support healthy aquatic communities.

OBJECTIVE: FA-1 - By mid-2008, existing fisheries and benthic community data for the various reaches throughout the watershed will be compiled using existing NH Department of Environmental Services, NH Fish and Game Department, and Upper Merrimack Monitoring Program databases.

Activities

- Identify specific reaches where the historical data indicates that the macroinvertebrate and/or fish populations are declining and/or shifting to less desirable species types.
- Identify/evaluate causes for species shifts or declining populations.
- Identify and map impediments to upstream and/or downstream fish passage due to “hanging” culverts (i.e., where the outlet end is raised above the stream bed) and/or dam structures.
- Consult with NHDES River Restoration Coordinator to seek assistance in using the NH River Restoration Task Force to help identify existing fish passage impediments and potential restoration alternatives to improve fish passage at culverts and existing dams.
- Consult with NH Fish and Game Department to review any creel survey results, stocking patterns, electro-shocking results, or other scientific and anecdotal data.
- Incorporate findings and measures into the overall watershed restoration plan with a draft scheduled to be completed by mid-2009.

OBJECTIVE: FA-2 - By 2012, gaps in mainstem and tributary systems data will be filled.

Activities

- Conduct a field survey along major tributaries and mainstem of the Merrimack River to evaluate the severity and prioritize the restoration needs to improve fish passage at stream crossings in accordance with the pending stream crossing guidance criteria.
- Develop a map of high priority stream crossing impediments and a description of the primary passage impediment.
- Continually monitor proposed roadway improvement projects within the watershed and coordinate with the project proponent to improve existing stream crossing conditions, as needed based on the priority mapping.

GOAL 12: Those areas of the upper Merrimack River watershed that are not supporting healthy aquatic communities are restored.

OBJECTIVE: FA-3 - By 2012, at least 50% of unnatural barriers to passage for native aquatic species, including fish, will be removed in the upper Merrimack River watershed.

Activities

- By mid-2010, develop a list and rank stream crossing improvement needs for crossing within the watershed along with a cost estimate of the culvert/bridge replacement.

RIPARIAN LANDS MANAGEMENT

Vegetation

Background

Landscapes across New Hampshire are being transformed by invasive plant species. In the upper Merrimack watershed, Purple Loosestrife, Hydrilla, Water Chestnut, Curly-Leaf Pondweed, and Variable Milfoil have invaded our water bodies and shorelands. Because they have no insects that feed on them or diseases from their native areas, these invading species crowd out native vegetation and become the dominant plants. This imbalance has a profound effect on the upper Merrimack ecosystem. Wildlife that depends on native plants for shelter and food now must relocate or cannot survive. Water bodies that are choked with these species can make boating, fishing, swimming, and other recreational uses difficult or impossible.

Some of these invaders were introduced as ornamental plants while others came to New Hampshire when aquarium owners emptied their tanks of exotic plants. Moving boats between water bodies is another common way of spreading invasive species. In all of these cases, introductions can be prevented by reaching out to citizens and boating enthusiasts and providing them with information and tools so that they don't unwittingly introduce invasive plants to the upper Merrimack.

The economic cost of invasive species is high. Billions of dollars have been spent on the control and eradication of these invaders. It is more cost effective to monitor the watershed for invasive species and eradicate them before they become entrenched. To preserve habitat and the region's natural heritage early detection coupled with rapid response is the best strategy for preventing the spread and establishment of invasive species. Conservation groups, nursery professionals, and Cooperative Extensions are collaborating in efforts to identify and control invasive plant populations.

GOAL 13: Colonization by invasive plant species in the upper Merrimack watershed is controlled so that biodiversity and healthy natural systems are maintained.

OBJECTIVE: VGN-1 - By mid-2008, locations along the river that are impacted by invasive plant species will be identified and activities will be specified as part of a comprehensive plan to address protection of native species and restoration of sites with non-native infestations.

Activities

- Work with Natural Heritage Bureau, The Nature Conservancy, and other nonprofits and agencies to review existing surveys or conduct additional baseline surveys to determine areas with invasive populations or are sensitive to invasions.
- Work with Natural Heritage Bureau, The Nature Conservancy, and other nonprofits and agencies to draft plan address invasive prevention and control in the upper Merrimack watershed. The plan will utilize the early detection / rapid response approach.
- Maintain an updated list of alternative native plants to replace the invasive plant populations. Distribute lists to local conservation commissions, lake associations and local plant supply businesses.
- Refer inquiries from the community at large to Invasive Plant Atlas of New England (IPANE) materials relating to invasive species.
- Encourage training sessions in every community to provide a network of local people that are able to identify invasive species.
- Identify and incorporate restoration needs and measures into the overall watershed restoration plan with a draft scheduled to be completed by mid-2009.

BUFFERS AND SETBACKS

Background

The health of streams and rivers depends to a great extent on the lands that surround them. Over the last two decades, researchers have shown that preserving naturally vegetated corridors along streams can “buffer” them from the degrading effects of nonpoint source pollution while reducing the impact of floods, providing habitat for wildlife, and offering recreational benefits to people. Protected stream and river corridors or “riparian buffers” are now widely advocated by a range of federal, state, and local agencies for protecting water quality on agricultural, forestry, residential, and other lands.

Riparian buffers are the single most effective protection for our water resources in the upper Merrimack River watershed. These strips of grass, shrubs, and trees along the banks of rivers, streams, and ponds filter polluted runoff and provide a transition zone between water and human land use. Buffers are also complex ecosystems that provide habitat and improve the stream and river communities they shelter.

Natural riparian buffers have been lost in many places over the years. Restoring them will be an important step forward for water quality, stream and riverbank stability, wildlife, and aesthetics in the upper Merrimack River watershed. Landowners, town road agents, local governments, farmers, and conservation organizations can all help protect and restore the riparian buffers which in turn protect and restore the quality of our streams and our river.

Establishing the appropriate width for riparian buffers can vary depending upon the availability of land and what primary function the buffer is to provide. There isn't one generic buffer width that will keep the water clean, stabilize the banks, protect fish and wildlife, and satisfy human demands on the land. A minimum riparian buffer width of 50' from the top of the bank will provide bank stabilization, support fisheries habitat, limited sediment control, and nutrient removal with very little wildlife habitat and no flood control capacity. There is an increasing benefit for every foot of buffer width established. An optimal condition in the upper Merrimack River watershed would be one with 300' riparian buffers along all stream and river banks to provide the maximum amount of benefit for pollution uptake, sediment control, flood attenuation, bank stabilization, fisheries habitat, and wildlife habitat.

GOAL 14: Continuous and functional buffers along the upper Merrimack and its tributaries are maintained and enhanced.

OBJECTIVE: BS-1 - By the mid-2008, all current setback and buffer requirements imposed at the state or local level in the upper Merrimack municipalities will be inventoried.

Activities

- Develop a GIS map and data table showing current setback and buffer requirements throughout the corridor based on local and state regulations.

OBJECTIVE: BS-2 - By the end of 2008, recommendations will be formed and presented to UMLAC municipalities to improve the effectiveness of their ordinances based on the existing conditions and the available scientific information that has been developed and adopted within the New England region.

Activities

- Update GIS map and data table to show recommended or proposed buffer and setback requirements based on proposed NHDES Shoreland Protection Rules requirements and other relevant data such as that contained in the *Wildlife Action Plan* to protect key habitat areas.
- Present updated buffer and setback information to UMLAC municipalities at special meetings or in conjunction with planning board, zoning board of adjustment, or conservation commission meetings.

OBJECTIVE: BS-3 - By end of 2008, existing outreach materials will be identified and distributed to assist citizens and landowners in recognizing the importance and effectiveness of setbacks and vegetated buffers.

Activities

- Develop a brochure or pamphlet to highlight and educate residents and landowners on the benefits of the recommended buffer and setback requirements.
- Work with NHDES Watershed Management Bureau to develop PowerPoint presentation on the topic of vegetated buffers, developing buffer ordinances, and implementing buffer ordinances.

GOAL 15: Continuous and functional buffers are established along those areas of the upper Merrimack and its tributaries where they don't exist. Setbacks along the upper Merrimack and its tributaries are established or maintained to ensure stream bank and habitat integrity.

OBJECTIVE: BS-4 - By mid-2008, areas are identified for improving and enhancing functional buffers in key locations.

Activities

- Provide local planning boards and conservation committees a list with accompanying maps of areas that are in need of improvement of buffers along the river.
- Utilize the updated GIS map information to overlay existing, functional buffers with information contained in the *Wildlife Action Plan* and the NHDES 303(d) List of Impaired Waters for the upper Merrimack and its tributaries.
- Prioritize areas within the upper Merrimack watershed for improvement or enhancement of existing, functional buffers.

OBJECTIVE: BS-5 - From 2007-2011, an incentive-based approach will be developed to allow landowners to maintain their existing uses in buffer areas and encourage a no-net decrease in the buffer area when the expansions of uses are proposed within that area.

Activities

- Investigate other incentive-based approaches to buffer establishment and protection in New England and develop a strategy for the upper Merrimack and its tributaries.
- Work with UMLAC municipalities to draft incentives that would allow developers the same number of lots outside the buffer as they would in a conventional layout, considering the amount of land that is high, dry, and flood-free.
- Work with UMLAC municipalities to develop low-density bonuses for land conserving designs, and density disincentives to discourage land consuming layouts.

OBJECTIVE: BS-6 - By early 2009, funding sources will be identified to assist landowners in implementing or enhancing buffer areas along key stream reaches.

Activities

- Research and develop a funding source “menu” for UMLAC that identifies and prioritizes funding programs applicable for buffer establishment, maintenance, and restoration.
- Secure funding and implement a pilot project that educates the public about the value of riparian buffers, delineates existing, protected, functional buffers in a project area, and permanently marks the buffer boundaries for developers and the public.

LAND USE AND OPEN SPACE

Background

Land conservation and protection through open space acquisitions and conservation easements are perhaps the most effective methods for protecting the area's natural resources, rural character, quality of life, natural heritage, wildlife habitat and the quality of our water resources. In fact, many of the goals and objectives contained in this Plan could be achieved through land conservation efforts. Following the housing spurt of the mid to late 1980's, many communities as well as state and federal agencies and private, non-profit organizations made major strides in purchasing and/or acquiring conservation easements on valuable land parcels. Much of the land protection effort was done between 1980 and 2000.

The Society for the Protection of NH Forests, through their 2005 *New Hampshire's Changing Landscape Report*, provides valuable insight on the current status as well as recent trends with regard to land conservation and development in the various UMR Communities. Based on 2004 property ownership data compiled by SPNHF, all of the UMR communities, except for Northfield, currently have more than 10% of their land area already conserved or protected as town forests, parks, dedicated open space and/or as other state or locally owned land. The City of Concord has the highest percentage of land area protected at about 18.5%, followed by Boscawen at 15.7%, Bow at 14.6%, Franklin at 13.3%, Canterbury at 11.2%, and Northfield has about 0.9% of its land area protected. The total amount of protected land area in the six UMR communities consists of about 18,315 acres. However, between 1998 and 2004, only an additional 0.7 % or about 1,290 acres have been added to the list of protected lands in the six UMR Communities. The Town of Bow had the greatest increase with an additional 783.4 acres protected, followed by an estimated 289 acres in the City of Concord, approximately 134.0 acres in Canterbury and about 84.0 acres were protected in Northfield. The Report also states that between 1998 and 2004, more land was developed than protected in Concord, Boscawen, and Northfield. This trend has the potential to continue as the demand for residential housing continues to migrate northward and westward along major highway corridors such as I-93 and Routes 3 and 4. Since 2004, there are perhaps many other instances where other lands have been protected through easements and acquisitions on the part of conservation-minded individuals and organizations. This information will need to be updated for each community as part of this Plan.

Going forward, it will be extremely important for municipal officials to review existing zoning, identify areas most suitable for future development, establish land protection goals, identify funding needs and to coordinate closely with public land trusts and other land preservation organizations to protect valuable goals.

GOAL 16: Land uses support the upper Merrimack River's designated uses, hydrologic functions, and the Rivers Management and Protection Act.

OBJECTIVE: LU-1 - By late 2008, corridor municipalities will be provided with minimum impact principles that can be implemented as incentives and land use regulations.

Activities

- Inventory protected land areas in each community and develop community mapping working with CNHRPC to assess status of protected lands and identify unique areas or parcels that should be targeted for protection based on resource value and relevant information.
- With assistance from CNHRPC and NHDES, attend at least one Planning Board within each of the communities to present an update on regional development trends, effects of possible build-out scenarios and the use of innovative practices and principles for encouraging low impact development (LID) techniques (*this activity could be combined with WQ-1*).
- Develop fact sheet or post-card mailer listing available resources and relevant web sites for additional local land use control information and stormwater management BMPs.
- Circulate questionnaire to local Planning Boards to obtain feedback on their biggest concerns and needs for resource information.

OBJECTIVE: LU-2 - By 2009, all upper Merrimack municipalities have recommendations and tools so that they can draft and adopt appropriate local zoning maps and ordinances that support the goals of the Rivers Management and Protection Act.

Activities

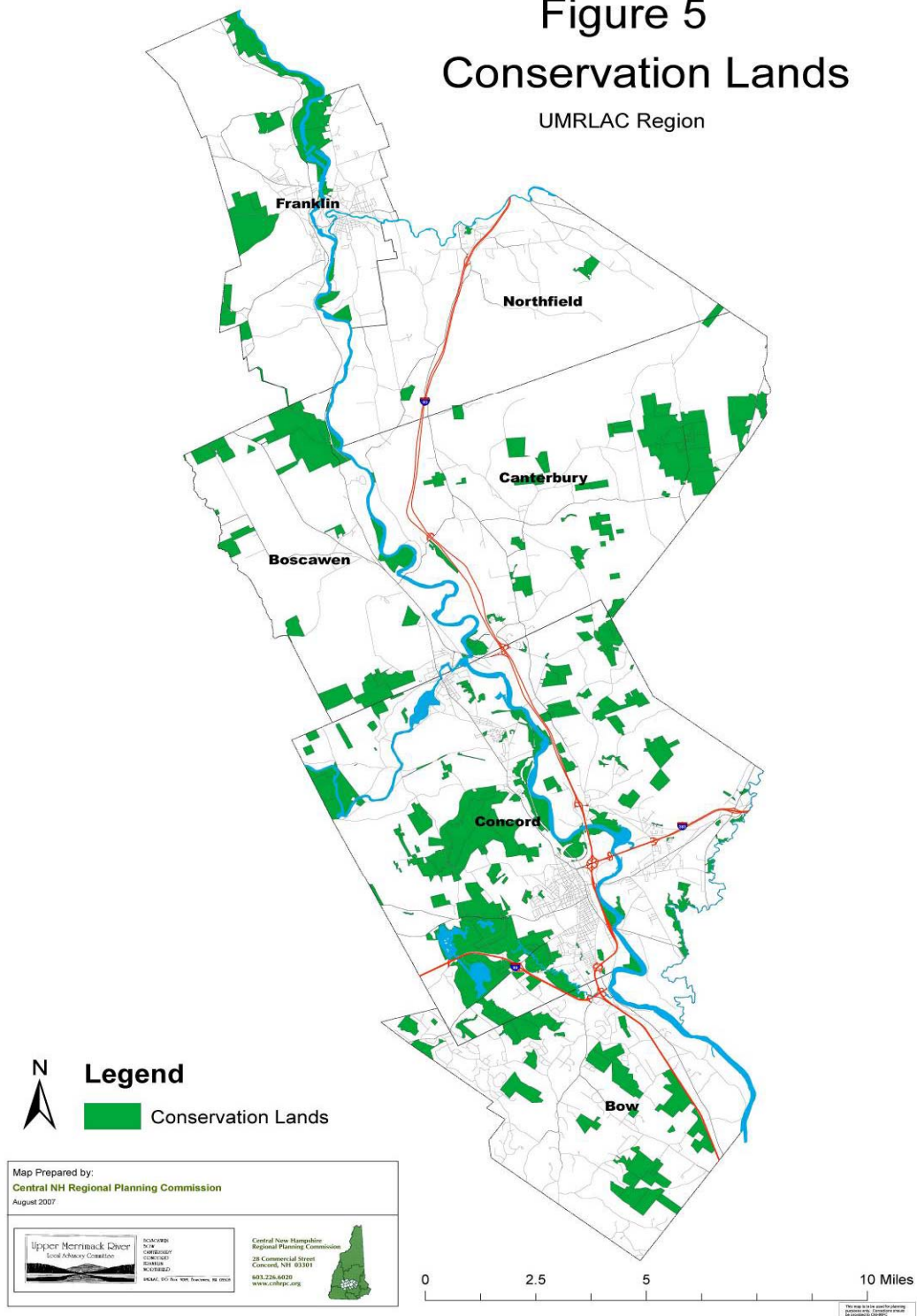
- Develop guidance manual and host workshop to present latest information on innovative local zoning regulations including recent NHDES draft model ordinance on Stormwater Management.
- Post guidance document and supporting information on web site

OBJECTIVE: LU-3 - On an ongoing basis, municipalities and landowners will have information on how they can work with cities, towns, and local land trusts to conserve their land through easements and conservation sales.

Activities

- Provide links and contact info on UMLAC web site to web sites of local land trust organizations.
- Partner with local land trust organizations to host an annual open space / land preservation workshops to discuss regional needs and efforts.
- In conjunction or as an alternative to a workshop, produce a mailer or fact sheet to send to local planning board and conservation easements about recent land conservation efforts.
- Identify and inform local land trust organizations about key land parcels along the river corridor that would be good candidates for land preservation.

Figure 5
Conservation Lands
 UMRAC Region



Floodplains

Background

Floodplains generally represent the broad, relatively flat areas directly adjacent to the rivers. These areas periodically flood during high flow events and serve to buffer against flooding problems downstream. Floodplains are an integral part of river health as they absorb flood waters, reduce peak flows, and channel scour as well as filter the water in the process. Preservation of floodplain areas has become increasingly important as the upland areas in the watershed are converted to impervious surfaces and increase the runoff volume discharged to streams and rivers during storm events. Development within the floodplain greatly compounds this problem by taking away available flood storage during storm events and increasing the runoff volumes. There have been several major flooding events in the last two decades including the most recent flood events of April 2007, May 2006, October 1996, and April 1987. These floods were relatively close in magnitude to what is statistically referred to as the 100-year flood (a flood that has a one percent chance of occurring in any given year). The recent number of major floods in this relatively short time period suggests that there may be an increasing trend of more frequent large rainfall events. The pressure to develop our floodplain areas is likely to increase as the value for other developable upland areas increases and/or becomes less available. Recent development patterns suggest floodplains along the Merrimack River are vulnerable to development pressures because they are parallel and adjacent to major transportation corridors such as I-93 and US Route 3. This makes undeveloped land space in the floodplain highly attractive for commercial development. Communities in the upper Merrimack River will need to revisit their floodplain management ordinance requirements and determine whether the development controls are sufficient to protect these areas and limit the potential for greater downstream flooding as well as in their own communities due to reduced flood storage volumes.

Goal 17: Encroachments within floodplains and floodways along the upper Merrimack River and its tributaries are avoided or minimized so that flood storage functions and ecological values are protected.

OBJECTIVE: FP-1 - By end of 2008, review floodplain zoning regulations in all UMR communities, research new floodplain control language from NHOEP or other planning resources and recommend suggested language and/or control measures for communities to adopt and improve their protection of flood plain areas.

Activities

- Compile, review, and compare floodplain ordinances for each of the upper Merrimack communities.
- Research new approaches and model ordinances developed elsewhere concerning floodplain protection.
- Identify and map key locations within watershed area that represent important floodplain areas.
- Based on a comparison of historical aerial photos, identify and quantify major changes in land use conditions within the floodplain area over the last 20 to 30 years.
- Identify areas that have been historically prone to flooding resulting in major property damage and/or disruption to vehicle travel along public roadways.

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Schiff, R., J.G. MacBroom, and J. Armstrong Bonin, 2007, Guidelines for Naturalized River Channel Design and Bank Stabilization, NHDES-R-WD-06-37. Prepared by Milone & MacBroom, Inc. for the New Hampshire Department of Environmental Services and New Hampshire Department of Transportation, Concord, NH.

Schueler, T. E. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices, Metropolitan Washington Council of Governments.

Society For the Protection of New Hampshire Forests. 2005. New Hampshire's Changing Landscape; Population and Land Use Changes; What They Mean for the Granite State? www.forestsociety.org

Trowbridge, P. 2006. Environmental Indicator Report: Land Use and Development. New Hampshire Estuaries Project.

Appendices

Appendix A

Key to Abbreviations Used in this Management Plan

7Q10 flow	-Statistically the lowest average flow for a 7-day period with a once in ten-year occurrence frequency. Used to establish wastewater discharge permit requirements and flow allocations contained in permits
303(d) list	- federal “impaired” water bodies list
AOT	- Alteration of Terrain program
BMP	- Best Management Practices
CALM	- Consolidated Assessment Listing Methodology
CNHRPC	- Central NH Regional Planning Commission
CSPA	- Comprehensive Shoreline Protection Act
CWP	- Center for Watershed Protection
FERC	- Federal Energy Regulatory Commission
GIS	- Geographic Information Systems
GRANIT	-NH Geographically Referenced Analysis and Information Transfer System
IPUOCRS	- Instream Protected Uses and Outstanding Characteristics and Resources
LID	- Low Impact Development
LRRPC	- Lakes Region Regional Planning Commission
NHDAMF	- NH Department of Agriculture, Markets & Food
NHDES	- NH Department of Environmental Services
NHFG	- NH Fish and Game Department
NHRRTF	- NH Rivers Restoration Task Force
NRCS	- Natural Resources Conservation Service
OEP	- NH Office of Energy and Planning
RMPP	- Rivers Management and Protection Program (RSA 483)
RPC	- Regional Planning Commission
RSA 483	- Rivers Management and Protection Program
SPNHF	- Society for the Protection of NH Forests
TMDL	- Total Maximum Daily Load
UMPP	- Upper Merrimack Monitoring Program
UMR	- upper Merrimack region
UMRLAC	- Upper Merrimack River Local Advisory Committee
UNH	- University of New Hampshire
USGS	- United States Geologic Survey
WAP	- <i>Wildlife Action Plan</i>
WMB	- Water Management Bureau

Appendix B

Inventory of Local Ordinance Regulation in the UMLAC Communities

Ordinance / Municipality	Boscawen	Bow	Canterbury	Concord	Northfield	Franklin
Dates of last update/amendment (month/yr) of each ordinance	03/14/06	05/09/06	03/14/06	7/8/2007	3/13/2007	7/10/2006
Density and/or Minimum Lot Size Requirements	Between 1/4 - 2 acres	2 acres	2 acres	0.10 to 4 ac	.05 acres to 5 acres	0.5 ac to 5.0 ac in Conservation district
Septic System Setbacks from Wetlands or Open Water	100'	75'-150'	125'	75', 100', 125'	75'	75 to 100'
Wetland Protection Ordinance	Yes	Yes	No	Yes	Yes	Yes
Wetland Buffer Requirements	50- 100'	30'-150' 50' buffer for vernal pools	No	50'	50'	Webster Lake watershed only
Shoreland Protection Zones or Districts	Yes, great ponds, Merrimack and Contoocook Riv and tributary streams	No	No	Yes, for Great Ponds & 4th Order streams	No	Webster Lake; 50 to 75 ft
Setback From Merrimack River	None	75 – 200'	200' setback	No	250'	None
Shoreland Ordinances for Streams Third Order or Lower	tributary streams	75'-200'	No	No	50'	none

Ordinance and regulations	Boscawen	Bow	Canterbury	Concord	Northfield	Franklin
Open Space Requirements within Conservation and Watershed Districts	No but included in cluster development	A minimum of 50% of original lot area, and $\geq 25\%$ of open space must be buildable land. The minimum original tract size shall be 10 acres.	No but included in cluster development	Yes, varies with land use zoning; 40% for cluster development; Conditional Use Permit required for alterations in buffers	Included in cluster development	66% open space required in cluster development'
Impervious areas Restrictions for Aquifer protection or other Zones;	There is no Aquifer Protection	Not limits defined in the Aquifer District	The dev. shall not result in coverage of more than 35% of the lot by impervious surface	15% in Penacook Lake Watershed Protection District	in general max 70% commercial and Max 30% residential	In Webster lake watershed, max of 30% of impervious area for new develop.
Bluff setbacks	n/a	n/a	50 ft (Merr. River Bluff). In areas where the top of the river bluff, it is 150 ft to 200 ft	50'	n/a	n/a
Preserving Naturally Vegetated Buffers	50' in SP district; Conditional Use Permit required for activities w/in Wetland District	Wetland Buffer 150'-200'; Buffer to streams, lakes, ponds, vernal pools, bogs 75'-200';	Yes, varies	75' from wetlands, great ponds and 4th order streams. CUP required.	50-250'	Webster Lake 50 to 200 ft: 100 ft perimeter for cluster develop.
Allows for Alternative Development Types (ex. Cluster)	Yes	Yes	Yes	Yes	Yes	Yes

Appendix C

List of Relevant Resources and Reference Tools for Community Officials

Water Resources

Alteration of Terrain Permits, When are they Required – Fact Sheet; NH DES Alteration of Terrain (Site Specific) Program, www.des.state.nh.us/factsheets/wqe/wqe-3.htm

Aquatic Plants and Algae of NH Lakes and Ponds. 2007. prepared by J. Connor and A. P. Smagula, NHDES Limnology Center. Report # wd-05-30. A Field Guide to Native and Exotic Species in NH. www.des.state.nh.us/wmb/exoticspecies/documents/PlantBook.pdf.

Aquifer Protection Best Management Practices (BMPs) Guidance Document, prepared by the Lakes Region Planning Commission for the Tri-Town Area; Belmont, Northfield and Tilton, www.lakesrpc.org/BMP/aquifer/index.html.

Best Management Practices for Forestry: Protecting New Hampshire's Water Quality; prepared by UNH Cooperative Extension; www.extension.unh.edu/Forestry/Pubs/BMPBook.pdf

Economic Impact of Potential Decline In New Hampshire Water Quality: www.nhlakes.org/docs/Surface-Waters-PhaseIV-Final-Report.pdf

EPA Guidance Documents and Model Ordinances on Stormwater Management and Erosion Control www.epa.gov/nps/ordinance/postcons.htm.

Environmental Indicator Report; Land Use and Development; prepared by NH Estuaries Project, dated May 2006, available via www.nhep.unh.edu/resources/pdf/env_ind_water_quaity-nhep-06.pdf.

Guide Book for NH Wetland Permits, NH DES Wetlands Bureau, www.des.state.nh.us/Wetlands/Guidebook

Innovative Stormwater Treatment Technologies BMP Manual, provided by NH DES Watershed Management Bureau, May 2002. www.des.state.nh.us/wmb/was/manual/.

Instream Flow Pilot Program Reports and Reference Documents. Lamprey and Souhegan Rivers. NH DES Rivers Management and Protection Program; www.des.state.nh.us/Rivers/Instream/.

Local Government Environmental Planning Assistance Network (LGEAN) Stormwater Management Toolbox related to BMP Design and Maintenance available at www.lgean.org/html/toolbox.cfm.

Manual of Best Management Practices for Agriculture, NH Department of Agriculture, Markets & Food, www.agriculture.nh.gov/divisions/markets/documents/BMPs_NH_Agriculture.pdf

NHDES Draft Model Ordinance on Permanent (Post-Construction) Stormwater Management, dated April 17, 2007, available by contacting Eric Williams at NHDES at 271-2358.

NHDES Water Conservation Information for Municipalities and Public Water Supplies. www.des.state.nh.us/h2o_conservation.htm

State of the Upper Merrimack; 1995-1997, A River Quality Report. Upper Merrimack Monitoring Program; prepared by M.L Tremblay and S.C. Landry. available at www.merrimackriver.org

University of New Hampshire Stormwater Center; Design Details and Performance Results for various Stormwater BMPs including Porous Pavement at www.unh.edu/erg/cstev/

Upper Merrimack River Water Quality Assessment, 2004 Final 305(b) Report and 303 (d) List; prepared by NHDES; www.des.nh.gov/rivers/documents/Assessments/Upper_Merrimack.pdf.

Upper Merrimack River Annual Water Use versus Stream Flow; Year 2004; prepared by NHDES available at www.des.state.nh.us/Rivers/Instream/2004report/documents/upper_merrimack.pdf.

Upper Merrimack and Pemigewasset River Study Plan; June 6, 2006; prepared for Army Corps of Engineers, www.nae.usace.army.mil/projects/ma/merrimack/merrimackpsp.pdf.

Stormwater Manager's Resource Center; Various Model Ordinance Examples and Guidance Information Related to the Local Review Process, www.stormwatercenter.net/

Volunteer River Assessment Program (VRAP); Publications and Information Resources, Annual Reports. Maps and Water Quality Data; www.des.state.nh.us/wmb/vrap/info.html.

Volunteer Lakes Assessment Program (VLAP); Publications and Information Resources, Annual Reports. Maps and Water Quality Data; <http://www.des.state.nh.us/wmb/VLAP/>.

Stream Channel Integrity

River Restoration and Fluvial Geomorphology White Paper. 2006. NHDES-R-WD-06-27. Prepared by Milone & MacBroom, Inc. for NHDES and NHDOT. www.des.state.nh.us/Rivers/documents/FinalNHWhitePaper.pdf

Guidelines for Naturalized River Channel Design and Bank Stabilization, February 2007. prepared by Milone & MacBroom, Inc. for NHDES and NHDOT. www.des.state.nh.us/rivers/documents/NH_NRCDBS_Guidelines.pdf

Native Shoreland and Riparian Buffer Plantings for New Hampshire
www.des.state.nh.us/WMB/VRAP/documents/NativeShorelandRiparianBufferPlantingsNH.pdf

Shoreline Protection

Adopted Rule Changes to the NH Comprehensive Shoreland Protection Act, effective April 1, 2008, www.des.state.nh.us/cspa/pdf/CSPAchanges_incorporated.pdf

Connecticut River Joint Commission Fact Sheets on the Value of Riparian Buffers;
<http://www.crtc.org/buffers/Guidance%20for%20Communities.pdf>

Model Vegetation Restoration Plan for Shoreland Properties, www.des.state.nh.us/cspa/files/modlveg.pdf

Protecting and Enhancing Shoreland Areas for Wildlife Habitat; UNH Cooperative Extension;
www.extension.unh.edu/Pubs/PubsSG/shoreland.pdf

General Land Use Planning and Resource Protection

Community Planning, Natural Resource Inventories, Training and Grant Funding Assistance provided by UNH Cooperative Assistance Program, www.extension.unh.edu/CommDev/CCAP.htm

Environmental Planning for North Country Community Officials Workshop Presentations provided by the Center for the Environment at Plymouth State University at www.plymouth.edu/cfe/outreach.html

NH Smart Growth Guidance, Floodplain Management and other Community Planning Resources, provided by the Office of Energy and Planning, www.nh.gov/oep/programs/SmartGrowth/community/index.htm.

Resource Environmental Planning Program (REPP) for Community Cultural and Resource Protection Approach provided by Central NH Regional Planning Commission www.cnhrpc.org/environmental/repphome.html or Lakes Region Planning Commission, <http://www.lakesrpc.org/>

Fish and Wildlife Information

NH Wildlife Action Plan, prepared by NH Fish and Game, www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm

NH Fish and Game Wildlife Strategic Plan, www.wildlife.state.nh.us/Inside_FandG/Strategic_Plan_1998.pdf

Open Space and Conservation Lands

Open Space for New Hampshire: A Toolbook of Techniques for the New Millennium; www.nhmf.org/open-space.htm

Does Open Space Pay? by Phil Auger, UNH Cooperative Extension;
www.extension.unh.edu/Pubs/ForPubs/nrgn1010.pdf

The Economic Impact of Open Space; the Society for the Protection of NH Forests;
www.rsginc.com/pdf/economic_impact.pdf.

Land Conservation: Preserving New Hampshire's Quality of Life. www.spnhf.org/landconservation/

New Hampshire's Changing Landscape 2005; www.spnhf.org/research/research-projects.asp.
