Lower Merrimack River Corridor Management Plan

Prepared by:

Nashua Regional Planning Commission
115 Main Street PO Box 847 Nashua, NH 03061
www.nashuarpc.org

On behalf of:
Lower Merrimack River Local Advisory Committee

May 2008

The Nashua Regional Planning Commission wishes to express their thanks and appreciation to the New Hampshire Department of Environmental Services for both the financial and staff support used in completing this management plan. Financial assistance was provided through settlement funds from the New Hampshire Department of Environmental Services, Hazardous Waste Compliance Bureau, Waste Management Division.

We would also like to thank the members of the Lower Merrimack River Local Advisory Committee for their leadership, volunteerism, and continued dedication to Merrimack River and surrounding communities.

Karen Archambault
Jim Barnes
Stan Kazlouskas
George May
Glenn McKibben
Kathryn Nelson
Ray Peeples
Bob Robbins
Cynthia Ruonala

Cover Photo Credit:

Joe Drapeau, Bedford, NH
From Photographers Forum

TABLE OF CONTENTS

TABLE OF CONTENTS (con't)

TABLE OF CONTENTS (con't)

TABLES

FIGURES

APPENDICES

CHAPTER 1 CORRIDOR PLAN PURPOSE AND NEED

This Plan is an update to the original Lower Merrimack River Corridor Management Plan adopted in September 1989 pursuant to requirements contained in the New Hampshire Rivers Management and Protection Program (RMPP). The Lower Merrimack River was originally included as one of five rivers provided protection under the New Hampshire Rivers Management and Protection Program. In 1990 the Lower Merrimack River Local Advisory Committee (LMRLAC) was formed to provide an advisory role on matters pertaining to the management of the river and to comment on development plans which might affect the resource values for which the river was designated. The LMRLAC must also develop a local river corridor management plan and update those plans every five to ten years as necessary under RSA 483:10. In addition, RSA 483:8-a, III(c) allows the corridor management plan to be adopted as part of a communities master plan. Educating, informing, and assisting the four corridor communities in formal adoption of the corridor management plan as part of each corridor community's Master Plan is one of the chief responsibilities the Lower Merrimack River Local Advisory Committee will perform as part of the plan update process. However, even if adopted within the four corridor communities, responsibility for managing, monitoring, and implementing the Corridor Management Plan will remain with the Local Advisory Committee.

1.1 Purpose and Need for the Plan

The purpose of the Merrimack River Corridor Management Plan (the Plan) is to provide guidance to the communities adjacent to the Lower Merrimack River as they make decisions having the potential to affect the Lower Merrimack River watershed, its river corridor, and the Lower Merrimack River itself. While the document is specifically advisory to the corridor communities of Merrimack, Litchfield, Hudson, and Nashua, the Plan's goals, objectives, and recommendations may also be applicable to decision-makers in other neighboring watershed communities, and even upstream environments not included in the Lower Merrimack River Watershed.

In addition to satisfying the statutory requirements of the RMPP, the corridor plan provides a comprehensive and consistent voice to the management of the Lower Merrimack River corridor throughout its watershed and across municipal boundaries. The Plan provides a regional focus for management in an area where growth rates continue to challenge both manmade and natural environments. Overall, the Local Advisory Committee has adopted a single guiding principle that serves as the driving force for all of LMRLAC's activities:

Preserve the character and integrity of the Merrimack River and its corridor by protecting its natural, historic, and scenic resources and to ensure its continued utilization as a multiple use river.

1.2 Scope of the Plan

The Merrimack River begins at the confluence of the Pemigewasset River and the Winnipesaukee River near Franklin, New Hampshire and flows 115 miles to Newburyport, Massachusetts where it meets the Atlantic Ocean. The Lower Merrimack River Corridor is a 15-mile segment of the Merrimack River beginning at the northern borders of the towns of Merrimack and Litchfield, New Hampshire, flowing south through the town of Hudson and city of Nashua to the Massachusetts border. The corridor itself contains the land area within one-quarter mile from the ordinary high water mark on each side of the river (or to the landward extent of the 100-year floodplain, whichever distance is greater) as shown in Figure 1.

Legislation was enacted in 1990 to designate segments of the Lower Merrimack River into RSA 483, the New Hampshire Rivers Management and Protections Program. The following factors were considered during the nomination process:

- Recreational uses and activities
- Non-recreational uses and activities
- Prohibited uses
- Existing land uses
- Floodplains, wetlands, fish and wildlife habitat, open space, and other significant natural resource protections
- Locations of dams, bridges, and other water-related structures
- Access
- Dredging, filling, mining, or other earth-moving activities

This plan is designed to incorporate the topics discussed initially in the nomination of the Lower Merrimack River, thereby continuing the discussion of these important river features into the management of the river corridor.

1.2.1 Description of the Corridor Area

The Merrimack River watershed extends from the White Mountain Region of northern New Hampshire southward into east-central Massachusetts. The fourth largest river watershed in New England, it encompasses approximately 5,010 square miles and 76 percent of the watershed (3,810 sq mi) lies in New Hampshire. The Merrimack River is formed by the convergence of the Pemigewasset and Winnipesaukee Rivers in Franklin, New Hampshire. The River travels through varied terrain past the cities of Concord, Manchester, and Nashua, and on into Massachusetts where it flows southeasterly and empties into the Atlantic Ocean at Newburyport. Major New Hampshire tributaries to the river include the Contoocook, Piscataquog, and Nashua Rivers. Other smaller tributaries include the Turkey, Soucook, Suncook, and Souhegan Rivers.

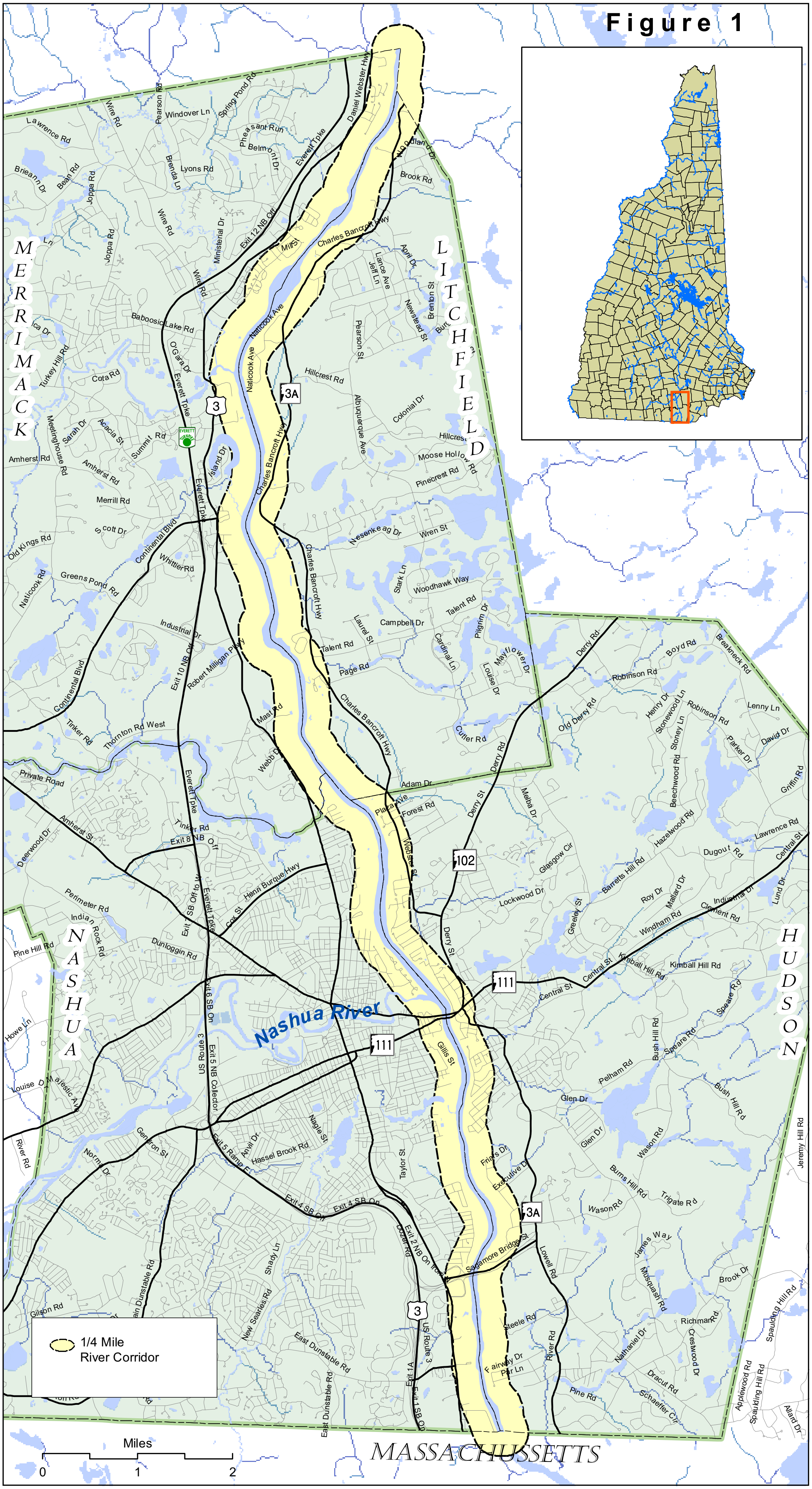
In 2006, an estimated 146,895 people lived within the towns and cities of the Lower Merrimack River corridor. These population figures indicate a population density of 1,269 persons per square mile within the four adjacent communities of Merrimack, Litchfield, Hudson, and Nashua.

Insert
Figure 1 – Base Map

Scroll Down for Figure 1

Lower Merrimack River Corridor Plan
Base Map

Figure 1



Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

Many competing demands are placed upon the Merrimack River as it flows from northern New Hampshire to the Atlantic Ocean. Water supply, industrial use, waste assimilation, irrigation, fisheries and wildlife, and recreation are only a few. In fact, the "Community River" classification the Lower Merrimack River corridor nicely reflects this balance of competing interests within the range of uses present in the river corridor. "Community Rivers" are those where the natural, scenic, recreation, and community values of the river are to be protected, while still accepting of agricultural, residential, and commercial uses of the river that do not impact public instream uses. Public instream uses include activities that are flow-dependent, such as navigation, recreation, fishing, and protection of water quality. Finding a balance between these competing demands forms the basis for prioritizing management issues developed in this plan.

1.3 Priority Management Issues

The Lower Merrimack River Local Advisory Committee distributed approximately 1,600 questionnaires in the fall of 2005 to property owners within the river corridor in order to determine the relationship between area residents, business owners, municipal officials, and river users and the Lower Merrimack River. Two hundred thirty-five responses were received; results included the following findings:

	Range	Value	Opinion	Objectives that Address Identified Values
Strengths	Out of ten natural resource categories, residents indicated:	**Open Space** **Water Supply** and **Scenic Value**	Contribute most to residents' quality of life.	**2.3** **7.1** **9.1**
Opportunities	Out of seven natural resource characteristics, residents indicated:	**Water Quality** **Open Space** and **Wildlife/Waterfowl Habitat**	Are most important in considering corridor protections.	**2.3** **8.2** **8.3** **10.2**
Threats	Out of four negative corridor characteristics, residents indicated:	**Loss of Farmland to Development** and **Abusive Recreational Behaviors**	Were noted as being most noticeable.	**2.2**
Needs	Out of eight protection measures, residents indicated:	**Community Education** **School Education** and **Conservation Planning**	Were noted as being most necessary.	**1.1** **3.1** **3.2**

**Note: Corridor Plan goals and objectives are discussed in Chapter 2.*

These priority management issues inform a number of objectives identified for management of the Lower Merrimack River corridor in Chapter 2 of this plan. Since the priority management issues identified in the 2005 survey are rather broad, LMRLAC has focused its attention on those priority management issues that represent needs in the corridor, including community/school education and conservation planning. The specific plan objectives which directly relate to these priority management needs are listed below:

1.4 Process and Participants

1.4.1 Sources of Data and Technical Assistance

Information on the Merrimack River is available from numerous sources, most of which was available in printed reports from other organizations and agencies. Many of these sources were used during the preparation of this plan, and a complete bibliography is provided at the end of the Plan. We would like to take this opportunity to acknowledge the support of the following agencies that provided funding or assistance with the creation of this Plan:

NH Department of Environmental Services, Water Division
Nashua Regional Planning Commission
Lower Merrimack River Local Advisory Committee
Town of Hudson
Town of Merrimack
Town of Litchfield
City of Nashua

1.4.2. Corridor Plan Process

The Lower Merrimack River Local Advisory Committee kicked off the corridor plan update in the Summer of 2004 with an initial public outreach program to familiarize citizens and municipal officials with the role of the LMRLAC. In the fall of 2005 citizen surveys had been completed providing LMRLAC with a solid framework for the priority management issues as identified by corridor town residents. Watershed audits were then completed in order to better understand the existing regulatory framework for watershed and rivers protection within the four corridor towns. Town Master Plans, zoning, and site plan review regulations were also reviewed at this time. During this background research period, Conservation Commissions, Planning Boards, and the public at large were notified of LMRLAC activities and encouraged to attend meetings and field trips organized by the committee.

Updating the corridor plan formally began in January 2007 and an initial draft for public review was completed in May 2008. The completed document was provided to the NH Department of Environmental Services Rivers Management and Protection Program on May 5, 2007.

CHAPTER 2 GOALS AND OBJECTIVES

Many of the goals and objectives for this corridor management plan were amended from the goals contained within the previous September 1989 plan. The goals were originally developed by an advisory committee composed of representatives from the four member communities, Litchfield, Merrimack, Nashua, and Hudson. The goals and objectives appearing in this Chapter build upon those original goals and were reviewed by the Lower Merrimack River Local Advisory Committee (LMRLAC) throughout the preparation of this management plan. Each of the overall goals and objectives are described below, arranged by topic area, listed in order of importance.

Objectives that relate to the priority management values discovered through the 2005 public survey, are shown in italics below.

These goals and objectives form the basis for the Recommended Actions in this Plan (Chapter 5), which contain detailed action items that will be used for implementing the Lower Merrimack River Corridor Management Plan. It is recognized that some of these goals and objectives may inherently conflict. To remedy this, a vision statement which provides additional guidance and direction for future corridor management actions has been developed.

Vision Statement for the Lower Merrimack River Corridor:

To preserve the character and integrity of the Merrimack River and its corridor by protecting its natural, historic, and scenic resources to ensure its continued use as a multiple use river.

Goal 1	**Administration**		***Coordinate the implementation of LMRAC goals, objectives, and actions with corridor towns.***
Objective:	1.1	*Strengthen relationships with local or regional entities involved in protection or management of the Lower Merrimack River or its tributaries by coordinating at least one joint activity or meeting with these groups, yearly.*	
Objective:	1.2	Internally improve LMRLAC as an organization by evaluating membership, duties, and public awareness of the organization on a yearly basis.	
Objective:	1.3	Contribute to enforcement activities by partnering with state and local authorities	
Goal 2	**Conservation**		***To retain open space along the Lower Merrimack River corridor.***
Objective:	2.1	Preserve the natural character of undeveloped/underdeveloped properties along the Lower Merrimack River by partnering with municipalities in conservation efforts.	
Objective:	2.2	*Conserve prime and active farmland within the Lower Merrimack River corridor through purchase of easements and/or development rights and adoption of local regulations which protect farmlands.*	
Objective:	2.3	*Retain the existing character of the Lower Merrimack River shoreline by planning a "greenbelt" system along the Lower Merrimack River shoreline.*	
Goal 3	**Corridor Management**		***To promote the conservation, protection, and sound management of the Lower Merrimack River corridor.***
Objective:	3.1	*Introduce Low Impact Development (LID) techniques and strategies into regulatory approaches to achieve more efficient developments in the Lower Merrimack River corridor.*	
Objective	3.2	*Implement regulations to address setback, buffer, and shoreland protection issues within the Lower Merrimack River corridor.*	
Objective	3.3	Implement mitigation requirements that counteract development impacts to corridor resources and values.	
Objective	3.4	Encourage connectivity in the management of Lower Merrimack River corridor resources.	

Goal 4	**Historic Resources**	***To promote, preserve, enhance, and protect the historic sites, buildings, character, and settings of the Lower Merrimack River corridor.***
Objective:	4.1	Identify and protect the historic resources of the Lower Merrimack River corridor.
Objective:	4.2	Increase public interest in and knowledge of Lower Merrimack River corridor historic resources and historic preservation tools.
Goal 5	**Public Access and Awareness**	***To increase public access to and use of the Lower Merrimack River.***
Objective:	5.1	Increase the recreational use of the Merrimack river corridor by at least 20% as measured in numbers and types of recreational users over the next 10 years by increasing the quality of the recreational resource.
Objective:	5.2	Increase the recreational use of the Merrimack river corridor by at least 20% as measured in numbers and types of recreational users over the next 10 years by increasing the quantity of the recreational resource.
Objective:	5.3	*Increase the knowledge of local citizenry of the Lower Merrimack River corridor resources by conducting at least yearly information dissemination efforts.*
Goal 6	**Restoration**	***To restore river conditions to those ecologically endemic to the natural state of the River.***
Objective:	6.1	Restore and enhance the Lower Merrimack River corridor streambank to more natural conditions.
Goal 7	**Scenic Quality**	***To promote the appreciation and protection of special scenic vistas associated with the Lower Merrimack River and its corridor.***
Objective:	7.1	*Protect the significant views from the Lower Merrimack River by adopting local regulations that protect views from river user vantages.*
Goal 8	**Water Quality**	***To protect water quality in the Lower Merrimack River.***
Objective:	8.1	Compile current data on physical, chemical, and biological indicators of water quality in the Lower Merrimack River corridor.
Objective:	8.2	*Maintain, restore, and enhance the Class B water quality standard and minimize any further degradation of important biological and chemical indicators through water quality monitoring and inspections.*
Objective:	8.3	*Implement local ordinances and performance standards that further the protection of water quality through regulation of land uses within the Lower Merrimack River corridor.*
Objective:	8.4	Participate in state processes which directly or indirectly benefit the protection of river resources within the State.
Goal 9	**Water Quantity**	***To restore and protect water quantity in the Lower Merrimack River.***
Objective:	9.1	*Maintain flow conditions that will support the outstanding natural, cultural, and recreational resources associated with and dependent upon the Lower Merrimack River by participating in the process for adopting an instream flow for the Lower Merrimack River under RSA 483:9-c.*
Goal 10	**Wildlife and Aquatic Habitats**	***To maintain and enhance wildlife and wildlife habitat residing within or dependent upon the Lower Merrimack River and its associated corridor.***
Objective:	10.1	Increase the variety of protected wildlife habitats by at least 10% to promote greater diversity in the kinds of wildlife species present within the river corridor.
Objective:	10.2	*Support informed management of habitat and species using information contained in the NHF&G Wildlife Action Plan.*

*Note: Objectives shown in italics support priority management issues identified in the 2005 public surveys, results of which are discussed in Section 3.1 – Priority Management Issues.

CHAPTER 3 CORRIDOR RESOURCES

Many land uses and activities are limited by the physical characteristics of an area, and this Chapter looks at the physical characteristics of the corridor which may influence the numbers and types of activities which may be accommodated. In addition, ensuring a diversity of plant and animal species and the continuation of endangered and threatened species depends on promoting and protecting the diversity of corridor habitats. Once destroyed, it is difficult to recreate specific habitat conditions required for many individual species. Scenic vistas, natural views, and archaeological or historic resources are other components that will be considered physical resources in this Chapter. The visual impacts of a single action, such as a clear cut or construction of an expansive building or structure, can have a profound impact on the visual quality of the river corridor.

In many instances the negative impacts of development on the River's physical resources can be avoided through proper planning for long-term conservation of the resource and through careful consideration of the physical and natural characteristics of the site prior to development. It is in this interest that the existing physical and natural characteristics of the Lower Merrimack River corridor are provided below.

3.1 Water Resources and Water Quality

Formed by the convergence of the Pemigewasset and the Winnipesaukee Rivers in Franklin, New Hampshire, the Merrimack River measures 116 miles in length and drains a 5,010 square mile watershed in New Hampshire and Massachusetts. Composed of the smaller Winnipesaukee, Pemigewasset, Contoocook, and a section of the Nashua River subwatersheds, it is the largest watershed in New Hampshire, encompassing approximately 3,800 square miles. The river flows 66 miles though New Hampshire from Franklin to the Massachusetts border. Approximately 15 miles of the Lower Merrimack River have been designated under the New Hampshire Rivers Management and Protection Program.

As a multiple-use river, the capacity of the Merrimack River to support numerous and competing uses is limited. For example, the river is used for waste assimilation and drinking water by numerous communities. The removal of large quantities of waters from the river decreases its capacity for waste assimilation. In addition, a reduction in flow places stress on the fish and wildlife species that depend on the river ecosystem. It is, therefore, important to maintain a balance between the many river uses and users to ensure the continuation of the multiple-use capabilities of the Merrimack River.

3.1.1 Water Resources

The Merrimack River corridor surface waters, in conjunction with the river's larger watershed, form an extensive system of rivers, streams, lakes ponds, wetlands, and groundwater. Actions affecting these areas such as chemical contamination, damming, or dredge and fill activities, will ultimately have an impact on the river. Given the vast size of the watershed and the focus of this document, this section discusses the major tributaries, wetlands, lakes and ponds, and the groundwater resources of the river corridor.

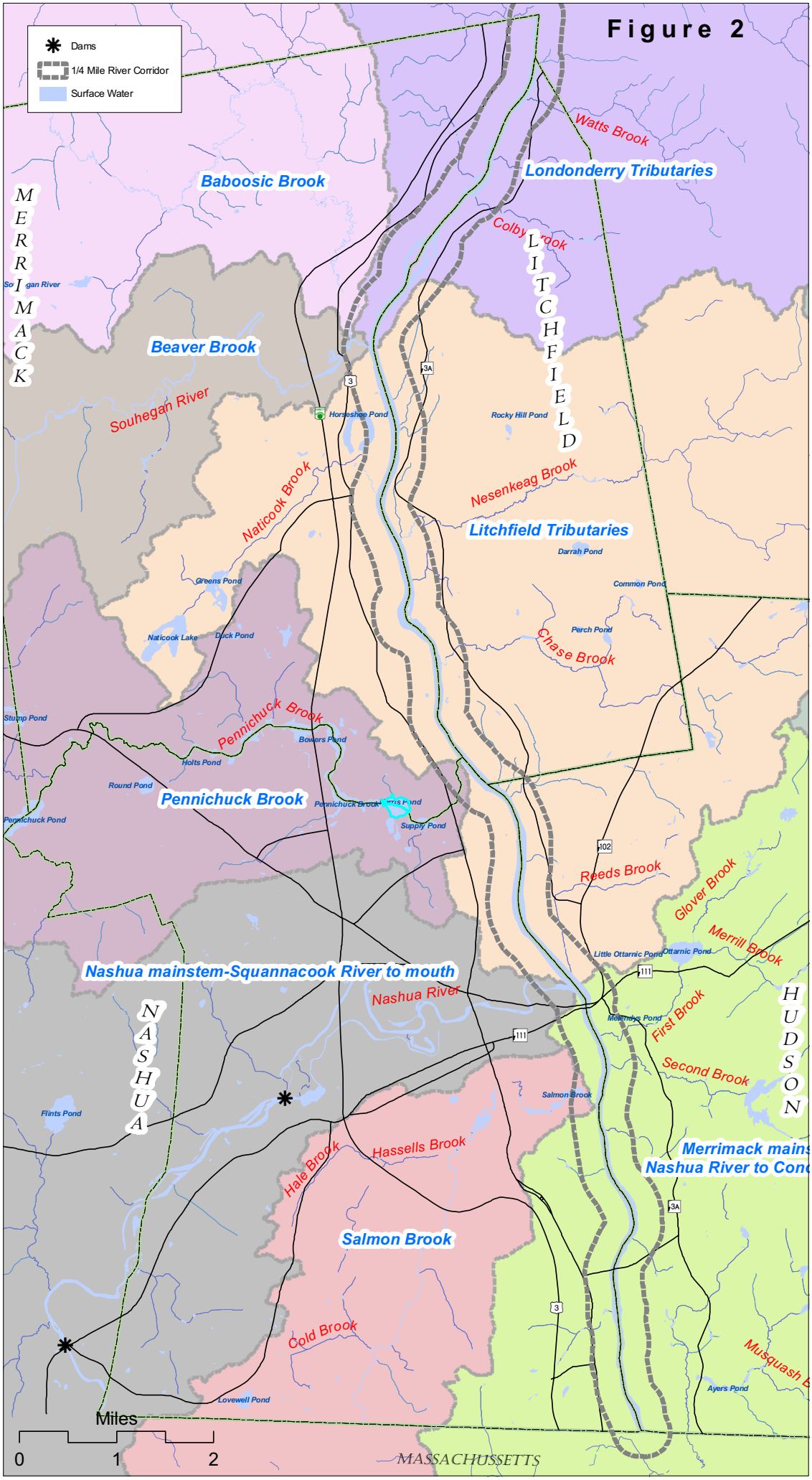
This page intentionally left blank.

Insert
Figure 2 – Watershed Map

Scroll Down for Figure 2

Lower Merrimack River Corridor Plan
Watershed Map

Figure 2



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

The Merrimack River Basin is composed of an intricate network of surface waters that perform many functions such as providing fisheries and wildlife habitats; conveying flood waters, providing water supplies; power generation; recreational opportunities, and scenic views. Because of their interconnected relationship, activities that take place in the watershed, even at far distances from the river corridor, can result in impacts in unexpected locations.

3.1.1.a Tributaries

The Souhegan River, Nashua River, and Pennichuck Brook are the three largest tributaries to the Lower Merrimack River. The Souhegan River, Pennichuck Brook, and the Nashua River are the three largest tributaries to the Lower Merrimack. Other smaller tributaries include Baboosic Brook, Naticook Brook, Salmon Brook, Nesenkeag Brook, Colby Brook, Reeds Brook, and First Brook The Lower Merrimack River watershed, and its major tributaries, are shown in Figure 2.

3.1.1.b Lakes and Ponds

The lakes and ponds in the corridor communities and further beyond into the larger NRPC region form the headwaters of the tributaries that flow into the Merrimack River. Only Horseshoe Pond in Merrimack empties directly into the river. Table 1 shows each of the public surface waters found within the corridor communities. Public surface waters are those that are greater than ten acres in size and therefore are regulated according to the Comprehensive Shoreland Protection Act, discussed in Section 4.1.1.c of this document. These public waterbodies are also depicted on the Wetlands Map (Figure 5).

Table 1: Public Waterbodies Within the Lower Merrimack River Corridor Communities

Waterbody	Status	Bordering Towns	Area (in acres)	Approximate Elevation
Green's Pond	Natural Lake	Merrimack	40.0	195
Horseshoe Pond	Natural Lake	Merrimack	37.1	
Naticook Lake	Raised by Damming	Merrimack	71.7	206
Pennichuck Pond	Natural Lake	Hollis Merrimack Nashua	48.8	186
Retention Pond B	Artificial Impoundment	Merrimack	11.4	
Stump Pond	Raised by Damming	Amherst Merrimack	18.1	190
Ayers Pond	Artificial Impoundment	Hudson	12.0	120
Otternic Pond	Raised by Damming	Hudson	34.0	170
Robinson Pond	Raised by Damming	Hudson	88.0	211
Unnamed Pond	Natural Lake	Hudson	52.7	135
Darrah Pond	Natural Lake	Litchfield	17.3	178
Bowers Pond	Artificial Impoundment	Nashua	88.0	175
Harris Pond	Artificial Impoundment	Nashua	83.0	166
Holt Pond	Artificial Impoundment	Nashua	21.4	182
Lovewells Pond	Natural Lake	Nashua	11.9	216

Table 1: Public Waterbodies Within the Lower Merrimack River Corridor Communities

Waterbody	Status	Bordering Towns	Area (in acres)	Approximate Elevation
Mine Falls Dam	Artificial Impoundment	Nashua	242	
Nashua River I Dam	Artificial Impoundment	Nashua	50.0	
Round Pond	Raised by Damming	Nashua	13.4	193
Supply Pond	Artificial Impoundment	Nashua	15.5	135
Status Key:				
Natural Lake	*Refers to natural lakes and ponds that are > 10 acres in size and have not been raised by a manmade dam*			
Raised by Damming	*Refers to natural lakes and ponds that are > 10 acres in size and have been raised by damming.*			
Artificial Impoundment	*Refers to manmade waterbodies (usually impounded by a dam, but some may be dug ponds). Before creation of the pond there was either no natural pond, or the natural pond was less than 10 acres in size.*			

Source: NHDES 2007 Official Public Waterbodies List. Updated 2/21/2007

It is important to note that in addition to tributary streams running directly into the Merrimack River, the region's lakes and ponds are also connected to the Merrimack River basin. Pollutants that are discharged into lakes and ponds may eventually reach the river itself. Chemicals can accumulate over time in lakes and ponds, since their flushing rate is significantly reduced as compared to those of flowing streams. Pollutant discharges can therefore be temporally detached from the ultimate downstream effects, since it may take decades for accumulated pollutants, generally held within ponded sediments, but will ultimately be leached or released into the river. It is important to consider pollutant discharges into ponds and lakes with a long-term perspective, due to the capacity for these waterbodies to assimilate pollutant loads over time, while considering the difficulty with which pollutants may be flushed from a lacustrine environment once unhealthy levels have been reached.

The region's lakes and ponds also provide wildlife habitat for a diversity of plant and wildlife species. An interconnected network of surface waters can provide useful corridors along which animals may travel from one location to another. In addition, the lakes and ponds also provide breeding grounds and nursery areas for several species of waterfowl and fish. These habitats need to be protected to ensure the continued diversity of wildlife in the region.

3.1.1.c Floodplains

Floodplains are areas adjacent to water courses and surface waters that are susceptible to flooding during periods of excessive water run-off. Flooding can damage structures and land uses located in the floodplain. To prevent excessive loss from flooding, Congress created the National Flood Insurance Program in 1968. As part of the program, the Federal Emergency Management Administration prepared a series of maps identifying flood-prone areas. Three specific zones were delineated and assigned a flood insurance zone designation based on the probability of a flood event, as follows:

Zone A: Special Flood Hazard Areas inundated by the 100-year flood. Over a 30-year period, there is about one chance in four (25%) that this level of flooding will occur in a given year.

Zone B: Areas between the Special Flood Hazard Area (Zone A) and the limits of the 500-year floodplain that are protected from the 100-year flood by dike, levee, or other water-control structures; also areas subject to certain types of 100-year shallow flooding where depths are less than 1 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile.

Zone C: Areas of minimal flooding

To qualify for the Flood Insurance Program (FIP), municipalities must have adopted local land use and building construction controls designed to reduce the impact of flooding in compliance with minimum standards established by the FIA. All four communities in the River corridor participate in the Federal Flood Insurance Program and utilize the official Floodway Maps and the Flood Insurance Rate Maps to determine floodplain boundaries. Further discussion on each of the corridor communities' regulation of the floodplain through local ordinance is provided in Section 4.1.2 of this document. The boundaries of the 100-year floodplain are depicted on Figure 3. The 100-year floodplain is generally confined to low-lying areas adjacent to the river and its tributaries, whereas the 500-year floodplain encompasses more extensive areas running the length of the river. Because of low elevations and generally flat terrain, the most extensive floodplain area within the corridor is located in Litchfield.

Aside from transmitting floodwaters, floodplains provide areas for groundwater recharge, wildlife habitat, open space and recreation. Often, low-intensity land uses are most compatible with goals of alleviating the economic and human losses associated with flooding. Picnic areas, parks, parking areas, recreation trails, and conservation areas are examples of low-intensity uses that are generally fully compatible with floodplains and their regulation.

3.1.1.d Aquifers and Groundwater

Stratified drift deposits are composed of sand and gravel that have been sorted and deposited by glacial meltwaters. Extensive, coarse deposits of stratified drift deposits can store large columns of water. The storage capacity of the aquifer is directly related to the size of the soil particles and the degree of sorting. The high porosity of the coarse grained aquifers allows groundwater to flow through quite readily. Porosity in a well-sorted aquifer is greater than in a poorly sorted aquifer; therefore, the larger pore size allows water to be transmitted more easily and increases the speed of water withdrawal.

Stratified drift aquifers have been the focus of groundwater investigations in the northeast United States because of their ability to store and rapidly transmit large volumes of water. The entire study corridor, except for a few locations at higher elevations, is identified as being part of an extensive, interconnected network of stratified drift deposits that extends along both sides of the river. While the majority of the corridor is underlain by finely-grained stratified drift deposits with transmissivity of less than 2,000 square feet per day, there are a number of coarse grained drift deposits with greater transmissivity. Aquifer transmissivity zones are shown on Figure 4.

This page intentionally left blank.

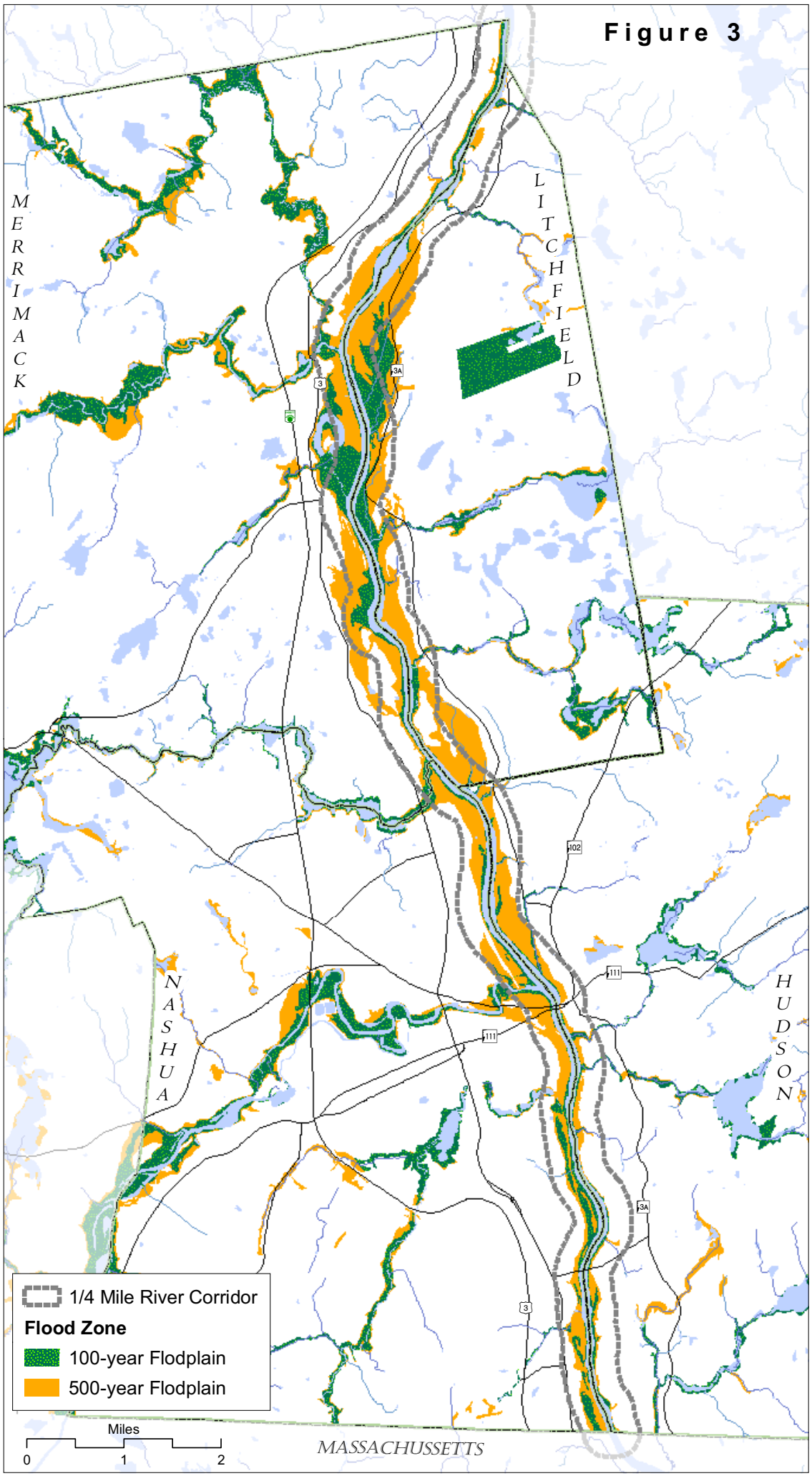
Insert
Figure 3 – Flood Zones Map

Scroll Down for Figure 3

Lower Merrimack River Corridor Plan

Flood Zones

Figure 3



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

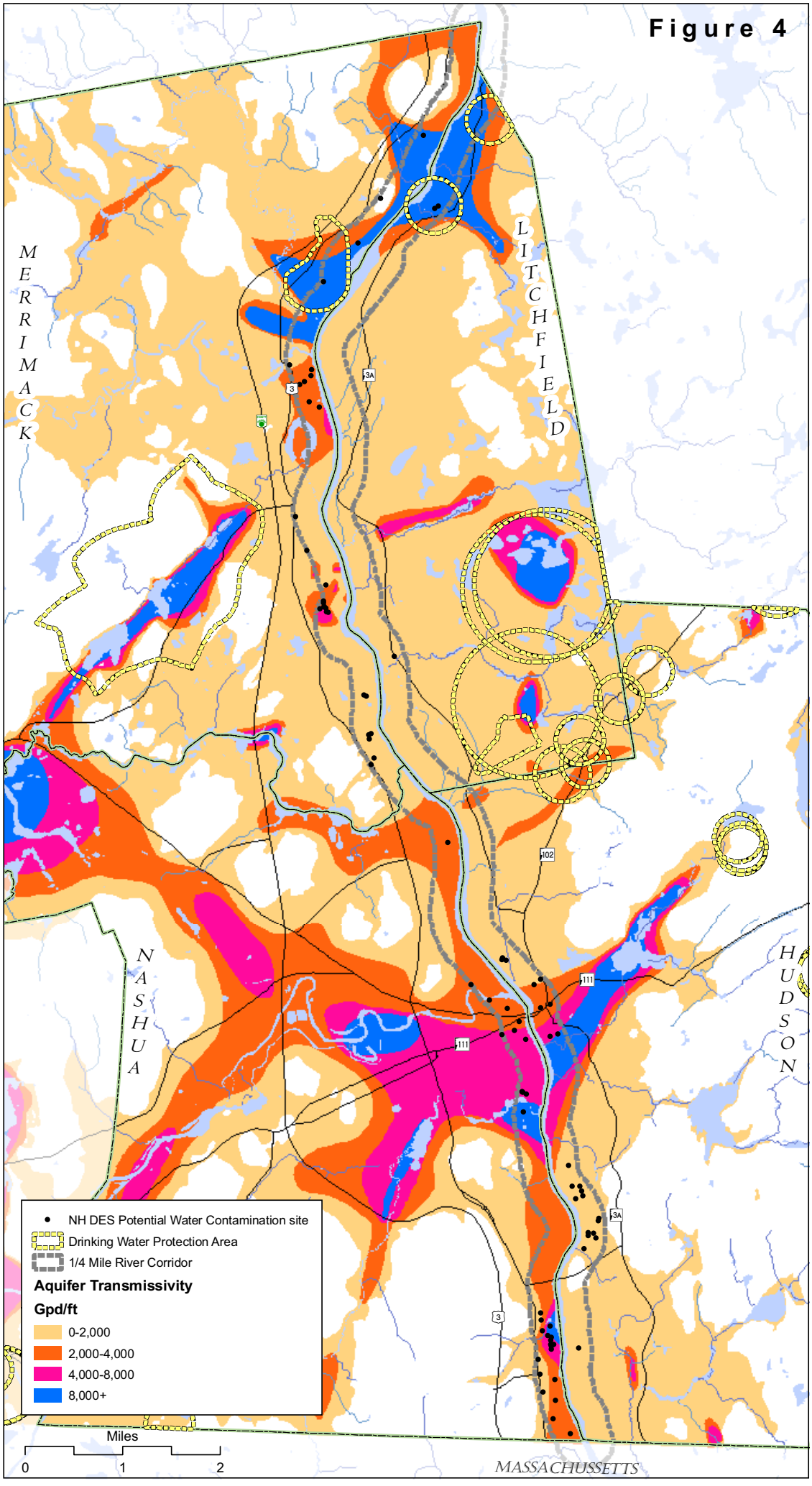
Insert
Figure 4 – Aquifer Map

Scroll Down for Figure 4

Lower Merrimack River Corridor Plan

Aquifer Map

Figure 4



NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

3.1.1.e Wetlands

Once thought of as wastelands and areas to be filled, the important role that wetlands play in the hydrologic and ecologic health of an area is now recognized. Wetlands perform many important functions such as flood control and natural stream flow regulation, erosion control, and water purification while providing nursery grounds and wildlife habitat for numerous species. A number of large and relatively undisturbed wetland areas exist within the river corridor, pictured on Figure 5.

The State of New Hampshire Wetlands Bureau defines a wetland as "an area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." This definition is consistent with federal wetland definitions, which can be found in the 1987 US Army Corps of Engineers Wetlands Delineation Manual.

Another useful tool in wetlands identification is the National Wetlands Inventory (NWI) mapping. This inventory is a series of wetland maps produced primarily from aerial photographs. The maps can be used to identify wetlands based on vegetation, visible hydrology, and geography in accordance with the established classification criteria. NWI maps are available for the Lower Merrimack River corridor. However, communities should also consider aerial photo interpretation or on-the-ground surveys for a better wetland delineation since NWI maps offer only a coarse filter. Aerial photos can also help to identify vernal pools, which will not appear on NWI maps.

The NWI classification system begins by dividing wetlands into five groups or broad systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The riverine system covers streams and rivers, the lacustrine system covers lakes and large ponds, and the Palustrine system covers small ponds and typical vegetative wetlands. Once assigned to a particular system, a wetland is further classified by subsystem to reflect hydrologic conditions. Class levels describe the appearance of a wetland in terms of vegetation or substrate. A series of overlays containing the wetlands information are produced at the same scale as corresponding USGS Topographical Maps, as well as in digital formats.

Large wetland areas are present throughout the each of the corridor communities. Many of these areas are adjacent to the river and its tributaries while some appear to be isolated from any substantial surface water. Litchfield contains the largest amount of wetland acreage in the river corridor. Few wetland areas are identified within the Hudson and Nashua portions of the corridor, possibly due to the steepness of the riverbank or the intensity and timing of development. The importance of these few wetland areas is quite high, however, since these areas serve an important role in the health and stability of the greater ecological community.

Wetlands are protected for a number of reasons. Wetland areas provide habitat for a diversity of wildlife species. Wetlands also play a role in storage capacity for waters during flooding or storm events, providing flood control for surrounding upland areas. Wetlands are also aesthetically pleasing and add diversity to the visual quality of a landscape. And finally, wetlands provide a certain level of water purification by filtering sediments, nutrients, and chemicals from the water. It is therefore important that the integrity of the wetlands be preserved to maintain the ecologic and hydrologic balance in the natural environment.

Existing regulations in the four corridor communities provide a wide range of protection levels for wetlands, which are discussed in more detail in Section 4.1.2.

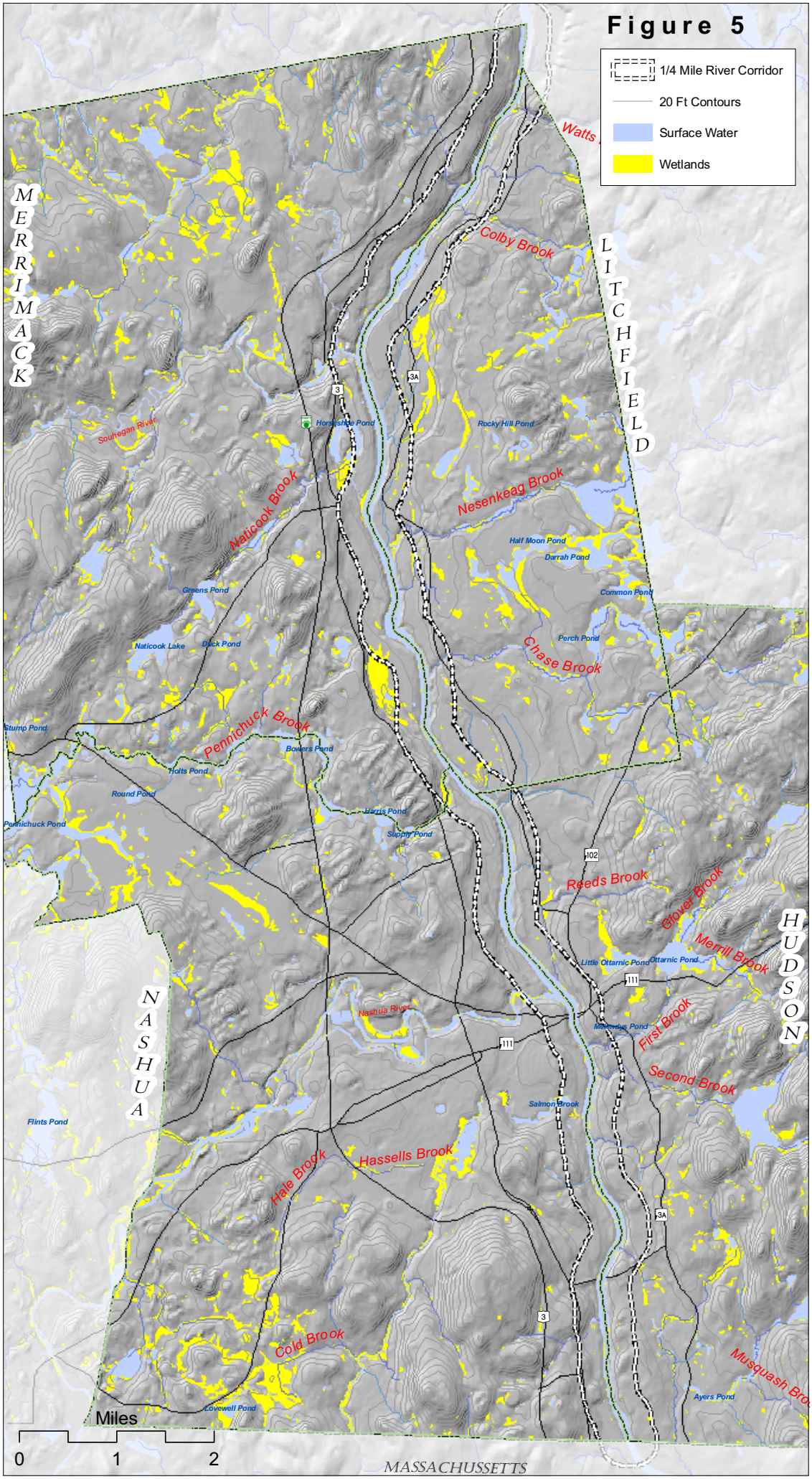
This page intentionally left blank.

Insert
Figure 5 – Wetlands Map

Scroll Down for Figure 5

Lower Merrimack River Corridor Plan

Wetlands Map



Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

3.1.2 Water Quality

Two major types of pollution impact the water quality of the Merrimack River and its tributaries: point source and nonpoint source pollution (NPS). Point source types of pollution include discharges from an identifiable source such as a pipe. All point sources of pollution that discharge to surface waters are required to obtain a permit under the National Pollutant Discharge Elimination System (NPDES). NPDES permits specify the effluent limitations, compliance schedules, and monitoring and reporting requirements. Under the NPDES process, discharges are categorized as municipal or industrial and are classified as major or minor, as described below in Table 2.

Table 2: Regulatory Framework and Requirements for Municipal and Industrial NPDES Permitees

Municipal	• Flow equal to or greater than 1 mgd* • An impact on downstream users, or • discharge upstream of a public water supply
Industrial	Complex point system that considers: • toxic pollutant potential • wastewater flow rate • type of wastewater • amounts of conventional pollutants • heat load • presence of downstream water supply • water quality limitations of the stream

*mgd = million gallons per day

Nonpoint sources of pollution are not as easily identifiable and in many instances have more than one origin. Sources of NPS include agricultural activities, septic system effluent, runoff from construction sites, erosion, road salting, and urban run-off. Because of the difficulty in pinpointing non-point sources of pollution, they are difficult to assess and regulate. Within the river corridor, insufficient treatment of municipal wastewater is a significant point source pollutant. Nonpoint sources of pollution are also a serious and recognized threat to the water quality of the Merrimack River.

Considered one of the ten most polluted rivers in the county during the 1960s, a majority of the Merrimack River basin now fully or partially supports the State's water quality standards for Class B waters (the fishable/swimmable criteria). This achievement is primarily due to the construction of municipal waste treatment facilities and NPDES limitations on discharges, both results of the Clean Water Act (CWA). The CWA provided construction grants to assist municipalities in the construction of waste water treatment facilities. Unfortunately, federal funding for construction grants has declined significantly during the past decade.

Figure 6 shows sites that are potential contamination sources of hazardous pollutants to the Lower Merrimack River and its tributaries. These sites are not recognized threats, meaning that they are not necessarily actively releasing hazardous substances into surface or groundwater, but by the nature of their business, activity, or land use, have the *potential* to emit toxic pollutants if Best Management Practices are not followed. As such, these sites have the potential to emit either point source or non-point source contaminants into surrounding waterbodies and are shown in this document to give an idea of the geographic extent of these sites. Additionally, Figure 6 shows the existing water quality monitoring stations that have been established on the Merrimack River and known outfalls located along the banks of the River and its tributaries.

This page intentionally left blank.

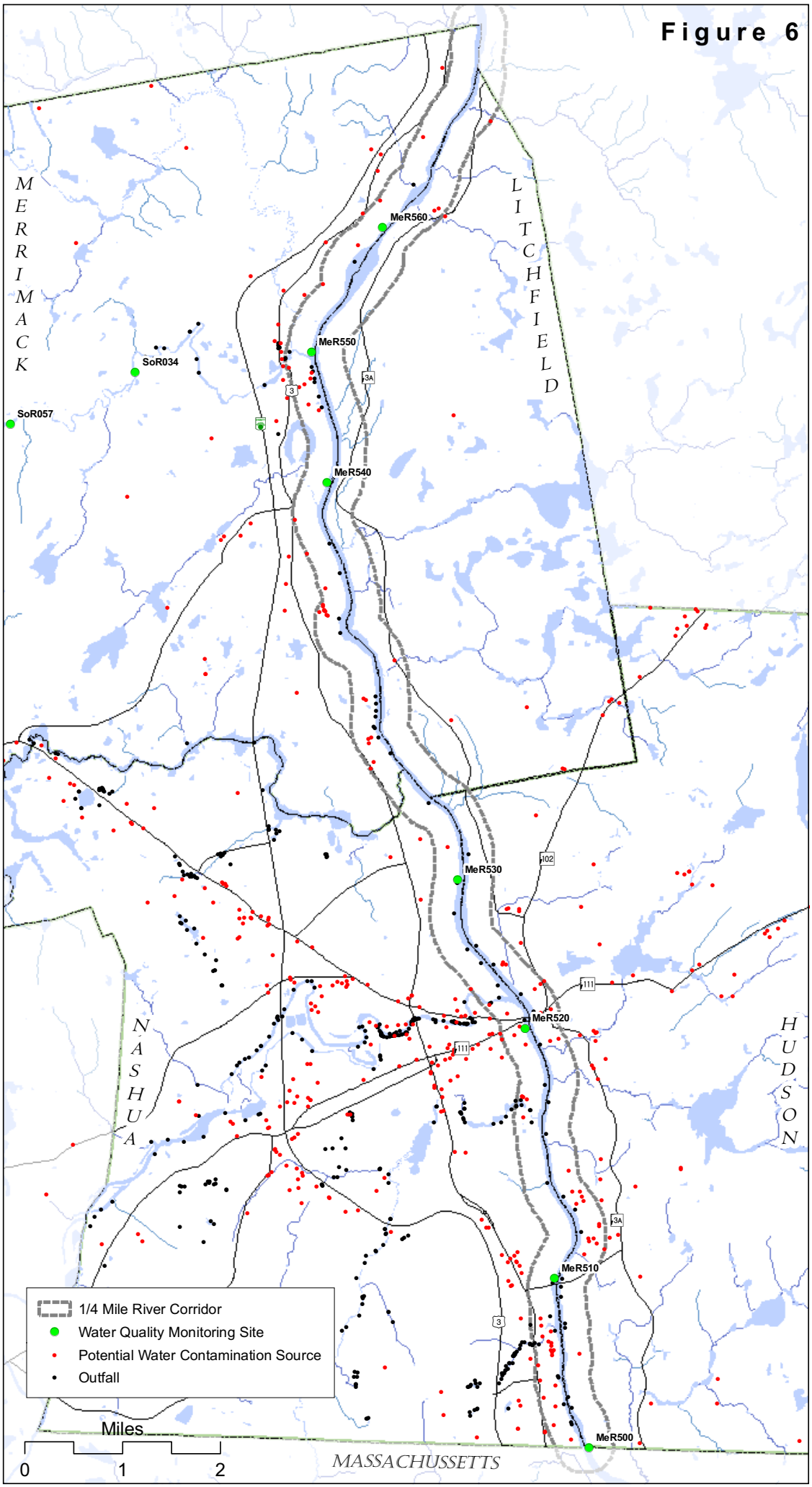
Insert
Figure 6 – Water Quality Map

Scroll Down for Figure 6

Lower Merrimack River Corridor Plan

Outfalls & WQM Sites

Figure 6



N

Data Source:
NH Department of Environmental Services

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

3.1.2.a Point Sources of Pollution

A total of 14 registered industrial discharges currently take place within the lower Merrimack River Basin and are listed in Table 3 below.

Table 3: Industrial Discharges Within the Lower Merrimack River Basin

Facility Name	Location	Receiving Stream	Type of Discharge	Effective Date	Expiration Date
Brox Industries	Hudson	Glover Brook	Minor industrial	6/16/2004	9/1/2009
Chemfab/Saint Gobain Plastics	Merrimack	Merrimack River	Minor non-contact cooling water	4/25/2000	4/25/2005
Derry WWTF	Derry	Merrimack River	Major municipal, aerated lagoons	8/11/2004	8/11/2009
Jones Chemicals, Inc.	Merrimack	Merrimack River	Non-contact cooling water	4/25/2000	4/25/2005
Merrimack WWTF	Merrimack	Merrimack River	Major municipal, activated sludge	7/14/2001	7/14/2006
Nashua WWTP	Nashua	Merrimack River	Major municipal, activated sludge	8/1/2000	8/1/2005
Fish Hatchery - Nashua National	Nashua	Nashua River	Minor, fish hatchery	9/27/1974	8/1/1979
Fish Hatchery - Milford	Milford	Purgatory Brook	Minor, fish hatchery	6/1/2004	6/1/2009
Villages of Windham Condominium	Windham	Seavey Pond	Non-contact cooling water	10/20/2004	4/25/2005
Greenville WWTF	Greenville	Souhegan River	Minor municipal, activated sludge	3/3/2002	3/3/2007
Milford WWTF	Milford	Souhegan River	Major municipal, activated sludge	3/24/2000	3/24/2005
Waterhouse Country Store	Windham	Swale to Beaver Brook	Groundwater treatment system	3/3/2006	9/9/2010
Greenville WWTP	Temple	Tobey Reservoir	Water filtration facility	3/1/2002	11/15/2005
Manchester Airport	Londonderry	Unnamed to Little Cohas	Storm water and deicing runoff	Application	TBD

Source: NHDES 2007. Compliance Supervisor, Wastewater Engineering Bureau. Personal communication June 27, 2007.

As is the case with many regulations, there are problems with enforcement and violations of the NPDES permit requirements. Repeated NPDES permit violations usually result in a letter from the New Hampshire Department of Environmental Services (NHDES) Waste Water Engineering Bureau (WWEB) Water Division informing the violator of the infraction and an order directing the violator to bring the discharge into compliance. If these actions do not result in compliance, legal action can be brought against the facility under section 505 of the Clean Water Act. Legal action has successfully brought facilities into compliance in many areas of the country.

Combined sewer systems present another pollution problem faced by many Northeast cities, including Manchester, Lebanon, Exeter, Portsmouth, Berlin, and Nashua. Combined sewer systems are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant and then overflow, discharging excess stormwater and wastewater directly to nearby streams, rivers, or other surface waters. These overflows, called combined sewer overflows (CSOs), contain not

only stormwater but also untreated human and industrial waste, toxic materials, and debris. They are a major water pollution concern for the Lower Merrimack River.
The City of Nashua completed a study of their nine CSOs at a cost of approximately $373,000 in 1992. The City has recently begun to separate all sources of stormwater flow into its collection system by constructing separate stormwater and sewer systems. Further, the City is revising its High Flow Management Plan in an effort to maximize the flow to the wastewater treatment facility during wet weather events. It is expected that all of the CSOs will be eliminated by the year 2019 at an estimated cost of $100 million (NHDES 2003).

3.1.2.b Nonpoint Sources of Pollution

1. Road Salt

Road salt is a potential source of calcium and chloride contamination in surface and groundwater. High levels of sodium and chloride in the drinking water supply can pose serious health risks to pregnant women, infants, and people with heart, kidney, or live diseases, hypertension, and other metabolic disorders. High salt concentrations can also cause problems for animals and plants, kill trees, and corrode metals and concretes. Increased concern for water quality has led to reductions in salt applications particularly in areas impacting public surface and groundwater supplies, and areas containing large numbers or concentrations of individual wells. The Towns of Merrimack and Hudson actively limit their use of salt in these sensitive areas. All roads east of Route 3 in Merrimack are designated as no-salt routes as are roads near municipal wells or surface water supplies. In Hudson, the majority of the no-salt routes are located between the River and Route 3A. No-salt routes in Nashua are limited to the vicinity of the City's water source, Pennichuck Brook. At present, Litchfield has no road salt application policy. One major road salt problem facing the river is that it is paralleled on the east and west by State roads, NH Routes 3 and 3A. Existing State policy is to salt all state-maintained roads in the winter.

2. Subsurface Waste Disposal

Subsurface disposal of wastes is another more localized potential NPS. The entire river corridor in Nashua and the majority of Merrimack is served by public sewer. Approximately two-thirds of the Hudson portion of the corridor is sewered, from the Litchfield town line to Wason Road, including the Sagamore Industrial Park. There is no public sewer system, however, in the Town of Litchfield. Nutrient rich effluent from failed or failing septic systems can drain into the river creating optimal conditions for algal blooms and other aquatic plant growth. The effluent could also cause problems with bacterial contamination of surface water and groundwater. The rate of septic system failure should be examined in all of the areas without sewers to determine if a problem currently exists and to assess the potential for future problems.

Current State regulations require septic tanks and leachfields to be setback a minimum of 75 feet from surface waters, wetlands, and open drainage areas. Communities have the authority to adopt regulations that are stricter than State standards, including wider vegetated buffer widths to allow for greater filtration of effluents.

3. Phosphates

Phosphates, most often resulting from detergents, can also cause problems with surface and groundwater resources. Phosphorous is the limiting nutrient that controls the growth of aquatic vegetation. Commercial laundries and car washes can be large sources of phosphates while laundry and dish detergents are household sources of phosphates. Many communities have dealt with phosphate

problems by prohibiting car washes and other large users of phosphates within the shoreline zones of surface waters through zoning amendments. Whereas local zoning requirements can be an effective local solution, a statewide ban on the use of phosphate detergents (with exceptions for certain users and conditions) would have the added benefit of achieving upstream water quality increases in downstream locations.

4. Underground Storage Tanks

Underground Storage Tanks (USTs) are another potential NPS posing a substantial threat to both ground and surface waters. Leaks in USTs are hard to detect and can go unnoticed for long periods of time while causing extensive contamination of water resources. The rules developed for controlling nonresidential underground storage and handling of oil and petroleum liquids, NH Code of Administrative Rules Env-Wm 1401.32 *Facility Owner Responsibility Per Statute* explicitly prohibits the discharge of any regulated substance to any land, groundwater, or surface water of the State in accordance with RSA 146-C:2. USTs with a volume of 1,100 gallons or more are required to register and obtain a permit from the DES Oil Remediation and Compliance Bureau. Tanks with a volume less than 1,100 gallons, oil transmission and oil production facilities, residential fuel oil tanks for onsite consumption, and tanks for the storage of non-petroleum products are exempt from State regulations at this time. In addition, many tanks currently covered by Env-Wm 1401 may still not be registered with the DES Oil Remediation and Compliance Bureau. There also may be a number of abandoned tanks along Routes 3 and 3A that pose potential threats to the area's surface and groundwater resources.

To reduce the potential impact of USTs on surface and groundwater resources, many communities have conducted UST inventories to locate existing and abandoned USTs and have attempted to determine their contents. Additionally, owners of abandoned tanks are provided with information and assisted with proper closure of the tank. Table 4 provides an inventory of above-ground storage tanks and underground storage tanks in the corridor communities, and identifies the number of underground storage tanks which are leaking and have entered into a remediation program with the DES.

5. Hazardous and Toxic Wastes

A number of industrial operations exist in the corridor area that use, generate, transport, or store hazardous and toxic chemicals. Facilities that treat, store, or dispose of hazardous wastes are regulated by the Federal Resource Conservation and Recovery Act (RCRA). The RCRA program addresses proper management of hazardous wastes and requires all facilities to obtain an operating permit. The RCRA program operates on a "cradle to grave" practice where the waste is tracked from the facility where it is initially generated, to its storage location, and to its final disposal site. The Federal RCRA program regulates facilities that generate 1,000 kg or more of hazardous waste per month. Two of these sites are currently undergoing a corrective action in cooperation with EPA enforcement, the Hampshire Chemical Corporation site and the Coating Systems site, both in Nashua.

The State of New Hampshire *Hazardous Waste Rules* regulates all generators of hazardous waste in two classifications: small quantity generators (less than 100 kg per month) and large quantity generators (greater than 100 kg per month). Table 4 provides a list of the small and large quantity generators in the four corridor communities.

Table 4: Hazardous Waste Sites, Facilities, and Releases in Lower Merrimack River Corridor

Type of Facility or Event	Hudson	Litchfield	Merrimack	Nashua	Regional Total
Above-ground Storage Tanks (ASTs)	14	0	15	39	68
Underground Storage Tanks (USTs)	68	14	66	300	448
Leaking Underground Storage Tanks (LUSTs)	23	2	15	87	127
Oil Spill or Hazardous Release	9	0	4	20	33
Small Quantity Generators (SQGs)	25	1	14	49	89
Large Quantity Generators (LQGs)	15	0	8	21	44
Inactive Asbestos Disposal Sites	144	0	1	174	319
Superfund Sites (listed and proposed)	0	0	1	2	3

3.1.2.c Erosion and Sedimentation

Another potential NPS is soil erosion and sedimentation. Soil is eroded by wind and water when exposed through agriculture, silviculture, and construction activities during land conversions. Some of these eroded soil particles are transported by water into rivers, streams, lakes, and wetlands. Since the river corridor is located within a rapidly developing section of the State, this discussion of erosion and sedimentation will focus on development and construction activities.

During land conversions, much of the protective vegetative layer is stripped from the site resulting in an increase in the velocity and the volume of runoff. This increase in velocity results in a corresponding increase in the capacity of the runoff to transport soil particles. Increased volume results in a similar expansion of the erosive capacity of the runoff. Turbidity and sedimentation are the two major surface water problems associated with soil erosion. Increased turbidity in streams, generally evidenced by a decrease in clarity, can prevent sunlight from penetrating lower water levels inhibiting photosynthesis and decreasing available oxygen levels. The reduced levels of oxygen place additional stress on fish species and other aquatic organisms, while the suspended soil particles themselves can damage sensitive gills. Once the particles settle out of the water, accumulated sediments can cover beds of aquatic vegetation and spawning areas, significantly impacting plant and fish species.

Sedimentation can also result in the formulation of new land area, the build-up of sand bars, or the filling of wetlands. A decrease in the size of a wetland means a reduction of water storage capacity during peak flows. Sedimentation also decreases the capacity of surface waters to hold water. This reduction in capacity may result in a shortened life span for municipal reservoirs or impoundment structures.

A number of methods exist for controlling soil erosion and sedimentation ranging from simply retaining as much of the natural vegetative cover as possible to constructing drainage systems to control runoff. Requirements for erosion and sedimentation control vary with each community, and are discussed in detail in Section 4.2.1. Information on soils can be useful in determining the erodibility of a soil and the extent of erosion control needed. Soils located on steep slopes (generally defined as slopes 25% or greater) are also more susceptible to erosion.

Within the shoreland area, high-powered boat wakes are another potential erosion problem. Waves created by large craft undercut banks causing the soil above to slump and enter the river. Streambank erosion has the same effects on water quality and fish habitats as other sources.

3.1.2.d Superfund Sites

A Superfund site is any land in the United States that has been contaminated by hazardous waste and identified by the Environmental Protection Agency (EPA) as a candidate for cleanup because it poses a risk to human health and/or the environment. Sites are proposed by municipalities, then EPA accepts public comments on the sites, responds to the comments, and places those sites that meet the requirements on the NPL for listing. The National Priorities List is a list of the worst hazardous waste sites that have been identified by Superfund. Any site on the NPL is eligible for cleanup using Superfund Trust money. The NPL is primarily an information resource that identifies sites that may warrant cleanup. Currently, there are two sites on the NPL in the corridor communities, the NH Plating Company site in Merrimack, and the Sylvester site in Nashua. A third site, the Mohawk Tannery (or Granite State Leathers) in Nashua has been proposed for listing on the NPL. These three sites are described in Table 5 below:

Table 5: Existing and Proposed Superfund Sites in the Corridor Communities

Name	Location	Status	Description
NH Plating Company	Merrimack	Listed	Four natural lagoons located on-site were used for disposal of wastes and waste waters resulting from electroplating operations and are now contaminated with volatile organic compounds (VOCs) and heavy metals, Cadmium is present in groundwater throughout the site. Lagoon soils also contain elevated levels of heavy metals and cyanide.
Sylvester	Nashua	Listed	The site was operated as a sand pit for an undetermined number of years. During the late 1960s, the owner began an illegal waste disposal operation intending to fill the sand excavation. Household refuse, demolition materials, chemical sludge, and hazardous liquid chemicals were dumped at the site. The household refuse and demolition materials were usually buried, while the hazardous liquids were allowed to percolate into the ground adjacent to the old sand pit or were stored in steel drums that were placed on the ground.
Mohawk Tannery	Nashua	Proposed	The site is being proposed to the NPL on the basis that sludge discharged from the Mohawk Tannery facility contains elevated levels of arsenic, cadmium, chromium, lead, pentachlorophenol, chlorobenzene, and trichloroethylene, which is in direct contact with ground water, a drinking water source. Wastewater containing chromium also has been discharged directly into the Nashua River via an outfall pipe from a tank on the Mohawk Tannery property. The facility produced tanned hides for leather between 1924 and 1984 and is currently inactive. The former tannery produced both alkaline and acid waste-streams.

3.2 Water Quantity

3.2.1 Water Supplies

Previous sections have focused on the issues of water quality, water rights, and the many competing natural and manmade uses and users of the Merrimack River. Water in the Merrimack River basin is a finite resource. Even though water levels in the river are highly influenced by impoundments and dams, flow levels are not guaranteed. Heavy snow and rain may cause an excess one year while drought conditions may be experienced in the next. Large withdrawals and cumulative impacts of a number of smaller withdrawals also have the potential to create problems related to the quantity and quality of water available for other users. Balancing water needs of the many competing uses of the river for fish

and wildlife habitat, waste assimilation, hydropower, water supply, and recreation is currently a challenge in the river corridor and the surrounding watershed.

The Merrimack River and its tributaries are not free-flowing and are influenced by impoundments in numerous locations. Of the Merrimack River tributaries, only Colby Brook and Reeds Brook are free-flowing. However, no dams currently exist in the river corridor. Dams have been constructed to moderate the discharge/flow rates of the river over time, providing storage and release of water during dry periods to temporarily augment flows. Water flow within the river corridor is influenced by the Amoskeag Dam, upstream in Manchester, and the Pawtucket Dam, downstream in Lowell. According to a US Fish and Wildlife Service special report on anadromous fish, the pool of the Pawtucket Dam extends upriver for 18 miles to a location between Thornton's Ferry and Reeds Ferry in Merrimack. The river has an average flow of 7,500 cubic feet per second (cfs) at the last gauging station in Lowell, MA. The average discharge at the Amoskeag Dam is 4,850 cfs and the Federal Energy Regulatory Commission (FERC) has ordered a minimum release of 833 cfs or whatever is entering the impoundment if less at the dam. The average flows of the major tributaries to the Merrimack River below the Amoskeag Dam are shown in the Table 6 below.

Table 6: Average Flows for Tributaries into the Lower Merrimack River

Tributary	Cubic Feet per Second (cfs)	Million Gallons per Day (mgd)
Piscataquog River	305 cfs	
Souhegan River	281 cfs	
Nashua River	667 cfs	
Average flow within the study corridor	5,892 cfs	3,818 mgd

River flow is measured at three gauging stations by the USGS at Franklin Junction and Goffs Falls in NH, and in Lowell, MA. The data from these stations is used to calculate various flow frequencies. The lowest 7-day sustained flow, occurring approximately once in ten years, is commonly abbreviated 7-Q-10. The 7-Q-10 flow is used as the minimum flow for waste assimilation in calculating waste loads. The 7-Q-10 flow at Goffs Falls, located below the Amoskeag Dam, is 667 cfs (432 mgd), while further downstream at the Lowell station, average flow is 930 cfs (602 mgd). The lowest flow at the mouth of the river, 199 cfs (128 mgd) was recorded on September 23, 1923.

Fluctuation in flows may create problems between competing uses. Uses which may coexist comfortably during periods of high flows (such as waste assimilation and drinking water supply) will not be compatible during periods of low flow, particularly flows less than 7-Q-10. Waste discharges could conceivably exceed their permit limitations and create serious water quality problems that would threaten health, reduce the available water supply, stress plant and animal species, and limit recreational use of the river. Optimum treatment of waste discharges can reduce adverse impacts on water quality during low flows. In addition, seasonal water storage and peak demand sources can augment supplies when river flows are low.

The minimum flows required to sustain most uses have been established. This information needs to be obtained and assessed for each individual use. Once identified, the information can be compiled in a minimum instream flow for the river. This minimum instream flow figure can be used in calculating the safe yield of the river. A demand/yield analysis study of the river should be conducted to determine the capacity of the river to meet the natural and manmade needs for water. The NH Rivers Management and Protection Program RSA 483 specifically states that one of the purposes of the protection measures designed as part of the program is "that no significant adverse impacts on water quality or other in-stream characteristics shall be permitted; and that adequate flows be maintained for the appropriate use or uses of the river or segment or segments of such rivers." The Instream Flow Pilot Project has

conducted a Protected Instream Flow study for the Souhegan River. It is expected that a protected instream flow for the Souhegan will be established in early 2008. Once established, the methodology will be used for other designated rivers. More information on the Instream Flow Pilot Project can be found at http://www.des.nh.gov/Rivers/Instream.

Existing demands for water are currently being met through a combination of groundwater and surface water resources; however, future conditions may require water allocations. The DES Water Resources Division Water User Registration Program provides valuable information on the quantities and types of water users that can be used if water allocation ever becomes necessary. In addition to the Water User Program, the NH Drought Management Plan provides statewide information to communities on how to deal with water shortages. The plan establishes the administrative framework for anticipating drought conditions and coordinating response. It includes monitoring hydrologic conditions, identifies water conservation options, and recommends appropriate response and the roles of participants for four different levels of drought conditions.

3.2.2 Water Rights

Water rights in New Hampshire, as throughout the eastern states, are based on the Riparian Doctrine, also known as the Public Trust Doctrine. The basis of this doctrine is that only persons owning land fronting on a natural watercourse possess the rights to use the water flowing by their land. Riparian use is further limited by the reasonable use rule. This rule allows a riparian owner to divert water for any purpose if the use is reasonable with respect to other riparian owners, that is, the use does not unreasonably interfere with a legitimate riparian use or pose undue burdens on downstream users. Riparian rights extend to the water's edge of a navigable waterway while non-navigable rivers or streams may be privately owned.

This ownership principle, however, is subject to the priority of higher rights where the rights of the public, the state, and the federal government have greater priority than the rights of the individual. In addition, RSA 271:20 define public waters as "all natural bodies of fresh water having an area of ten acres or more" and such waters "are held in trust by the State for public use." Public use includes access to the river for recreation which is extremely limited within the study corridor. The New Hampshire legislature has on many occasions granted specific water rights to municipal use of specific streams or ponds. A number of legislative acts for water withdrawals have been made in the past, such as those to Wilton, Manchester, Milford, Hudson, and Pennichuck Water Works.

3.3 Soils and Geology

3.3.1 Geology

The bedrock geology of the lower Merrimack Valley was formed hundreds of millions of years ago during the Ordovician and Silurian periods. The original sedimentary rocks, deposited by shallow seas that once inundated much of New Hampshire, were faulted, folded, and were exposed to high temperatures, and pressures, and eventually eroded. These processes transformed the sedimentary rock into metamorphic rock that exists today. Molten magma from the earth's core intruded into the overlying metamorphic rocks forming igneous intrusions. Granite is the most common form of intrusion in New Hampshire.

The Merrimack Group, underlying the River corridor from the Massachusetts border to approximately the Litchfield-Bedford town line, is the dominant geological formation in the corridor. This group is composed mostly of buff slate, buff quartzose slate and gray calcareous slate in the chlorite zone and

purplish-brown biotite schist and gray quartz-mica schist in the higher metamorphic zones. The extreme northern portion of the corridor is underlain by granite, quartz, and granodiorite. In addition, a band of light gray to white medium grained binary granite and quartz monzonite cuts through the corridor just north of Nashua and Hudson.

About 100,000 years ago glaciers invaded and covered most of New Hampshire. This period of glaciation is the most significant factor in the development of the existing landscape. The enormous force of the ice as it invaded and receded, scraped and molded the earth's surface creating the high peaks and outwash plains that exist in New Hampshire today. In addition, meltwater channels blocked by debris formed great shallow lakes. As the glaciers began to recede and melt, streams flowing from the ice sheets carried sediments which were deposited in the valleys. As the velocity of the meltwater slowed, the sediments dropped out forming stratified deposits of similar sized grains.

Because of their ability to store and transmit high volumes of water, these stratified drift deposits are often prime locations for aquifers. The entire length of the River corridor is underlain by stratified deposits of sand and silt that overlay marine clay deposits. Not surprisingly, the entire length of the river corridor is classified as a stratified drift aquifer. Aquifers are an important source of groundwater supplies and a more detailed discussion of the aquifers and existing aquifer protection in the study corridor can be found in the section on groundwater in Section 3.1.1.d.

3.3.2 Sand and Gravel

Aquifer sand and gravel deposits are also prime areas for sand and gravel excavations. Sand and gravel resources are necessary and important components of the construction industry. Improper removal of these materials and poor site restoration can have a significant impact on groundwater quality. The soil above the groundwater acts as a filter by removing suspended contaminants as the water percolates down through the soil. Therefore, if too much material is removed, the filtering capacity of the soil is reduced and contaminants can reach the groundwater in increased concentrations. RSA 155-E *Local Regulation of Excavations*, prohibits excavations "that would substantially damage a known aquifer, so that designated by the United States Geological Survey." To protect a community's aquifers, local excavation regulations can establish a minimum depth of soil that must remain above the seasonal high water table for excavations in the aquifer district. In addition, local aquifer protection regulations would also specify the types of land uses and activities permitted within the district, allowing the community to prohibit uses that have a negative impact on groundwater and to control to some degree the operation of allowed uses.

3.3.3 Topography

Simply put, topography is the general form of the land surface. As discussed in the first section, New Hampshire's topography is largely due to the glaciers that covered the State until about 14,000 years ago. Since that time, numerous factors, such as wind, water, temperature, floods, earthquakes, and humans have subtly and dramatically altered the landscape.

Elevation and slope are the two major components of topography. Elevation is the measure of the height of a given point of the land surface relative to mean sea level. Slope is the measure of the pitch or the steepness of the surface between two given points and is calculated by dividing the change in elevation (rise) by the distance (run) between the two points (rise/run). The slope of the land is a critical determinant of its ability to support certain land uses. In addition, the changes in elevation and slope provide vantage points for viewing the surrounding landscape as well as subjects for views.

The relatively flat and low-lying Merrimack River valley rarely exceeds 200 feet above mean sea level (aMSL) in the four towns within the river corridor. The highest elevations in the study are found in the northern section of Merrimack where elevations generally range between 150 and 200 feet aMSL. Corridor elevations for the majority of the Town, however, range between 100 and 150 feet aMSL. Similar elevations are also found along the corridor in Litchfield. Elevations in Hudson and Nashua also range between 100 to 200 feet aMSL with the majority of the area between 100 and 150. The River itself only drops about 20 feet as it travels the fifteen miles from the Manchester-Bedford line to the Massachusetts border.

Slope is one of the limiting factors to be considered when determining the development potential of a parcel of land. Information on slope is generally considered in conjunction with the other environmental factors of geology, soils, and hydrology. Generally, slopes of zero to three percent are not well drained and are often associated with wetlands. Land with slopes of three to eight percent and good soils are usually considered ideal for development because constraints are minimal, while development on slopes of eight to 15 percent will require some additional planning to provide for proper drainage and soil stabilization. Areas of moderate slope, 15 to 25 percent, are sensitive to development and best suited for open space uses such as natural areas, hiking and nature trails, picnic areas, environmental education and outdoor recreation. With proper design, however, and providing other environmental conditions are favorable, these areas can successfully be developed for more intense uses. Slopes greater than 25 percent are very steep and highly susceptible to erosion.

Slope varies throughout the study corridor. The most significant steep slope areas in the study corridor are located along the river in south Hudson from the Massachusetts border to the area near St. Anthony's Friary and in northern Merrimack from Reeds Ferry to the Bedford-Merrimack town line. Slopes along the river in these areas generally exceed 25 percent. The majority of the study corridor, however, is comprised of gentle to moderate slopes. The river is characterized by steeply sloping banks that level off to relatively flat areas. In some areas, a flat shelf can be found just below the edge of the bank. The shelf varies in width and length and is located approximately 10-15 feet below the top of the bank in many of the steeper sloped areas in Hudson, southern Nashua and northern Merrimack and Litchfield. The shelf, where it is wide enough and stable, provides a potential location for a hiking trail. Such a developed trail would be naturally buffered from the adjacent land uses by the area between the shelf and the top of the bank.

Areas with slopes greater than 25 percent are highly sensitive to development and should be protected to reduce the potential for erosion that could result in sedimentation and water quality problems in the River. The impact of soil erosion and sedimentation is discussed in more detail in Section 4.2 – Watershed Audit Findings. To highlight the major points, erosion and the resulting sedimentation can increase the turbidity of the water, decrease the capacity and lifespan of impoundments and modify the flow of the water such that streambank erosion is accelerated. In addition, information on slopes can be used to locate potential sites for boat ramps, public access points, and recreation areas.

Steep slopes also present a number of problems when considering the development of recreation areas. Boat ramps located on steep banks, for example, would require major alterations of the site. Extensive cuts across the slope would be necessary to facilitate safe access to the River and would consume large areas of land. Trails in steep slope areas would also have to be carefully designed and constructed. Foot traffic on steep slopes could negatively affect vegetative cover leaving open areas where runoff would concentrate and increasing erosion along the path and lower areas of the slope. In addition, steep slopes present a number of safety concerns, particularly for children, older adults, and the handicapped.

3.3.4 Soils

Soil type is a critical factor in determining the types of land uses and the development potential of a parcel of land. The Natural Resource Conservation Service (NRCS) has conducted extensive surveys and analyses of the soils of Hillsborough County. The general soil map defines broad areas that have a distinctive pattern of soils, relief, and drainage. The information contained on the general soil map and in the description of the soil associations is useful in evaluating soils for general uses in large areas and is adequate for evaluating the soils within the Merrimack River corridor at this level. The soils within the Merrimack River corridor fall into four soil associations, described in Table 7 below.

Table 7: Major Soil Associations in the Lower Merrimack River Corridor

Occum-Pootatuck-Suncook	Composed of deep, nearly level, well-drained, moderately well-drained, and excessively drained, loamy and sandy soils on floodplains. Extends on both sides of the River from just below the junction of the Nashua and Merrimack Rivers north to just south of the Sawmill Brook in Litchfield. Suitable for farming and support a substantial amount of agriculture in the Town of Litchfield.
Hinckley-Windsor	Typified by deep, nearly level to steep, excessively drained, gravelly and sandy soils on terraces. Used for urban and suburban development for which they are well suited. Poor agricultural uses due to poor moisture holding capacity.
Pipestone-Windsor-Deerfield	Deep, nearly level to gently sloping, poorly drained, excessively drained, and moderately well drained, sandy soils mostly in depressions on stream terraces. Not suitable for most uses because of a high seasonal high water table. Windsor soils, however, are well suited for development and are commonly a good source of sand for construction.
Urban land-Windsor-Canton	Deep, nearly level to sloping, excessively drained and well drained, sandy and loamy soils on terraces and uplands. The majority of land in this association has been developed along both sides of the River in Hudson and Nashua beginning at the Massachusetts border.

3.4 Wildlife and Fisheries

3.4.1 Wildlife

The Merrimack River corridor provides habitat for a diversity of fish and wildlife species including the federally endangered bald eagle and several state endangered or threatened species. This diversity provides many recreational opportunities for fishing and bird watching. Diverse habitats such as wetlands, forests, fields, rivers, and streams support a variety of species in quantities healthy enough to ensure continuation of the species. Maintenance of quality habitat is important to the survival of all species. The New Hampshire Wildlife Action Plan provides information on wildlife habitat and its relative condition as compared to other similar habitats in the state. Figure 7 shows the quality of habitat in the corridor communities, as ranked in the Wildlife Action Plan.

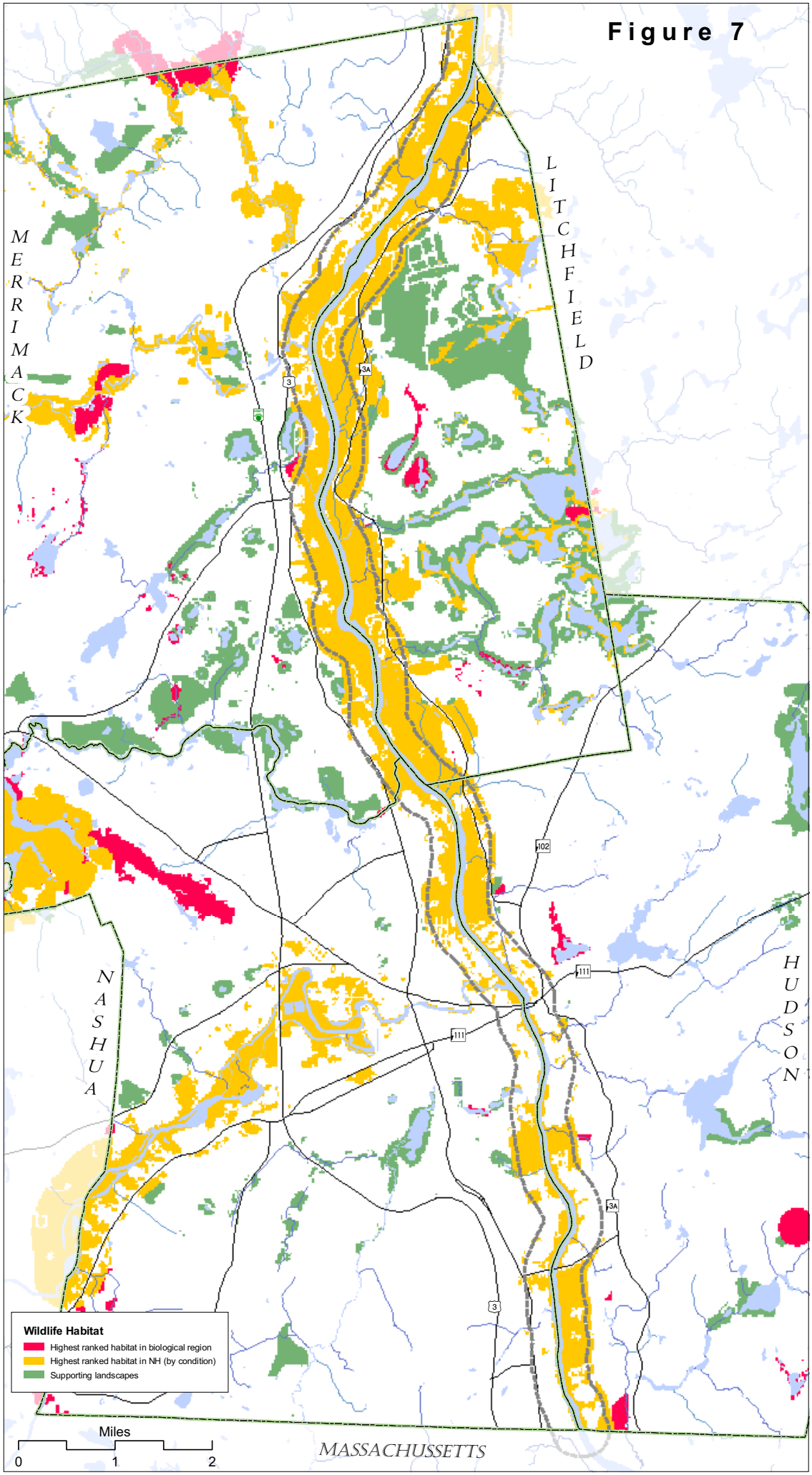
Insert
Figure 7 – Wildlife Habitat Map

Scroll Down for Figure 7

Lower Merrimack River Corridor Plan

Wildlife Habitat

Figure 7



N

Data Source:
NH Fish & Game
Wildlife Action Plan

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

State and federally listed threatened and endangered species present within the four corridor communities appear in Appendix 1. Only one federally endangered species is present within the Lower Merrimack River corridor, the Karner Blue Butterfly. The species feeds exclusively on wild lupine, a state threatened species. Wild lupine has historically been maintained by fire and the butterfly could be found primarily in Oak Savannas and Pine Barrens, and occasionally in Lake Dune complexes (Haack, not dated).

Depending on the season, the River corridor is host to a wide diversity of bird species. Approximately 220 species of birds have been documented in the corridor. Similar to the animal species, the bird species found in the corridor are those indigenous to southern New Hampshire. Species of gulls, doves, woodpeckers, chickadees, and jays would be found throughout the years while other species such as warblers, sparrows, wrens, swallows, robins, and several species of raptors are only seasonal residents. Other species including a variety of ducks, geese, and herons nest in the area or migrate through the corridor.

Mammals present in the River corridor are those commonly found throughout the State, including raccoons, skunks, muskrats, porcupines, white-tailed deer, woodchucks, squirrels, mice, bats, rabbits, and other indigenous species that are adapted to living near humans and urban activities. Larger animals that require extensive habitat areas, or species that require solitude, such as moose, black bear, and lynx, prefer more rural environments.

The bald eagle is also known to inhabit the River corridor during the winter months. The River corridor provides the necessary elements of eagle winter habitat, perch, and roost sites along open waters for fishing. Perch sites, large open branched trees usually deciduous or pine, located on the riverbank or river islands, are used by the eagles during the day and provide good viewing areas for locating food. During the evening the eagles move inland to more sheltered areas, usually conifer stands that offer protection from wind and harsh temperatures.

Merrimack River corridor is second only to Great Bay, located in southeastern New Hampshire, in winter eagle activity.

The Audubon Society has documented the use of perch and roost sites in the Merrimack River corridor in northern sections of Merrimack and Litchfield. The information on preferred perch, roost, and forage sites was used to identify potential habitat areas along the River not currently being used by the eagles. These sites were identified in Merrimack and Litchfield as far south as Pennichuck Brook. One area is located just north of Reeds Ferry in Merrimack and across the River in Litchfield and extends south to two large islands. Other areas in Merrimack include the confluence of Naticook Brook and the Merrimack River, the Anheuser-Busch property between the railroad and the River, and Pennichuck Brook from Route 3 to the River.

Much of the documented and potential eagle wintering habitat is located in close proximity to major highways and the railroad. Eagles are able to adapt to and coexist with the noise and presence of cars and trains. Human activity, however, disturbs the birds causing them to take flight thereby using valuable energy stores unnecessarily. The presence of humans in wintering areas could have a negative effect on eagle populations within the state.

3.4.2 Fisheries

Game species in the Lower Merrimack River include yellow perch, chain pickerel, brown bullhead, white perch, small mouth bass, large mouth bass, walleye, carp, and rock bass. Non-game species include

pumpkin seed, white sucker, golden shiner, red-breasted sunfish, American eel, fall fish, and gold fish. In addition it is possible to find some brook trout in the rocky fast waters.

Anadromous fish species such as blueback herring, alewife, American shad, and Atlantic salmon are beginning to return to the River as a result of the anadromous fish restoration program begun in 1969. The program is a cooperative effort between the Massachusetts and New Hampshire state fisheries agencies, the US Fish and Wildlife Service, and the National Marine Fisheries Service. The first decade of the program focused on describing and quantifying the habitat for Atlantic salmon and American shad. This analysis included projections of habitat that would need to be developed to allow upstream movement. The results of the analysis projected that the habitat could support adult populations of 1,000,000 shad and 11,000 Atlantic salmon. It was also determined that six barriers on the main stem of the Merrimack River would require fish passage facilities for shad and salmon with two additional passage facilities required for salmon on the Pemigewasset. The goal of the restoration program is to establish a self-sustaining salmon population in the Merrimack River and its tributaries.

Fish passage facilities were completed at the Essex Dam in Lawrence in 1982 and at the Pawtucket Dam in Lowell in 1986. The passage facility at the Amoskeag Dam in Manchester was completed in 1989. The schedule for the construction of fish passage facilities on the two remaining dams on the main stem of the River at Hooksett Falls and Garvins Falls is tied to the number of fish passing through the facility immediately downstream. The Hooksett facility will be constructed five years after the passage of 15,000 shad at the Hooksett facility. The Sewalls Falls Dam breached in 1984 and no longer requires a fish passage facility. In addition, a salmon trapping facility will be constructed at the Eastman Falls dam in the spring following the second year of the passage or trapping of 50 multi-season salmon at the Amoskeag fish passage facility.

American shad and Atlantic salmon are considered sport fish. An established Atlantic salmon run will draw fishermen into the area which in turn could have a small impact on the regional economy. In order to assure the continuation of these fish species, it is essential to protect important spawning and nursery habitats, to improve fish passage along the main stem of the River and its tributaries, and to maintain minimum water quality and quantity standards.

3.5 Vegetation

Like the wildlife and fish species found in the Merrimack River corridor, the types of vegetation found in the corridor are likely to be those species indigenous to southern New Hampshire. Typical tree species found in the corridor include:

- Black locust
- Red maple
- Spruce
- Sycamore
- Birch
- Pine
- Silver maple
- Aspen

While harvesting forest products is a major industry in New Hampshire, it is unlikely that any of the parcels along the River would be used for commercial production. Since the majority of the parcels along the river are too small to make commercial harvest viable, there is little doubt that their value as development property would exceed their value as forest land. In addition to the tree species, a wide variety of grasses and shrubs can be found in the corridor.

The New Hampshire Fish and Game is the agency responsible for identifying and recording the State's endangered and threatened plant species. Plants are ranked using the Nature Conservancy system in the same manner as animals. The Wildlife Action Plan records indicate the presence of nine endangered or

threatened plant species and three ecological communities located within the river corridor or the general area. The plants are:

- Fall witch-grass
- Wild lupine
- Hairy star grass
- Blunt-leaved milkweed
- River birch
- Burgrass
- Bald spike-rush
- Arrow-headed rattle-box
- American plum

The three ecological communities present in the study area are described below:

New England Pitch Pine – Scrub Oak Barrens: Found on sandy soil derived from glacial outwash and lakebeds. "Barrens" refers to the infertile and droughty nature of the soils. Fire plays an essential role in maintaining the characteristic open vegetation. As seen in many of the remaining barrens of the state, fire suppression results in succession to pine forests. This community has been virtually eliminated from along the Merrimack River between Nashua and Concord.

Southern New England Lake Sediment / River Terrace Forest: A forest community of river bluffs and higher river terraces found on soils derived from wind and water deposited sediment of glacial outwash. A variety of habitats are found which support diverse plant species like hemlock, basswood, American ash, green ash, red oak, souring rush, and Christmas fern. Undisturbed large tracts are common.

Northern New England Level Bogs: Peatlands found in wet depressions and low areas with poor or no drainage, where the familiar "floating mat" develops. Bogs are a vegetation complex with deep organic soils formed from partially decomposed plant material. Bogs are open and dominated by heath-like shrubs and coniferous trees that are stunted due to the lack of nutrients in the soil.

This list of threatened plant species and unique ecological communities contains documented and historical occurrences of the species and is by no means a complete representation of the species limitations. Documented species could be found in other locations within the river corridor, as could other undocumented threatened species. The continued existence of these species and communities within the Merrimack River corridor depends on the conservation of their habitats.

3.6 Scenic Views and Vistas

Essentially, the entire Merrimack River corridor can be considered scenic, particularly those areas accessible to the public. There are, however, areas that are less scenic than others due to the presence of buildings, industrial developments, and other obtrusions on the landscape. Scenic views, north and south, can be obtained when crossing the Taylors Falls and Sagamore bridges in Nashua/Hudson. Greeley Park, in Nashua, and Merrill Park, in Hudson, also offer scenic views of the River and direct public access.

From the river itself, almost the entire riverbank is scenic in some manner. The banks of the river rise to a level where much of the development is blocked from view. Development can only be seen in those locations where buildings and parking areas are located directly at the top of the riverbank and are not screened by any type of vegetation. In addition, the river provides the opportunity to view many species of birds and other wildlife.

Riverbank developments can be designed to fit into the natural landscape. Buildings, structures, and other site developments, for example, can be setback from the top of the bank and screened from the River by a vegetative buffer. The BAE Systems development in south Hudson provides a good example of effective use of setbacks and vegetative screens. The development can barely be seen from across the river. Height limitations for buildings and structures can also be used to conserve the visual integrity of an area. In addition, planting vegetative buffers around existing developed areas will screen the development from the River and help stabilize the soil. Clearcuts or extensive thinning of existing tree stands can have negative impacts on the visual quality of a view or vista as well as create situations ripe for erosion. On the other hand, selective cuts and thinning can open up views that have been obstructed by vegetation growth. Proper site planning can ensure developments that are designed and constructed to fit harmoniously into the landscape.

3.7 Agricultural Lands

High quality or prime farmland is a very valuable but limited resource. The characteristics that make the land prime for agriculture also make it prime for development. Realizing the need for conserving the existing prime farmlands, the Natural Resource Conservation Service has developed a classification system based primarily on soil type to assist national, state, and local agencies in identifying prime farmland areas.

The SCS classification contains four farmland categories: prime, unique, state-wide important, and locally important. The characteristics of each farmland classification are as follows:

Prime
- Land best suited for food, feed, forage, fiber, and oilseed crops.
- Land with soil quality, growing season, and moisture supply to economically sustain high yields of crops when properly treated and managed.
- Land that can be continuously farmed without degrading the environment.
- Land which requires the least investment and the least amount of energy for maintaining productivity.
- Croplands, pasture lands, forest, or other land, but not urban built lands.

Unique
- Land other than prime used for specific high value food and other crops.
- Land with a combination of soil quality location, growing season, and moisture supply that will sustain a high quality / high yield of a specific crop (apple orchards, blueberry lands, vegetable truck gardens).

Statewide
- Land identified as important by state agencies.
- Land that could not be considered prime because of soil characteristics of erodibility and droughtiness.
- Land that requires greater input of fertilizers, soil amendments, and erosion control.

Local
- Land identified by local agencies.
- Poorly drained land with drainage improvements established.
- Fair to good crops when properly managed.

Prime farmland soils are most extensive in the Town of Litchfield, approximately 80 percent of the total area, while locally significant soils comprise another 10 percent. Prime farmland soils are especially rare in New Hampshire. Given this, the Trust for New Hampshire Lands has identified all of the prime farmland soils in Litchfield as being of State significance for the purposes of protection through the Land

Conservation Investment Program. Land costs in southern New Hampshire, however, may prohibit the program from purchasing any parcels and make it difficult even to obtain easements.

While Figures 8A and 8B depict significant amounts of farmland soils existing in all four of the communities, much of the prime farmland has been developed. The majority of the prime farmland soils in Merrimack and Nashua are located adjacent to the railroad tracks. In addition, other prime farmland areas are tied up in large parcels of industrial lands, such as those owned by Anheuser-Busch. (It should be noted that the property does support some agricultural activity as the property houses stables for the world famous Budweiser Clydesdales.) Much of the remaining farmland soils have been developed for residential and commercial use, particularly along NH Routes 3 and 3A. Of the four communities, Litchfield contains the most undeveloped farmland in the River corridor. Increasing land values and development pressures, however, are rapidly changing this situation.

In addition to its importance for the production of food and fiber, agricultural land use is an important form of open space in a community. Open fields and farm buildings provide for diversity in the landscape and the pastoral setting is usually pleasing. Active agricultural operations in the river corridor are limited to the northern sections of Hudson and almost the entire Litchfield section of the riverbank. While agriculture is currently the dominant land use in the Litchfield portion of the river corridor, this situation has begun to change and the change is likely to continue. Large parcels of agricultural land have been sold to developers in the past few years and subdivision plans have been proposed. Land prices have risen dramatically over the past ten years, making it less profitable to keep land in agricultural use and more profitable to sell. Active agriculture should be conserved to ensure the continued local production of food and fiber, to maintain open space and diversity in the landscape, and to retain the cultural aspects associated with farming life. The ability to conserve productive farmland in parcels large enough to provide for efficient use of the land with generation of sufficient economic returns for the farmer is an issue with which the region will continue to struggle.

This page intentionally left blank.

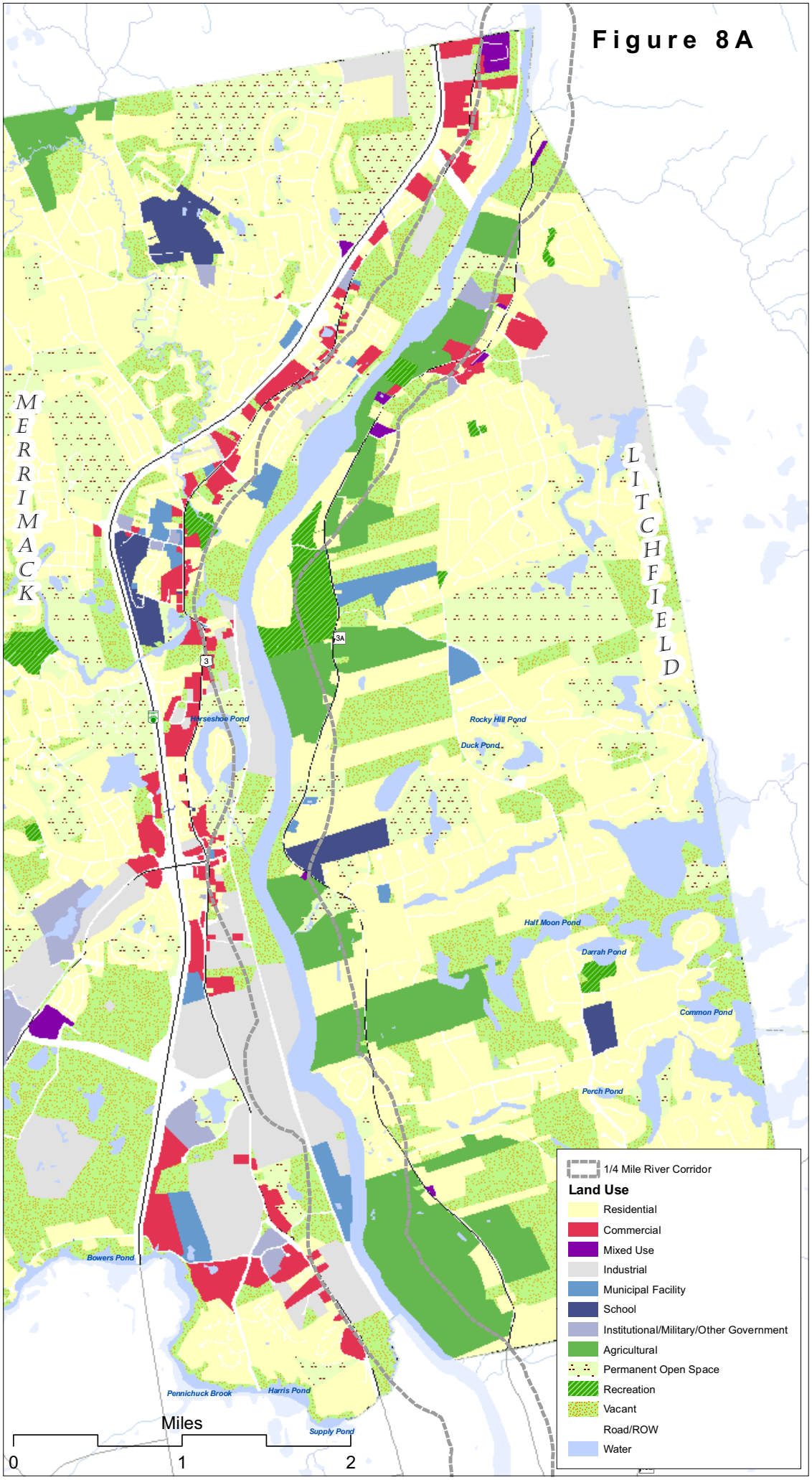
Insert
Figure 8A – Land Use (North)

Scroll Down for Figure 8A

Lower Merrimack River Corridor Plan

Land Use

Figure 8A



N

NRPC

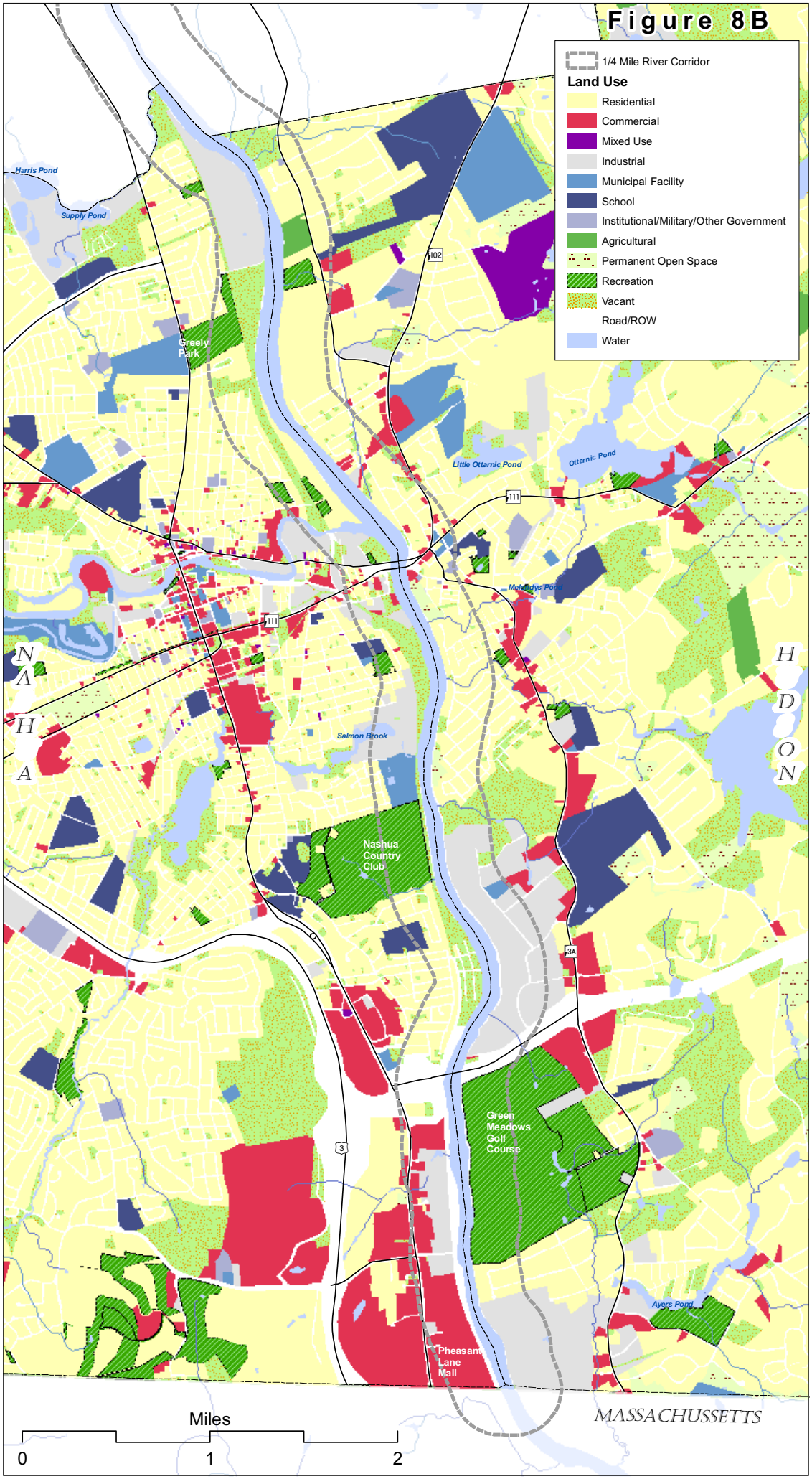
Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

Insert
Figure 8B – Land Use (South)

Scroll Down for Figure 8B

Lower Merrimack River Corridor Plan
Land Use

Figure 8B



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

3.8 Conservation Lands

Of the total 5,434 acres within the Lower Merrimack River corridor, approximately 229 acres (4.2%) has been set aside as permanently protected open space. Additionally, another 347 acres (6.4%) are secured in public recreational lands (ball fields, municipal parks, etc.) that provide an important contribution to public spaces, habitat areas, and scenic relief from development. Figure 9 depicts the locations of conservation lands within the corridor communities.

3.9 Public Access and Recreation

3.9.1 Recreation Overview

The Merrimack River provides numerous recreational opportunities to the residents of the communities along its banks, to the region, and to the State as a whole. Activities such as boating, canoeing, kayaking, rowing, fishing, and swimming take place immediately on the river, while its banks are used for hiking, cross country skiing, picnicking, bird-watching, nature study, and overall enjoyment of the scenic views. Numerous state and federal studies have identified the need for increased recreation areas and facilities to serve an ever growing and changing population. Generally, an increasing population results in an increasing demand for recreation.

Since the river corridor is located in a heavily populated area, increased recreational opportunities could serve a large number of people within a range of economic and social sectors. Unfortunately, recreational activities on and around the Merrimack River are limited, partly due to an extremely limited number of public access points. Additionally, existing trails along the Merrimack River are underutilized since they are not connected in a cohesive network, often do not have adequate parking or other facilities to provide a comfortable recreational experience, and as is the case in many urban settings, trail conflicts between user types are not uncommon. The existing trail facilities and river access points are pictured in Figure 8.

It is difficult to quantify existing recreational use of the river because there have been no studies of the type and quantity of recreational uses within the river corridor, and most information to date is anecdotal. However, there are some common and popular recreational activities in the corridor that are discussed below.

3.9.1.a Boating

Boating activity on the river includes both motorized and non-motorized including canoeing, kayaking, crewing, and motor boating. Boating use is limited most directly by public access, with only three public boat launching facilities within the river corridor. The Greeley Park boat ramp is the only public launch that is capable of handling large watercraft and trailers. Large watercraft use is also impeded by the abundance of shallow or rocky waters, making the river more suitable for canoes, kayaks, and other similar small watercraft. Since shorelines are often shallow and contain submerged snags and other debris, the use of jet skis is also somewhat hazardous throughout the corridor.

The river is used by canoers and kayakers. Rapids and flat-water experiences are both provided. The stretch of the river from the Amoskeag Dam to Moores Falls contains quick water and rapids ranging from Class I to Class III in difficulty. Below Moores Falls is a five-mile reach of flat-water and quickwater to Cromwells Falls, another short rapid with a varying degree of difficulty depending on the water's level. Below Cromwells Falls, the river is flat to the state line.

This page intentionally left blank.

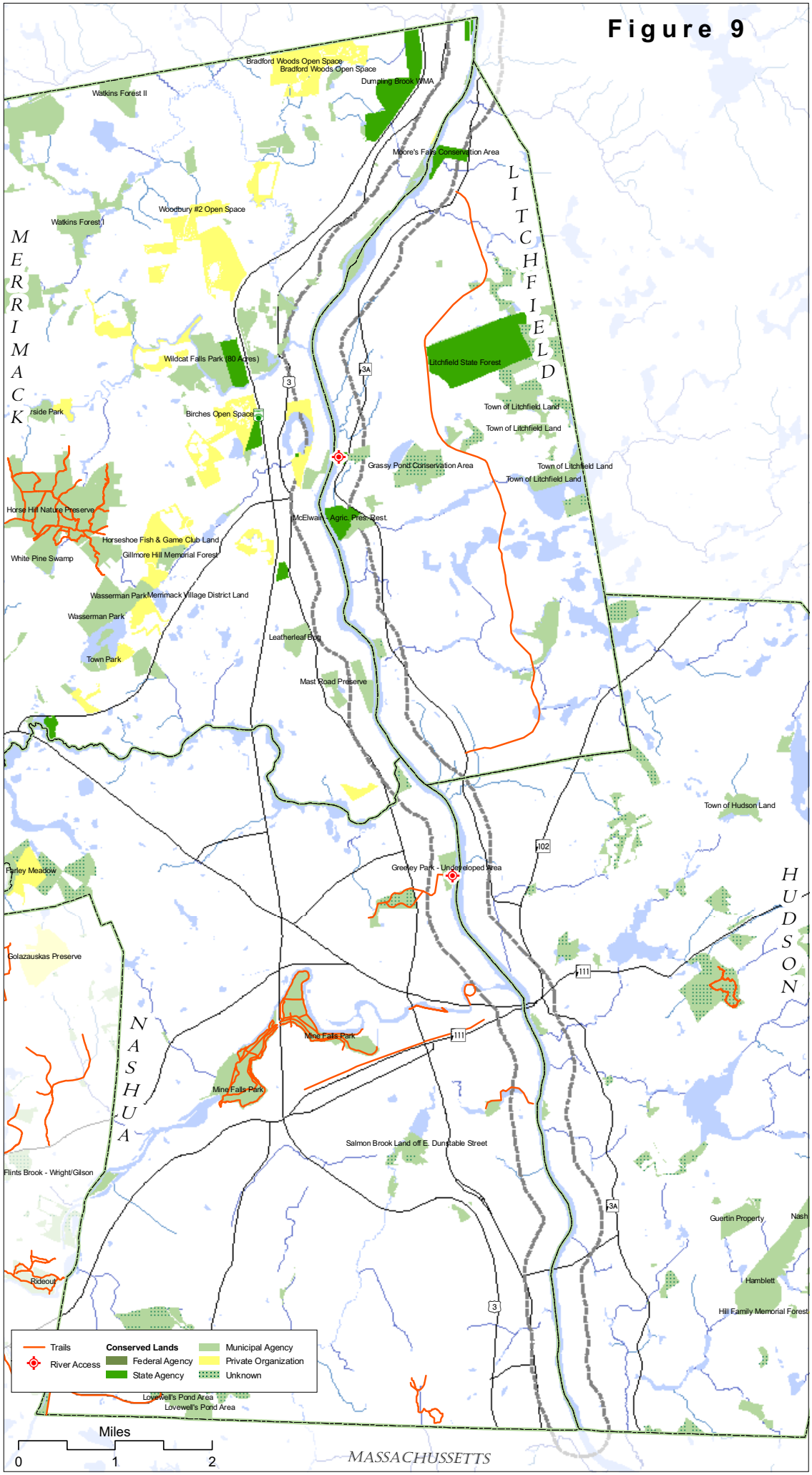
Insert
Figure 9 – Conserved Lands

Scroll Down for Figure 9

Lower Merrimack River Corridor Plan

Conserved Lands

Figure 9



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

Members of the Independence Rowing Club also train competitively on the Merrimack River, with a seasonal dock on the river just south of the Taylors Falls Bridge. Two national regattas are held annually on the Merrimack, generally in August and October. When water levels in the river are normal, four lanes of rowers can be safely accommodated, however, at low levels two lanes are safely accommodated.

An increase in the number and location of access points would enable a larger portion of the population to use the river for boating. In addition, the general population needs to be informed about the opportunities for boating on the river, the types of boating most appropriate, the location of access points, and the impacts of boating on natural communities and water quality.

3.9.1.b Fishing

Small and large mouth bass are the most important game species in the Merrimack River, while other species include perch, pickerel, and walleye. Fishing on the river is done from both the shore and from small watercraft. Programs are currently in place to restore anadromous fish (particularly American shad and Atlantic salmon) to the river. Established shad and salmon runs would increase the use of the river for angling, particularly from the shore; however, the success of the anadromous fish restoration effort depends upon the conservation of important habitats and continued efforts to allow fish to pass the existing dams.

3.9.1.c Swimming

Swimming is not currently a recreational opportunity available within the study corridor due to the presence of bacterial from raw sewage released periodically into the Merrimack in upstream locations. Water quality has been improving steadily in recent years due to improvements in wastewater treatment.

3.9.1.d Hiking

Participation in hiking, walking, and other trail activities is increasing rapidly and takes place in the corridor area along the banks of the river where permitted by formal easement. Existing trails in the river corridor are illustrated in Figure 9. The Merrimack River was also selected as part of the New Hampshire Heritage Trail which when completed would extend the length of the trail and places emphasis on the development of the trail by youth organizations. The trail is envisioned to be an interconnected network of individual trails developed and constructed by individual communities rather than a statewide project, even though the Division of Parks and Recreation was designated as the agency responsible for overseeing the development of the trail and for selecting the locations.

Trail development and maintenance of the existing trails in the corridor is first determined by the types of uses allowed an expected on trail systems. However, even after trails are designed and constructed, issues such as requirements for upkeep and maintenance (which will depend on the types of users present), trail security and law enforcement (especially in relation to vandalism) and issues of landowner liability need to be addressed. Fortunately, trail development for public use is not a new concept and there are several models of successful trail development and maintenance projects to serve as examples. Additionally, RSA 212:34 – *Liability of Landowners* provides protection to landowners providing public uses on private properties.

3.9.2 River Tours

In the summer of 2006, four river tours were led by representatives from the Lower Merrimack River Local Advisory Committee through each of the four corridor communities. The purpose of the river

tours was to introduce interested persons to the Merrimack River's recreational resources and to familiarize committee members with existing and potential recreational opportunities within the corridor.

Participants noted the many recreational opportunities, such as fishing, hiking/walking, biking, nature study, picnicking, and boating/canoeing/kayaking were present on the river, however these opportunities remain underutilized due to an inadequate number of access points. In addition, many existing access points were described as underdeveloped, in a state of neglect, or unknown to many area residents.

Additionally, evidence of erosion is present in all four corridor communities. Stream bank erosion, trash, and other debris were visible in all four communities, and possible violations of the Comprehensive Shoreland Protection Act were also detected.

Upgrading, improving, and constructing additional access to the river would promote and allow more area residents to visit and enjoy the River, which in turn may foster an increased appreciation for and environmental stewardship of this important resource, and increased use of parks and picnicking areas would become a natural deterrent to vandals and illegal dumpers.

Recreational access issues identified in each of the four communities are summarized by location in Table 8.

Table 8: Recreational Access Issues Identified in the May 2006 River Tours

Location		Identified Issues / Opportunities
Merrimack	Thornton's Ferry	Opportunity for upgrading
	Reed's Ferry	Erosion issues.
	Merrimack Village District Dam	Effects of impending removal need to be considered and addressed as part of any eventual removal.
Nashua	Greeley Boat Ramp	This is the only public access point in the corridor which can accommodate larger boats. Needs to be upgraded in terms of location and number of parking spaces and ramp upgrade, perhaps similar to the Lambert's Boat Ramp in Hooksett. Illegal dumping, vandalism, ATV use were all noted. Formalizing and mapping trails would help control off-trail activities. Site is confusing to get to due to poor signage. Adjacent Beazer property presents creosote contamination issues.
	Proposed Redevelopment of former Hampshire Chemical Site	Would like to maintain a wooded buffer and implement stormwater control measures while incorporating public river access at the site.
	East Hollis Street Area	Corresponds with East Hollis Street Area Plan. Improve recreational opportunities and river access in this area. Potential partnering opportunities with rowing club.
	Nashua Waste Water Treatment Plant	Continue informal monitoring of discharges.
	Salmon Brook	Receives stormwater runoff from adjacent parking lot. Large debris jams collect in the Brook.

Table 8: Recreational Access Issues Identified in the May 2006 River Tours

Location		Identified Issues / Opportunities
Litchfield	Church rear property	Opportunity for access and parking for canoe launch.
	Various trails	Opportunities for increased connectivity of trails hindered by problems associated with ATV and dirt bike use and illegal activities behind farmland.
	Conservation initiatives	Development pressure makes procurement of conservation land imperative to preserve character of this segment of river corridor.
	Areas of Historic Significance	Old locks, Keeper's House, and old trolley tracks could be promoted and showcased.
	Executive Drive	Potential existing easement. Steep slope leads to walking trails and sandy beach area.
Hudson	Pump House Park (off Sycamore Drive)	River access could be improved. Picnic opportunities and good view of old arch bridge.
	Merrill Park	Greatest potential for increased recreation and access. Facilities are in poor state, with visible erosion needing mitigation to prevent further damage. View of historic bridge abutments and general scenic vista.
	Green Meadow Golf Course	Recreation and public access issues should be incorporated into any development plan for the site.

Source: LMRLAC 2006. River Tours Outcome Summary. Lower Merrimack River Local Advisory Committee. September 25, 2006.

3.10 Hydropower and Water-dependent Uses

Water has been used throughout history to generate power. Many of the country's cities are situated along rivers and streams where the water could be harnessed to run mills. Today, water is used to generate electricity at dams throughout the Merrimack River Basin. Hydropower has a significant impact on the river corridor because of the generating facilities in Manchester at the Amoskeag Dam and in Lowell at the Pawtucket Dam. The Amoskeag Dam controls the amount of water released to the river corridor while the pool of the Pawtucket Dam extends for 18 miles behind the impoundment to the Town of Merrimack.

Moores Falls is the only area within the river corridor where there is potential for additional hydro-development. The site was actually investigated by a company in the early 1980s, however, given the economic climate at the time the project was not constructed. Future changes in the economy as well as changes in the environment could at some point make the development of this site feasible.

Flow regulation can have both positive and negative impacts on the uses and users of the river. Impoundments are used to reduce flood damage on downstream areas and stored water can later be used to augment low flows. On the other hand, particularly where the water is used as an energy source, flows could be regulated in such a manner as to produce lower than normal flows. In addition, increased reliance on the 7-Q-10 low flow could result in allocations of flows up to this minimum level. To guard against this, when renewing licenses for existing facilities the Federal Energy Regulatory Commission (FERC) should be required to establish minimum discharge standards at levels greater than 7-Q-10 or whatever is coming down the river, commonly called run of the river, with no fluctuation allowed in the level of the impoundment.

State agency policies regarding the construction and reconstruction of new and existing hydropower facilities are mixed. Renewed interest in hydropower during the 1970s led to the 1981 amendments in

RSA 481 in support of hydro-development, declaring "a special need for dams and reservoirs and other hydroelectric production facilities." RSA 482, while supporting hydro-development, provides for public participation in determining the public benefit of dams and requires the DES Dam Bureau to consider the effect of the impoundment on "scenic and recreational values and upon fish and wildlife and upon the natural flow of the water in the stream below the dam and any hazards to navigation, fishing, bathing, and other public uses."

The New Hampshire Fish and Game Commission's policy, particularly with regard to the Merrimack River, is "to protect and safeguard free-flowing streams and rivers because they are a limited habitat necessary for fishing." To support this policy, the Commission discourages new dam construction, reconstruction of breached dams, significant diversions of water, or any other activity that would significantly alter fisheries habitats. The Commission also actively opposed the reconstruction of Sewalls Falls Dam for hydropower.

3.11 Historic and Archaeological Resources

Prehistoric and historic sites along the River include Indian sites, cellar holes, cemeteries, and remains of transportation and navigational systems. In addition to residential units, historic resources include mill buildings, trading posts, brickyards, meetinghouses, garrison houses, bridges, railroad structures, and cemeteries.

3.11.1 Archaeological Resources

Even though there are no written records to study, the archaeological sites present along the Merrimack River often contain artifacts that tell detailed stories. In recent years the River corridor has been an active archaeological research area. Almost 200 archaeological sites have been recorded along the entire length of the Merrimack River in New Hampshire.

The Merrimack River provided a major system of communication for prehistoric populations for thousands of years. The River and its banks provided many readily exploitable resources including fish, migratory birds, and diverse flora and fauna. The river was also an important route for trade and transport of raw materials. The Merrimack Valley supported a resident prehistoric population from the Paleo-Indian until the initial period of Anglo-American settlement and hundreds of sites are known to exist along the Merrimack and its many streams and tributaries. The "Mouro-mak" trail (Price 1967) which linked the people in northeastern Massachusetts with tribes in the Upper Merrimack Valley, resulted in hundreds of camps and village sites located along its course on both sides of the River.

Occupation during prehistoric times along the Merrimack River is well documented and numerous sites have been recorded between Manchester and Nashua. The lack of sites recorded in river backlands for the same area would seem to suggest that occupation in the area was largely limited, perhaps by cultural choices, to the riverbank proper.

3.11.1.a. Early Archaic Period (10,000 – 8,000 years before present)

No sites associated with the Early Archaic period have been identified in the Lower Merrimack River corridor.

3.11.1.b. Middle Archaic (8,000 – 6,000 years before present)

Within the study area, artifacts within this period are prevalent along the river corridor. Middle Archaic evidence has been found at study area sites including the Litchfield, Smolt, Thebodeau, Campbell, and Danforth Field Site. The best documented and published Middle Archaic site is the Neville Site at Amoskeag Falls on the Merrimack River in Manchester. However, tools from this period have been found at numerous other documented sites within the river corridor.

3.11.1.c. Late Archaic (6,000 – 3,000 years before present)

Later Archaic sites typically include evidence of domestic architecture, ceremonial types of artifacts, forest resources processing sites with roasting pits, and stations at falls for seasonal fishing of salmon and shad. The Litchfield, Nesenkeag, Two Feather, Colby Far, Danforth's Sand Bank, Smolt Site, and Tebodeau sites in Litchfield represent the Late Archaic period very well. All of these sites appear to involve special tasks including stone tool maintenance or manufacture. Other activities including ritual burial, woodworking, and plant food preparation are also evident.

3.11.1.d. Woodland Periods (3,000 years before present to 1600 AD)

The Woodland Periods are marked by the introduction of pottery and by the introduction of and increasing dependence on domesticated food for subsistence in some areas. Early Woodland sites (3,000 – 1,900 years before present) are inexplicably rare, and the more numerous Middle (1,900 – 1,000 years before present) and Late (1,000 – 1,600 AD) sites are generally badly disturbed by land alterations. During the Late Woodland period, villages generally shifted to more defensible hilltop positions and are generally more sedentary, often covering several acres. Among the best documented sites of the Woodland periods in the State are the Smyth site in Manchester at Amoskeag Falls, Seabrook, Pickpocket Falls in Exeter, and at the Great Bay site in Greenland (DHR 1988). In the river corridor, the Early Woodland Period is represented at the Litchfield Site, while the Middle Woodland period is defined by features and pottery at the Smolt and Campbell sites. The Late Woodland is represented by dated features at the Smolt, Litchfield, and Colby sites. Artifacts associated with this period are also evident at a Nashua site.

Within the river corridor, at least 20 prehistoric sites and districts of significance have been documented within 1,000 feet of either side of the Merrimack River. Although in many cases the record of the sites has been obliterated by historic residential and/or industrial development, many still contribute to our understanding of the regions prehistory, and several survive with an outstanding level of integrity. Table 9 lists the prominent prehistoric sites located within the Lower Merrimack River corridor.

3.11.2 Historic Resources

A number of major historic Indian trails have been identified in and around the Lower Merrimack River corridor. These include the Merrimack, Nasamok, Souhegan, Pawtucket, and Massabesic trails, which led to the development of trading posts situated in Litchfield and Merrimack. The Indian trails served to channel movement in and out of the valley.

The earliest residents in this section of the Merrimack Valley were the Naticook Indians, led by Chief Passaconaway, who were attracted by the farming potential of the fertile floodplains and seasonal fishing afforded by the Merrimack River. King Phillip's War forced the Indians to ultimately depart from the Merrimack Valley and the area they knew as "Naticook" which included portions of what are today the towns of Litchfield and Merrimack.

In 1652 a survey of the Merrimack was conducted from Massachusetts to the outlet of Lake Winnipesaukee. Early settlements were promoted by a number of considerations including a great portion of meadow land, uplands which had already been found ready for cultivation, and trapping potential that was second to none in the State. The fur trade in particular was a significant catalyst in opening new lands to settlement. As beaver were successively trapped out of areas near the frontier trading posts, Native Americans began pursuing these resources in new regions that were increasingly remote from the European settlements. To maintain their business traders followed; the Native Americans moved to new areas, and European settlers moved into the abandoned clearings. By 1667, the fur trade with the Native Americans had become so important that the Provincial Court of Massachusetts passed an act regulating it.

The first land grant in the Nashua area was made by the Massachusetts Bay Colony to Reverend Samuel Whiting of Lynn, Massachusetts in 1659. The town of Dunstable was chartered in 1673 as an outpost of the Colony, consisting of 200 square miles on both sides of the Merrimack River. In 1680, there were 30 families in the community. The year 1725 marked a turning point for the outpost with the ending of the Captain John Lovewell's War. As a result of the defeat of the Souhegan and Naticook tribes, more rapid agrarian development ensued. Beginning in 1730, the original Dunstable settlement began breaking away as separate entities: the following dates are significant:

- 1733: Hollis, Merrimack, and Nottingham West are founded.
- 1734: Litchfield founded
- 1746: Merrimack and Hudson founded
- 1760: Amherst founded
- 1794: Milford founded
- 1836: Dunstable becomes Nashua

Until the damming of the Merrimack for industry, the River was filled with migratory fish that attracted European settlers, in addition to the Native Americans before them. In its natural state, the Merrimack River had at least three rapids or waterfalls between Nashua and Lowell which were used by early settlers to great advantage. Taylor's Falls, located a mile below the junction of the Nashua and Merrimack Rivers, was a location where settlers found it easier to catch fish than in smaller streams. Prior to the construction of the Taylor's Falls Bridge across the Merrimack River from Nashua to Hudson in 1827, people crossed the river by ferry, since there was no bridge crossing between Lowell and Manchester. The Cummings Farm Ferry, Hills Ferry and Little's Ferry all operated in the mid 1700s allowing passengers to cross from Nashua to Hudson. Ferries also linked Litchfield and Merrimack including Temple's Ferry, Thornton's Ferry, and Reed's Ferry.

In time, the Merrimack was also used for floating logs to sawmills downstream as well as operating as a critical transportation route linking New Hampshire to important commerce centers downstream. The region's lumber and timber trades were important industries, along with brick manufacturing in Litchfield and Merrimack. Communities on the river had a prosperous trade, evidenced by general merchandise stores and fleets of canal boats carrying produce and merchandise to Lowell and on to Boston through the Middlesex Canal. It was not until 1814 that the Merrimack River was navigable from present-day Lowell to Concord, New Hampshire, made possible by the completion of a series of 21 locks, dams, and canals.

In Nashua, the Nashua Manufacturing Company's early and successful development of a canal/power system was a widely respected engineering feat in the 1820s. To harness the power of the Nashua River, the company built a 30-foot dam at Mine Falls and a three-mile long power canal to channel the water to the new mill site. An additional transportation canal was constructed to bring boats out to the Merrimack. The dam and locks of solid stone masonry measured 24 feet high. Each lift was ten feet wide

and 82 feet long. The canal was constructed from Main Street at the bridge to the Merrimack River. The canal beside Canal Street was filled in at about the time of the First World War prior to an expansion of the mills in the area. The part of the canal to the west of the bridge toward Mine Falls is still recognizable today.

Reliance on the canal system was diminished with the construction of the railroad in Nashua in 1838. Merchants were quickly drawn to the railroad as a more reliable means of transportation since it was not subject to the whims of seasonal freshets in the river which could delay shipments for several weeks. Additionally, merchants could purchase smaller amounts of goods at a time, lessening the chance of loss in a falling market. Unable to withstand competition from the railroad, the last commercial boat passed through the Merrimack River canals in 1852, and the charter was extinguished by the courts in 1869.

Nashua's growth into a manufacturing town increased the need for a permanent bridge across the Merrimack River. In 1827 the original Taylor's Falls Bridge was constructed as a covered wooden toll bridge on the site of the present bridge of the same name. In 1854 the bridge became a public right-of-way jointly owned by the communities of Nashua and Hudson (formerly Dunstable and Nottingham West). Construction of a concrete Taylor's Falls Bridge began in 1909, and was completed in 1912. After years of deterioration, the bridge was permanently closed to traffic in 1970 and removed in 1973 to make room for a new bridge that opened in 1974.

Along the river corridor in cities such as Manchester and Lowell, the Merrimack River afforded ample opportunity for water power. Owing to the lack of an appreciable drop, however, the Merrimack River in the Nashua area has far less water power potential than in other parts of the corridor. The River drops 4.5 feet from Bedford to Nashua, mainly at the rapids of Moore's Falls near Reed's Ferry and Cromwell's Falls in the south near the Nashua line. However, this drop was enough to furnish water power for cotton mills and other factories including the Nashua Manufacturing Company.

However, the relative lack of water power on the Merrimack River had little impact on the growth of Nashua. In 1830, the town's population stood at 2,400 making it the second largest in the county. The railroad reflected the city's growth and by the later 19th century Nashua was the center of an extensive system of railroad and freight facilities unsurpassed by any inland city in New England, with a total of six lines radiating outward from the city. Spurred on by an accessible and economical mode of transportation, Nashua and to a lesser degree Hudson, began to prosper as manufacturing centers.

In Nashua, the textile industries and paper companies continued to flourish in the early 1900s. By the mid twenties, these were joined by shoe factories. In the meantime, long exploited for its convenience as a conduit for wastes, the Merrimack River became one of the dirtiest and most heavily industrialized waterways in the United States.

Litchfield, on the other hand, experienced quite a different pattern. Isolated on the east bank of the River from the railroad on the west side, Litchfield was denied easy access to markets afforded by the railroad, and since the area was already blessed with richer soils than many of its neighbors, Litchfield turned to agriculture and so the economic base remained closely tied to the soil.

The prosperity of the mills was short-lived. By 1950 there was a shift in the textile industries from the northeast to more favorable southern climates. This potential economic disaster was offset by an influx of other industries beginning in the 1950s, including electronics firms. To a large degree, the loss of heavy industry in the region had a major positive impact on the health of the river. From 1950 to 1980 the Nashua region experienced rapid growth in technology-related industries which also had a major impact on nearby bedroom communities such as Litchfield and Merrimack. With the decline of the railroad, the construction of the F.E. Everett Turnpike began, ushering in passenger and freight transportation by automobile and truck. Passenger rail service was then discontinued in 1967.

Today, neither the industries, nor the means of transportation which depended on and defined the River during the 19th century remain in significant use in this part of the Merrimack Valley. Although the River is no longer valued for its power, the cities and towns along its banks are vital and growing. The River remains an important, yet largely overlooked, resource which contains relics and remnants of years past. The prominent historic resources contained from this recent era are described in Table 9, below.

Table 9: Prominent Prehistoric and Historic Resources in the Lower Merrimack River Corridor.

Map Code	Location	Site Name	Type	Date	Significance
Litchfield Sites					
1	East bank of Merrimack, south of Watts Brook	Three Flakes	Prehistoric	Archaic	Unique as single component site where lithic tools manufactured.
3	East bank of Merrimack, Moore's Falls vicinity	Litchfield Site	Prehistoric	Middle Archaic to Late Woodland	Multi-purpose site, tool manufacturing and repair, burial ground.
4	East bank of Merrimack, Moore's Falls vicinity	Naticook East Bank	Prehistoric	Late Archaic	Limited occupation during single time period. Tool manufacturing or repair, food processing.
5	East bank of Merrimack, Moore's Falls vicinity	Two Feather Site	Prehistoric	Late Archaic	Temporary occupation involving tool manufacture or repair, hunting and fire-related activity.
6	East bank of Merrimack, NE of Reed's Ferry	Moore's Falls Locks	Historic	1814	Three locks provided a bypass to the longest rapids on the Merrimack River system.
7	Colby Brook to the rear of the Colby Farm storehouse	Grist Mill	Historic	1830	Local grist mill on Colby Brook.
8	East bank of Merrimack overlooking Moore's Falls	Moore's Falls Site	Prehistoric	Late Archaic	Limited occupation, quartz industry, hunting, fishing, food processing.
9	East bank of Merrimack at Colby Brook	Colby Farm Site	Prehistoric	Late Archaic to Late Woodland	Temporary site, hunting, fishing, food preparation, and tool manufacture.
10	East bank of Merrimack opposite Souhegan confluence, Litchfield	Rodonis Field Site	Prehistoric	Middle Woodland	Evidence of short-term residence by small groups of people.
11	East bank of Merrimack across from Thornton's Ferry	Litchfield Island Site	Prehistoric	Unknown	Site was repeatedly occupied and a variety of activities practiced.
13	East bank of Merrimack near Chase Brook	Smolt Site	Prehistoric	Middle Archaic to Late Woodland	Site occupied during spring or early summer to collect plant foods.
14	East bank of Merrimack	Nesenkeag Site	Prehistoric	Late Archaic	Temporary task-specific site; tool manufacture or repair, hunting, or woodworking.

Table 9: Prominent Prehistoric and Historic Resources in the Lower Merrimack River Corridor.					
15	East bank of Merrimack near Cromwell's Falls vicinity	Campbell Site	Prehistoric	Middle Archaic and Woodland	Multi-component prehistoric site with evidence of tool maintenance and food procurement.
16	East bank of Merrimack between Cromwell's Falls and Chase Brook	Thebodeau Site	Prehistoric	Middle Archaic, Late Archaic, & Late Woodland	Multi-component habitation on site with flaked stone tools.
17	Chase Brook just east of Route 3A	Grist Mill Site	Historic	19th Century	Remains of old grist mill.
18	East bank of Merrimack	Danforth Archaeological District	Prehistoric		
	18A	Riverbank Site	Prehistoric	Middle Archaic to historic	Tool manufacturing or maintenance
	18B	Danforth Field Site	Prehistoric	Middle Archaic	Short-term occupation, possibly for hunting or fishing.
	18C	Danforth Sand Bank Site	Prehistoric	Middle Archaic	Tool manufacturing or repair, hunting, butchering, or skinning may have been practiced.
34	East bank of Merrimack, Merrimack landing in N. Ferry Road vicinity	Thornton's Ferry	Site of early ferry crossing	1700s	Site of ferry operated in 1700s by Matthew Thornton, one of the signers of the Declaration of Independence.
36	West side of Route 3A	Century Farm	House and Barn	1780	Fine example of the Georgian style; Litchfield's most substantial late 18th century house.
37	East side of Route 3A	Litchfield Town Center	District of civil structures	1844-1924	Litchfield Town Hall (1851); Community Church (1844); Library (1924) and several fine older residences.
Merrimack Sites					
2	Off Constance St.	Brickyard	Historic	1800	Bricks and brick fragments mostly submerged under a small pool.
12	West bank of Merrimack	Cromwell's Falls Lock	Historic archaeological	1814	Best preserved of eight remaining locks on Merrimack River system from Concord to Lowell. Originally 21 locks.
24	West and east sides of Route 3 at Greeley Street	The Signer's House & Matthew Thornton Cemetery	House and Cemetery	1770 and 1742	Late Georgian style structure with associations with Matthew Thornton. Oldest cemetery in Merrimack. Includes grave of Thornton and concentration of early gravestones.
35	West side of Merrimack at Depot Street	Reed's Ferry	Site of early ferry crossing		

Table 9: Prominent Prehistoric and Historic Resources in the Lower Merrimack River Corridor.					
38	West side of Merrimack at Cromwell's Falls or Thornton's Ferry	Cromwell's Trading Post	Site of Indian Trading Post	1656	One of the earliest trading posts on the Merrimack River. Burned in 1665.
Hudson Sites					
19	East bank of Merrimack	Asparagus Field Site	Prehistoric	Unknown	Tool manufacturing or repair.
20	East bank of Merrimack	Merrimack Street Site	Prehistoric	Unknown	Thin scatter of flakes suggest tool manufacture or repair.
21	East bank of Merrimack	Kenyon Street Site	Prehistoric	Unknown	Thin scatter of flakes suggest tool manufacture or repair.
25	Derry Road	Hills House	House	1890	Excellent example of Shingle style summer dwelling designed by Boston architect Hubert Ripley.
26	Library Street	Hills Memorial Library	Library	1909	Constructed of native materials in Tudor Style.
27	Derry Street	G.O. Sanders House	House	1873	One of the best surviving examples of French Second Empire style in the State.
Nashua Sites					
22	Confluence of Nashua & Merrimack Rivers	Nashua River Mouth Site	Prehistoric	Middle Archaic to Late Woodland	Prehistoric site on intact land surfaces. Variety of materials recovered: stone tools and cooking vessels.
23	West bank of Merrimack near Stateline	Pheasant Lane Mall Site	Prehistoric	Unknown	Site of prehistoric quartz workshop. No subsurface artifacts recovered.
28	Center of Nashua, north of Nashua River and west of Merrimack River	Nashville Historic District	District	1800 – 1930	Broad representation of 19th and early 20th century styles including many high style. Historical associations with individuals important to commercial and industrial development of Nashua.
29	Temple Street	Hillsborough County Courthouse	Courthouse	1901	Typical early 20th century institutional structure in Classical Revival style.
30	Main Street	Hunt Memorial Library	Library	1903	One of the early designs of internationally known Ralph Adams Cram. Important state example of Gothic style.
31	Abbot Square	Abbot-Spaulding House	House	1804	Important example of Federal and Colonial Revival periods of architecture in Nashua.
32	Concord Street	General George Stark House	House	1850	One of the finest dwellings in the Italian villa style in New Hampshire.

Table 9: Prominent Prehistoric and Historic Resources in the Lower Merrimack River Corridor.					
33	Factory & Pine Streets	Nashua Manufacturing Company Historic District	Mill District	1823-1948	Nashua's first and largest textile mill; good example of late 19th century industrial design.

This page intentionally left blank.

CHAPTER 4 CORRIDOR ASSESSMENT

Many land uses and activities in the Lower Merrimack River corridor are limited by physical characteristics, which have been discussed in Chapter 3 – Corridor Resources. Also important in determining the range of potential uses of a given site are the sociopolitical characteristics defined by the set of existing regulatory conditions, community vision, and expected values of different areas. This Chapter discusses the external sets of constraints operating within the Lower Merrimack River corridor, and their effects on the existing and potential uses and management of the corridor.

4.1 Regulatory Framework

4.1.1 Regulations

Federal, state, and municipal regulations are often the most conspicuous management tools available to a community and its resources, often having great impact on how resources are utilized or affected over time. Regulatory standards, however, are not immutable, and often change over time as needs and desired outcomes change. It is therefore important for stakeholders to remain abreast of existing regulations at all levels of government in order to fully understand the scope, intent, and reach of particular regulations, rules, and ordinances as they relate to specific resources and to other existing or proposed regulations. The following sections discuss some of the more prominent regulatory mechanisms that are in place to safeguard and regulate the Lower Merrimack River.

4.1.1.a New Hampshire Rivers Management and Protection Program

The Lower Merrimack River is designated under the Rivers Management and Protection Program as a Community River. RSA 483:9-b provides for the protection of rivers or river segments holding the community river designation, and includes the following protections:

- Construction of new dams for public water supply, flood control or hydroelectric energy production purposes may be allowed if such construction is consistent with management and protection of the resources for which the river or segment is designated.
- Construction, operation, and/or maintenance of new hydroelectric power facilities are allowed at existing or breached dams provided that:
  (a) The operational mode of any proposed facility shall be run-of-the-river, with project outflow equal to project inflow on an instantaneous basis and the project does not significantly alter the natural flow characteristics of the river; and
  (b) The proposed facility does not provide for diversion of the river or segment above or below the existing dam for a significant distance; and
  (c) The height of the impoundment is constant and, for existing or breached dams, is not raised above the maximum historic level of impoundment at that site.
- Interbasin transfers of water from a designated community river or segment shall not be permitted.
- No new channel alteration activities shall be permitted which interfere with or alter the natural flow characteristics of the river or segment or which adversely affect the resources for which the river or segment is designated. However, such channel alterations may be approved when necessary for the construction, repair, or maintenance of public water supply intake facilities in the river or river corridor.
- The use of native vegetation to stabilize the streambank of designated community rivers is encouraged.

- A protected instream flow level shall be established for each designated community river or segment and any upstream impoundment or diversion facility which may affect the natural flow characteristics of such river or segment pursuant to RSA 483-A:9-c.
- Water quality shall be restored or maintained at least at the Class B level. Significant adverse impacts on water quality or other instream public uses shall not be permitted.
- The department shall review and consider adopted local river corridor management plans prior to issuing any water discharge permit, terrain alteration permit, or wetlands permit (in accordance with RSA 485-A:13, RSA 485-A:17 or RSA 482-A).
- Any new solid waste storage or treatment facility shall be set back a minimum of 250 feet from the normal high water mark of and shall be screened with a vegetative or other natural barrier to minimize visual impact.
- Any motorized watercraft operating within 150 feet of the shoreline of a designated community river or segment shall travel at the slowest possible speed necessary to maintain steerage way, but at no time shall exceed six miles per hour.

4.1.1.b Alteration of Terrain Permit:

Alteration-of-Terrain (AOT) permits are designed to protect New Hampshire surface waters by minimizing soil erosion and controlling stormwater runoff, as required by RSA 485-A:17. Generally an AOT permit is needed before initiating any ground-disturbing activities to a contiguous area 100,000 square feet (2.3 acres) or more in size or 50,000 square feet in size if the location is within 250 feet of a lake, great pond, fourth-order stream, or designated river as defined in RSA 483-B, the Comprehensive Shoreland Protection Act. Some general provisions for AOT permits apply:

- For a single family subdivision in which the lot development will not be carried out at the same time as roadway construction, (i.e., the roadway and other work within the right-of-way will be completed and stabilized prior to grading the lots), the only item considered in calculation of disturbed area is the roadway. For example, for a 50 foot right-of-way, 2,000 linear feet of roadway would create an area of disturbance of 100,000 square feet, thus requiring a Site Specific permit.
- For other types of developments and earth removal operations, a contiguous earth disturbance of 100,000 square feet including building area, parking, driveways, roadways, utility construction, landscaping and borrow areas would require a Site Specific permit.
- For earth removal operations in existence on the effective date of the regulations, May 4, 1981, the "footprint" of the area of disturbance at that time is considered to be grandfathered, but any contiguous disturbance of 100,000 square feet or more outside that footprint requires a Site Specific permit.
- In addition to the above, RSA 483-B, the "Comprehensive Shoreland Protection Act," requires that any person intending to conduct an activity within the 250 feet of the protected shoreland resulting in a contiguous disturbed area exceeding 50,000 square feet to first obtain a permit.

4.1.1.c Comprehensive Shoreland Protection Act

Chapter 483-B of the New Hampshire Statutes contains the New Hampshire Comprehensive Shoreland Protection Act (CSPA), which is designed to protect the fragile and valuable resources adjacent to public surface waters. The CSPA contains minimum standards necessary to protect these public surface waters and their environs and serves to:

- Maintain safe and healthful conditions.
- Provide for wise utilization of water and related land resources.
- Prevent water pollution.

- Protect aquatic life and habitats.
- Protect buildings and lands from the effects of flooding and erosion.
- Protect archaeological and historic resources.
- Protect commercial fishing and industry.
- Protect wetlands.
- Control land uses, building sites, and placement of structures.
- Conserve shoreline cover.
- Preserve public waterbodies in their natural state.
- Promote wildlife habitat, scenic beauty, and scientific study.
- Protect public use of surface waters.
- Conserve natural beauty and open spaces.
- Anticipate and respond to the impacts of development in shoreland areas.
- Provide for economic development in proximity to public waters.

Further details on the provisions, allowances, and prohibitions contained within the CSPA can be found within the subparagraphs of Chapter 483-B. Recent modifications to the implementation and structure of the CSPA will go into effect in April 1, 2008.

4.1.2 Ordinances

Relative to corridor resources, there are a number of planning documents specified through municipal land use ordinances and zoning regulations in each of the four communities that relate to riparian and land management of the surrounding resources. Table 10 below shows the pertinent municipal ordinances and zoning regulations, and where in the municipal code they can be found, related to corridor management in each of the adjacent towns. It should be noted, however, that while one section of ordinance may deal specifically with a particular resource of interest, that resource may also appear in several other locations in the municipal ordinance; this table only references the predominant sections where information on a resource's allowable uses may be found.

Table 10: Municipal Ordinances Related to River Corridor Management Enacted within the Lower Merrimack River Corridor Communities

Management Category	Hudson	Litchfield	Merrimack	Nashua
Wetlands	CH 334, Article IX – *Wetland Conservation District*	Section 1200 – *Wetlands Conservation District*	2.02.7 – *Wetland Conservation District – Permitted Uses*	Chapter 16, Article VIII – *Wetlands*
Floodplains	Chapter 218 – *Flood Damage Prevention*	Section 1100 – *Floodplain Conservation District*	2.02.8 – *Flood Hazard Conservation District – Permitted Uses*	Chapter 16, Article VII, Division 18 – *Floodplain Development*
Aquifers and Groundwater	n/a	Section 1250 – *Aquifer Protection District*	2.01.11 – *Aquifer Conservation District*	n/a
Shoreland Protection	n/a	n/a	2.02.12 – *Shoreland Protection District*	n/a
Wastewater Treatment	n/a	n/a	n/a	Chapter 18 – *Sewage Disposal*
Wellhead Protection	n/a	n/a	2.01.11.D.2 - *Prohibited Uses, Wellhead Protection Areas*	Chapter 16, Article X – *Water Supply Protection District*

Table 10: Municipal Ordinances Related to River Corridor Management Enacted within the Lower Merrimack River Corridor Communities

Management Category	Hudson	Litchfield	Merrimack	Nashua
Stormwater Management	n/a	n/a	n/a	Chapter 16 Article IV, Section 16-145 – *Stormwater Management Standards*
Erosion and Sedimentation	n/a	n/a	n/a	n/a
Watershed Protection	n/a	n/a	n/a	n/a

4.1.3 Subdivision / Site Plan Review Regulations

Each corridor community has specified a list of required information which must be submitted for approval for a subdivision processes and/or nonresidential or multi-family dwelling development. Site plan review sets forth the specific information which must be submitted during the review process, including application requirements and design standards. The breadth of these regulations sets the scope of information submitted to decision makers on individual properties and developments, and property owners and developers alike may find it useful to understand the application and approval processes within and between municipalities.

4.1.4 Other Guidance

4.1.4.a Lower Merrimack River Local Advisory Committee

The Lower Merrimack River Local Advisory Committee (LMRLAC) is the locally appointed river management advisory committee for the Lower Merrimack River. Committee members are nominated by the local governing bodies of Hudson, Litchfield, Nashua, and Merrimack. The Commissioner of the NH Department of Environmental Services (Commissioner) appoints at least one person from each municipality to the local river management advisory committee, and each committee must be composed of at least seven members who represent a broad range of interests in the vicinity of the designated river or segment. These interests shall include, but are not limited to, local government, business, conservation interests, recreation, agriculture, and riparian landowners. If an interest is not represented by the local governing bodies' nominations, the Commissioner may appoint a member from the vicinity of the designated river or segment to the local river management advisory committee who will represent that interest. Each member serves a term of three years.

LMRLAC's duties include advising the Commissioner and municipalities on matters pertaining to the management of the Lower Merrimack River. In turn, municipal officials, boards, and agencies shall inform LMRLAC of any actions which they are considering in managing and regulating activities within designated river corridors. LMRLAC also reviews federal, state, or local governmental plans to approve, license, fund or construct facilities that would alter the resource values and characteristics for which the river or segment is designated. LMRLAC has already developed a Development Review Checklist to assist and guide the application review process, providing a standard template from which all applications are initially evaluated. Annually, LMRLAC reviews and comments on permit applications taking place within the Lower Merrimack River corridor. Formal review of State permit applications is common, while other permits originate at the municipal level. LMRLAC is also responsible for reporting

annually to the Department of Environmental Services Commissioner on the status of compliance with federal and state laws and regulations, local ordinances, and plans relevant to the designated river or segment and corridor.

LMRLAC is also charged with the development of a local river corridor management plan, which may be adopted by the representative municipal Planning Board pursuant to RSA 675:6 as an adjunct to the local master plan. Advisory Committees are encouraged to seek such adoption from the Planning Boards, since the plan does not have any regulatory authority unless adopted by municipal master plans.

4.1.4.b Guidelines for Naturalized River Channel Design and Bank Stabilization

These guidelines (NHDES and NHDOT 2007), produced jointly by the New Hampshire Department of Environmental Services and the New Hampshire Department of Transportation, provide a project classification system that can be used to determine whether a project is routine, moderate, or comprehensive which then can guide the selection of designs for bank stabilization methods. The guidelines also provide a description of the primary types of river channel distress to aid in accurate problem identification. Also provided is a project monitoring and evaluation tool which can be used in the monitoring phase of project work.

4.1.4.c Innovative Land Use Planning Techniques: A Handbook for Sustainable Development

To address the need for guidance and technical assistance on Innovative Land Use Controls authorized by RSA 674:21, the New Hampshire Regional Environmental Planning Program (REPP) has produced a guide with model ordinances and regulations on a number of innovative land use techniques which consider the following topic areas:

- Lot Size Averaging
- Feature-based Density
- Village Plan Alternative Subdivision
- Inclusionary Housing
- Stormwater Management
- Steep Slopes and Ridgeline Protection
- Wildlife Habitat Management
- Energy Efficient Development
- Transfer of Development Rights
- Conservation Subdivision
- Infill Development
- Growth Boundaries
- Wetlands
- Drinking Water
- Shoreland and Riparian Areas
- Floodplains
- Erosion and Sediment Control
- Transit-oriented Development
- Livable/Walkable Design
- Access Management
- Dark Skies Lighting
- Landscaping Regulations

More information on the content of these chapters can be found at the NHDES website: http://www.des.state.nh.us/REPP/index.asp?go=ilupth. These chapters provide municipalities with new techniques and tools for achieving local master plan objectives through changes in land use ordinances and zoning regulations.

4.1.4.d New Hampshire Wildlife Action Plan

The New Hampshire Fish and Game Department has worked to create the state's first Wildlife Action Plan. The plan provides New Hampshire decision-makers with tools for restoring and maintaining critical habitats and populations of the state's species of conservation and management concern. The plan incorporates statewide data such as species occurrence records into a Geographic Information System

which contains wildlife species profiles, profiles of important habitats, and strategies for habitat conservation. Existing wildlife management activities will also be incorporated into the database. Since river corridor areas often contain important wildlife habitat, the Wildlife Action Plan will be a useful resource in evaluating critical management needs within the Lower Merrimack River corridor. More information on the NH Wildlife Action Plan can be found online at the NH Fish and Game Department's website at: http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm

4.2 Watershed Audit Findings

A Watershed Audit is often used to establish the baseline of existing watershed protection strategies present in a given community. In 2006, watershed audits were administered to knowledgeable municipal staff in each of the four Merrimack River corridor communities: Litchfield, Merrimack, Nashua, and Hudson. Each audit measures the extent to which eight watershed protection tools (watershed planning, land conservation, aquatic buffers, better site design, erosion and sediment control, stormwater management, non-stormwater discharges, and watershed stewardship programs) are enacted in the community. The results and themes of these audits, arranged by the watershed protection tools of interest, are discussed in Table 11 below. Copies of the actual audits are included at the end of the corridor plan in Appendix 2.

TOOL 1: WATERSHED PLANNING: Watershed planning involves the creation of regulatory measures and planning methods that limit impervious cover and redirect development to the most appropriate and least sensitive areas.	**TOOL 2: LAND CONSERVATION**: Land conservation includes programs to conserve underdeveloped, biologically sensitive, or areas of cultural or historic importance	**TOOL 3: VEGETATIVE BUFFERS**: Vegetative buffers help protect aquatic ecosystems by requiring development to occur at a removed distance from shoreland areas, providing a natural shield from potentially hazardous activities or substances.	**TOOL 4: BETTER SITE DESIGN**: Better site design includes local ordinances and codes that can reduce impervious cover and redirect runoff through design decisions.
TOOL 5: EROSION AND SEDIMENT CONTROL: Erosion and sediment controls include both physical mechanisms and regulatory practices to prevent erosion.	**TOOL 6: STORMWATER MANAGEMENT**: Stormwater management includes all structural practices that help mitigate the impacts of stormwater runoff into waterbodies.	**TOOL 7: CONTROL OF POINT DISCHARGES**: Controlling site-specific pollutant sources such as sanitary waste and deicing chemicals which can enter surface waters through runoff or direct discharges.	**TOOL 8: WATERSHED STEWARDSHIP**: Watershed stewardship programs generally foster human behavior that prevents or reduces pollution over a range of land uses and activities.

Table 11: Watershed Audit Findings and Comparisons for Hudson, Nashua, Merrimack, and Litchfield

Mechanism and Activity	Nashua	Hudson	Merrimack	Litchfield
WATERSHED PLANNING				
Conservation Easements	Yes	Yes	Yes	Yes
Land Acquisition Programs	Yes	Yes	Yes	Yes
Infill Development	Yes	Yes	No	Yes
Community Redevelopment	Yes	Yes	No	Yes
Infrastructure Extension Limits	No	Yes	No	No
Transfer of Development Rights	No	Yes	No	No
LAND CONSERVATION				
Cultural and Historic Areas	Progressive	Encouraged	Encouraged	Progressive
Agricultural Land	Absent	Encouraged	Absent	Encouraged
Critical Habitat Areas	Absent	Encouraged	Absent	Progressive
Wetlands	Required	Required	Required	Required
Steep Slopes	Required	Required	Required	Required
Forested Areas	Absent	Encouraged	Absent	Encouraged
Stream Channels	Required	Required	Required	Required
AQUATIC BUFFERS				
Stream Buffers	Required: 75′ for Prime Wetlands[1] and 40′ for Critical Wetlands[2]	Required (50′ no disturbance)	Required (25′ no cut buffer, 40′ bldg setback, 50′ shoreland setback)	Required (50′ no disturbance)
Nashua Prime Wetlands[1] = Merrimack River, Nashua River, Salmon Brook, Pennichuck Brook, Bowers Pond, Harris Pond, Holts Pond, Pennichuck Pond, Supply Pond, Lovewell's Pond, Horse Pond, Old Ridge Road wetlands, Nashua Canal, and Nashua Cove. *Nashua Critical Wetlands[2] = Boire Brook, Coburn Pond, Cold Brook, Colerain Brook, Hales Brook, Harris Brook, Hassells Brook, Lincoln Brook, Lyle Reed Brook, Mill Pond, Muddy Brook, Old Maid's Brook, Round Pond, Spectacle Brook, Spit Brook, Trout Brook, Sandy Pond.*				
Wetlands Buffers	Primary = 75′ Critical = 40′ 3,000-9,000 sq ft =20 >9,000 sq ft = 40′ Vernal Pools =20′	50′ wetland	25′ buffer 40′ setback	50′ wetland 200′ vernal pool
Riparian Cover	Required	Required	Absent	Absent
BETTER SITE DESIGN (REDUCED IMPERVIOUS SURFACES)				
Minimum Road Widths in Low Density Neighborhoods (< 500 ADT)	28 ft	23-26 ft	23-26 ft	23-26 ft
Minimum Right-of-Way for Residential Streets	50 ft	50 ft	50 ft	50 ft
Cul-de-Sac Minimum Radius	50 ft (30 ft if no future extension capacity)	50 ft	50 ft	50 ft
Curb and Gutter	Required	Required	Required	Required

Table 11: Watershed Audit Findings and Comparisons for Hudson, Nashua, Merrimack, and Litchfield

Mechanism and Activity	Nashua	Hudson	Merrimack	Litchfield
Parking				
Minimum Parking Spaces				
Office Uses	3/1000 ft²	3/1000 ft²	3.1-3.5/1000 ft²	3.1-3.5/1000 ft²
Commercial Uses	4/1000 ft²	4/1000 ft²	4.1-5.5/1000 ft²	5.5/1000 ft²
Residential Uses	2/unit	2/unit	Absent	2/unit
Shared Parking	Encouraged	Encouraged	Encouraged	Absent
Compact Car Parking	Absent	Absent	Absent	Absent
Spillover Parking	Paved with pervious materials	Paved with pervious materials	Paved with pervious materials	Paved with pervious materials
Landscaping	Required	Required	Absent	Required
Cluster Development	Encouraged	Encouraged	Encouraged	Allowed for Older People Only
Consolidated Open Spaces within Subdivisions	Required	Required	Absent	Required
Natural Open Space Management Minimums within Subdivisions	Absent	Required	Absent	Required
Specific Allowable Uses within Open Space	Required	Required	Required	Required
Sidewalks				
Both Street Sides	Absent	Absent	Absent	Absent
Minimum Width	5 feet	5 feet	5 feet	Absent
Trail Substitutions	Absent	Allowed	Allowed	Allowed
Single Family Driveways				
Pervious Materials	Allowed	Allowed	Allowed	Absent
Two-track Designs	Absent	Allowed	Allowed	Absent
Shared Driveways	Absent	Prohibited	Allowed	Prohibited
Rooftop Discharges into Yards	Allowed	Allowed	Allowed	Allowed
EROSION AND SEDIMENT CONTROLS				
Controls used in the past 3 years				
silt fences	Yes	Yes	Yes	Yes
straw bales	Yes	Yes	Yes	Yes
construction sequencing	Yes	Yes	No	Yes
construction phasing	Yes	Yes	Yes	No
preservation and non-disturbance of natural vegetation	Yes	Yes	Yes	Yes
preservation and non-disturbance of stream and wetland buffers	Yes	Yes	Yes	Yes
stair-step grading	No	Yes	No	No
temporary seeding and mulching	No	Yes	Yes	Yes
permanent seeding and mulching	No	Yes	Yes	Yes
dust control	No	Yes	Yes	No

Table 11: Watershed Audit Findings and Comparisons for Hudson, Nashua, Merrimack, and Litchfield

Mechanism and Activity	Nashua	Hudson	Merrimack	Litchfield
erosion blankets and geotextiles	Yes	Yes	Yes	Yes
fiber rolls	No	Yes	Yes	No
temporary stream crossings	Yes	Yes	Yes	No
stabilized construction entrances	No	Yes	Yes	Yes
exit tire wash	No	Yes	No	No
energy dissipation at pipe outlets	No	Yes	Yes	No
check dams in natural or manmade channels	Yes	Yes	Yes	Yes
sand/gravel bag barriers	No	Yes	Yes	No
brush or rock filters	No	Yes	Yes	No
storm drain inlet protection	Yes	Yes	Yes	No
catch basin inlet filters	Yes	Yes	Yes	Yes
sedimentation basins	No	Yes	No	No
sediment traps	No	Yes	Yes	Yes
filtration of dewatering operations	No	Yes	Yes	No
secondary filtration	No	Yes	Yes	No
dikes or berms	No	Yes	Yes	No
pipe slope drains to bypass erodible soils	No	Yes	No	No
stockpile stabilization	Yes	Yes	Yes	Yes
Inspections				
responsible party	Planner	Inspector	Public Works Engineer	Planning Board Consulting Engineer
schedule	As needed, generally quarterly	Weekly	Weekly or Bi-monthly depending on site difficulty	(Contained in stormwater plan)
Erosion and Control Plan	Required	Required	Required	Required
Training Opportunities	No	Yes	No	No
Violations Enforcement				
Fines	No	Yes	No	Yes
Injunctions, Cease and Desist Orders, stop work orders	No	Yes	Yes	Yes
Board/Commission Review	No	Yes	No	No
Withholding Certificate of Occupancy or Road Bond	No	No	Yes	No
EPA Notification	Yes	No	No	No

Table 11: Watershed Audit Findings and Comparisons for Hudson, Nashua, Merrimack, and Litchfield				
Mechanism and Activity	**Nashua**	**Hudson**	**Merrimack**	**Litchfield**
STORMWATER MANAGEMENT (PHASE II COMMUNITIES)				
Management Systems	Storm sewers, some CSOs remaining	Storm sewers and open channels	Storm sewers and open channels	Storm sewers and open channels
Top Three Management Practices	1) Subsurface infiltration units 2) Treatment basins 3) Vortechnics	1) Silt fences and straw bales 2) Infiltration systems 3) recharge systems	1) Reports and recommendations 2) On-site retention and infiltration 3) Natural swale or wetland retention to discourage sheet flow	1) Catch basins 2) Silt fences and check dams 3) detention / retention ponds
Stormwater Management Plan at Site Plan Review	Required	Required	Required	Required
Inspection During Construction	Required	Required	Required	Required
Maintenance Responsibilities	Private Owner	Private Owner, Municipality, HOA, or Developer	Municipality	Private Owner, Municipality, or HOA
Violations Penalties	NH RSA 676:17: (Initial fine of $275 and a daily fine of $550/day/violation)	Fines and revocations of permits	Notification to EPA to issue a $32,000 per day fine	Enforcements contained within individual approvals
NON-STORMWATER DISCHARGES				
Sanitary Waste Management	Centralized wastewater treatment plant	Centralized wastewater treatment plant and individual septic systems	Centralized wastewater treatment plant and individual septic systems	Individual subsurface disposal systems and leach fields
Septic System Maintenance Regulations	Yes	Yes	No	No
Required inspections of privately owned septic systems	Yes	No	No	Yes
Municipal Spill Response Plans	Yes	Yes	Yes	Yes
Deicing Systems	Sand and Road Salt	Sand and Road Salt	Sand, Road Salt, and Calcium Chloride	Sand
Municipal Salt Storage Facility	Yes	Yes	Yes	Yes

Table 11: Watershed Audit Findings and Comparisons for Hudson, Nashua, Merrimack, and Litchfield				
Mechanism and Activity	**Nashua**	**Hudson**	**Merrimack**	**Litchfield**
WATERSHED STEWARDSHIP PROGRAMS				
Stream Restoration Projects	Yes	Yes	No	No
Pet Waste Management Ordinance	Yes	Yes	No	Yes
Street Sweeping	Weekly March – September	Annually (Downtown swept 3-4 times per year)	As needed	Annually
Use of Fertilizers and Pesticides on Public Lands	Yes	No	Yes	Yes

Notes:
Absent = Conservation program not in place.
Encouraged = Conservation program encouraged, but not mandated in all cases.
Required = Conservation program required.
Progressive = Conservation requirements or local programs operate at levels higher than State or Federal mandates.

4.3 Existing Land Uses

Land uses provide a general classification of activities that are loosely organized around the prescribed zoning of a particular area. Land uses are often more intuitive ways of viewing development patterns than zoning, since most everyone can relate to residential, commercial, and industrial uses, whereas zoning is strictly codified, and is therefore described differently between towns and is not readily comparable. General land uses within the quarter-mile river corridor for each of the towns is quantified in Table 12, and are illustrated in Figures 8A and 8B.

Table 12: Existing Land Use Types in the Lower Merrimack River Corridor.

	Merrimack		Litchfield		Nashua		Hudson		Corridor Total	
Land Use	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Agriculture	0	0.0%	579.3	36.8%	0	0.0%	15.9	1.1%	595.2	9.6%
Commercial	62.5	3.8%	15.8	1.0%	139.2	8.8%	20.3	1.5%	237.8	3.8%
Industrial	393.7	23.9%	0	0.0%	235.9	14.9%	265.2	19.2%	894.8	14.5%
Institutional	0.3	0.0%	14.8	0.9%	0	0.0%	3.2	0.2%	18.3	0.3%
Residential	224.4	13.6%	320.8	20.4%	257.4	16.3%	458.8	33.1%	1,261.4	20.4%
Mixed use	21.1	1.3%	11.6	0.7%	0	0.0%	0	0.0%	32.7	0.5%
Municipal Facility	62.7	3.8%	4.6	0.3%	28	1.8%	8.9	0.6%	104.2	1.7%
Open Space	96.4	5.8%	64.7	4.1%	0	0.0%	15.4	1.1%	176.5	2.9%
Recreational	0.7	0.0%	71.1	4.5%	111.5	7.0%	173.4	12.5%	356.7	5.8%
Roadways	101	6.1%	50	3.2%	287.6	18.2%	113.4	8.2%	552	8.9%
Right-of-Way	11.5	0.7%	0	0.0%	47.1	3.0%	0.6	0.0%	59.2	1.0%

Table 12: Existing Land Use Types in the Lower Merrimack River Corridor.

	Merrimack		Litchfield		Nashua		Hudson		Corridor Total	
Land Use	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
School	0	0.0%	14.4	0.9%	9.9	0.6%	2.8	0.2%	27.1	0.4%
Vacant	411.7	25.0%	191.7	12.2%	221.5	14.0%	70.9	5.1%	895.8	14.5%
Water	262.8	15.9%	235.9	15.0%	244.3	15.4%	235.6	17.0%	978.6	15.8%
Total Corridor	**1,648.8**		**1,574.7**		**1,582.4**		**1,384.4**		**6,190.3**	

The character of each of the towns may partially be captured by the land uses which have the highest contributing percentages: Merrimack's land uses are predominated by both vacant land and industrial uses; agriculture makes up the highest percentage of land use in Litchfield; Nashua has relatively even and high percentages of industrial, residential, and roadway uses; and the bulk of Hudson's area is predominated by residential uses. For the region as a whole, residential uses make up the largest percent land area, at 20.4 percent.

At smaller scales, and particularly for the river corridor itself, zoning can be a useful tool to allow prediction of future land uses and conditions based on current municipal regulations. While regulatory standards may fluctuate over time, zoning amendments are generally heavily scrutinized and publicly reviewed, and therefore zoning remains a feature which may be reasonably predictable. The corridor zoning requirements are illustrated in Figures 10A and 10B.

4.4 Issues Summary

The following sections discuss the status of the Lower Merrimack River corridor in relation to the overall management goals identified in Chapter 2 of this management plan. These issues will then be transformed into recommendations appearing in Chapter 5. In essence, these identified issues provide guidance on the actual studies, activities, or processes that would be useful in supporting the overall goal of preserving the character and integrity of the Merrimack River.

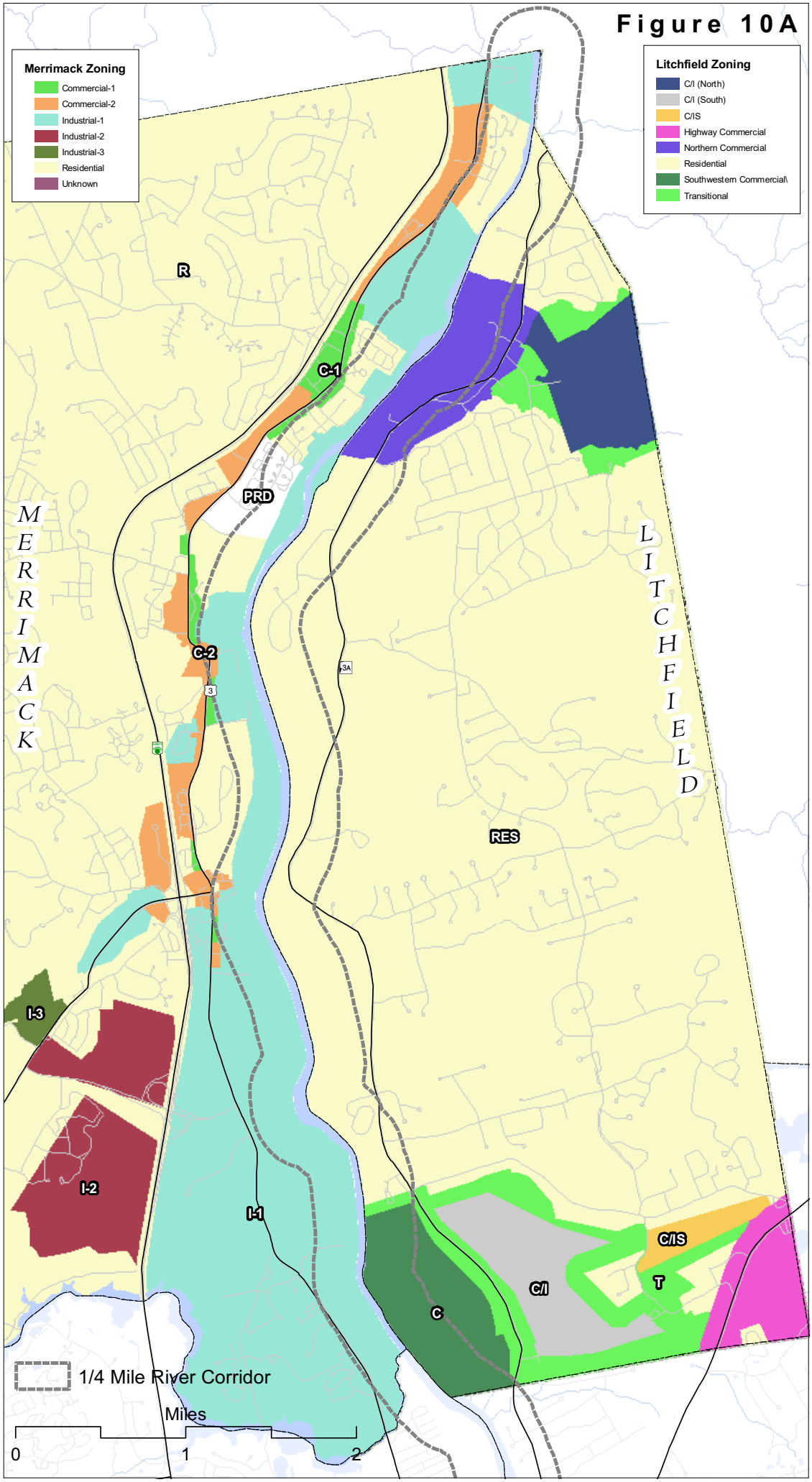
Insert
Figure 10A – Zoning Map (North)

Scroll Down for Figure 10A

Lower Merrimack River Corridor Plan

Zoning Map

Figure 10A



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

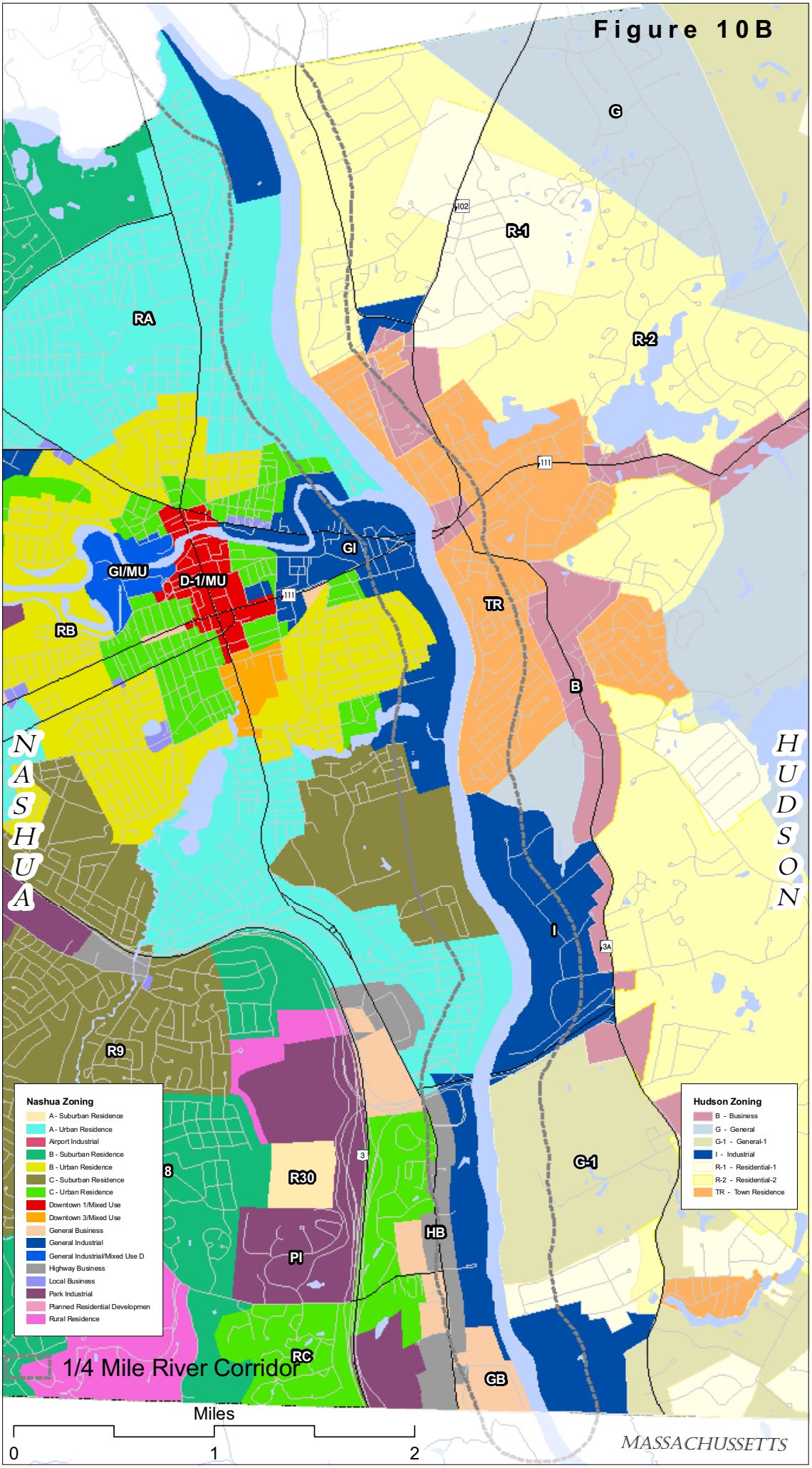
Insert
Figure 10B – Zoning Map (South)

Scroll Down for Figure 10B

Lower Merrimack River Corridor Plan

Zoning Map

Figure 10B



N

Maps prepared by the Nashua Regional Planning Commission are for planning purposes only. NRPC uses data gathered from multiple sources at various scales of accuracy. No warranties, expressed or implied, are provided for the data herein, its use, or its interpretation.

NRPC

Prepared by NRPC GIS, May 2007
Project Location: J:\GIS\Projects2006\Merrimack_River_06\report\report_floodplains.mxd

4.4.1 Administration

Processes and administration of corridor-related issues and permits are handled differently in each corridor community, which can be problematic for issues that have trans-jurisdictional effects or implications since there is no oversight agency or group for day-to-day activities occurring within the river corridor. There is potential for increased coordination of violations tracking, enforcement, and permitting opportunities, perhaps through the local Conservation Commissions and the Lower Merrimack River Local Advisory Committee. The Corridor Management Plan itself can serve as a unifying resource if incorporated into municipal Master Plans, giving each town a common basis for making recommendations and pursuing actions that promote wise use of the corridor. The DES One-Stop Database found at http://www.des.nh.gov/OneStop.htm is a resource that tracks permit information. It could also prove invaluable not only for understanding the cumulative effects of incremental developments but also for increasing public involvement in the management of corridor resources and concerns.

Citizens can always report potential violations through the DES Wetlands Bureau via a form on their website at http://www.des.nh.gov/Wetlands/pdf/complain.pdf. Also, since each of the municipalities already has policy, personnel, and a regulatory framework that works well individually, there is strength to be built upon in the efforts of arranging collective management of the overall corridor, both in violations reporting and enforcement.

4.4.2 Conservation

While each of the communities has tools available to help in permanently protecting important land or resource areas, dedication of permanently protected open space is still a difficult hurdle for the corridor communities. Land values continue to escalate which means that communities are finding it increasingly difficult to purchase large parcels of land outright, and need to step-up partnering efforts. As such, there is also a need to implement conservation on a smaller scale, using innovative methods which right now are only encouraged in the corridor communities rather than required. Conservation subdivisions, smaller or shared access, and innovations in stormwater controls are all methods which have the ability to incrementally preserve undeveloped land, yet they are often misunderstood and require education of both municipal professionals and the general public to implement these methodologies on a wider scale. In some cases, these methodologies are not even allowed under existing zoning or developers are not given enough incentive to work for more efficient designs given the education curve necessary at the permit approval stage

4.4.3 Corridor Management

Management of the Merrimack River is mainly controlled by the existing regulatory framework contained within the corridor communities, consisting of regulations, ordinances, and permitting approvals. It is apparent that each of the corridor communities has made strides toward better protection of the corridor resource; however, critical pieces of regulatory oversight are sometimes still lacking, or when in place, there is a lack of enforcement or long-term evaluation of protective measures. None of the four corridor communities have adopted erosion control standards or watershed protection measures within their zoning ordinances, making it difficult to regulate activities or disturbances that occur to already developed properties within the corridor. In addition, only Merrimack has adopted a zoning ordinance which regulates development within the shoreland area.

The watershed audits also reveal that the protective measures afforded to the river throughout the corridor vary widely between communities, which may have the unintended consequence of encouraging developments to occur in places which have the least control or influence over it.

4.4.4. Historic Resources

All four communities in the river corridor actively protect historic resources, though information on the Lower Merrimack River corridor as a collective resource has not yet been officially recognized. There is room, and need, for more active protection of historic resources along the Merrimack River which may have the combined effect of contributing to overall recreation, open space, or wildlife habitat protection goals at the same time.

4.4.5 Public Access and Awareness

Public access to the river resource continues to be a matter of concern from both quantity and quality standpoints. An increased public presence allows for both increased appreciation and potential degradation of the river corridor, so recreational uses of the river environment need to be carefully managed and directed. Currently, there are few public access points to the river, and those that are available are not well publicized or known, some contain structural deficiencies in terms of facilities, parking, and maintenance, and some are not well patrolled (either formally or informally) allowing inappropriate activities or vandalism to persist. However, the Merrimack River itself is a much beloved resource that is still a "diamond in the rough." An increased number of attractive and well-managed facilities will help to promote even greater appreciation of the river corridor by a wider, environmentally conscious audience.

4.4.6 Restoration

Each of the corridor communities have made increasing efforts towards effectively regulating new developments with riparian resource considerations in mind, but it is somewhat more difficult to regulate existing uses and even more difficult to achieve rehabilitation or restoration of existing structures that do not violate any existing standards but do represent outdated or no longer permitted designs. Outfalls and streambank stabilization structures along the Merrimack River corridor range in design and condition and many are problematic in the degree to which they accommodate riparian interests either in terms of materials, velocity of discharge, height, landscaping, or aesthetic concerns. Communities will need to use a variety of voluntary and involuntary approaches to achieving restoration of outdated, unsafe, or incompatible structures.

4.4.7 Scenic Quality

While hard to define, scenic quality is an important resource that remains largely ignored, in that structural heights and screening standards are the same for either upland or riparian properties. Viewsheds from the river are not currently protected, and viewsheds to the river from individual homes are often in violation of the State Comprehensive Shoreland Protection Act but are not enforced.

4.4.8 Water Quality

The Lower Merrimack River corridor has enjoyed over 20 years of continuous water quality field data, however, sophisticated water quality testing for a variety of water quality contaminants is both laborious and expensive and is currently lacking. As development pressure increases along the corridor, water quality issues will also change. Dedicated volunteers and funds will be necessary to guarantee that monitoring data remains current and relevant to changing contaminant issues. In addition, regulatory frameworks lack the rigor needed to address a full spectrum of water quality issues ranging from road salt applications to aquifer protections to erosion control. Standards for regulating the cumulative effects of smaller developments are currently absent within the corridor community towns, and will become increasingly necessary as infill of developments and retrofitting of existing sites become more common.

In addition, water quality improvements may only be achievable when the full spectrum of upstream and downstream uses and impacts are considered at a variety of government levels, and additional partnering may be needed with entities having jurisdiction primarily outside of the corridor area.

4.4.9 Water Quantity

As population and demand for river uses continues to increase, the flexibility for water users to persist or expand will continue to decrease. Consumptive uses of surface waters are in direct conflict with other uses, and the adjacent communities need additional information in order to fully understand the degree to which these competing uses can be accommodated. As a primarily drinking water resource for over 80,000 residents in the Nashua region (via Pennichuck Water Works) understanding the demand for and allocation of surface waters is important, and will only continue to increase in need and importance as the population continues to change and grow.

4.4.10 Wildlife and Aquatic Habitats

As development pressure in riparian lands and aquatic habitats continue to increase, the need to protect these habitats for fish and wildlife populations will also increase if we are to maintain viable populations of water-dependent habitats and species. Currently, only Litchfield regulates the development of critical habitat areas, and language is entirely absent from both Nashua and Merrimack's land use ordinances. Maintaining up-to-date Natural Resource Inventories within the corridor communities will help guide decision-makers when considering the needs of fisheries and wildlife. This is the first step toward adopting regulations which actively protect these resources.

This page intentionally left blank.

CHAPTER 5 RECOMMENDED ACTIONS

Previous chapters provide information on the resources of the Merrimack River corridor as well as existing land use, zoning, and property ownership. Each section identifies a number of issues and problems associated with protecting the water quality and quantity of the river and with conserving the quality of the corridor. This section contains specific recommended actions aimed at maintaining or improving the river resources identified in the previous chapters. While the recommendations in this chapter are specifically made for the river corridor, many can also be applied to activities throughout the watershed as well. The recommendations are arranged and discussed in relationship to the goals and objectives of the corridor plan, given in Chapter 2 of this document, and are arranged in the relative order of importance as determined by the LMRLAC. The full list of action items, grouped by objective, is included as Appendix 3 of this document.

5.1 List of Recommended Actions

Action Class 1: Administration

Rank	ID	Action
1	1.3.1	Encourage DES to increase enforcement of existing environmental regulations such as Alteration of Terrain and dredge and fill of wetlands and NPDES violations.
2	1.1.1.	Inform and educate citizens and enforcement officials on the applicable federal, state and local regulations to ensure proper understanding of the regulation and the rationale behind them.
3	1.3.2	Report any violations of federal, state or local regulations. To facilitate citizen reports, LMRLAC should partner with the Conservation Commissions, code enforcement officers, and police departments of the four communities to work jointly on developing a process by which citizens and municipalities can follow in reporting wetland, stormwater, shoreland protection, and pollutant discharge violations. As part of this cooperative effort, informational pamphlets describing the applicable regulations and the appropriate violations reporting options should be distributed. A website for information on violation should also be created so that citizens can be more involved in reporting local conditions.
4	1.2.1	The communities and other organizations should use the power of the press to its fullest in promoting the issues and activities surrounding the river. Publicize all public meetings, clean-up days, public access dedications, recreation events and volunteer activities.
5	1.2.2	Utilize the assistance of the Nashua Regional Planning Commission to conduct a series of meetings in each corridor community to discuss the information contained in the Merrimack River Corridor Management Plan and its recommendations.
6	1.1.2	Facilitate a process by which projects within the river corridor being reviewed by local Conservation Commissions are simultaneously reviewed by the LMRLAC.
7	1.2.3	Seek training for the Local Advisory Committees from DES so that LACs are better able to assist in notification and enforcement of violations.
8	1.2.4	Actively recruit new membership into the LMRLAC.
9	1.2.5	For large or complex applications, require that project applicants attend LAC meeting to demonstrate how Alteration of Terrain and wetland requirements will be met through the project proposal.

Action Class 2: Conservation

Rank	ID	Action
1	2.1.1	Partner with local Conservation Commissions to sponsor regularly scheduled informational meetings on topics related to river conservation that are of interest to community residents. The discussions should focus on the impacts of individual actions and the benefits derived from the river. Suggested topics include: • protection of water resources and water conservation; • impacts of non-point pollution sources (NPS) on water quality and what can be done to decrease NPS on an individual basis; • conservation mechanisms available to private landowners and the benefits of the different alternatives; • proper applications of fertilizers and pesticides for weekend gardeners and homeowners; • care and maintenance of septic systems; and • historic resources of the corridor.
2	2.1.2	Develop asset inventory logs for all undeveloped / underdeveloped properties within the Lower Merrimack River corridor.
3	2.1.3	Partner with the local Conservation Commissions to support requests for funding the purchase of conservation easements and land in their annual budget request. Provide Conservation Commissions with support documentation on priority properties deserving protection.
4	2.1.4	Partner with local Conservation Commissions in each community to develop information pamphlets to be enclosed with regular mailings on river conservation issues.
5	2.1.5	Request the Hudson Board of Selectmen to dedicate all revenue from the current use land use change tax for the purchase of conservation lands.
6	2.1.6	Request that the corridor community municipal officials include funds for the purchase of conservation easements and lands in the capital improvements program on an annual basis. LMRLAC should encourage the Conservation Commissions to submit conservation funding requests.
7	2.2.1	Adopt innovative zoning for conservation subdivision regulations in Litchfield. Conservation subdivisions can be used to conserve open space, prime and active farmland, environmentally sensitive areas and significant wildlife habitats.
8	2.3.1	Adopt a watershed conservation district which creates standards for development within areas adjacent to riparian habitats in all four corridor communities to begin the development of a greenbelt along the Merrimack River corridor.
9	2.1.7	Conduct a study to quantify the economic benefit of open space in each community.

Action Class 3: Corridor Management

Rank	ID	Action
1	3.1.1	*Adopt impervious surface limitations that restrict development to less than 10% allowable impervious surface within the river corridor.*
2	3.2.2	*Adopt local wetlands, stormwater, surface, and groundwater land use regulations in each corridor community that will provide a level of protection that maintains the existing condition of the Merrimack River.*

Action Class 3: Corridor Management

3	3.2.1	Support local communities in the development and adoption of local river protection regulations which identify permitted uses and their requirements, as well as give development standards for the allowable locations of public and private boating docks.
4	3.2.3	Protect steep slopes and other environmentally sensitive areas through adoption of land use regulations that prohibit or limit development in these river corridor areas.
5	3.2.4	Adopt regulations that limit alterations to natural stream channels and banks and require restoration for already degraded streambank segments and mitigation of unavoidable impacts to stream and river banks.
6	3.2.5	Adopt local shoreland protection regulations in all four corridor communities that are designed to protect the Lower Merrimack River according to specific local needs and conditions.
7	3.2.6	Determine a tiered set of required buffer distances for use in regulating land uses adjacent to the Merrimack River based upon the hydrology and topographic features surrounding this unique riparian resource, acknowledging that a one-size-fits-all setback may not be the most appropriate or equitable means of managing this surface water.
8	3.3.1	Encourage the adoption of mitigation requirements when the natural appearance and function of shoreland elements are degraded, both in new construction and for existing developments.
9	3.4.1	Support designation of the Nashua River into the Rivers Management and Protection Program by assisting in the nomination and designation process.
10	3.4.2	Support DES and the New Hampshire Legislature in adopting additional surface water protection regulations.
11	3.2.10	Amend the subdivision and site plan review regulations in all four communities to include requirements to maintain and manage vegetative buffers between site developments and surface waters, including developments that facilitate public access to the Lower Merrimack River. These regulations should include development standards that limit cutting of vegetation within sensitive areas.
12	3.2.7	Amend or adopt floodplain regulations in corridor communities to restrict the construction or enlargement of buildings and structures within the 100-year floodplain. Periodically inundated with water, floodplains are best suited for low intensity uses such as recreation where little damage to property will occur.
13	3.2.8	Partner with the corridor communities' Conservation Commissions to amend the wetland regulations to include the following: • 75-foot minimum setback for buildings, structures, and parking areas • 50-foot required vegetated buffer for wetlands • 125-foot minimum setback for septic systems and leachfields located in somewhat poorly drained soils or soils with a rapid or very rapid permeability.
14	3.2.9	Amend the local excavation regulations in all four communities to prohibit excavations within the shoreland zone and to allow them as a special exception within a specified distance of the shoreland. Excavations change the hydrologic patterns of runoff, increase the susceptibility of the area to erosion and degrade visual quality.

Action Class 4: Historic Resources

Rank	ID	Action
1	4.1.1	Conduct historic resource surveys of the river corridor in each community through volunteer efforts. The NRPC can provide assistance to the organizations interested in conducting historic surveys.
2	4.1.2	Obtain assistance in preparing National Register applications for eligible sites.
3	4.2.1	Partner with corridor community historic preservation offices to publicize updates to historic resource inventories.

Action Class 5: Public Access and Awareness

Rank	ID	Action
1	5.3.4	*Organize recreational opportunities for the general public at least twice a year that are designed to provide positive recreational experiences to users in order to facilitate greater appreciation for river resources.*
2	5.3.1	Increase public awareness of the Merrimack River as an asset to the four communities through which the Lower Merrimack River flows and to the region as a whole through development of flyers, public service announcements, recreational opportunities, and partnerships with other entities having high media profiles.
3	5.1.1	*Encourage corridor communities to acquire public access easements along the shoreline to be used for a recreational trail within the River corridor.*
4	5.3.7	Establish a trained team of volunteers within each community to facilitate education and recreation programs that emphasize the wise use of the river through recreational programs and uses. Educational messages should focus on conservation and recreational uses, but should also be flexible enough to provide landowners with answers to questions regarding liability and law enforcement. Where possible, volunteer programs should be incorporated into schools as to be accessible to youth and families.
5	5.2.3	Acquire and develop public boat access areas in each community. Communities should consider utilizing both municipally owned properties as well as purchasing land along the river. When developing public boat access areas, both sides of the river should be serviced appropriately.
6	5.2.4	Develop a continuous trail system along the shores of the river. The trail should follow the riverbank wherever possible. In instances where existing development presents a barrier the trail should skirt around the development and come back to the riverbank when possible. Develop a plan for construction and maintenance of a corridor trail system that provides incremental phasing for sections of trail which may be accomplished within distinct planning phases.
7	5.3.8	Partner with the local Conservation Commissions and historical societies in each community to develop and install interpretive signs to highlight important natural and historic areas.
8	5.2.1	Increase public access to the Lower Merrimack River through development of a non-motorized recreational trail system along the shores of the Lower Merrimack River.
9	5.2.2	Develop additional boat launching facilities along both sides of the Lower Merrimack River corridor.
10	5.3.3	*At least once a year, distribute educational information that discusses the wise use of the Lower Merrimack river and its corridor environment to corridor community schools and civic groups.*

Action Class 5: Public Access and Awareness

11	5.3.5	Develop a clearinghouse for useful information related to landowner liability, responsibility, and opportunity concerning use of public recreational facilities which cross private property.
12	5.3.6	Develop a database of Lower Merrimack River corridor property owners, updated at least once a year, to assist municipalities, conservation commissions, and the LMRLAC in communicating with landowners on important corridor issues and opportunities.
13	5.1.2	Utilize service organizations in each community to construct and maintain existing and future trail networks. Encourage organizations to adopt sections of the trail and become responsible for their maintenance.
14	5.1.3	Request conservation and pedestrian easements along the river during the site plan and subdivision review processes in all four communities. These areas can then be used to meet the open space and recreation requirements. RSA 674:36, Subdivision Regulations, and RSA 674:44, Site Plan Review Regulations authorize communities to include open space and recreation land criteria in their regulations and to consider these criteria when reviewing development proposals.
15	5.1.4	Encourage increased police presence at existing and future public areas on the river to protect visitors, to discourage vandalism, loitering and other inappropriate behavior, and to enforce use restrictions. This will become increasingly more important if individual landowners agree to public access easements across their property.
16	5.2.5	Develop parking areas at strategic locations to provide additional river access that minimize neighborhood impacts.
17	5.2.6	Investigate the possibility of developing shared parking programs between municipal buildings and/or private firms to provide additional evening and weekend parking for trail and river users wherever possible.
18	5.3.9	Acquire and/or improve signage at existing areas and provide signs for future public access areas to identify locations. Existing public access areas are inadequately marked and difficult to find. New or improved signs should be designed to increase public awareness of and access to river facilities.
19	5.3.10	Develop maps and information brochures in each community showing the location and the conditions of use for each public access point, the trail and shared parking area, and significant natural and historic areas; and have them readily available at the municipal building.
20	5.1.5	Establish standard hours of operation for any public river-related recreational facilities and provide access to the facility during those hours.
21	5.2.7	Facilitate the leasing of the Greeley Park boat ramp from the City of Nashua to the NH Fish and Game Department to allow for facilities improvements including adequate parking and boat launch facility.

Action Class 6: Restoration

Rank	ID	Action
1	6.1.1	Clean up river habitats and shoreland areas that are already polluted with debris, contaminants, and garbage to improve site-specific water quality.
2	6.1.2	Encourage and educate Conservation Commissions, developers, and the general public about alternatives to rip-rap streambank stabilization methods.
3	6.1.3	Encourage active restoration of degraded streambank through the development and implementation of regulatory requirements or incentive based performance standards.

Action Class 7: Scenic Quality

Rank	ID	Action
1	7.1.1	Adopt height restrictions, in conjunction with shoreland protection regulations, to limit the height of new buildings in the shoreland zone to a maximum of two stories to effectively screen development from the river and maintain the visual integrity of the corridor.
2	7.1.2	Adopt landscaping regulations, in conjunction with shoreline protection regulations, to screen developments from the river and public recreation areas, including trails.

Action Class 8: Water Quality

Rank	ID	Action
1	8.1.1	Facilitate active participation in and support local water quality monitoring programs, including sampling for a wide variety of chemical components (VOC, mercury, lead, PCBs, etc.). The results obtained can provide valuable information regarding the health of the State's rivers and streams.
2	8.4.2	Monitor all proposals for intakes, discharges and water transfers, and provide comment during the DES 401 Water Quality Certificate review process. The impacts of the discharges on other water uses and users should be specifically described in any proposal documents.
3	8.1.2	Conduct an inventory of all in-use and abandoned underground storage tanks in each community, paying particular attention to those tanks located in the river corridor or near a tributary. The inventory can be conducted by the conservations commissions and should include the following information: tank volume, age and content, construction material, single or double walled, size and location of additional containment area, leak detection systems, and monitoring. This will supplement information available from the DES Oil Remediation and Compliance Bureau (ORCB) for registered facilities with underground storage capacities of 1,100 gallons or greater. In addition, owners of abandoned tanks should be provided with information and assistance on proper closure. Any faulty tanks detected in the inventory should be reported to the ORCB.
4	8.3.2	Encourage corridor community Planning Boards to adopt regulations that require qualified inspections of development projects to ensure adherence to the community's regulations, conformance with any conditions of the approved development plan, and proper installation and maintenance or erosion and sedimentation control devices.
5	8.3.3	Develop and adopt aquifer protection regulations in Hudson, Litchfield and Nashua to protect groundwater resources. This is particularly important for Hudson and Litchfield since groundwater is presently their sole source of drinking water. Model regulations and assistance in drafting regulations are available from NRPC. Since the river flows through an aquifer, these regulations will also protect the water quality of the river.

Action Class 8: Water Quality

6	8.4.3	Encourage the Legislature to develop and adopt legislation prohibiting the use of phosphate detergents in the State of New Hampshire.
7	8.4.4	Encourage DES to continue to jointly protect the water quality and quantity of the Merrimack River in both New Hampshire and Massachusetts. The recent Merrimack River Initiative involving both states provides a good foundation for building interstate cooperation to protect the water quality of the river and the watershed.
8	8.1.3	Utilize volunteers to conduct useful research into such things as outfall locations and periodic monitoring of effluent reports generated by NPDES facilities.
9	8.3.4	Develop and implement comprehensive road salt application management programs aimed at limiting salt applications within the river corridor in Hudson, Litchfield and Nashua.
10	8.3.5	Amend the subdivision regulations in Hudson and Litchfield to remove exemptions of smaller subdivisions from needing to complete erosion and sedimentation control plans. This will provide increased protection for the community's wetlands, lakes, ponds, rivers and streams from the negative impacts of erosion and sedimentation. Amend the Nashua site plan review and subdivision regulations to require adequate erosion and sedimentation control during development.
11	8.3.6	Amend the subdivision and site plan regulations in all four communities to require as a condition of approval a state approved erosion and sedimentation control plan and an alteration of terrain permit for all developments that disturb 100,000 square feet of contiguous earth or 50,000 square feet of contiguous earth within 250 feet of the protected shoreland.
12	8.1.4	Study the Lower Merrimack River to encourage the assessment of a wide range of chemical components (VOCs, mercury, lead, PCBs, etc.) to facilitate better understanding of the existing water quality and its trends over time.
13	8.2.1	Obtain baseline biological and chemical monitoring data in a format useable for existing state assessment tools.
14	8.4.1	At least yearly, discuss discharger compliance with NHDES in regards to NPDES permits, violations, and ongoing enforcement actions to monitor permit activity in the Lower Merrimack River Corridor.
15	8.2.2	Identify the strategies most needed to address non-point source pollution through yearly assessments of the top issues contributing to pollution problems in order to minimize NPS in the Lower Merrimack River.
16	8.2.3	Reduce nutrient loading to the Lower Merrimack River corridor system, including nutrient loading into tributary streams by encouraging yearly voluntary inspections of facilities within the corridor.

Action Class 9: Water Quantity

Rank	ID	Action
1	9.1.1	Encourage New Hampshire to develop and adopt minimum instream flow regulations for the Merrimack River and its major tributaries.
2	9.1.2	Encourage the four communities to work jointly with the State of Massachusetts and the EPA in NHDES efforts to conduct a demand/yield analysis of the Merrimack River to determine the existing types and levels of water use and to project future water demands throughout the watershed.
3	9.1.3	Encourage the development of a comprehensive study that quantifies the surface and groundwater resources that comprise the drinking water supply of the Lower Merrimack River watershed, so that resource use can be better understood and managed.
4	9.1.4	Develop and maintain an inventory of flow dependent Instream Public Uses and Outstanding Characteristics and Resources (IPUOCRs).

Action Class 10: Wildlife and Aquatic Habitats

Rank	ID	Action
1	10.1.1	Encourage the corridor communities to include vernal pools as part of their respective local wetlands definitions.
2	10.2.1	Utilize permit review opportunities to facilitate involvement of wildlife and aquatic habitat protection into project designs and development approvals through use of information contained within the NH Wildlife Action Plan.
3	10.2.2	Incorporate critical wildlife habitat needs into priority ranking of desired conservation lands for use in land or easement acquisition pursuits. Encourage the Town of Merrimack and City of Nashua to include critical wildlife habitat into their land conservation regulations.
4	10.1.2	Maintain, enhance, and promote populations of resident and anadromous fish, freshwater mussels, and other aquatic resources.

5.2 Recommended Participants

Community action will have the greatest influence on conservation of the Merrimack River corridor. Many of the issues and problems of the river are most effectively addressed at the local level. The majority of the recommendations require some amount of action at the local level, with reduced reliance on state or federal actions. These include a broad spectrum of actions ranging from regulatory mechanisms such as zoning and code enforcement to educational and volunteer activities.

Accomplishing many of the recommendations depends on the support and involvement of many organizations within each community. For example, municipal governments must not only support the general concept of developing a trail along the river but also be willing to commit to funding such as matching funds for land or easement purchases or staffing for additional police protection. Other organizations with a role in conserving the Merrimack River corridor include: Planning Boards, Conservation Commissions, private conservation and environmental organizations, regional planning commissions and the Natural Resource Conservation Service. The following discussion focuses on the municipal, regional, state, local and private organizations involved in protecting the Merrimack River and its watershed.

5.2.1 Lower Merrimack River Local Advisory Committee

According to State statute, one of the main tasks charged to the Local Advisory Committee is to "develop or assist in the development and adoption of local river corridor management plans under RSA 483:10." Comprised of representatives from the business, recreation, agriculture, and conservation community as well as riparian landowners and local government, the Lower Merrimack River Local Advisory Committee plays a unique, citizen-based, multidisciplinary role as stewards over activities in the Lower Merrimack River corridor. LMRLAC activities vary from reviewing wetland applications and site plans for development, to assisting with trail projects and commenting on conservation activities within the corridor. As part of the corridor plan update process, LMRLAC's chief objective will be to establish stronger relationships with the local Planning Boards and coordinate development activities in the corridor to ensure the long-term protection of the Lower Merrimack River.

5.2.2 Municipal Governing Bodies

The majority of municipal government recommendations concerning the river corridor deal with amendments to the zoning regulations or financial commitments. All four towns are managed differently, either through Town Council, Board of Alderman, Board of Selectmen, and Town Meetings,. However, in each situation, it is important that every municipality be aware of the need to protect the river and be committed to any efforts to conserve the river corridor. This will require an extensive education effort in all four communities, but is particularly important in Litchfield, Merrimack and Hudson because of the influence of the Town Meeting on municipal operations. The success of any effort to protect the river corridor has a direct relationship to the support and commitment of the municipal governing body.

5.2.3 Planning Boards

As the municipal board responsible for drafting new zoning ordinances, amending existing regulations and administering the municipality's land use regulations, the Planning Board plays a major role in protecting the Merrimack River and its watershed. While the board recommends changes to the zoning regulations, they must ultimately be approved by the community's governing body. Changes to the site plan and subdivision review regulations, however, can be made by a majority vote of the Planning Board without the approval of the municipal governing body. The Planning Board can also use non-regulatory actions to protect the river such as recommending changes to the proposed design and negotiating with developers for conservation easements. Planning Board support is key to the success of protecting the Merrimack River corridor, and these entities must be encouraged to use their regulatory and non-regulatory powers to pursue the objectives of this plan.

5.2.4 Budget Committees

The municipal budget is generally prepared by the Budget Committee. It is important that the Budget Committee be informed of the need for conserving the river corridor, particularly with regard to funding for conservation efforts. Though the Budget Committee does not make the final decisions, their support of a program is important.

5.2.5 Conservation Commissions

Conservation commissions are another municipal body intimately involved with conserving the Merrimack River corridor. Municipality's have the authority to create Conservation Commissions under RSA 36-A. Specific responsibilities listed in the statute include: conducting an inventory of the

municipality's natural resources; coordinating the activity of unofficial bodies organized for similar purposes; and maintaining an index of the municipality's natural and scenic resources. In addition, Conservation Commissions may do the following: recommend to the governing body a project for the protection, development and sound utilization of all the areas in the index; acquire in the name of the municipality by gift or purchase conservation lands and be responsible for their management and control; carry over funds from year to year for purchasing conservation areas; and provide public information on conservation issues.

Given these responsibilities, Conservation Commissions have a major role in protecting the Merrimack River. Therefore, the Conservation Commission in each community should take a lead role in developing a greenway/trail system along the Merrimack River. The Conservation Commissions in conjunction with the municipal recreation department should identify key parcels along the river for public access and investigate alternative funding schemes for purchase and site development. The commissions should also conduct land owner contacts for obtaining conservation and pedestrian easements along the river. In addition, the commissions should be responsible for providing general conservation information to the residents of the communities.

5.2.6 Regional Planning Commissions

The Nashua Regional Planning Commission (NRPC) serves as a forum for inter-municipal issues and regional policy. Regional issues currently being studied by the NRPC include: solid waste, septage, regional housing needs, transportation, water supply and the Merrimack River. In addition to addressing the regional issues, NRPC also provides technical assistance to the individual member communities such as master plan and capital improvement program updates, revisions to zoning, subdivision and site plan review regulations, drafting water resource management and protection plans, conducting historic preservation inventories and preparing National Register nominations, and professional planning services through the circuit rider program. Therefore, the NRPC is the appropriate forum to discuss issues affecting localities and the region.

The NRPC is committed to assisting the communities in protecting the Merrimack River corridor. As a regional agency, the NRPC has a great deal of information about the communities within its region. This document is an example of the resources available to the NRPC and how they can be used to analyze the impact of the individual communities on one entity, the Merrimack River. With this information, the NRPC can assist the communities in developing consistent regulations and methods for achieving the goal of protecting the river corridor. NRPC staff can also assist communities with applications for funding and with making landowner contacts.

5.2.7 Natural Resource Conservation Service

The Natural Resource Conservation Service (NRCS) can provide communities with valuable information on soil and soil potentials. The NRCS can assist communities in developing setback and buffer requirements based on soil types; in evaluating wetlands and wetland impacts; in evaluating erosion problems; and in providing general information on erosion and sedimentation control.

5.2.8 Merrimack River Watershed Council

The Merrimack River Watershed Council (MRWC) is a private, non-profit organization concerned with the issues of the entire Merrimack River watershed including: water quality; supply and flow; land use; protection of environmentally sensitive areas; protection of the river corridor; and recreation. With approximately 2,500 members in New Hampshire and Massachusetts, the MRWC is actively involved in conservation efforts in both states. The MRWC can provide New Hampshire communities with

assistance in a number of areas including: trail development, landowner contacts, conservation and pedestrian easements and providing public information on the river.

5.2.9 Conservation Organizations

Assistance is available from a number of conservation organizations active in the State including: the Society for the Protection of New Hampshire Forests, the New Hampshire Audubon Society, the Nature Conservancy, the Trust for Public Lands, and the New Hampshire Rivers Council. These organizations can provide valuable information on wildlife, forest management and land conservation techniques. Funding for the purchase of conservation lands and easements, however, is extremely limited and innovative partnerships are needed for successful land conservation projects to take shape and materialize on the ground.

This page intentionally left blank.

REFERENCES

Billings, Marland P. 1956. The Geology of New Hampshire Part II – Bedrock Geology. Department of Resources and Economic Development, Concord.

Goldthwait, James W., et al. The Geology of New Hampshire Part I – Surficial Geology. Department of Resources and Economic Development. Concord.

Hudson History Committee. 1977. Town in Transition, Hudson, New Hampshire 1673-1977.

Hurd, D. Hamilton. 1992. Town and City Atlas of the State of New Hampshire 1673 – 1977. Boston: D.H. Hurd & Co.

Kenyon, Victoria Bunker. 1984. Archaeological Study of Nashua, New Hampshire. December 1984.

_____. 1984. Cultural Resources Review and Impact Evaluation, Merrimack C-330215-03 & -05.

_____. 1984. Determination of Eligibility, Danforth Archaeology District, Litchfield, NH.

Kenyon, Victoria. Determination of Eligibility, Thebodeau Site, Litchfiled, NH 45-70.

_____. 1980. Evaluation of Significance of the Three Flake Site, NH 45-28. July 1980.

_____. 1984. The Lund Collection: Nashua, New Hampshire. NH State Cooperative Regional Archaeology Plan.

LMRLAC 2006. River Tours Outcome Summary. Lower Merrimack River Local Advisory Committee. September 25, 2006.

McAllister, Mary Beth et al. 1980. A Phase I Archaeological Assessment of the Moore's Falls Hydroelectric Porject. Durham, NH: Archaeological Research Services, University of New Hampshire.

Merrimack Historical Society. 1976. The History of Merrimack, New Hamsphire. Merrimack Historical Society.

Moorehead, Warren. 1931. The Merrimack Valley Archaeological Survey. Salem: Peabody Museum.

Nashua Regional Planning Commission. 1989. Merrimack River Corridor Management Plan. September 1989.

NHDES (New Hampshire Department of Environmental Services) 2003. Combined Sewer Overflows Environmental Factsheet. New Hampshire Department of Environmental Services. WD-WEB-9. 2003.

_____. 2007. Personal communication with Minda Shaheen regarding NPDES discharges to the Lower Merrimack River basin. Peg Bastien, Compliance Supervisor, Wastewater Engineering Bureau. New Hampshire Department of Environmental Services. June 27, 2007.

_____. http://www.des.nh.gov/Rivers/Instream. Information on the Instream Flow Protection Pilot Program. River Management and Protection Program. Watershed Management Bureau.

_____. http://www.des.state.nh.us/Rivers/merrim1.htm. Information on the designated segment of the Lower Merrimack River. Rivers Management and Protection Program, Watershed Management Bureau. New Hampshire Department of Environmental Services.

_____. http://www.des.state.nh.us/REPP/index.asp?go=ilupth. Regional Environmental Planning Program Innovative Land Use Planning Techniques Guide. New Hampshire Department of Environmental Services.

_____. http://www.des.nh.gov/OneStop.htm. OneStop Web Site. Online web-based database for environmental data.

NHFGD (New Hampshire Fish and Game Department). http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm. New Hampshire Wildlife Action Plan.

New Hampshire Division of Historical Resources. 1989. Historical Resources in the Merrimack Study Area, Concord to Franklin.

Price, Chester B. 1967. "Historic Indian Trails of New Hamphsire," The New Hamsphire Archaeologist 14:1-12.

Sargent, Howard. Cultural Resource Review and Impact Evaluation, Hudson C-330112-02.

_____. Cultural Resource Review and Impact Evaluation, Salem Project C-330193-02.

_____. 1980. Phase I Cultural Resource Review of the Nashua-Hudson Circumferential Highway.

Stark, General George. "Frederick G. Stark and the Merrimack River Canals," Granite Monthly: Vol ix, pp 5-15.

#526B-22