

BIODIVERSITY CONSERVATION PLAN

Merrimack, NH

Prepared for:
Merrimack Conservation Commission



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December 2010

Cover Photograph: Appalachian oak rocky woods, a rare natural community in New Hampshire that supports many rare plants located on conservation lands in Merrimack.

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Grateful appreciation is extended to all Merrimack Conservation Commission members. Andy Powell provided much assistance in gathering existing information and conducting field visits, as well as provided general oversight for the project as elected by the Conservation Commission. Thanks to all of the forum participants and community members that provided their insights and observations throughout the duration of the project. And a special thanks to Dan Cyr of Bay State Forestry Services, Laura Deming of New Hampshire Audubon, and Matt Tarr of UNH Cooperative Extension for their time, enthusiasm, and expertise provided during the “Walk About,” a day-long event that focused on Merrimack’s natural resources.

Merrimack Conservation Commission

Andy Powell – Chairman

Robert Croatti – Vice Chairman

Phil Straight

John P. Diggins III

Eber Currier

Douglas Starr

Tim Tenhave – Town Council representative

The Merrimack Conservation Commission (MCC) was established in accordance with RSA 36:A to assist in protecting the natural resources of the municipality. The Commission advises and makes recommendations for the protection, development and utilization of local natural resources and open space.

The Commission's goal is to ensure proper utilization and protection of Merrimack's natural resources.

CURRENT GOALS:

1. To establish land management plans for town owned land,
2. Maintain land acquisition for the protection of open space and natural resources,
3. Create buffer zones for protection of wetlands, and
4. Increase community education and outreach programs.

The MCC meets twice monthly. Meetings are aired on Merrimack Public Cable T.V. Channel 20. The Merrimack Conservation Commission (MCC) is comprised of 7 full time commission member positions and 3 alternate member positions. The Commission serves as a focal point of the town regarding environmental concerns and advises the state on permit applications for dredge and fill activity. In addition, the Commission conducts workshops, seminars, manages land owned by the Town and monitors specific projects.

Conservation Commission
Community Development Department
6 Baboosic Lake Road
Merrimack, NH 03054
Phone: (603) 424-3531
Fax: (603) 424-1408

Office Hours:
Monday- Friday 8:00am-4:30pm
Located in the Lower Level of Town Hall

SUBCOMMITTEE LINKS:

Horse Hill Nature Preserve:
<http://www.hhnp.org/>

Grater Woods Town Forest:
<http://www.flickr.com/photos/marcn/sets/72157594492492467/>

LINKS TO VARIOUS STATE AGENCIES:

NH Department of Environmental Services:
<http://des.nh.gov/>

NH Fish and Game Department:
<http://www.wildlife.state.nh.us/index.htm>
Wildlife Action Plan:
http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm

NH Natural Heritage Bureau:
<http://www.nhdfi.org/about-forests-and-lands/bureaus/natural-heritage-bureau/>

University of NH Cooperative Extension:
<http://extension.unh.edu/>

INTRODUCTION

Statement of Purpose

The Biodiversity Conservation Plan has been prepared for the town of Merrimack to provide guidance into the identification and protection of open space for significant natural resources. The Merrimack Conservation Commission (MCC) has stated that the purpose of the plan is to focus on the conservation of wildlife habitats and biological diversity, which promotes informed land use decisions using an ecological perspective. It shall serve as a planning tool for the Merrimack Conservation Commission, Planning Board, Community Development Office, schools, and individuals. To this end, the following general goals of the plan are as follows:

1. To identify priorities for future wildlife habitat and natural community protection initiatives, whereby providing information to be used as the basis for financial planning options;
2. To promote and support the conservation, restoration, and enhancement of ecological integrity and sound management of biological diversity, including populations of rare species, critical wildlife habitats, and significant natural communities;
3. To incorporate meaningful and detailed ecological data into the town Master Plan;
4. To continue to raise awareness of the ecological attributes of Merrimack through community outreach and education;
5. To provide an action plan indicating what should be addressed, by whom, when and how for the next five and ten years

Biological Diversity and Conservation Planning

Currently, New Hampshire's population is growing at a rate that is twofold that of the other New England states. The population has doubled in the forty years leading up to the turn of the century in 2000, and there was a rise in population of 17.2% between 1990 and 2004 alone. This growth is followed by VT (10.4%), RI (7.7%), ME (7.3%),

MA (6.7%), and CT (6.7%). New Hampshire's development pressure will continue to threaten the state's natural resources if not managed with diligence.

To better understand the trend of development specific to the region, the NH Office of Energy Planning has projected that Hillsborough County will be the fastest growing county in NH with an increase in population of 101,680 from 2000-2025. In another local study the Nashua Regional Planning Commission (NRPC) conducted a buildout impact analysis of each of its 12 communities, including Merrimack. This research helps to establish the potential growth within the region if all suitable land is developed. NRPC's projections suggest that there could be a total population growth of 32% throughout the 12 communities, resulting in an additional 64,857 people living in the region at buildout.

The bulk of population growth is in the southern third of the state; however 75% of protected lands are located in the northern regions. This entrusts towns in southern New Hampshire with a great responsibility for managing their natural resources and biological diversity, and establishes citizens as stewards of the land if we are to use informed decision making to promote a more sustainable approach at land use planning.

Biological diversity, or biodiversity, refers to the variety, variability, and complexity of life in all its forms (plants and animals) and includes various ecological processes (e.g., nutrient cycling, flooding, fires, wind events, and succession) that have helped to shape them over time. Biodiversity includes various levels such as individual species and their genes that have evolved over time, as well as the many intricate plant and wildlife populations. It refers to even higher levels of organization including natural communities and even entire ecosystems, such as wetlands, woodlands, and rivers. Therefore, the concept of biodiversity engenders all levels of biological organization and the interactions of all living organisms.

Planning for the conservation of biodiversity is not a new concept altogether. It has helped in such efforts as the recovery of the American bald eagle; assisted in building preserves and managing other lands for species of conservation concern, as well as our most common species; aided in the identification of biodiversity hot spots; and helped to identify and protect critical wildlife habitats within our landscape. It has been a center

piece for natural resources protection, restoration, and adaptive management for the past four decades.

This form of land use planning is ever-changing. It evolves with better understandings of natural resources protection and as we continue to develop new areas. It is a vision that should be based on the principles of conservation biology and incorporate the current ecological structure of a given area (such as a town, a watershed, or an entire region). Thus, biodiversity conservation planning strives to incorporate the socio-economic fabric of our world with that of the ecological structure in an effort to help build more sustainable, more resilient New Hampshire communities into the future.

Community Outreach and Education

As an integral part of this project, the MCC wanted to and provided opportunity by involving the residents into the conservation planning process. This outreach and education effort involved two basic areas of concentration.

Community Forum

In November 2008, the Merrimack Conservation Commission sponsored an open community forum to introduce the biodiversity planning concept. A summary of this project was presented, which was followed by a mapping exercise. This exercise provided participants with an opportunity to discuss and map various observations of significant natural features in Merrimack. This process provided some very valuable insights into Merrimack's abundant wildlife, plants, and critical habitats.

Participants of the evening, which included many residents of Merrimack, were encouraged to continue reporting wildlife sightings, as well as any interesting or unusual plant observations. To aid in this endeavor, a volunteer packet was assembled that included instructions, a topographic map of Merrimack to plot observations by location, observations forms, and lists of critical habitats and focal species of conservation concern (Appendix A). The volunteer effort provided great planning assistance for site assessments in 2009.

Natural Resources Workshops

A series of three workshops were presented in 2009 as a means to promote community outreach and education on various aspects of Merrimack's natural resources. The first workshop was held in February and focused on winter mammal tracking at the Merrimack Middle School. Approximately 10 students and their instructor, Rick Glatz, participated in an exercise to learn how to set up a winter mammal tracking survey. The goal of this workshop was to stimulate student interest in mammal tracking and to begin a long-term sampling program of wildlife in Grater Woods.

In May, the second workshop was presented to approximately 20 participants at Grater Woods. Vernal pool ecology was the theme of this event, which explored common and rare obligate species of vernal pools, as well as other species that use them for critical habitats (such as breeding and feeding). Other aspects discussed during the field outing included how to distinguish vernal pools from other smaller wetlands, species identification from egg masses, ecological functions of vernal pools, and the significance of these ecosystems for biodiversity.

The third workshop, "Walk About," was held in November. This day-long workshop involved three different locations, including two-hour walks at Horse Hill Nature Preserve and Grater Woods separated by a beaver habitat presentation at the Merrimack Middle School during lunch time. This format provided opportunities for participants to join for one or all sessions of the day. It was estimated that 80-90 participants joined the "Walk About." Critical wildlife habitats, natural communities, species of conservation concern, and proper forest management associated with Merrimack's open space properties was the theme of the day.

The morning walk was held at Horse Hill Nature Preserve where trip leaders (Jeffrey Littleton of Moosewood Ecological, Dan Cyr of Bay State Forestry Services, and Laura Deming of NH Audubon Society) led a hike up to Blodgett Hill to discuss a rare forest community and associated plants, wildlife inhabitants, and past land use history that has helped to shape the current landscape. The walk then led participants to Lastowka Pond to learn about wetlands ecology and their roles in maintaining biodiversity in Merrimack. Discussions centered on past forest management, wetland

wildlife including the state endangered Blanding's turtle, and an introduction to beaver ecology while looking upon an active lodge.

Matt Tarr, Wildlife Specialist and Associate Professor at the UNH Cooperative Extension, discussed the history and ecology of beavers in the northeast. Attendees enjoyed their lunch as Matt presented a slide show in the Merrimack Middle School cafeteria. Following the presentation, the group visited the newly constructed education center behind the school where Matt talked about the evolving beaver meadow.

The final session of the workshop involved a walk through Grater Woods. Jeff Littleton and Dan Cyr led the group along wetlands and woods roads to discuss significant features of the property. This included various critical wildlife habitats such as vernal pools, mast forests, deer wintering areas, and a locally significant natural community, as well as some of the wildlife that has been observed. Dan also discussed the goals of the forest management project that have recently taken place and how wildlife habitats were taken into account.

CURRENT ECOLOGICAL CONDITIONS

Overview of Study Area and Inventory Approach

Merrimack lies within the Gulf of Maine Coastal Plain, a subsection of the U.S. Forest Service's Lower New England ecoregion that spans the southeastern portion of New Hampshire and continues into Maine and Massachusetts (Figure 1). This ecoregional classification system is based on natural divisions defined by physical characteristics (climate and landforms) and biological attributes. These natural divisions define ecoregions and their associated subsections are useful in synthesizing information regarding plant distributions and ecosystems. Simply stated, it is a systematic approach of understanding and classifying the ecological structure of our natural world on a large scale.

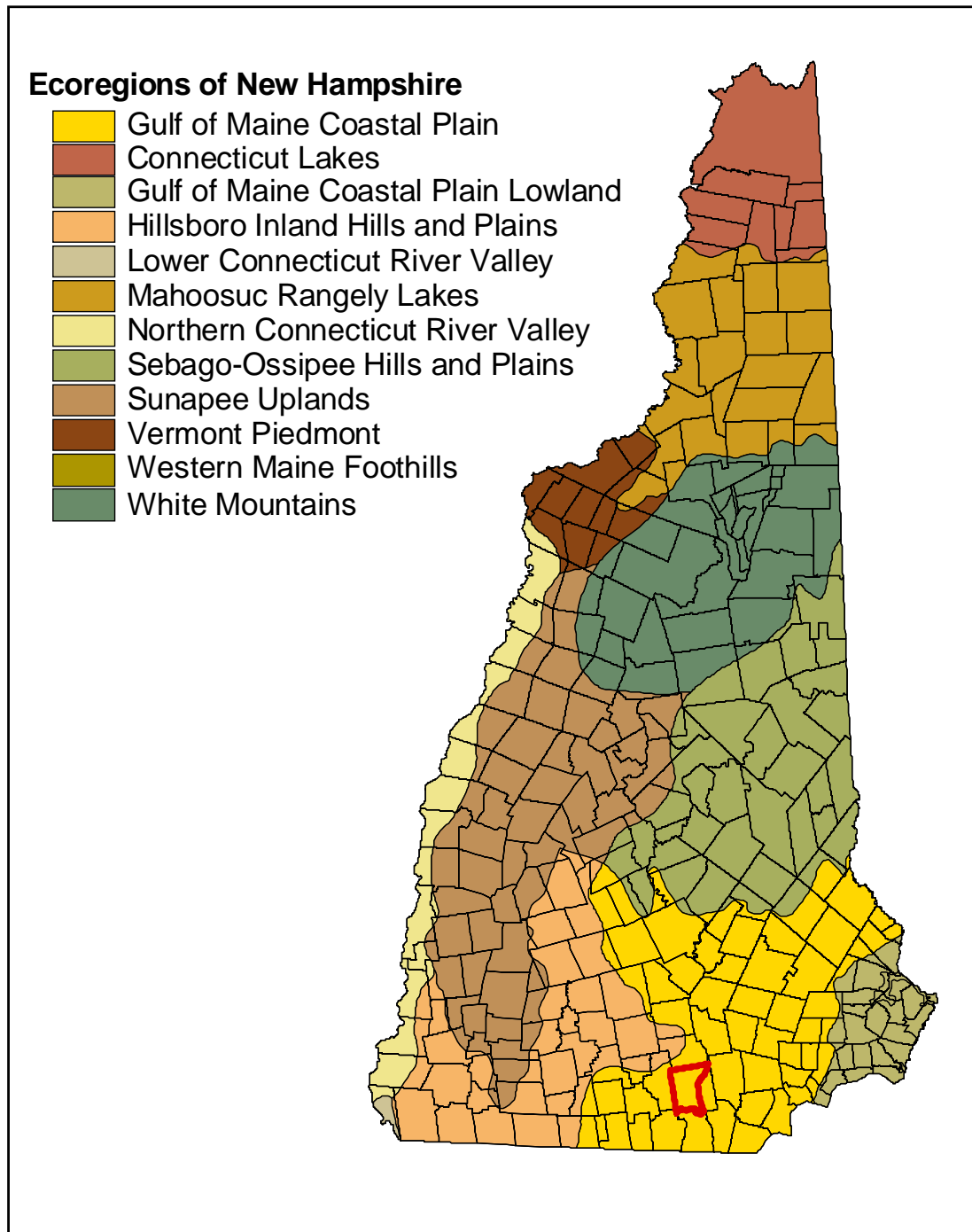


Figure 1. Ecoregion of Merrimack, NH (outlined in red). This map shows the distribution of ecoregions used by the NH Natural Heritage Bureau in conservation planning. Moosewood Ecological LLC.

The Gulf of Maine Coastal Plain is basically associated with moderately deep sandy till soils in the hilly regions and a mixture of sands, gravels, and silts associated with river valleys produced by retreating glaciers. Bedrock geology that typifies this ecoregion includes granite, as well as metamorphic features such as gneiss and schist. These latter two can give rise to enriching soil conditions that can support rare or unique natural communities and plants. Hemlock-white pine-oak forest and red oak-hardwood forest represent the major upland ecosystems.

The town of Merrimack lies within the south-central portion of New Hampshire within the greater Merrimack River watershed. Within this large watershed, two distinct units have been mapped by the NH Fish and Game Wildlife Action Plan (Figure 2). These include the Coastal Transitional and Non-tidal Coastal subwatersheds. These were delineated in such a manner to provide a broad-scale, comprehensive assessment of, and approach, for the protection of aquatic ecosystems and the biodiversity associated with each.

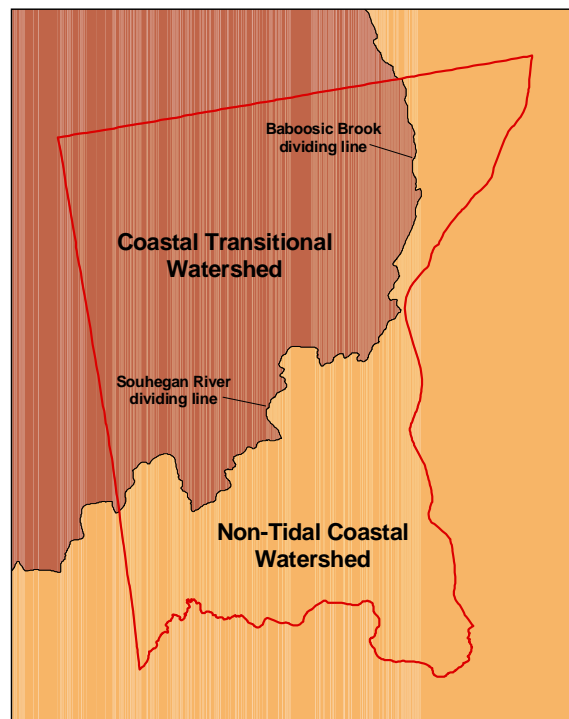


Figure 2. Major watershed units of Merrimack, NH (outlined in red). This map shows the two main watershed units identified by the NH Fish and Game Wildlife Action Plan. Moosewood Ecological LLC.

Merrimack covers approximately 33.5 square miles, or 21,412 acres (Figures 3 and 4). Its landscape is varied in form and is characterized by lowland river floodplains along the Merrimack River and Souhegan River and rolling hills associated with Blodgett Hill, Horse Hill, Wilson Hill, Turkey Hill, and Bumbo Hill. Extensive wetland systems are found in the north along Baboosic Brook and to the south along Pennichuck Brook. These varying landforms offer great diversity for wildlife and plant communities alike.

To begin the process of collecting site-specific data, a total of 39 parcels, approximately 1,788 acres of town-owned open space, were visited from December 2008 through September 2009 (Figure 5). This afforded the opportunity to collect data on a variety of wildlife over a 10-month period to help maximize species detection, especially species of conservation concern. This ability to span such a time period provides for an efficient approach to wildlife inventories. For example, breeding Neotropical migrant birds are best detected during late-May to early-July; while amphibians and turtles are more easily observed in early spring when they emerge from their wintering habitats to travel to vernal pools or larger wetlands.

The 39 parcels were identified and prioritized for rapid site assessments using existing spatial data, ecological reports, and land management plans. Roadside surveys were also used to augment data collection and verification of existing NH Wildlife Action Plan habitat data. No private properties were entered for data collection (although in the future permission should be obtained for areas of special interest).

The primary goal of the rapid site assessments was to collect data on significant wildlife habitats and to record observations on wildlife, including species of conservation concern. Secondary goals were to identify exemplary natural communities and note invasive species. Sites visited were assessed for the following attributes:

1. Verification of coarse-scale NH Fish and Game Wildlife Action Plan habitats;
2. Identification of fine-scale, site-specific critical wildlife habitats;
3. Identification of rare species and other species of conservation concern (as listed by the NH Wildlife Action Plan), including amphibians, birds, mammals, and reptiles;

4. Other target “keystone” species including otter, bear, bobcat, mink, and moose;
5. Incidental observations of additional wildlife;
6. Identification of exemplary natural communities and rare plants; and
7. Invasive plants observed were also noted

Winter and early spring mammal tracking surveys were conducted to begin to identify the presence of medium- to large-sized mammals in Merrimack and to note potential wildlife corridors across selected roadways. Special emphasis was placed on the presence and location of focal species, including bear, bobcat, deer, mink, moose, and otter. These species represent a suite of mammals that have large home ranges and/or utilize critical habitats during the winter months (such as deer wintering areas and south-facing rocky slopes).

Merrimack Biodiversity Conservation Plan

Topographic Base Map

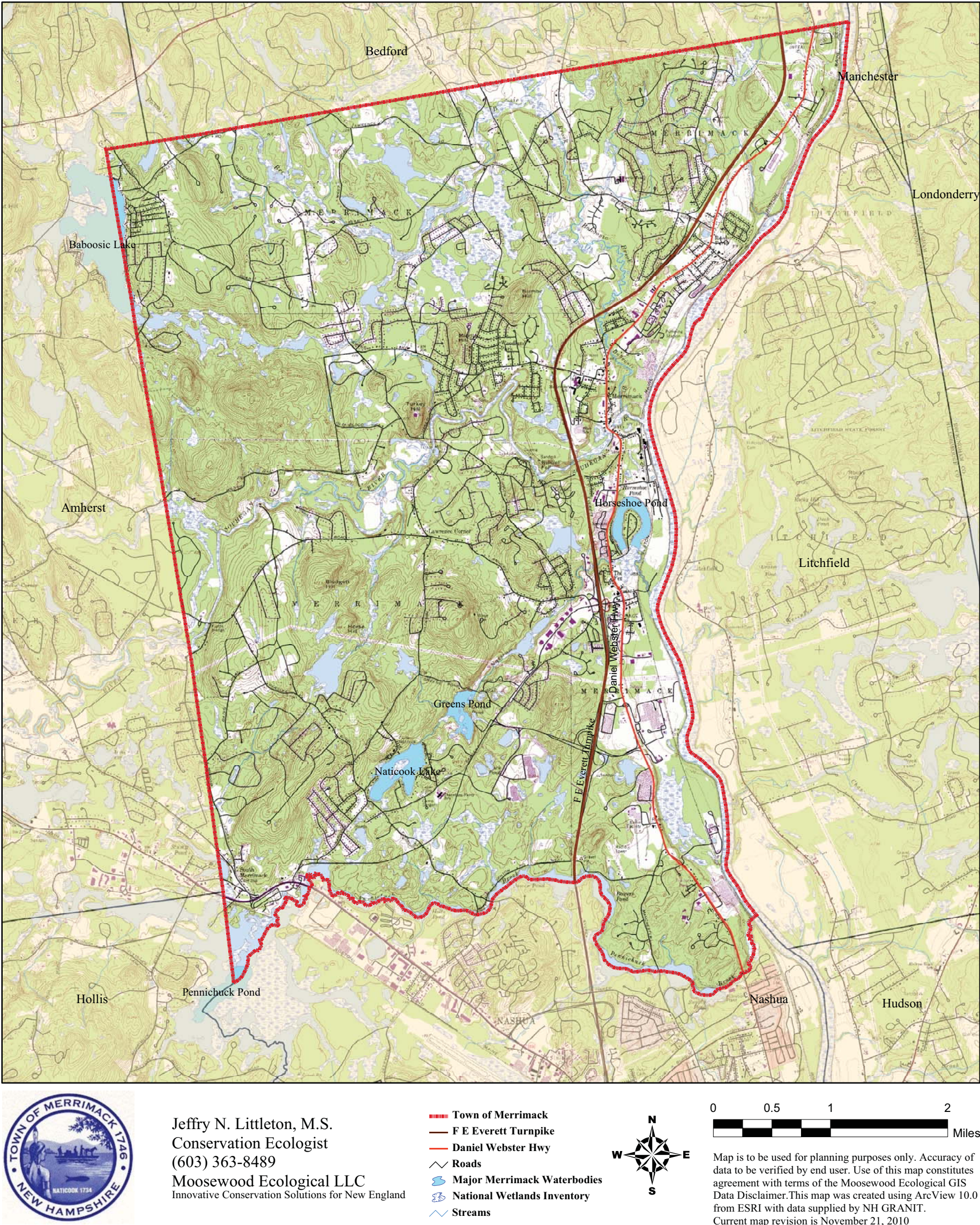


Figure 3. U.S. Geological Survey topographical map of Merrimack, NH. This map indicates the general topography and distribution of transportation systems, general developed areas, ponds, lakes, rivers, streams and larger wetland systems. Moosewood Ecological LLC.

Merrimack Biodiversity Conservation Plan

Aerial Base Map (NAIP 2003)

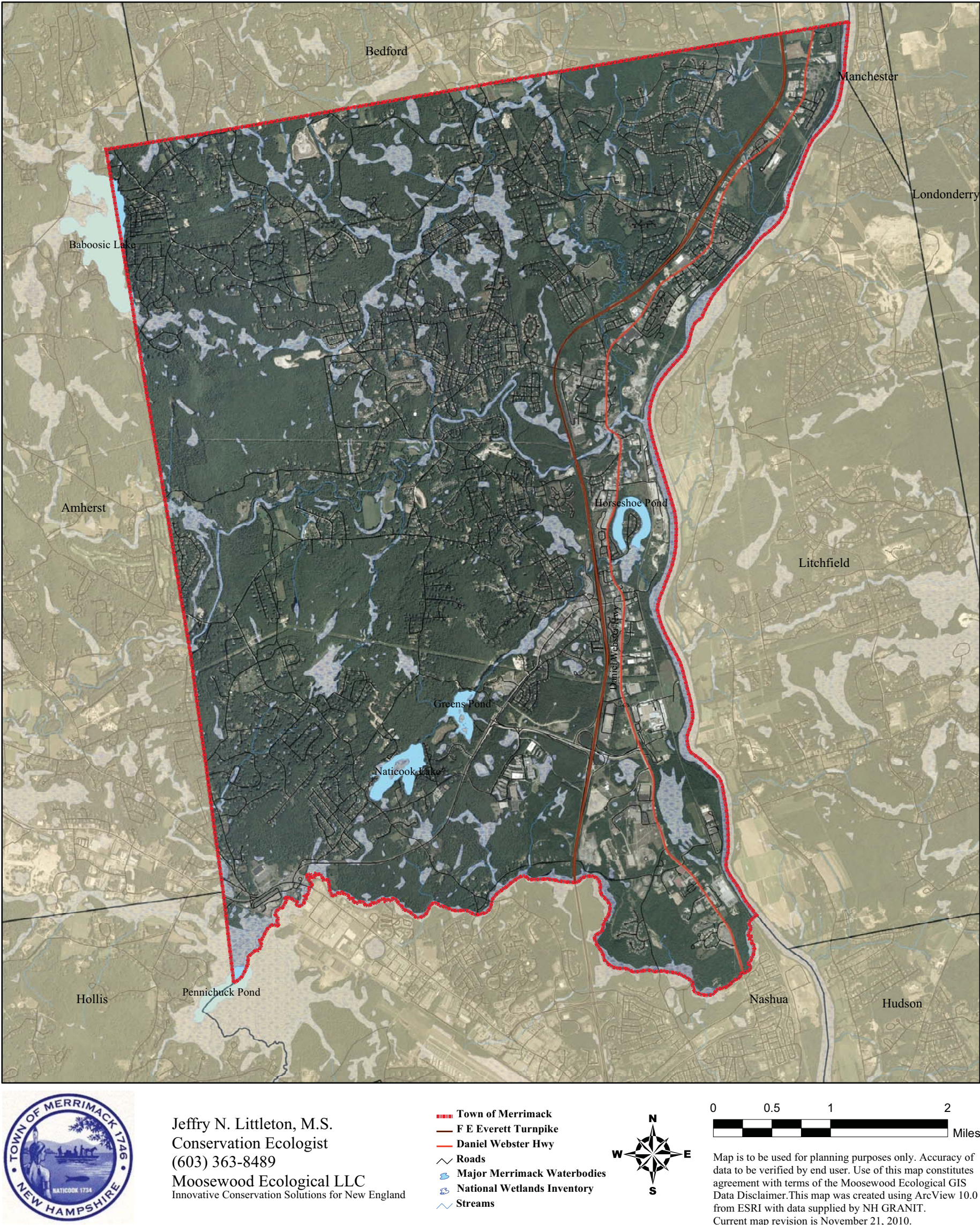
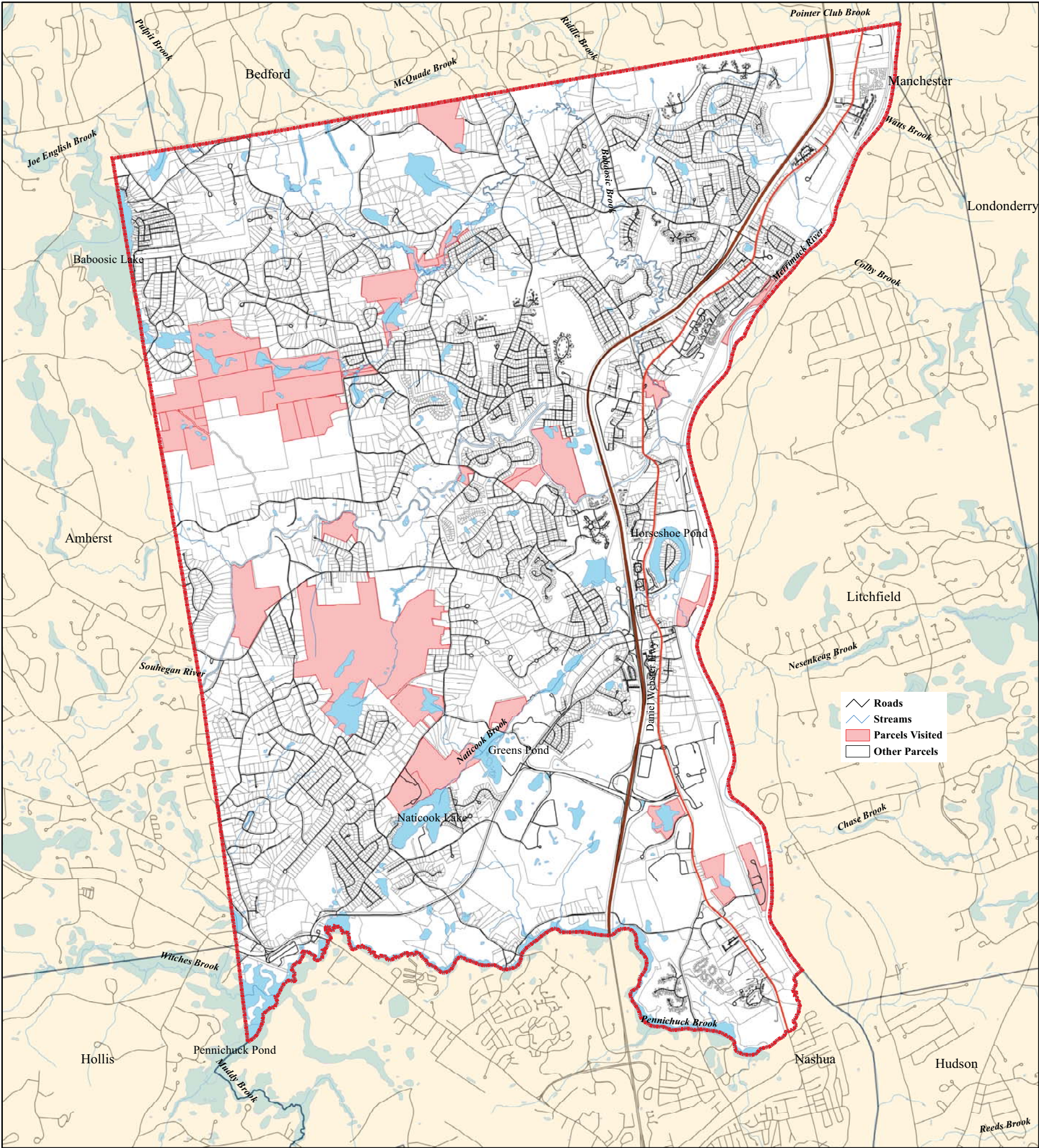


Figure 4. Aerial photography of Merrimack, NH. This map indicates the distribution of transportation systems, developed areas, utility right-of-ways, fields, forested areas, ponds, lakes, rivers, streams and larger wetland systems. Moosewood Ecological LLC.

Merrimack Biodiversity Conservation Plan

Parcel Base Map



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Map is to be used for planning purposes only. Accuracy of data to be verified by end user. Use of this map constitutes agreement with terms of the Moosewood Ecological GIS Data Disclaimer. This map was created using ArcView 10.0 from ESRI with data supplied by NH GRANIT. Current map revision is December 7, 2010.

Figure 5. Parcel base map of Merrimack, NH. This map shows the distribution of sites visited for assessment purposes. Moosewood Ecological LLC.

Limitations of Data and GIS Disclaimer

A variety of existing and newly created data layers were consulted to prepare the natural resources maps found herein. These existing data have been developed by numerous governmental agencies and other sources. They have been produced specifically for the town, the state of New Hampshire, or the entire United States using *remote data*. These sources of data were developed from interpretation of satellite imagery and aerial photography. The data were produced at various scales and therefore represent different degrees of errors, omissions, and inaccuracies.

While these limitations do represent some uncertainties, this type of research is the first step, and the most cost-effective, in developing an understanding of Merrimack's natural resources. In the ideal world, all data would be accurate, precise, and up-to-date. However, to produce such a level of accuracy and precision would be grossly time-consuming and ultimately very costly. Therefore, the data used does contain inaccuracies and further research is warranted.

Moosewood Ecological refined some existing data and developed new data based on aerial photography interpretation, site visits, and roadside surveys. Areas assessed represent only a sample of the town and do not represent a comprehensive ecological inventory and should not be construed as such. Additional ecological inventories and biological monitoring efforts in the future should be conducted to build upon the collective knowledge gathered at this time.

The maps contained herein are for education and planning purposes only. They are suitable for general land use planning. However, they are not suitable for detailed site planning and design, including wetlands delineations and other jurisdictional determinations. As such, boundaries of all habitats, including wetlands, are approximate locations and should therefore be field verified. The accuracy of the data is the end user's responsibility, and Moosewood Ecological can not be responsible for the accuracy and completeness of GIS data. Moosewood Ecological makes no warranty, expressed or implied, as to the accuracy or completeness of the GIS data. Furthermore, Moosewood Ecological shall assume no responsibility for any errors, omissions, or inaccuracies in the information provided.

Ecologically Significant Areas

Merrimack, with its diverse terrain and location within the southern tier of New Hampshire, is characterized by a variety of ecologically significant areas (ESA) that reflect the town's biodiversity. This diverse landscape supports a wide range of species, including common and infrequent wildlife and plants and a variety of species of conservation concern, as well as significant types of habitats.

ESAs include *important wildlife habitats* and *exemplary natural communities*. These two elements are defined and discussed below. An ESA functions as 1) habitats for rare species and other species of conservation concern; 2) rare or declining habitats and natural communities in New Hampshire; and 3) connectivity to other habitats within a largely undisturbed forested landscape. For the purposes of this report, the following ESAs were considered as significantly important for the protection and maintenance of biodiversity in Merrimack:

1. Wildlife habitats as mapped by the NH Fish and Game Wildlife Action Plan, including marshes, peatlands, open waterbodies, grasslands, floodplain forests, hemlock-hardwood-pine forests, and Appalachian oak-pine forests;
2. Additional wildlife habitats mapped by Moosewood Ecological, including rivers and smaller streams, riparian buffers, heron rookeries, deer wintering areas, forested swamps, vernal pools, active agricultural lands (hayfields/pastures, orchards, and row crops), shrublands, and ledge outcropping;
3. Rare and uncommon natural communities as defined by the NH Natural Heritage Bureau;
4. Large unfragmented forest blocks¹ with embedded wetlands and other habitats lumped in close proximity to one another (For Merrimack, this would include unfragmented blocks larger than 200 acres.); and
5. Habitats that support known rare species

¹ For Merrimack, large unfragmented forest blocks would include those larger than 100 acres.

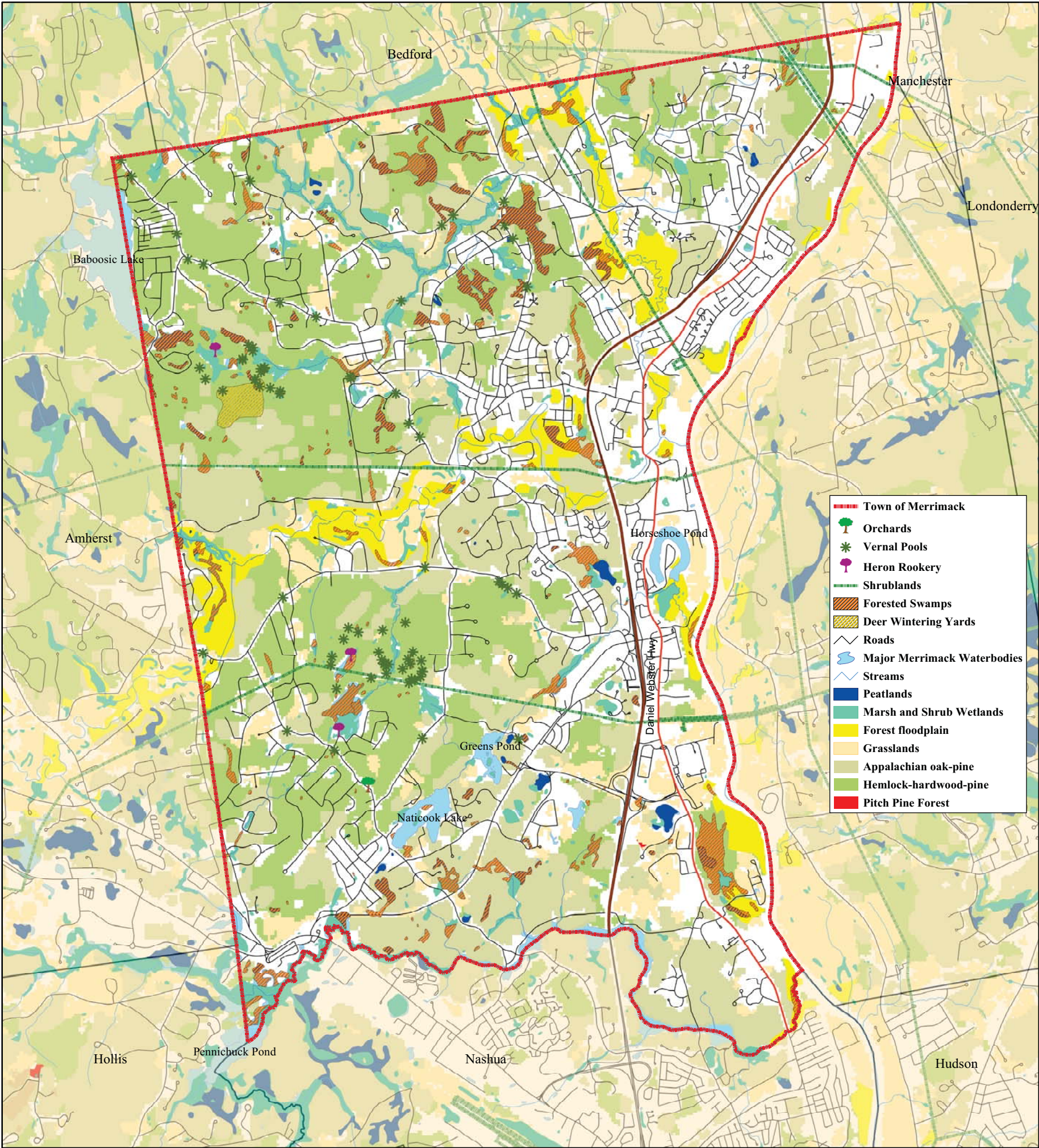
Important Wildlife Habitats

The NH Fish and Game Department, in cooperation with other agencies, organizations, and individuals, produced the NH Wildlife Action Plan (WAP) in 2005, which was updated in 2010 to reflect more fine-tuned data. This document was designed as a planning and educational tool for federal, state, and municipal governing bodies, conservation commissions, land trusts and other conservation organizations, and private landowners, as well as the general public, to promote the conservation and management of NH's biological diversity. The WAP provides a resource for developing informed land use decisions and land management planning. The intent is to ensure an adequate representation of various wildlife habitats are maintained across our landscape, keeping common species common in NH and working to prevent the loss of our rare and endangered species.

The following accounts provide a description of each of the sixteen significant wildlife habitats that were identified in Merrimack (Figure 6 and Table 1). These habitats were broad in scope as mapped by the WAP (noted with an asterisk*) and were confirmed by on-site observations. Site assessments aided in mapping other fine-scale significant. Species in **bold** type have been identified by the WAP as species of concern conservation. Additional descriptions have been included for wildlife habitats found in the WAP (Appendix B).

Merrimack Biodiversity Conservation Plan

Important Wildlife Habitats



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Figure 6. Important Wildlife Habitats in Merrimack, NH. This map demonstrates the distribution of upland and wetland habitats that express especially high and/or unique biodiversity attributes, including rare species and rare or declining habitats. Moosewood Ecological LLC.

Table 1. Summary of important wildlife habitats of Merrimack¹.

Wildlife Habitat Type	Size or Location
Marsh and Shrub Wetlands*	814 acres
Peatlands*	365 acres
Floodplain Forests*	1,158 acres
Forested Swamps	780 acres
Hemlock-Hardwood-Pine Forests*	6,650 acres
Appalachian Oak-Pine Forests*	6,283 acres
Grasslands*	1,600 acres
Shrublands	280 acres
Orchards	1 location
Deer Wintering Areas	2 sites; approx. 68 acres total
Ledge Outcropping	Gilmore Hill, Blodgett Hill, Horse Hill
Woodland Seeps	various
Vernal Pools	76 sites
<i>Grater Woods</i>	20 pools
<i>Horse Hill Nature Preserve</i>	27 pools
<i>Other Sites</i>	29 pools
Heron Rookeries	
<i>Long Pond</i>	9 active nests
<i>Grater Woods</i>	inactive rookery
<i>White Pine Swamp</i>	inactive rookery
Lakes and Ponds	
<i>Baboosic Lake</i>	228.5 acres; mostly in Amherst
<i>Naticook Lake</i>	62.4 acres
<i>Greens Pond</i>	34.8 acres
<i>Horseshoe Pond</i>	43.7 acres
<i>Long Pond</i>	6.6 acres
<i>Pennichuck Pond</i>	53 acres; along Pennichuck Brook
<i>Holts Pond</i>	21.5 acres; along Pennichuck Brook
<i>Bowers Pond to Harris Pond</i>	160.7 acres; along Pennichuck Brook
<i>Supply Pond</i>	15.5 acres; along Pennichuck Brook
<i>Stump Pond</i>	19.1 acres; also located in Amherst
Rivers and Brooks	
<i>Merrimack River</i>	8.5 miles
<i>Souhegan River</i>	8.2 miles
<i>Pennichuck Brook</i>	44.1 miles
<i>Naticook Brook</i>	3.5 miles
<i>Baboosic Brook</i>	11.1 miles
<i>McQuade Brook</i>	0.5 mile
<i>Riddle Brook</i>	0.4 mile
<i>Unnamed Streams (perennial and intermittent)</i>	35.2 miles

Source: Ecological Inventory by Moosewood Ecological (Littleton 2009); NH Fish and Game Department Wildlife Action Plan (2005)

*Wildlife habitats mapped as part of the NH Fish and Game Wildlife Action Plan.

¹ Refer to the map in Figure 6 for specific locations.

Upland Forests*

The upland² forests of Merrimack represent many examples of coniferous, hardwood, and mixed forest types. Collectively, these forests can be classified into two distinct ecosystems: hemlock-hardwood-pine forests (northern transitional hardwoods) and Appalachian oak-pine forests. These two large forest ecosystems somewhat overlap, creating a beautifully rich diversity of plant communities due to vegetative influences from the north, as well as those of a more southern affinity. These forests also can serve as prime habitat for a variety of wildlife that is found at the northern limit of their home range, including many species of reptiles, birds, and amphibians.

The NH Wildlife Action Plan estimates that the total cover of these two forest ecosystems totals nearly 13,000 acres in Merrimack. However, this estimate includes many areas of dense residential development with smaller patches of forest. Eliminating these areas gives a better estimate of contiguous forest cover, resulting in approximately 8,611 acres or roughly 40% of Merrimack.

The hemlock-hardwood-pine forest ecosystem is widespread in the southern tier of New Hampshire and according to the NH Wildlife Action Plan it represents 52%, or 3,562 acres, of forest cover in Merrimack. However, based on observational evidence it is likely that this percentage is somewhat higher. Coniferous and mixed forests typify this ecosystem and are composed of various amounts of eastern hemlock, American beech, red oak, white oak, white pine, and red maple. Other hardwoods are present, but less abundant, include black oak, sugar maple, white ash, hop-hornbeam, hickory, American chestnut, and the occasional chestnut oak.

According to the NH Wildlife Action Plan, the Appalachian oak-pine forest represents about 48%, or 3,263 acres of forest cover in Merrimack, but is likely an over estimate. This forest type is mostly limited to the southern part of the state and greatly contributes to Merrimack's biodiversity. It is characterized mainly as hardwood and hardwood-dominated mixed forest types. Common hardwood species include white oak, black oak, red oak, hickories, and red maple. Other hardwoods present but less abundant include sugar maple, white ash, hop-hornbeam, American chestnut, and chestnut oak.

² Upland forests are those types of forests that grow in dry to moderately moist sites but exclude forests that grow in wetlands. Upland forests make up the majority of the forested ecosystems in Merrimack.

Coniferous species mainly include white pine with some occasional eastern hemlock and even less abundant pitch pine.

These two upland forest ecosystems provide significant habitats for various common and rare species. Species diversity for the hemlock-hardwood-pine forest totals 140 vertebrates throughout New Hampshire, including 15 amphibians, 73 birds, 39 mammals, and 13 reptiles. While species are not quite as robust as above, the Appalachian oak-pine forest still accounts for 104 vertebrates. These include 8 amphibians, 67 birds, 17 mammals, and 12 reptiles. Obviously, both forest ecosystems share many of the same species but some are unique to each ecosystem.

Diverse wildlife communities were observed in the Merrimack upland forests. Birds sighted include raptors such as red-tailed hawk, **red-shoulder hawk**, **Cooper's hawk**, broad-winged hawk, and barred owl, as well as many Neotropical migratory birds (scarlet tanager, **veery**, ovenbird, black-throated green warbler) and other resident songbirds. Most mammals found in association with southern New Hampshire were observed, including deer, moose, bear, **bobcat**, coyote, fox, fisher, snowshoe hare, eastern cottontail, red and gray squirrels, as well as other smaller members of the rodent family. Garter snakes were commonly observed in upland forests, as well as painted and state endangered **Blanding's turtles**. Rare species that have been previously recorded in Merrimack include the state endangered **New England cottontail**, state endangered **hognose snake**, and state threatened **northern black racer snake**. The latter two species are known to currently exist in the town. Other rare wildlife that may also exist in these upland forests includes **wood thrush** and **eastern box turtle**.

A major direct threat to Merrimack's forests is the construction of new roadways. Roadways fragment the remaining forested blocks, which exposes wildlife to increased road mortality and decreases core forest habitat needed by certain area sensitive species, such as **bobcat**, ovenbird, and raptors. Other threats are associated with habitat loss and conversion as a result of land development projects. These elements also lend themselves to exposure pathways for the colonization of invasive plants that can alter species composition and diversity of native trees, shrubs, and other plants. Lastly, non-native forest pests such as the hemlock wooly adelgid and the Asian long-horned beetle poses

serious risks to forest health as can other introduced pathogens. The hemlock wooly adelgid was reported at the Twin Bridges Park in 2007 and currently exists there today.

Grasslands*

According to the NH Wildlife Action Plan, grasslands are estimated to account for approximately 1,600 acres in Merrimack. These upland habitats include hayfields, pastures, cropland, and other types of open fields (such as landfill, athletic fields). Wet meadows (beaver meadows), such as that found behind the Merrimack Middle School, also function as critical grassland habitats.

Typical plant composition for upland grasslands includes various grasses and sedges, goldenrods, asters, meadowsweet, and milkweeds. Medium- to large-sized shrubs and young trees may also be present but are not common. Management within each type of grassland habitat varies depending upon the type of land use but all should be maintained in a fashion that prevents the establishment of shrubs and trees. Grasslands will naturally succeed into shrublands, and eventually develop into a forest without human intervention.

Grasslands provide critical open habitat for wildlife that greatly contributes to Merrimack's diversity, specifically that of birds, insects, and reptiles. **Eastern meadowlark** and **vesper sparrow** were observed in the grasslands located between the railroad corridor and the Merrimack River behind the Anheuser-Busch facility. Until 2 years ago, the state threatened **grasshopper sparrow** was also observed in the same location. Although not observed in surveys in 2009, this species may return to Merrimack if its habitat is maintained or possibly even broadened. **Vesper sparrow** was also observed at the Turkey Hill ballpark. These birds use grasslands as their primary breeding and nesting habitats. Other birds of Merrimack found in association with grasslands were red-tailed-hawk, **American kestrel**, **American woodcock**, eastern kingbird, red-winged blackbird, mourning dove, northern mockingbird, chipping sparrow, tree sparrow, song sparrow, northern cardinal, northern flicker, eastern phoebe, American goldfinch, brown thrasher, indigo bunting, and eastern bluebird.

Many reptiles, including several of conservation concern, are known to use grassland habitats as well. Snakes include **eastern smooth green snake**, state threatened **northern black racer**, state endangered **eastern hognose snake**, garter snake, and red-bellied snake. **Wood turtles** may typically use fields for thermoregulation and turtles in general may use these habitats for nesting sites, including the state endangered **Blanding's turtle**. Finally, the **northern leopard frog** also utilizes extensive grasslands, especially those in close proximity with floodplain forest complexes.

Grasslands and their associated wildlife have been in decline due to the mass abandonment of agriculture within the last 100-150 years. When farming and open land was more prevalent grassland species thrived in the state. However, grassland bird populations are declining more rapidly than any others in the northeast³ and are in clear decline in New Hampshire⁴. Other threats to grasslands are habitat loss and conversion due to land use. Without the preservation of grassland habitats certain species will not remain a part of Merrimack's landscape, resulting in lower biodiversity overall.

Shrublands*

Shrublands are typically characterized by a combination of shrubs⁵ and young shrub-like trees that dominate this habitat. Mixed grasses and forbs⁶ are generally present and interspersed throughout but less abundant overall. Merrimack shrublands include utility right-of-ways (i.e., Horse Hill Nature Preserve and Wildcat Falls Conservation Area), reverting sand and gravel pits (i.e., Gilmore Hill Memorial Forest), old farmlands, and patch cuts created during forestry projects (i.e., Grater Woods, Mitchell Woods, and Wildcat Falls Conservation Area). Certain shrub swamps (i.e., Grater Woods and sections of Baboosic Brook corridor) may also function as critical shrubland habitat for a subset of wildlife. As noted above, grasslands will naturally succeed into shrublands if not maintained, and likewise, shrublands will eventually revert to forests. Each of these areas

³ Sauer et al. (2003)

⁴ Hunt (2009)

⁵ Shrubs are low growing woody plants that generally range from 5-20 feet in height. Unlike most trees that have one trunk, shrubs have multiple trunks. Shrubland habitat can also include shrub-like trees that grow wide while in the open but in the absence of active management will eventually revert into a forest.

⁶ Forbs include herbaceous flowering plants that are not grasses and include wildflowers such as goldenrods, asters, dandelions, and milkweeds.

(except shrub swamps) must be managed appropriately in order to maintain this habitat type and support its various wildlife communities.

Upland shrubland habitats are significant for many birds and reptiles. They serve as primary and secondary habitats for breeding, nesting, and feeding. Species of conservation concern that use shrublands include **eastern smooth green snake**, state threatened **northern black racer**, **eastern box turtle**, state endangered **eastern hognose snake**, **eastern towhee**, **ruffed grouse**, **whip-poor-will**, **American woodcock**, **wood turtle**, **bobcat**, and the state endangered **New England cottontail**. The latter three species can also be associated with certain shrub swamps as well. Common wildlife species observed in these habitats were common yellowthroat, song sparrow, gray catbird, white-tailed deer, moose, and garter snake.

Shrubland habitats have been steadily declining in the state. During the abandonment of farms, grasslands succeeded into shrublands and were once widespread throughout the state. Most of these shrublands have succeeded into forests, rapidly reducing the size and distribution of this critical habitat and negatively impacting wildlife that requires this habitat. Other threats to shrubland habitat include fragmentation, habitat loss and habitat conversion, haphazard use of off-highway recreational vehicle (OHRV) activities, and establishment of invasive plants, including honeysuckles, buckthorn, autumn olive, Asian bittersweet, and swallowworts. Invasive species can be quite aggressive; resulting in a change in plant composition from native species to one dominated more with invasive species, which hold little or no value to wildlife.

Ledge Outcropping

Ledge outcropping is characterized by exposed bedrock that is generally located on tops or side slopes of hills. It is often primary habitat for snake hibernacula⁷, as well as bobcat sunning sites during the winter months. This habitat exists on the eastern and southeastern steep slopes of Blodgett Hill in Horse Hill Nature Preserve. This location contains the most extensive outcropping that was observed in Merrimack. This ledge outcropping may be significant for state endangered **eastern hognose snake** and state

⁷ Snake hibernacula serve as critical areas where snakes congregate and spend winter months.

threatened **northern black racer** although it is not considered the most optimal ledge habitat. However, the surrounding extensive hardwood oak-dominated forest provides feeding habitat for these species. Gilmore Hill Memorial Forest has less significant outcropping, and small areas exist elsewhere.

Orchards

Various agricultural land uses create a mosaic of habitat structures used by many types of wildlife, including common and rare species. While grasslands may include some of these different types of agricultural lands (i.e., pastures, hayfields, and croplands) orchards are not represented. Orchards are yet another type of agricultural practice that can provide a significant habitat for a suite of wildlife that are adapted to relatively open lands but do not have such strict requirements for grasslands. Orchards may include actively managed and abandoned fruit orchards, as well as plant nurseries and Christmas tree farms.

Orchards share some similar structural characteristics to upland grasslands and shrublands combined, potentially providing habitat for some species of conservation concern, including **eastern smooth green snake**, state threatened **northern black racer**, **eastern box turtle**, state endangered **eastern hognose snake**, and **wood turtle**. Orchards harbor a robust insect population that can serve as a valuable food source for wildlife, including many types of birds and smaller mammals. Orchards also provide a source of fruit for many species and support important pollinators, such as honey bees.

Floodplain Forests*

The major floodplains in Merrimack are associated with the Souhegan River and Merrimack River. Other floodplain forests are found along Baboosic Brook, especially along the lower reaches as it meanders towards its confluence with the Souhegan River where the topography becomes broader. According to the NH Wildlife Action Plan, floodplain forests are estimated to cover approximately 1,158 acres. However, this appears to be an overestimate of the true acreage due to the residential and commercial

developments located within these habitats. Smaller floodplains may also be found in association with the smaller streams in Merrimack.

Floodplain forests perform a variety of significant ecological functions. They assist storing floodwaters and reducing overall flow rates that help reduce potential flooding downstream. They maintain water quality by buffering adjacent land uses and filtering excess nutrients, sedimentation, and toxicants. They also control erosion.

Floodplains are a mosaic of habitats that can greatly vary in structure, owing to their rich biological makeup. They can include both upland and wetland communities such as forests and less dense open woodlands, meadows, oxbow marshes, shrub thickets, vernal pools, and seeps. This interaction between wetland and upland communities forms the riparian zone. These habitats in turn support wonderfully diverse wildlife communities for breeding, nesting, feeding, shelter, and migration.

Floodplain forests provide habitat for many migratory and year-round resident birds. Waterfowl (such as wood ducks and mallards using vernal pools), American redstart, Baltimore oriole, **red-shouldered hawk**, Cooper's hawk, **American woodcock**, **veery**, and **wood thrush** use these dynamic habitats. Amphibians include spring peeper, wood frog, spotted salamander, green frog, pickerel frog, gray tree frog, and American toad. More importantly, floodplains are critical for **Jefferson's salamanders** and **northern leopard frog**, as well as some reptiles, including the state endangered **Blanding's turtle**, **wood turtle**, **spotted turtle**, and **ribbon snake**. Semi-aquatic mammals using river systems readily depend upon these riparian forests and signs of river otter, muskrat, beaver, and mink can typically be observed using intact floodplain forests.

In the past, many of New Hampshire's major and minor floodplain forests have been converted to other land uses such as agriculture or residential, commercial, and industrial developments. This fact exemplifies the great significance of protecting the remaining intact examples if we are going to conserve the wildlife and plant communities that reside within these habitats. Threats to the long term stability and ecological integrity of floodplains include fragmentation, habitat loss and conversion, altered natural

disturbance due to damming, and the introduction of invasive plants that can out-compete native species, potentially altering wildlife communities.

Marsh and Shrub Wetlands*

The marsh and shrub wetlands comprise approximately 814 acres in Merrimack, according to the NH Wildlife Action Plan. These wetland complexes are composed of 4 main wetland classes originally mapped by the U.S. Fish and Wildlife Service National Wetlands Inventory, including emergent marshes, aquatic beds (pond lilies), unconsolidated bottoms (open water), and shrub swamps. Each of these wetland classes are dictated by topographic setting, hydrologic regimes, soil development, nutrient availability, wildlife influence (e.g., beaver damming), and plant community composition. The only major wetlands not included in this habitat type are peatlands and forested swamps, which are described below as their own distinct habitat types.

Marsh and shrub wetlands offer dramatic variations in plant community structure. Various grasses, sedges, and rushes, dwarf shrubs, pond lilies, pickerel weed, wild flowers, and other herbaceous plants, as well as open water, typify Merrimack's marshes. In contrast, shrub wetlands are dominated by shrubs such as speckled alder, highbush blueberry, maleberry, winterberry, mountain holly, wild raisin, arrowwood, and chokeberry. They will usually also contain a mixture of herbaceous plants and sparse sapling trees, depending upon the density of the shrub layer and degree of wetness.

Both habitats perform significant ecological functions and hold great value to humans and wildlife alike. Ecological functions include storing floodwaters, providing wildlife habitats, maintaining good water quality of surface and groundwater resources, trapping sediments, reducing impacts of excess nutrients and toxicants, stabilizing shorelines, controlling erosion, and supporting rare species and natural communities. These wetlands also have significant societal values such as education and scientific research, visual aesthetics, recreation (fishing, hunting, and boating), and historical value.

Wetlands are widely known to have diverse plant and animal communities. This is mainly due to the fact that wetland ecosystems contain a wide variety of smaller habitats. This in turn provides many organisms with all or part of their life cycle needs.

Robust bird communities can be found in marsh and shrub wetlands. Waterfowl (such as wood duck, **American black duck**, mallard, common merganser, and Canada goose), **American bittern**, **great blue heron**, red-winged blackbird, northern kingbird, tree swallow, belted kingfisher, song sparrow, swamp sparrow, gray catbird, and common grackle, as well as various warblers (common yellowthroat and yellow warbler) commonly breed and nest in wetlands or along the wetland edge. Many waterfowl also depend on wetlands and open waterbodies during spring and fall migration. Other birds of conservation concern associated with marsh and shrub wetlands include **American woodcock**, and **least bittern**.

Mammals, including river otter, mink, beaver, and muskrat, rely heavily upon marsh and shrub wetlands for feeding and denning sites within or adjacent to the wetland. Other mammals known to use these wetlands include raccoon, state endangered **New England cottontail**, ermine, long-tailed weasel, **bobcat**, white-tail deer, moose, and bear. Many frogs and amphibians are common to marsh and shrub wetlands. Green frog, bullfrog, pickerel frog, spring peeper, wood frog as well as the American toad and red-spotted newt, were frequently recorded in Merrimack. **Northern leopard frog**, **Jefferson salamander** and spotted salamander are also associated with these habitats. Painted and snapping turtles were observed as well. Marsh and shrub wetlands also provide critical habitat for more secretive and less abundant species such as the state endangered **Blanding's turtle**, **spotted turtle**, **ribbon snake**, **eastern smooth green snake**, and northern water snake. Aquatic wildlife such as fish and macroinvertebrates are also integral to and dependant upon these wetland ecosystems and represent a significant part of the complex food cycle.

The interface between wetlands and their adjacent uplands form the riparian zone, which further adds complexity and diversity to the ecological structure and composition. The riparian zone is used by a wide range of semi-aquatic and terrestrial species for breeding, nesting, and feeding, or as connectivity to other significant habitats. The riparian zone is also very beneficial for aquatic species (fish and macroinvertebrates) that benefit from the shading of overhanging tree canopies. These trees help to maintain

cooler streams temperatures for long term survival of many species, including the brook trout.

It was estimated that approximately 53% of wetland acreage in the contiguous forty eight states was lost between 1780 and 1980⁸. The widespread devastation of loss and conversion has left a substantial mark; 117 million acres were filled, drained, or permanently flooded. New Hampshire is fortunate to have a conservative history of wetland loss. Between 1780 and 1980 it was estimated that approximately nine percent of the state's wetlands were lost through destruction and/or alteration; the second lowest of the fifty states. However, marsh and shrub wetlands are still vulnerable to human alterations through direct disturbance within the wetland or more often within the adjacent uplands. Threats include habitat loss and conversion, fragmentation, effects of stormwater, introduction of invasive plants, haphazard use of off-highway recreational vehicles (OHRV), compromised water quality due to ineffective riparian buffers, and damming.

Forested Swamps

Forested swamps represent another major class of wetland habitats, covering approximately 780 acres in Merrimack. Forested swamps are hydrologically connected to marsh and shrub wetlands or exist as isolated basin swamps. In Merrimack, these are commonly found as red maple- or hemlock-dominated swamps. However, swamp white oak and pitch pine swamps (two rare types of forested swamps) are also known to exist on in the town. The NH Natural Heritage Bureau observed the pitch pine-heath swamp on Merrimack Village District land while the swamp white oak swamp was observed on private property, which the location has not been released.

Forested swamps were not mapped as part of the NH Wildlife Action Plan but are considered as ecologically significant areas due to their close relationships with marsh and shrub wetlands and the associated wildlife. Some forested swamps function as vernal pools, providing critical habitat for such obligate species as wood frogs, spotted salamander, **Jefferson's salamander**, and invertebrates such as fingernail clams, caddis

⁸ Dahl (1990). Wetlands losses in the U.S. from 1780-1980.

fly, and other aquatic insects. Other species that use forested swamps for feeding and nesting are **red-shouldered hawk**, Cooper's hawk, barred owl, northern waterthrush, and **Canada warbler**.

Forested wetlands face many of the same threats associated with other wetland habitats. These include habitat loss and conversion, fragmentation, effects of stormwater, introduction of invasive plants, haphazard use of off-highway recreational vehicles (OHRV), and compromised water quality due to ineffective riparian buffers.

Peatlands*

In general, wetlands can be lumped into two categories: peatlands and non-peatlands. The previously discussed wetland habitats are considered non-peatlands. However, peatlands and non-peatlands can often be part of the same mosaic of plant communities within large wetland complexes, especially those associated with slow moving streams. Peatlands are considered as a distinct habitat type due to the unique species composition, sensitivities to changes in pH (level of acidity), and potential to contain rare species and unique natural communities.

Peatlands are characterized by acidic conditions with little groundwater input and limited nutrients, which dramatically slows down decomposition rates of plant material. This slow decomposition results in the accumulation of peat over time. Peatlands are classified into three wetland classes, including open emergent peatlands, shrub thickets, and forested wetlands. The NH Wildlife Action Plan has estimated that approximately 365 acres of peatlands are found throughout Merrimack.

Peatlands are considered significant due to their rare plants and natural community diversity. However, the state endangered **ringed boghaunter**, a type of dragonfly, is strongly associated with peatland habitats. This species has been previously observed within the Merrimack River watershed approximately 15 miles west of Merrimack⁹. Many of the same species that are associated with the marsh and shrub wetlands can also be found in association with open and shrub peatlands, including **eastern smooth green snake, ribbon snake, Jefferson's salamander, northern**

⁹ Littleton and Harty (2004).

leopard frog, state endangered **New England cottontail**, and **bobcat**. Peatlands also provide special habitat for unique plants.

Peatlands are sensitive to excessive loading of nutrients, sedimentation, and toxicants from adjacent land uses as they can change the water chemistry, altering both plant and animal communities. Excess flooding as a result of incompatible adjacent land use planning, as well as damming by beavers, can also dramatically alter peatland habitats. In summary, threats to these habitats include fragmentation, habitat loss and conversion, altered hydrology, nonpoint source pollution, unsustainable forestry practices, haphazard use of off-highway recreational vehicles (OHRV), and introduction of invasive plants.

Vernal Pools

Vernal pools are recognized in the NH Wildlife Action Plan as a critical habitat type but have not been mapped at the state level. The recognition of vernal pools as a critical wildlife habitat is recent. Due to their relative small size on-site evaluation is often the only indication they exist. Therefore, these habitats are more easily mapped at the town or site-specific level. Vernal pools were mapped using on site assessments and roadside surveys. A total of 76 potential and confirmed vernal pools were recorded in Merrimack, including 20 pools at Grater Woods and 26 at Horse Hill Nature Preserve.

Vernal pools are typically temporary or seasonal woodland pools that are found within upland or floodplain forests. These woodland pools fill with water in the spring and fall, and generally dry partially or even completely in the summer. They are isolated in small basins and are not associated with a permanent inflow or outflow of water. Significantly, they are devoid of fish populations.

Vernal pools are critical for the long-term survival of many species of amphibians, reptiles, and macroinvertebrates¹⁰. Species considered as obligate or strongly associated with vernal pools include the state endangered **Blanding's turtle**, **spotted turtle**, **ribbon snake**, **Jefferson's salamander**, **blue-spotted salamander**, spotted salamander, state endangered **marbled salamander**, wood frog, fingernail clams, and

¹⁰ Macroinvertebrates are large water bugs that can be easily seen with the naked eye. They inhabit aquatic ecosystems such as vernal pools, ponds, lakes, rivers, and streams.

fairly shrimp. **Bobcat** and state endangered **New England cottontail** can also be found using this habitat for feeding and/or cover from predation.

The main threats to vernal pools are associated with residential, commercial, and industrial development activities within and adjacent to this habitat, resulting in habitat loss and conversion. Fragmentation created by roadways can bisect a complex of vernal pools within close proximity from one another. This effect can result in high road mortality and lower genetic diversity, essentially isolating populations of amphibians. Forestry practices adjacent to vernal pools can have negative effects within upland habitats, as well as alterations in hydrology from removing the forest canopy that covers the pools. Increased rates of evaporation can cause the pools to dry out more rapidly and consequently desiccating egg masses before they can fully develop to maturity. In addition, the adjacent woodland is home to the wood frogs and salamanders that use the vernal pool for breeding. In fact, the majority of vernal pool breeding salamanders live the entire lives within 500 feet of the pool's edge.

Woodland Seeps

Woodland seeps are basically small swamps that are fed by groundwater and generally less than an acre in size. Seeps are found in a variety of physical settings, including upland forests and riparian zones associated with streams and wetlands. Plant species composition within seeps can be highly variable, depending upon specific site conditions. Woodland seeps have been observed in various locations in Merrimack, including Horse Hill Nature Preserve and Grater Woods.

Unless impacted by human land use, seeps are generally covered by continuous forest cover except when a tree is blown down during a storm. These blowdowns are ecologically significant as they provide a source of coarse woody debris that is important for a variety of ecological processes such as nutrient exchange and soil development through decomposition, as well as a microhabitat for a variety of amphibians, insects, microorganisms, and fungi.

Woodland seeps function as refugia for a variety of plants and animals, serving a critical ecological role during the driest months of the year. Frogs, salamanders, and

newts will typically use seeps when moving between other habitats. Seeps also function as an early spring food source for bear, turkey, deer, and moose, as well as a good source of oxygenated water when they are connected with streams.

Threats to this habitat type include logging and filling associated with development activities. Adjacent developments may have negative effects on groundwater quality and quantity, whereby reducing the functionality of seeps.

Heron Rookeries

Beaver impoundments and other wetlands often provide critical nesting habitat for **great blue herons**, which typically nest in colonies referred to as heron rookeries. Nests are generally found in dead trees (or snags) within or adjacent to the wetland. However, live white pines along the edge of wetlands are known to provide nesting sites as well. Great blue heron habitats can also function as breeding and nesting habitat for **osprey**.

Three heron rookeries have been observed in Merrimack. Only one is currently active, with fledglings observed in nine nests on Long Pond within Horse Hill Nature Preserve. Inactive sites include White Pine Swamp in the southwest portion of Horse Hill Nature Preserve and a large beaver impoundment in the western portion of Grater Woods.

Hérons are known to exhibit sensitivities to habitat loss and disturbance, especially during the breeding and nesting season. The loss of nesting sites in dead flooded trees is often the reason for inactivity. New beaver flooding is a prime and related activity. Also, maintaining a buffer of pines along ponds is a good forestry practice. Other major threats to heron rookery health include those cited for the marsh and shrub wetland habitat discussed above.

Deer Wintering Areas

During the winter months, deer congregate in wintering areas known as deer yards. These wintering areas are critical for deer survival as they provide areas of reduced snow cover on the ground, as well as protection from wind and storms. Often, a food source is close by as an added benefit. It is crucial for deer to reduce the amount of energy expended during the winter months when food supplies are scarce.

Deer yards are usually found within hemlock forests but can be found in a variety of other dense coniferous dominated forests as well, including spruce-fir forests and densely populated white pine stands. When heavy snow cover exists, deer will tend to stay confined to wintering areas and compact the snow for ease in traveling. Also, as a result of scarce food supplies deer will bark conifer saplings, and when present they seem to prefer hemlocks over other conifers. This involves using their bottom incisors to scrape or strip the bark and inner tissue for food. The compacted trails from high traffic, numerous bedding sites, and tree barking can help to confirm a deer wintering area.

Numerous deer beds, tree barking, and trails were observed in Grater Woods during winter tracking in 2009. It is estimated that the deer wintering area in Grater Woods and the adjacent property covers approximately 67 acres; it is a recognized critical habitat. Major travel routes and tree barking were also noticed within and surrounding this area. Another site was observed to contain a few deer beds. This much smaller area was located in a dense young stand of white pines on the Mitchell Woods property.

Major threats to this critical habitat include habitat loss from development and forestry. However, forestry projects can greatly enhance the value of deer yards by creating much needed food sources adjacent to the habitat by promoting regeneration of softwoods. This can also help save deer from traveling greater distances for winter food. Deer yards are also sensitive to continuous human disturbance during the winter months when they are actively used by deer.

Open Waterbodies*

Open waterbodies include rivers, streams, lakes, and ponds. Merrimack is defined by two major watersheds (Figure 2). The Coastal Transitional watershed covers most of the northern and northwestern parts of town. It includes the Souhegan River, Baboosic Brook, Long Pond, and Baboosic Lake, as well as many other western tributaries of the lower Merrimack River. The Non-tidal Coastal watershed covers the southern third of Merrimack and the extreme northeast corner. It is the main watershed of the lower

Merrimack River and includes Naticook Brook, Pennichuck Brook and associated ponds, Green's Pond, Horseshoe Pond, and Naticook Lake.

The rivers and smaller perennial streams mostly associated with these two watersheds are low gradient, meandering, characterized by sandy and cobbly substrates, and dominated by warm-water fishes. The Merrimack River and its major tributaries, as well as the numerous lakes within these watersheds, play a major role in supporting diverse native and diadromous fish species in New Hampshire. The Souhegan River has been identified as a successful **Atlantic salmon** nursery. The river is currently free-flowing for 16 miles thanks to continued efforts in removing dams, including the recent removal in Merrimack. Other examples of diadromous fish that may spawn in the tributaries of the Merrimack River include **American shad**, **alewife**, **American eel**, and **blueback herring**.

Streams and their associated riparian areas provide critical habitat for other semi-aquatic and terrestrial wildlife as well. The state-threatened **bald eagle** is known to use the Merrimack River. The 2010 winter eagle survey organized by NH Audubon yielded a total of 13 eagles observed along the river. Eagles have been observed in Merrimack along the river, as well as inland. Within the entire Souhegan River corridor, **blue-spotted salamander**, **spotted turtle**, state endangered **marbled salamander**, state endangered **eastern hognose snake**, state endangered **Blanding's turtle**, and **great blue heron** have been observed. The latter three are known to exist in the town of Merrimack.

One of the major threats to the open waterbodies of the Coastal Transitional and Non-tidal Coastal watersheds is non-point source pollution from pesticides, herbicides, fertilizers, stormwater management, and excess nutrients from inadequate septic systems. Other serious threats include dams and improperly designed culverts, invasive plants, recreation, the practice of unsustainable tree harvesting, habitat development and fragmentation.

While this represents a fairly comprehensive list of significant wildlife habitats some types may be even more abundant and their distribution may be greater throughout Merrimack. This is particularly true for woodland seeps and vernal pools since they are generally found in small isolated areas that can occur in a variety of forested and

residential settings, and are only now considered important enough to search out and record. Other significant small isolated habitats include turtle nesting areas and hard mast forests.

Natural Communities

Natural communities are defined by three features: 1) distinct plant assemblages, 2) their physical environments, and 3) the ecological processes that affect them. Essentially, they are ecological units that can be delineated throughout the landscape. Natural communities include both uplands and wetlands such as forests and woodlands, talus slopes, shorelines, marshes, forested swamps, peatlands, floodplains, and aquatic systems. Natural communities can be thought of as habitats for plants and provide a complimentary perspective to the previous section on *Important Wildlife Habitats*. Natural community classification and mapping is a way of providing more detail regarding the various plant communities that form a broader habitat type (for example, many types of natural communities can make up the marsh and shrub wetland habitat).

Natural communities provide scientists and resource managers with an ecological understanding of the land and its inhabitants to make informed decisions regarding land management options. Therefore, natural community classifications provide a powerful tool to guide strategic land use planning. Equally as important, they provide a basis from which inventory and monitoring programs can be developed, and a means to document and track rare species and exemplary natural communities.

The NH Natural Heritage Bureau (NH NHB), a bureau within the Department of Resource and Economic Development's Division of Forest and Lands, is responsible for locating, tracking, and facilitating the protection of rare and imperiled plants and exemplary natural communities (see Appendix C for a list of known rare natural communities in Merrimack). NH NHB has developed an extensive classification system for natural communities in New Hampshire. This classification system was the basis from which the various forest and wetland communities of Merrimack were identified.

Merrimack has the potential to contain 101 specific types of natural communities (Appendix D). Approximately 32 different natural communities have been observed

within the town (Table 2), of which two have been identified as locally significant and eight as being exemplary. Exemplary natural communities include all rare types of natural communities, as well as high quality examples of those that are more common in the state. The NH NHB regards exemplary natural communities as priorities for conservation. Rare natural communities are designated as S1 and S2 by the NH NHB. The following natural community table is not a comprehensive list for the town but does however represent a baseline documentation of known natural communities throughout the town and serves as a good base for a future comprehensive natural community inventory.

While many of the natural communities that have been identified in Merrimack represent fairly common types, exemplary types and those of local significance deserve special attention. Two rare upland forest communities were observed in Merrimack, including rich Appalachian oak rocky woods (S1) and pitch pine-scrub oak woodland (S1S2). The Appalachian oak rocky woods forest community is known to occur in two town-owned locations in Merrimack, one of which has formal protection while the other does not have such a designation. Several rare plant species are associated with this community type and a variety of these were observed in Merrimack. The pitch pine-scrub oak woodland is a historical record from NH NHB and may no longer be present. It is thought that this forest community had occurred in the area near Leatherleaf Bog where pitch pine still exists today.

A total of eight wetland communities found in Merrimack are designated as exemplary or locally significant. Six of these are considered as rare. The two most rare wetland communities include the swamp white oak basin swamp (S1) and the pitch pine-heath swamp (S1S2), which were previously observed by the NH NHB. The remaining four rare types include the two floodplain communities (silver maple floodplains can be found along the Merrimack River; the red maple floodplain was previously recorded by the NH NHB), a floodplain vernal pool along Baboosic Brook, and the Leatherleaf Bog (a protected parcel along Technology Drive). The red maple-black ash-swamp saxifrage swamp of Grater Woods and the red maple-black gum swamps found at Watkins Forest II are examples of locally significant natural communities.

Table 2. List of known Natural Communities of Merrimack.

Natural Community Types	State Ranking	Critical Wildlife Habitat
Wooded Uplands		
<i>Northern and transition hardwood - conifer zone</i>		
Hemlock forest	S4	Hemlock hardwood pine forest
Hemlock - white pine forest	S4	Hemlock hardwood pine forest
Hemlock - beech - oak - pine forest	S5	Hemlock hardwood pine forest
<i>Oak - pine zone</i>		
Dry red oak - white pine forest	S3S4	Hemlock hardwood pine forest
Dry Appalachian oak - hickory forest	S1S3	Appalachian oak pine forest
Pitch pine-scrub oak woodland^	S1S2	Appalachian oak pine forest
Appalachian oak - mountain laurel forest	S3	Appalachian oak pine forest
Rich Appalachian oak rocky woods	S1	Appalachian oak pine forest
Wooded Wetlands and Floodplain Forests		
<i>Floodplain forests</i>		
Silver maple - false nettle - sensitive fern floodplain forest	S2	Floodplain forests
Red maple floodplain forests	S2S3	Floodplain forests
<i>Boggy nutrient-poor swamps</i>		
Black gum - red maple basin swamp	S1S2	Peatlands - forested
Red maple- <i>Sphagnum</i> basin swamp	S4	Peatlands - forested
Swamp white oak basin swamp	S1	Peatlands - forested
Pitch pine - heath swamp	S1S2	Peatlands - forested
<i>Minerotrophic swamps</i>		
Red maple - black ash - swamp saxifrage swamp	S2	Matrix forest - inclusion
Seasonally flooded red maple swamp	S4S5	Marsh and shrub wetlands
Hemlock - cinnamon fern forest	S4	Peatland - forested
<i>Forest seeps</i>		
Acidic <i>Sphagnum</i> forest seep	S3S4	Matrix forest - inclusion
Subacid forest seep	S3S4	Matrix forest - inclusion
<i>Vernal pools</i>		
Vernal woodland pool	S3	Vernal pools
Vernal floodplain pool	S2	Vernal pools
Open Wetlands and Riparian Communities		
<i>Open emergent marshes, shrub thickets, and aquatic beds</i>		
Tall graminoid emergent marsh	S4	Marsh and shrub wetlands
Medium-depth emergent marsh	S4	Marsh and shrub wetlands
Cattail marsh	S4	Marsh and shrub wetlands
Deep emergent marsh - aquatic bed	S4S5	Marsh and shrub wetlands
Aquatic bed	S4S5	Marsh and shrub wetlands
Highbush blueberry - winterberry shrub thicket	S4	Marsh/shrub wetlands, Peatlands
<i>Open peatlands</i>		
Leather-leaf - sheep laurel dwarf shrub bog	S1S3	Peatlands - open
Highbush blueberry - mountain holly wooded fen	S3S4	Peatlands - shrub
Winterberry - cinnamon fern wooded fen	S4	Peatlands - shrub
Highbush blueberry-sweet gale-meadowsweet shrub thicket	S4	Peatlands - shrub
Floating marshy peat mat	S3S4	Peatlands - open

Source: Spurduto and Nichols (2004); NHNHB (2009); Ecological Inventory (2009)

^ = Historical record - may no longer exist

This list of natural communities has been cross-referenced to their associated wildlife habitat for direct comparisons. This affords the opportunity to view Merrimack in a more ecological perspective, integrating biological diversity planning with considerations for both wildlife habitats and natural communities that form ecologically significant areas.

Species of Conservation Concern – Rare Wildlife and Plants

A variety of species of conservation concern were recorded during the course of field investigations in 2009. This list was supplemented with the NH NHB database on rare wildlife and plants for Merrimack (Appendix C). Table 3 provides a list of rare and declining wildlife that has been observed in the town.

Having a total of 23 species, this list includes 12 birds, 2 mammals, 5 reptiles, 2 fish, and 2 insects of historical notation. Since this was not a comprehensive inventory of the town and considering the mobility and difficulty in locating rare or declining species it is possible that other wildlife of conservation concern may be present in Merrimack. Appendix E provides a list of known and potential species of concern based on the critical wildlife habitats expected in Merrimack. This provides for a wider range of the types of wildlife that could be present or potentially so into the future. For a summary of these species, including their distribution and conservation status, see Appendix A of the NH Wildlife Action Plan (2005).

A total of 11 rare plants were recorded in 2009 and 16 additional species have been previously documented by the NH NHB, of which 13 are listed as historical records (Table 4 and Appendix C). Interesting though, the skydrop aster was listed as historical but was documented in two locations in 2009. The majority of rare plants in 2009 were observed in a single exemplary natural community. A type of bulrush (*Trichophorum planifolium*) was also observed in this location, which is the first known record for this species in New Hampshire. It occurred in a small patch and is sensitive to human disturbance. This species is currently under review to determine if state endangered or threatened designation is warranted.

Table 3. List of known wildlife of conservation concern in Merrimack.

Species	Rarity Rank
Birds	
Black duck*	
American woodcock*	
Cooper's hawk*	
Eastern meadowlark*	
Eastern towhee*	
Great blue heron*	
Least bittern*	special concern
Red-shouldered hawk*	special concern
Ruffed Grouse*	
Veery*	
Grasshopper sparrow	S2
Vesper sparrow*	
Mammals	
New England cottontail	S1
Bobcat*	
Reptiles	
Blanding's turtle*	S1
Eastern hognose snake	S1
Wood turtle*	
Ribbon snake*	
Northern black racer	S2
Fish	
Banded sunfish	
Swamp darter	
Insects	
Karner blue butterfly^	S1
Persius dusky wing^	S1

Source: Ecological Inventory by Moosewood Ecological (Littleton 2009)
and NH Natural Heritage Bureau database (January 2009)

*Observed in 2009

^Historical observation

S1 - State Endangered

S2 - State Threatened

Table 4. List of known rare plants of Merrimack.

Species	Rarity Rank
Hoary mountain mint (<i>Pycnanthemum incanum</i>)*	S1
Early buttercup (<i>Ranunculus fascicularis</i>)*	S1
Blunt lobed woodsia (<i>Woodsia obtuse</i>)*	S1
Downy trailing bush clover (<i>Lespedeza procumbens</i>)*	S1
Hairy stargrass (<i>Hypoxis hirsuta</i>)*	S1
Downy false-foxglove (<i>Aureolaria virginica</i>)*	S1
Skydrop aster (<i>Symphiotrichum patens</i>)*	S1
False pimpernel (<i>Lindernia dubia</i> var. <i>anagallidea</i>)*	S1
Smooth bidens (<i>Bidens laevis</i>)	S1
Bald spike-rush (<i>Eleocharis erythropoda</i>)^	S1
Butterfly weed (<i>Asclepias tuberosa</i>)^	S1
Common sandbur (<i>Cenchrus longispinus</i>)^	S1
Goat's rue (<i>Tephrosia virginiana</i>)^	S1
Low bindweed (<i>Calystegia spithamea</i>)^	S1
Philadelphia panic grass (<i>Panicum philadelphicum</i>)^	S1
Siberian chives (<i>Allium schoenoprasum</i>)^	S1
Stiff tick trefoil (<i>Desmodium obtusum</i>)^	S1
Virginian mountain mint (<i>Pycnanthemum virginianum</i>)^	S1
Wild garlic (<i>Allium canadense</i>)^	S1
Wild senna (<i>Senna hebecarpa</i>)^	S1
Wright's spike-rush (<i>Eleocharis diandra</i>)^	S1
Dwarf ragwort (<i>Packera paupercula</i>)*	S2
Prostrate tick trefoil (<i>Desmodium rotundifolium</i>)*	S2
Smooth-forked chickweed (<i>Paronychia canadensis</i>)*	S2
Bird's foot violet (<i>Viola pedata</i>)	S2
Wild lupine (<i>Lupinus perennis</i>)	S2
Blunt-leaved milkweed (<i>Asclepias amplexicaulis</i>)^	S2

Source: Ecological Inventory by Moosewood Ecological (Littleton 2009), Kane and Powell (2009), and NH Natural Heritage Bureau database (January 2009)

*Observed in 2009

^Historical observation

S1 - State Endangered

S2 - State Threatened

Landscape-level Considerations

When prioritizing areas for conservation it is critical to incorporate a landscape-level perspective with fine-scale habitat data. This consideration aids in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the developed and natural environments. When these elements are considered in combination with the distribution of currently protected lands then a more successful conservation plan can be prepared that incorporates the concepts of biological conservation and ecosystem reserve design to help maximize and sustain biodiversity protection for the long-term.

One major landscape-level consideration includes the size and distribution of unfragmented lands in Merrimack (Figure 7). These areas are defined by the surrounding human infrastructure (roads and developed areas) and can negatively affect species survival rates, including mortality or lowered rates of breeding success. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented block, the species in question, the extent of loss of natural habitat, and intensity of human use.

Large blocks of unfragmented areas are widely known to support greater biodiversity than smaller blocks. As forest blocks become smaller due to the construction of roadways and developments their biodiversity will generally be reduced. This fragmentation affect has less immediate impact on generalist species or those with small home ranges (such as gray squirrels, raccoon, many amphibians and reptiles, and small rodents) while affecting and potentially eliminating area-sensitive specialists that need large forested blocks in order to maintain their home ranges and for long-term survival (such as bear, bobcat, moose, some reptiles, wood thrush, and goshawk). Appendix F provides a general list for habitat block size requirements for wildlife.

Merrimack Biodiversity Conservation Plan

Unfragmented Lands

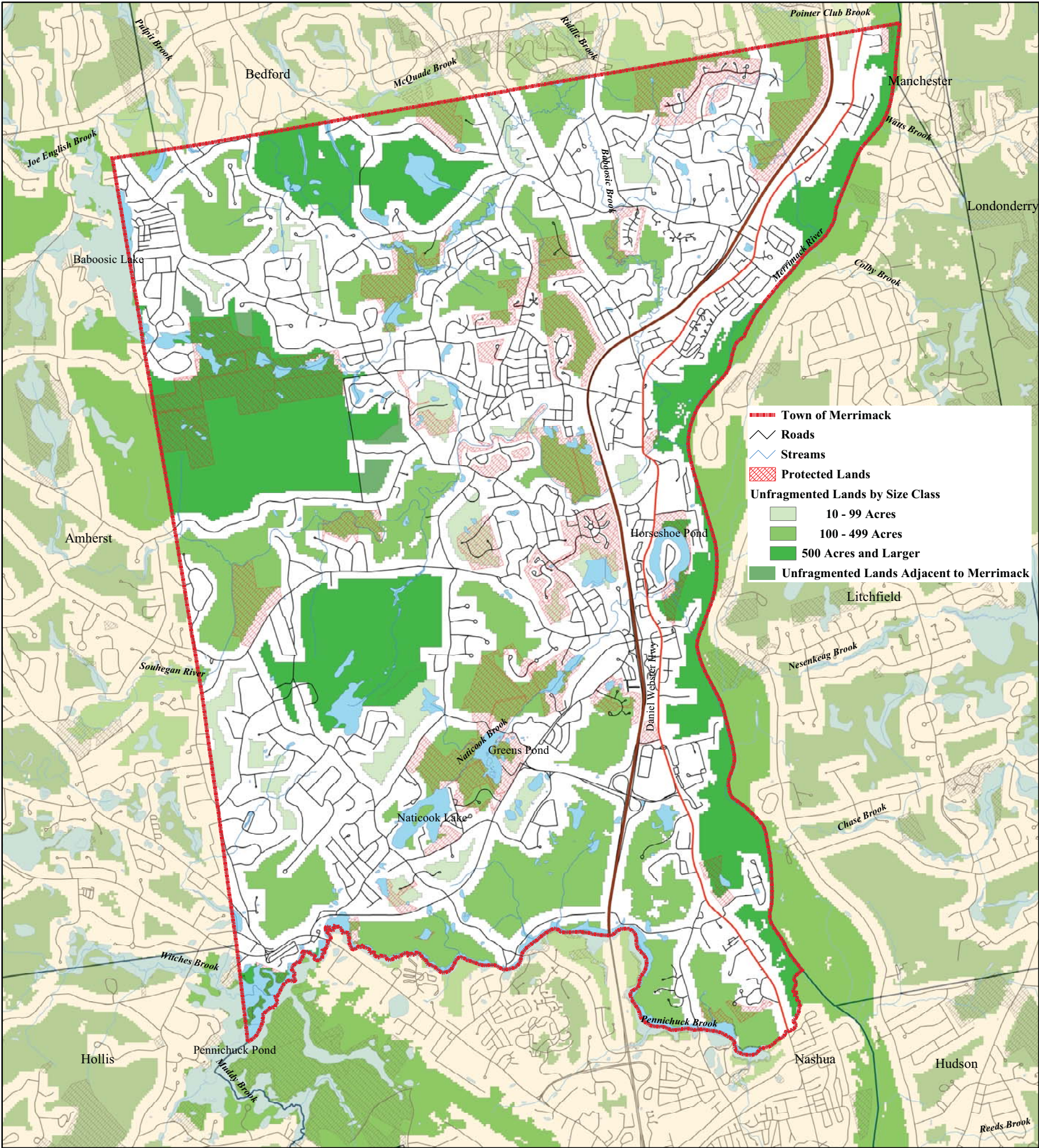


Figure 7. Unfragmented lands of Merrimack, NH. This map shows the distribution and size range of unfragmented, contiguous forest patches. Moosewood Ecological LLC.

Large landscapes provide the ability for wildlife movement and connect multiple habitat elements. By maintaining connectivity between critical habitats it may be possible to provide permanent wildlife corridors within the developed environment. Wildlife travel corridors function as areas that one or many species may use to move from one habitat need to another. This movement can be based on traveling to different areas for feeding, breeding, or shelter. These habitat elements are required by all species.

Wildlife must be able to travel safely throughout the landscape in order to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These may include features such as riparian zones of wetlands, ponds, and streams, ridgelines, utility right-of-ways, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, muskrat, fox, coyote, bobcat, deer, moose, fisher, mink, beaver, and bear.

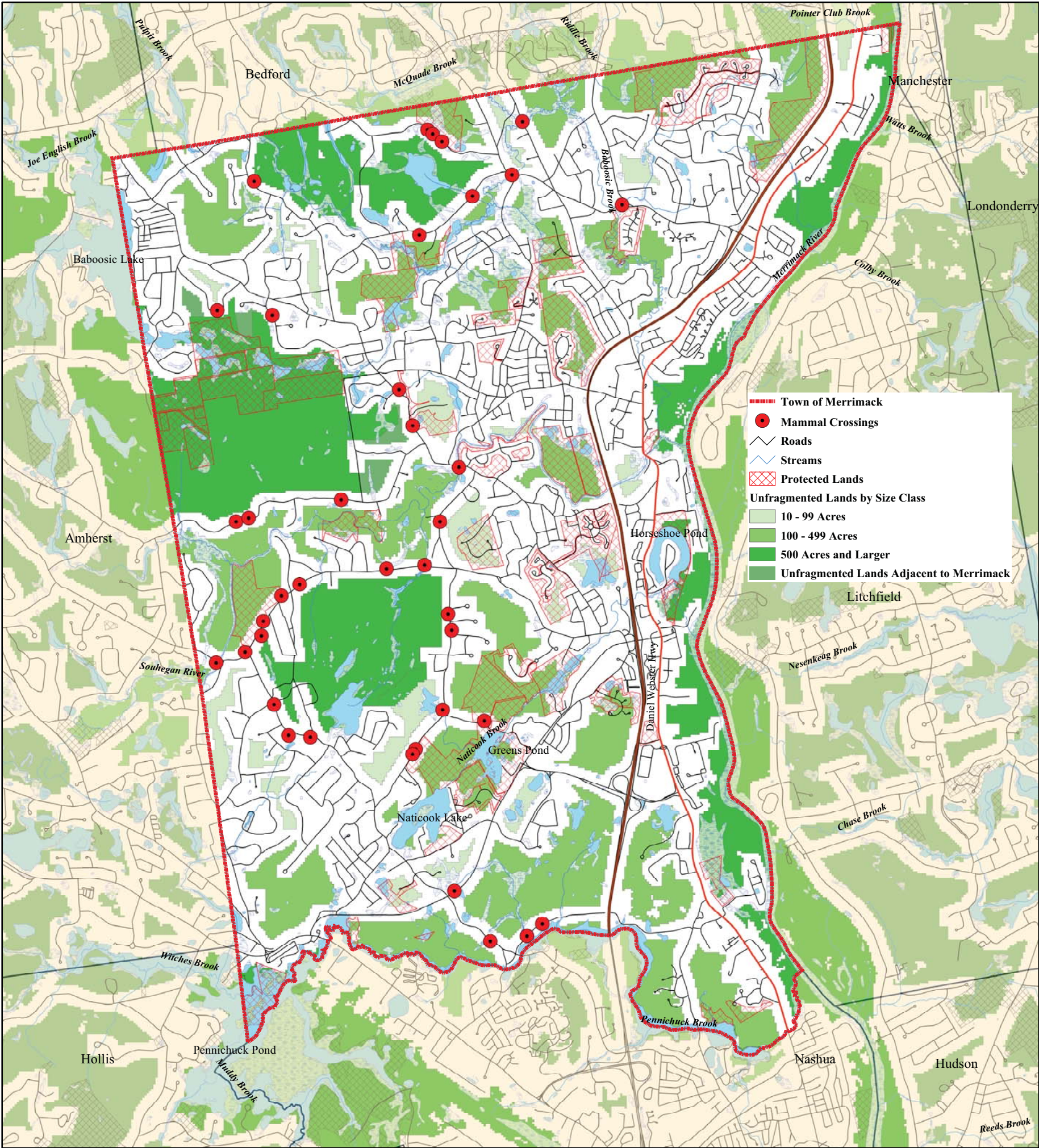
To fully understand the use of an area as a mammal corridor several years of tracking census studies need to be conducted. The use of wildlife trail cameras can also be used to enhance this understanding. However, one can begin to see the possibilities of corridor activity based on unfragmented lands and site-specific ecological assessments combined with notations on mammal movement across roadways (Figure 8). This map shows the results of mammal road crossings that were identified during the winter tracking surveys in 2008-2009. These data are useful in developing a baseline documentation of mammal road crossings to begin to identify areas important for corridors.

Corridors are not only significant for mammals but equally as important for amphibians, reptiles and migratory birds. Both amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of critical habitats. This can be especially devastating for local turtle populations as some species breed only after 15 years of age (for example, wood turtle). This affect can often be exacerbated as the same individuals must return back to their wintering habitats. Thus, there is a great significance in maintaining habitat

connectivity, as well as understanding where these patterns of movement are taking place. This latter point can be a very important educational tool for community education and awareness about corridors across roadways. It can provide a means to adjust transportation patterns to help eliminate potential road mortality. Potential sites for amphibian crossings were identified to begin assisting the town of Merrimack in this effort (Appendix G).

Merrimack Biodiversity Conservation Plan

Mammal Road Crossings



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Map is to be used for planning purposes only. Accuracy of data to be verified by end user. Use of this map constitutes agreement with terms of the Moosewood Ecological GIS Data Disclaimer. This map was created using ArcView 10.0 from ESRI with data supplied by NH GRANIT. Current map revision is December 5, 2010.

Figure 8. Distribution of mammal road crossings (December 2008-April 2009) in Merrimack, NH. Moosewood Ecological LLC.

The Merrimack River has been recognized as an important migratory bird corridor. As birds migrate up the Atlantic flyway they tend to use large river systems to move inland. These large rivers are easily distinguishable landscape features and provide a significant food source as birds migrate in the spring. The riparian forests, early successional habitats, and fields and other open areas adjacent to the Merrimack River provide great habitat for a variety of landbirds, waterfowl, and shorebirds during spring and fall migratory seasons.

Another consideration to take into account when developing a conservation plan is the distribution of protected parcels¹ and town-owned open space parcels² (Figure 9). This affords the opportunity to understand how various fine- and large-scale ecological attributes are arranged on the landscape and how they coincide with protected areas to best prioritize for conservation initiatives. This informed land use planning effort helps to determine how Merrimack can link significant areas with those parcels that have development constraints, as well as how and where to create larger reserves. These are the basic ideas of ecological reserve design that helps to maximize conservation values and ensure that representative ecologically significant areas are included for protection strategies.

¹ Protected parcels include those that have some form of permanent protection through covenants in their deeds.

² Town-owned open space parcels include those properties owned by the Town of Merrimack and the land exists in a relatively open state. These parcels do not have permanent protection.

Merrimack Biodiversity Conservation Plan

Town-owned Open Space Parcels and Protected Lands

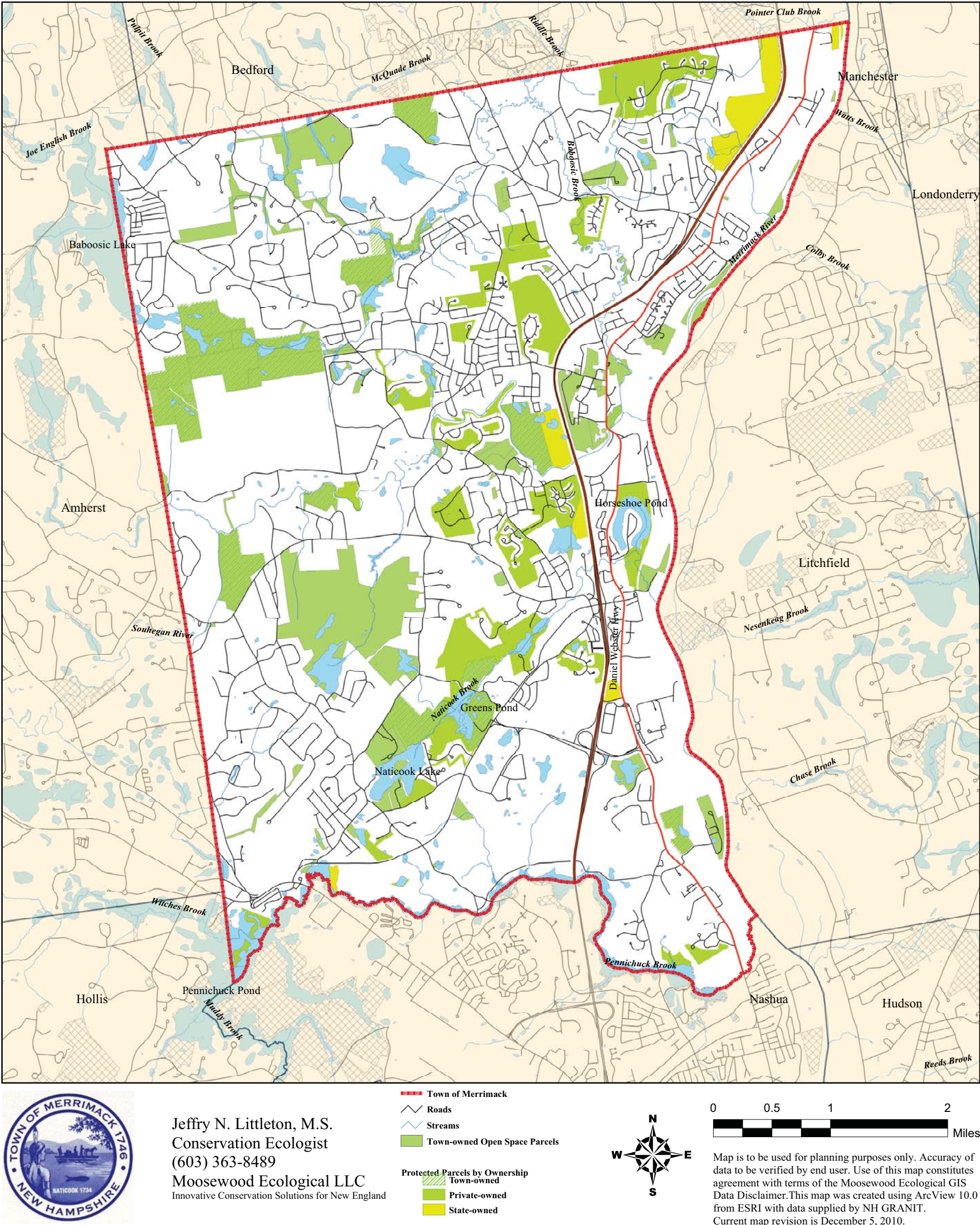


Figure 9. Distribution of open space parcels and protected lands by ownership in Merrimack, NH. Moosewood Ecological LLC.

PRIORITIES FOR CONSERVATION

Conservation Focus Areas

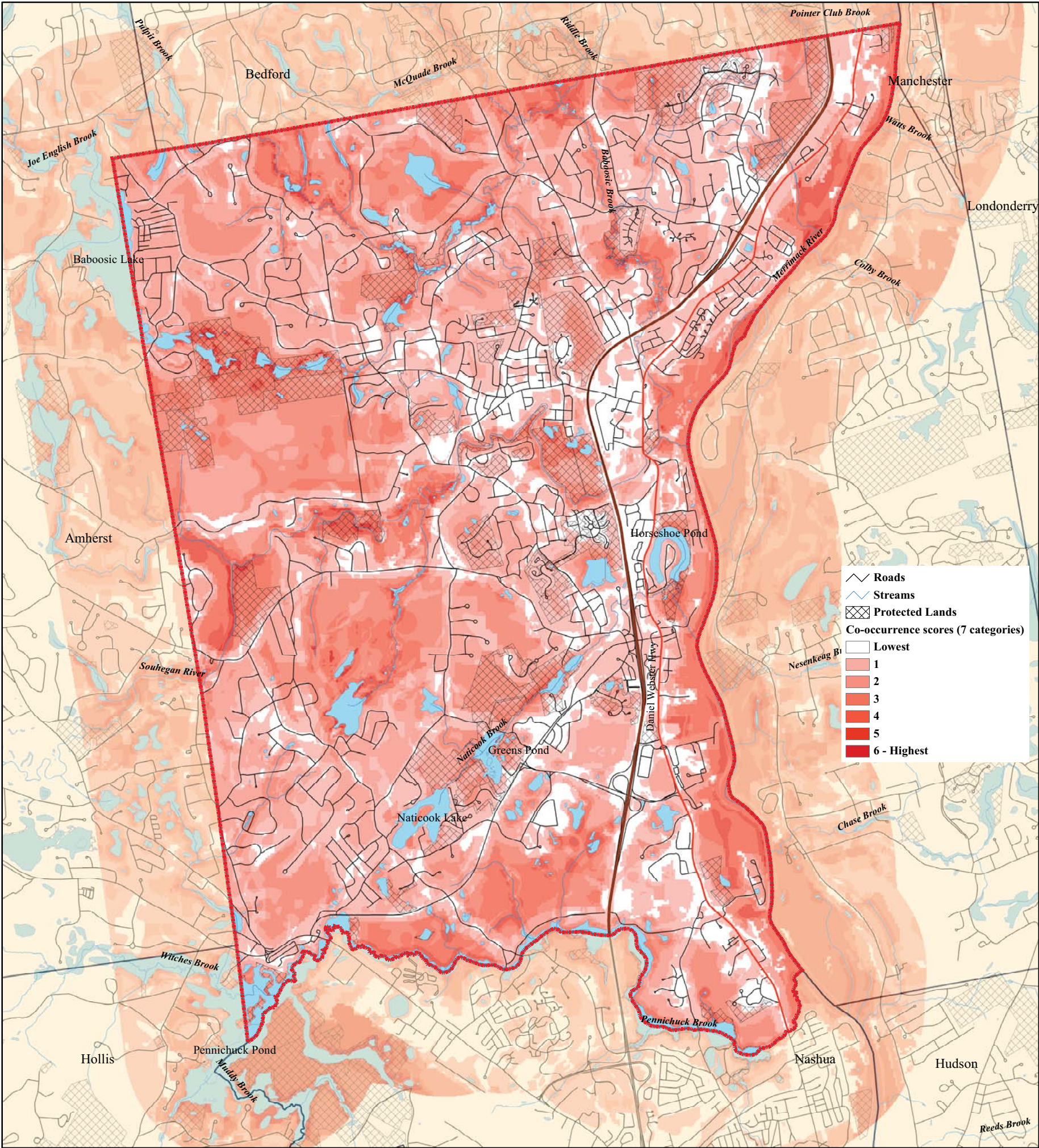
To continue the process of identifying Merrimack's most ecologically significant areas in town, a co-occurrence model was generated using a GIS (Figure 10). A co-occurrence model is an analytical tool that uses data to determine where various levels of natural resources occur in unison or overlap. This analysis, in its simplest form, demonstrates low, medium, and high levels of co-occurring resources to assist in the identification of "hotspots" for conservation. Essentially, it helps to prioritize conservation planning efforts to help maximize economic, social, and ecological benefits.

While the co-occurrence model is an effective tool for the initial analysis and identification of Conservation Focus Areas (CFA) it should be used in combination with an ecological interpretation of Merrimack's landscape. This type of interpretation should consider many of the landscape-level attributes listed above, including wildlife movement and habitat connectivity, ecological reserve design and proximity to protected lands, unfragmented lands, development pressure, land parcelization, and current land use, as well as the presence and distribution of rare species and clustering effect of critical habitats that occur in close proximity to one another.

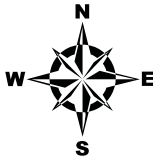
In consideration of these factors, a total of 5 CFAs have been identified as having the highest priority for protection (Figure 11). These include the Grater Woods CFA, Horse Hill CFA, Souhegan River Corridor CFA, Merrimack River Corridor CFA, and Baboosic Brook Corridor CFA. Each contains a list of the significant attributes that has led to their designation as a CFA.

Merrimack Biodiversity Conservation Plan

Co-occurrence Map



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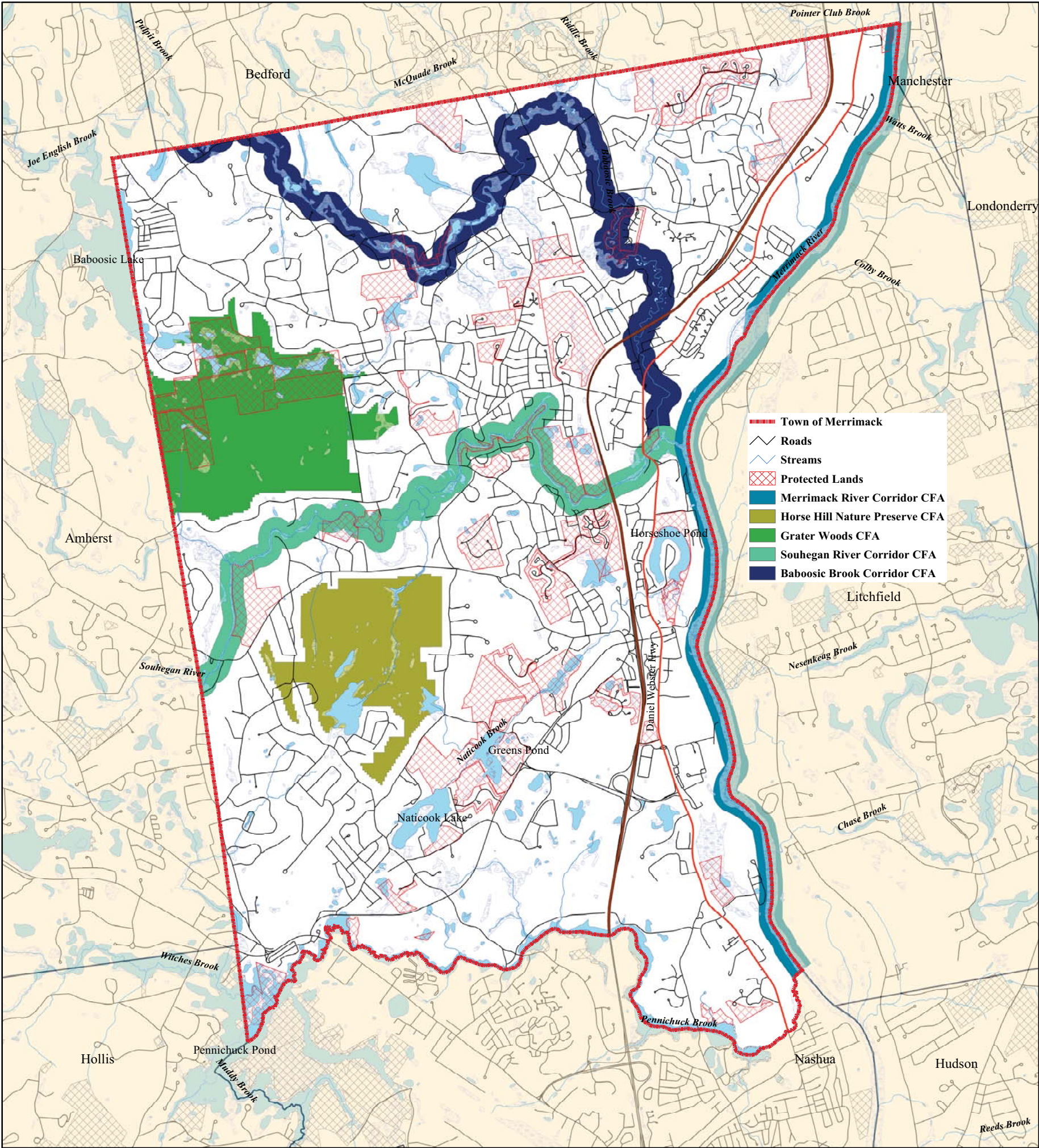
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Figure 10. Co-occurrence analysis of ecological data for Merrimack, NH. This map shows hotspots where ecological attributes overlap. The darker red coloration indicates greater overlap, or co-occurrence, of these resources. Conversely, the lighter the shade of red indicates fewer co-occurrences.

Moosewood Ecological LLC.

Merrimack Biodiversity Conservation Plan

Conservation Focus Areas



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Figure 11. Primary Conservation Focus Areas (CFA) in Merrimack, NH. This map shows the major ecologically significant areas with the highest priorities for land protection. These areas support relatively high and unique biodiversity attributes. Moosewood Ecological LLC.

Grater Woods CFA

The Grater Woods CFA contains approximately 1,300 acres. This area is located along the western boundary of Merrimack and southeast of Baboosic Lake. It is bound to the north by Baboosic Lake Road and South Baboosic Lake Road, and includes a variety of residential developments along Beebe Lane, Coleman Path, Trowbridge Drive, Parker Drive, Linden Way, Conservation Drive, and Marty Drive; bound to the east by the Merrimack Middle School and the residential developments off McQuestion Road, including Bambi Terrace, Silver Doe Lane, Merrymeeting Drive, Old Blood Road, Linda Drive, and Harrington Drive; bound to the south by Wilson Hill Road; and to the west by the town boundary line (although it appears that it continues into Amherst and coordination of conservation efforts is suggested).

The Grater Woods CFA represents Merrimack's largest unfragmented forested block interspersed with diverse wetlands and other significant habitats that are critical for a number of species of conservation concern. Not only does Grater Woods CFA exhibit high quality examples of common habitats¹, but it also contains a complex of interconnected ecologically significant areas that supports high biodiversity. The forests are those of hemlock-hardwood-pine mixing with that of Appalachian oak-pine forests, creating a diverse suite of trees and shrubs that includes relatively uncommon species such as chestnut oak, American chestnut, and mountain laurel. Wetlands are representative of all the major classes, including forested and shrub swamps, marshes, wet meadows, aquatic beds, beaver ponds, vernal pools, and peatlands. A significant acreage of this unfragmented block is owned by the town and managed as a conservation area. This affords a unique opportunity in Merrimack to dramatically increase the biodiversity value of this area.

Significant Ecological Attributes

- Unfragmented block size: approximately 1,700 acres
- Area of currently protected land: 500 acres

¹ High quality common habitats represent those that are large and intact, relatively isolated from developed areas, lacking invasive species, function as connectivity to other habitats, and/or support rare species.

- Critical wildlife habitats:
 - Rare species habitats
 - Extensive hydrologically connected wetland ecosystems (emergent marshes/beaver impoundments, wet meadows, shrub swamps, forested swamps, intermittent and perennial streams)
 - Deer wintering area
 - Vernal pool complexes
 - Mast forest – acorns, hickories
 - Core interior forest to support area-sensitive species
 - Inactive heron rookery that may be functional into the future for great blue herons or osprey
 - Potential wildlife corridors to areas outside of the CFA
- Exemplary or locally significant natural communities:
 - Red maple-black ash-swamp saxifrage swamp
- Observed species of conservation concern:
 - Blanding’s turtle (state endangered)
 - Ribbon snake
 - Hognose snake (state endangered)
 - Bobcat
 - Spotted turtle
- Other target species observed:
 - Bear
 - Otter
 - Moose
 - Mink
 - Interior forest breeding birds
 - Hawks and owls
- Connectivity to other areas

- For the most part, Grater Woods CFA is surrounded by residential developments to the east and north. However, there are opportunities to provide connectivity to other habitats and protected lands to the west into Amherst and south on privately owned open space. These include:
 - Aquatic and riparian connectivity along the tributaries to Baboosic Brook and Baboosic Lake;
 - Upland connectivity to the Souhegan River Corridor to the south; and
 - Upland connectivity to the remaining portion of the unfragmented block to the west in Amherst.
- Landscape implications for protection of CFA:
 - Being one of Merrimack's last remaining relatively large unfragmented forests, it carries great significance for biodiversity protection. Without such large areas various species would not be able to exist. These include bear, moose, bobcat, fisher, otter, mink, hawks, owls, and even small migrant songbirds such as ovenbird, veery, and scarlet tanager.
 - The CFA contains many high quality critical habitats within close proximity to one another and with very limited barriers to wildlife movement.
 - Opportunities still exist to provide connectivity to other CFAs, including Baboosic Brook Corridor and Souhegan River Corridor, as well as into Amherst.

Horse Hill CFA

The Horse Hill CFA contains approximately 847 acres. This area is located south of the Grater Woods CFA across the Souhegan River. It is bound to the north by Amherst Road; to the west by Fuller Mill Road, Farmer Road, Peaslee Road, and Penny Lane; to the south by Peaslee Road and Naticook Road; and to the east by Naticook Road. Much of the surrounding area is residential but some farmland exists to the north between it and the Souhegan River.

The Horse Hill CFA has many similar characteristics to the Grater Woods CFA. It represents Merrimack's second largest unfragmented forested block with wetlands and other significant habitats that are critical for a number of known rare species and other species of conservation concern. The forests are a mixture of hemlock-hardwood-pine and Appalachian oak-pine forests with abundant oak species distributed widely throughout the property. For the most part, these forests are about 30-40 years old due to a heavy cutting previously. This CFA is known to contain at least one rare forest community with state endangered plants. Wetlands are representative of all the major classes, including forested and shrub swamps, marshes, wet meadows, aquatic beds, beaver ponds, vernal pools, and peatlands. Some of these wetlands provide critical habitat for a known occurrence of a state endangered turtle.

- Unfragmented block size: 847 acres
- Area of protected land: 0 acres
- Critical wildlife habitats:
 - Extensive hydrologically connected wetland ecosystems (emergent marshes/beaver impoundments, shrub swamps, intermittent and perennial streams)
 - Rare species habitat; identified as potential New England cottontail habitat
 - Vernal pool complexes
 - Mast forest and shrubs – acorns, hickories, blueberries
 - Core interior forest to support area-sensitive species
 - Turtle nesting habitat in the utility ROW
 - Shrubland associated with the utility ROW
 - Early successional/shrub habitat next to parking area along Amherst Road
 - Potential wildlife corridors to areas outside of the CFA
- Exemplary and locally significant natural communities:
 - Rich Appalachian oak rocky woods
- Observed species of conservation concern:
 - Blanding's turtle (state endangered)

- Great blue heron
 - Sky drop aster (state endangered)
 - Downy false-foxglove (state endangered)
- Other target species observed:
 - Bear
 - Otter
 - Moose
 - Mink
 - Interior forest breeding birds
 - Hawks
- Connectivity to other areas:
 - While Horse Hill CFA is surrounded by dense residential developments there still exist opportunities to maintain connectivity to other habitats and protected lands, such as:
 - Aquatic and riparian corridor connectivity to the Souhegan River along tributaries running north from the CFA and through residential areas with open fields and forested lots,
 - Upland connectivity to the protected “Ireland” 80-acre parcel to the northwest, which has 1,200 feet of shoreline frontage along the Souhegan River, and
 - Upland, aquatic, and riparian corridor connectivity to a series of town-owned and privately-owned protected lands to the southeast, including Wasserman Park Conservation Area, Gilmore Hill, and Merrimack Village District lands.
- Landscape implications for protection of CFA:
 - Being the second largest unfragmented forest in Merrimack and in a highly settled area, it carries great significance for biodiversity protection. Without such large areas various species would not be able to persist. These include bear, moose, bobcat, fisher, otter, mink, hawks, owls, and even small migrant songbirds such as ovenbird, veery, and scarlet tanager.

- The CFA contains many high quality critical habitats within close proximity to one another and very limited barriers for wildlife movement.
- Opportunities still exist to provide connectivity to other CFAs, including the Souhegan River Corridor, as well as other protected lands.

Souhegan River Corridor CFA

The Souhegan River Corridor CFA focuses on a 500-foot area on either side of the river channel for its entire length within Merrimack, which represents about 840 acres of mixed land uses that range in their intensity of ecological disturbance. The uses range from residential and commercial developments, forests, wetlands, grasslands, and floodplains. Although these mixed land uses exist, river corridors are well-deserving of conservation efforts that seek to restore and protect habitat connectivity, water quality, rare species, exemplary natural communities, and critical habitats. This CFA should also include large parcels whose open space extends beyond the 500-foot area.

- Unfragmented lands within the river corridor include three distinct unfragmented blocks within corridor:
 - Western section adjacent to the town of Amherst and including the “Ireland” parcel (314 acres),
 - Middle section from Tomasian Drive to Turkey Hill Road (242 acres), and
 - The Wildcat Falls Conservation Area and with the NH DOT parcel adjacent to the F.E. Everett Turnpike (118 acres)
- Area of protected land:
 - Seven contiguous blocks of protected lands totaling approximately 340 acres, or roughly 40%, are found within or directly adjacent to the Souhegan River Corridor CFA, which includes Wildcat Falls Conservation Area
- Critical wildlife habitats:
 - River ecosystem
 - Marsh-shrub wetlands

- Forested swamps
- Floodplains
- Grasslands
- Shrublands
- Wildlife corridor along river
- Mast forest and shrubs – acorns, blueberries, apples
- Core interior forest to support area-sensitive species
- Turtle nesting habitat in the utility ROW and inactive sand and gravel pits
- Exemplary and locally significant natural communities:
 - At least one rare natural community and one rare system are known to exist within the corridor. The silver maple-false nettle-sensitive fern floodplain forest community was observed on the Riverside Park property, and the moderate gradient sandy-cobbly riverbank system was associated with the Wildcat Falls Conservation Area along the Souhegan River. However, they occur on private properties, and therefore the exact location and type of natural community and system is not available to the public without permission of the landowners.
 - Opportunities exist for more rare natural communities, especially those associated with the riparian zone, including the river channel, riverbanks, and floodplains.
- Observed species of conservation concern:
 - Limited access to the Souhegan River provided few opportunities to sample lands directly adjacent to the river. As such, there was only one species of conservation concern observed during 2009. A vesper sparrow was heard using the utility ROW next to the Turkey Hill ball fields and across from the Wildcat Falls conservation area. However, it is expected that some species do occur within the Souhegan River Corridor CFA due to the availability of habitats and distribution of rare species and other species of concern. To this end, the NH Wildlife Action Plan has reported

that a variety of species of conservation concern have been observed throughout the Souhegan River corridor, including:

- Blanding's turtle (state endangered)
- Spotted turtle
- Eastern hognose snake (state endangered)
- Blue-spotted salamander
- Marbled salamander (state endangered)
- Great blue heron
- Atlantic salmon
- Other target species observed:
 - Otter
 - Mink
 - Moose
- Connectivity to other areas:
 - While the Souhegan River Corridor CFA is surrounded by residential developments and other mixed land uses many opportunities exist to maintain connectivity to other habitats and protected lands, such as:
 - Aquatic and riparian corridor connectivity to the Merrimack River and Baboosic Brook along the mainstem of the Souhegan River,
 - Aquatic and riparian corridor connectivity to Horse Hill CFA via tributaries to the Souhegan River,
 - Upland connectivity to the Horse Hill CFA from the Ireland Parcel conservation area abutting the Souhegan River and along Amherst Road,
 - Aquatic and riparian corridor connectivity along tributaries with other wetland ecosystems,
 - Upland, aquatic, and riparian corridor connectivity to the Grater Woods CFA, and

- Upland, aquatic, and riparian corridor connectivity to the adjacent unfragmented block and other critical habitats of the town of Amherst.
- Landscape implications for protection of CFA:
 - The Souhegan River Corridor CFA contains some significant blocks of unfragmented areas with open and forested upland habitats mixed with various wetlands and tributary streams leading to the river. These varied habitats, including the river ecosystem, provide great diversity for both plants and wildlife.
 - The Souhegan River Corridor CFA contains some high quality critical habitats within close proximity to one another, including intact examples of shoreline.
 - Opportunities still exist to provide connectivity to all other CFAs as well as other critical habitats, affording corridors for wildlife movement.
 - The Souhegan River has been identified as a successful Atlantic salmon nursery. It is a free-flowing river for 30 miles with dam removal increasing. In other stretches, the “run-of-the-river” methods are used by hydroelectric plants that allow fish to migrate. Other examples of diadromous fish that may spawn in the Souhegan River include American shad, alewife, American eel, and blueback herring. The potential for these fish, as well as other wide-ranging migratory fish, to use the Souhegan River for spawning should be viewed as a high priority for conservation. Few examples of river habitat supporting this diversity exist in the state.

Baboosic Brook Corridor CFA

The Baboosic Brook Corridor CFA focuses on a 500-foot area on either side of the stream channel for its entire length (approximately 11 miles) within Merrimack. This area represents about 1,054 acres of mixed land uses that range in their intensity of ecological disturbance. The uses range from light to dense residential areas, commercial and industrial developments, forests, wetlands, grasslands and other open areas, and

floodplains. Although these mixed land uses exist stream corridors are well-deserving of conservation efforts that seek to restore and protect habitat connectivity, water quality, rare species, exemplary natural communities, and critical habitats. This CFA should also include large parcels whose open space extends beyond the 500-foot area.

- Unfragmented lands within the Baboosic Brook corridor include five distinct unfragmented blocks within corridor (moving from upstream to downstream at its confluence with the Souhegan River):
 - Unfragmented lands associated with the landfill (564 acres),
 - Unfragmented lands south of Bean Road and associated with Mitchell Woods and Watkins Forest I conservation areas (210 acres),
 - Unfragmented lands between Wire Road and Pearson Road near the town of Bedford (246 acres),
 - Unfragmented lands between Bedford Road and FE Everett Turnpike (130 acres), and
 - Unfragmented lands at the confluence with the Souhegan River that is mainly associated with the Merrimack River (2,035 acres)
- Area of protected land:
 - Two contiguous blocks of protected lands (Mitchell Woods and Watkins Forest I) totaling approximately 175 acres are found within or directly adjacent to the Baboosic Brook Corridor CFA
- Critical wildlife habitats:
 - Stream ecosystem
 - Extensive complex of wetlands (marsh and shrub, forested, and peatlands) along stream corridor
 - Floodplains
 - Vernal pool
 - Shrublands associated with extensive shrub swamps along stream corridor
 - Potential wildlife corridor along stream
 - Core interior forest to support area-sensitive species

- Turtle nesting habitat in the utility ROW and sand and gravel pits
- Exemplary and locally significant natural communities:
 - At least one rare natural community is known to exist within the corridor. However, it occurs on private property, and therefore the exact location and type of natural community and system is not available to the public without permission of the landowners.
 - Opportunities exist for more rare natural communities, especially those associated with the riparian zone, including the stream channel, streambanks, and floodplains, especially within the eastern-most stretches of the brook.
- Observed species of conservation concern:
 - Limited access to Baboosic Brook provided few opportunities to sample lands adjacent to the river. As such, there was one species of conservation concern observed during 2009. A wood turtle was observed along the streambank associated with the Watkins Forest I conservation area. Also, the NH Natural Heritage Bureau's database indicates that at least one reptile and one fish of conservation concern have been observed in the past. However, they were observed on private properties and the exact type of species and location are not available to the public without permission from the landowners. Finally, it appears that the New England cottontail (state endangered) may also have been recorded previously within the stream corridor. It is expected that more species occur within the Baboosic Brook Corridor CFA due to the availability of upland and stream-associated habitats.
- Other target species observed:
 - Mink
- Connectivity to other areas:
 - While the Baboosic Brook Corridor CFA is surrounded by various mixed land uses, some very intensive, there still exists many opportunities to maintain connectivity to other habitats and protected lands, such as:

- Aquatic and riparian corridor connectivity to the Souhegan River and Merrimack River,
 - Aquatic and riparian corridor connectivity to Grater Woods CFA via a tributary that runs through the Mitchell Woods and Watkins Forest I conservation area,
 - Upland connectivity to the Horse Hill CFA from the Ireland Parcel conservation area abutting the Souhegan River and along Amherst Road, and
 - Upland, aquatic, and riparian corridor connectivity along tributaries with other wetland ecosystems and parcels with significant open space availability, especially those in close proximity to the landfill and those near the confluence with Souhegan River and adjacent to the Merrimack River.
 - Upland, aquatic, and riparian corridor connectivity to the adjacent unfragmented blocks and other critical habitats of the town of Bedford.
- Landscape implications for protection of CFA:
 - The Baboosic Brook Corridor CFA still contains some significant blocks of unfragmented areas with open and forested upland habitats mixed with various wetland complexes along its meandering channel and tributaries leading to the brook. These varied habitats, including the stream ecosystem, provide great diversity for both plants and wildlife. However, the health of the brook will continue to be compromised if the density of houses and commercial areas are increased.
 - The Baboosic Brook Corridor CFA contains some high quality critical habitats within close proximity to one another, including intact examples of shoreline.
 - Opportunities exist to provide some connectivity to other critical habitats, affording corridors for wildlife movement.

Merrimack River Corridor CFA

The Merrimack River Corridor CFA focuses on a 500-foot area adjacent to the river channel for its entire length within Merrimack. This area represents about 532 acres of mixed land use that range in their intensity of ecological disturbance. These range from residential, commercial, and industrial developments, small forest strips, wetlands, grasslands, and floodplains. Although these mixed land uses exist river corridors are well-deserving of conservation efforts that seek to restore and protect habitat connectivity, water quality, rare species, exemplary natural communities, and critical habitats. This CFA should also include large parcels whose open space extends beyond the 500-foot area.

- Unfragmented lands within the river corridor include one distinct 2,035-acre block found in association with Merrimack, as well as Manchester and Litchfield, extending into Nashua and Hudson.
- Area of protected land:
 - Very little protected lands exist within the river corridor. Two small blocks of state-owned lands separated by the railroad are found in the northeast corner of Merrimack. Collectively, the Eagle Habitat conserved area represents about 10 acres. However, other areas of protected lands are located in close proximity to the CFA (e.g. Horseshoe Pond area, Leatherleaf Bog, and Mast Road Preserve)
- Critical wildlife habitats:
 - River ecosystem
 - Forested swamps
 - Floodplains
 - Grasslands
 - Shrublands
 - Rare species habitats
 - Wildlife corridor along river

- Turtle nesting habitat in the utility ROW, sand and gravel pits, and other open sandy sites
- Exemplary and locally significant natural communities:
 - At least one rare natural community (silver maple floodplain forest) was observed on the town-owned property off Depot Road.
 - Opportunities exist for more rare natural communities, especially those associated with the riparian zone, including the river channel, riverbanks, and floodplains.
- Observed species of conservation concern:
 - Limited access to the Merrimack River provided few opportunities to sample lands adjacent to the river. As such, there were two species of conservation concern observed during 2009. The vesper sparrow and eastern meadowlark were observed using grasslands between the Anheuser-Busch factory and the Merrimack River. This area also historically supported breeding grasshopper sparrows (state threatened). However, it is expected that more species do occur within the Merrimack River Corridor CFA due to the availability of habitats and distribution of rare species and other species of concern. To this end, the NH Natural Heritage Bureau has reported three known locations of one or more rare plants (state endangered and threatened) within the river corridor. It is also possible that the New England cottontail was previously observed in the CFA.
- Connectivity to other areas:
 - For the most part, the Merrimack River Corridor CFA has been transformed from its original natural habitats into one that is more dominated by human-created habitats and developments. However, even among this mixed land use there are some opportunities for habitat connectivity, such as:
 - Aquatic and riparian corridor connectivity to the Souhegan River and Baboosic Brook,

- Upland, aquatic and riparian corridor connectivity to Horseshoe Pond conservation area, Leatherleaf Bog, Mast Road Preserve, including various upland and wetlands habitats,
 - Aquatic and riparian corridor connectivity to Greens Pond, Naticook Lake, and their associated protected lands.
- Landscape implications for protection of CFA:
 - The Merrimack River Corridor CFA still contains some significant blocks of unfragmented areas along a major river ecosystem. The corridor is mostly open upland habitats mixed with some forest cover and tributaries leading to the river, particularly the Souhegan River and Baboosic Brook. These varied habitats, including the river ecosystems, provide great diversity for both plants and wildlife.
 - The Merrimack River Corridor CFA contains some rare species habitats and a rare natural community.
 - Opportunities still exist to provide connectivity to other critical habitats, affording corridors for wildlife movement.
 - The mainstem of the Merrimack River has long been recognized as a critical habitat wide-ranging migratory fish, including diadromous species. As noted above, the Souhegan River has been identified as a successful Atlantic salmon nursery, and other examples of diadromous fish may spawn in the river as well, including American shad, alewife, American eel, and blueback herring. The potential for these fish, as well as other wide-ranging migratory fish, to use the Souhegan River for spawning is directly dependent upon the ecological health of the Merrimack River. New Hampshire only has a few large river ecosystems that support diverse migratory fish populations. Therefore, it should be viewed as a high priority for conservation.

The town of Merrimack has many special places that are worthy of consideration for protection. The areas listed above are considered the primary CFAs, representing

some of the best locations in Merrimack where biodiversity planning could be most effective in the long-term. These efforts can dramatically increase the conservation value of the town and the various lands already under formal protection. They also represent areas where habitat loss and degradation could exhibit strongly negative effects. To compliment this list of 5 CFAs, secondary priorities have also been identified.

Other site-specific priorities include rare species habitats and rare natural communities not associated with the above CFAs. These include the following areas:

- Pennichuck Corporation lands associated with Pennichuck Brook;
- Wetland system east of transfer station;
- Transfer Station parcel(s);
- Fidelity Corporation wetlands block (north of Pennichuck Ponds);
- Wetland system and adjacent uplands in NW Merrimack (between Baboosic Lake Rd and Proctor Rd);
- Smaller parcels linking or part of a corridor linking protected lands, such as the area in the NE adjacent to the Dumping Brook Wildlife Management Area;
- Other lands adjacent to tributaries of Baboosic Brook, Souhegan River and Merrimack River. This effort could afford the opportunity to protect, enhance or restore riparian areas along these tributaries and maintain vegetative cover for habitat connectivity; and
- Parcels adjacent to currently protected lands and/or town-owned lands

Parcel-based Ecological Assessment Model

To assist the Town of Merrimack in identifying and evaluating the potential conservation value of a given parcel, especially those associated with the Conservation Focus Areas outlined above, an Ecological Assessment Model has been prepared to quantitatively rank individual parcels or a group of parcels under the same ownership (Appendix H). This simple model provides the town with a sense of which parcels of land should have a higher or lower priority for conservation. It provides a measure or guide

that the Town may use to plan actions that could potentially provide the highest biodiversity protection per funds expended. Additionally, it is a tool for overall financial planning. The identification and valuation of high priority parcels should be viewed as a continual work in progress.

The Ecological Assessment Model numerically ranks a parcel based on a series of questions. Each question has two or more choices to be answered and is associated with a particular score. For example, one of the questions asks the following:

What is the size of the parcel or parcels if they are under the same ownership?	a. <10 acres	1 point
	b. 10-49 acres	2 points
	c. 50-100 acres	3 points
	d. 101-199 acres	4 points
	e. >200 acres	5 points

After all of the questions have been answered, the scores are totaled to provide a quantitative ranking that can then be compared to all other parcels. Those with the highest scores may become priorities for natural resource protection initiatives. This does not imply that certain parcels are not worthy of consideration for protection, and it should only be used as the initial step in determining which conservation projects would be the best to expend time and money. For instance, it may take a similar amount of effort to protect a 50-acre parcel as it is for a 100-acre parcel. With limited funding it is helpful to understand where it may be best to expend this effort in order to maximize the town's benefits.

The model is divided in two sections. All of the questions for the first section can be directly answered using a GIS. These questions can be answered fairly rapidly for parcels within the Conservation Focus Areas, as well as the rest of the town. The advantage of conducting the assessment for the whole town is that it may indicate other parcels in town as having a high ranking, such as some of the secondary priority CFAs outlined above or otherwise. The second section was designed to be answered during a rapid site assessment, if applicable. These questions were based on the assessment approach used for this project. Finally, this second section should *only* be used when a landowner has provided permission for access to the land in order to conduct the rapid assessment.

RECOMMENDATIONS FOR BIODIVERSITY PLANNING

The information provided herein, including the various maps, should be used when developing land use planning techniques for biodiversity conservation. The data used to develop such information represents some of the most up-to-date information available to better understand Merrimack's ecological structure. As such, there are some general guidelines that the town can use to promote innovative and informed land use planning:

1. Protect large unfragmented blocks, especially those with high quality habitats located within close proximity of one another and with limited barriers to wildlife movement;
2. Protect known rare species populations;
3. Protect representative examples of critical habitats for known rare species;
4. Protect rare and representative examples of natural communities;
5. Protect intact wetland and stream riparian buffers and promote the restoration of degraded areas;
6. Support voluntary and regulatory approaches of biodiversity protection;
7. Expand existing protected lands;
8. Connect protected lands and other critical habitats with upland, aquatic, and/or riparian corridors;
9. Continue to study wildlife movement patterns to identify and design the most effective conservation corridors; and
10. Promote community education and outreach regarding Merrimack's biodiversity and the importance of long-term protection and management strategies

In light of the findings of this project the following are a set of specific recommendations for Merrimack. Each of these represents implementation strategies to help achieve the objectives based on the goals of the Biodiversity Conservation Plan. Following these recommendations is an action plan for implementation, including tasks

that could be performed by an appropriate town group or official board and a recommended timeline for completion.

Implementation Strategies

GOAL 1: To identify priorities for future wildlife habitat and natural community protection initiatives, whereby providing information to be used as the basis for financial planning options.

OBJECTIVE A: Initiate the Parcel-based Ecological Assessment

Use the Parcel-based Ecological Assessment Model (Appendix H) to prioritize specific parcels for conservation. Initial efforts should focus on parcels located within the primary and secondary Conservation Focus Areas. However, it would benefit the town to extend this analysis to all undeveloped parcels, as well as all parcels with 10 acres or larger of natural, undeveloped land to determine the feasibility of conservation initiatives.

GOAL 2: To promote and support the conservation, restoration, and enhancement of ecological integrity and sound management of biological diversity, including populations of rare species, important wildlife habitats, and significant natural communities.

OBJECTIVE A: Regulatory Methods

A natural resources audit should be prepared that examines the Town's zoning ordinances, subdivision regulations, Master Plan, Biodiversity Conservation Plan, and site plan review regulations. This audit can help to provide an overall assessment of biodiversity protection by current land use planning techniques, identifying opportunities for the revision of current zoning and establishment of additional land use planning regulations. Ecologically Significant Habitats defined above and the Parcel-based

Ecological Attribute Assessment Model should be considered in the audit process and inclusion into the recommendations.

The Town should consider reviewing and potentially revising some of its existing zoning ordinances and regulations that are centered on natural resources protection. Currently, Merrimack has the following applicable zoning ordinances and regulations:

- Wetlands Overlay District
- Flood Hazard Conservation District
- Aquifer Conservation District
- Shoreland Protection District
- Cluster Residential Development
- Subdivision Regulations
- Wellhead Protection Areas

The Town should consider developing innovative land use techniques to help protect natural features, including rare species, critical habitats, rare natural communities, and large unfragmented lands. *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* (NH Dept. of Environmental Services 2008) was designed to provide examples of various types of zoning regulations that could be implemented to promote more sustainable land use, including protective measures for various ecological attributes. This publication was developed for New Hampshire communities by the NH Department of Environmental Services in partnership with NH Association of Regional Planning Commissions, NH Office of Energy and Planning, and NH Local Government Center. It provides examples for various multi-density zoning (i.e., density transfer credit, agricultural incentive zoning, and infill development), environmental characteristics zoning (i.e., permanent stormwater management, habitat protection, riparian protection) and site-level design (i.e., landscaping).

OBJECTIVE B: Voluntary Methods

The Town should consider promoting joint management responsibilities for conservation areas in new Cluster Residential Developments for those parcels located within the Conservation Focus Areas. This measure will enhance the opportunity to manage the property based on its conservation values. This measure can also have great implications for more consistent land management across parcels managed by the Conservation Commission, especially with abutting parcels in the Grater Woods and Horse Hill Conservation Focus Areas. This is an important aspect of ecological management in an ever-increasingly parcelized landscape.

The Town should consider developing financial incentives for private landowners to restore degraded habitats, such as riparian buffer areas. This especially includes lands abutting Conservation Focus Areas.

The Town should continue to work with willing landowners in developing conservation planning strategies, including conservation easements and cooperative management agreements. This includes working with Pennichuck and Southwood Corporation to secure permanent conservation easements on their properties associated with Pennichuck Brook. Although highly developed, this aquatic system and its adjacent undeveloped uplands have a great potential to support species of conservation concern.

OBJECTIVE C: Biodiversity Monitoring Program

The Town should develop a long-term volunteer-based monitoring program for known and future populations of species of conservation concern. This program should be developed in consultation with a professional ecologist or biologist. The overall scope of the program would be to understand and document the distribution of rare and uncommon wildlife and plant species over time as a means to monitor Merrimack's biodiversity. This program should include simple, systematic protocols to be used by volunteers to monitor rare and uncommon species (e.g., the use of wildlife trail cameras). The Conservation Commission could oversee the general monitoring program for the entire town. However, subcommittees such as those for Grater Woods and Horse Hill Nature Preserve could administer and manage the program for their respective properties,

providing yearly monitoring data to the Conservation Commission so all monitoring efforts and results are maintained in a central location.

OBJECTIVE D: Adjacent Communities

The Town should continue to work with surrounding communities on conservation initiatives, especially Amherst and Bedford. Merrimack has conservation lands that abut these two towns and opportunities exist to increase their cross-border conservation value through partnerships and collaborations on projects. Merrimack also shares unfragmented lands with these two communities that could also benefit from partnerships. The town should continue to develop close communications with adjacent communities, including their Conservation Commissions.

OBJECTIVE E: Top Priorities for Conservation

Conservation protection should primarily focus on permanent land protection within the Grater Woods and Horse Hill CFAs. This can be achieved by developing a conservation plan for specific parcels and securing conservation easements on these properties in conjunction with a reputable land trust. The conservation plan should identify and delineate ecologically significant areas to be protected by the conservation easement. These areas represent the highest priorities for conservation due to high development pressure and high biodiversity in the town. However, it is generally recognized that land conservation can be very opportunistic as willing landowners step forward to examine their options. As such, the Town should work with willing landowners as these opportunities arise, especially sites within the CFAs. Other parcels can be ranked using the Parcel-based Ecological Assessment Model discussed in Goal 1, Objective A.

OBJECTIVE F: Culvert Assessment

The Town should consider developing a volunteer-based program to map and assess wildlife road crossings and their use of culverts. This program should be developed by a professional ecologist or biologist. The purpose of this program is to

identify and prioritize areas that inhibit aquatic connectivity and to prepare an action plan that addresses enhancement of aquatic connectivity.

OBJECTIVE G: Invasive Species

The Town should continue to develop an invasive species management plan, including mapped sites of infestations, management options for targeted species, and an evaluation of personnel needed to implement management techniques. This can be a volunteer-based program designed by a professional ecologist or biologist with the assistance of a licensed herbicide applicator. This type of program can be a very effective method for the Town to help save money through the use of volunteer labor.

OBJECTIVE H: Prioritize Sites for Restoration

The Town should develop and prioritize a list of sites for habitat improvement and/or restoration. This list should place emphasis on town-owned properties as well as willing private landowners, and include goals, objectives, and desired results for restoration.

OBJECTIVE I: List of Protected Parcels

The Town should continue to maintain a comprehensive list of protected parcels as a means of verifying the level of their protective status (conservation easement, deed restriction, fee ownership, etc.). This list should include, but not limited to, parcel number, owner, protection status, acreage, management practices, ecologically significant habitats, and species of conservation concern. This list would to help ensure a complete knowledge of conservation lands as it moves forward with conservation initiatives.

GOAL 3: To incorporate more meaningful and detailed ecological data into the town Master Plan.

OBJECTIVE A: Inclusion of Plan into Master Plan

Build public support of the Biodiversity Conservation Plan through informational sessions, published materials, and other means of community education and outreach as identified in Goal 4. Then, formally incorporate the Biodiversity Conservation Plan into the Natural Resources section of Merrimack’s Master Plan.

GOAL 4: To continue to raise awareness of the ecological attributes of Merrimack through community outreach and education;

OBJECTIVE A: Workshops

Develop a series of on-going workshops that focus on Merrimack’s biodiversity. These workshops could include indoor lectures in combination with local hikes (i.e., the Merrimack “Walk Abouts”) to visit sites of specific interest on an annual basis.

OBJECTIVE B: Community Education and Outreach Materials

Develop a brochure on the importance of stream ecosystems and the significant role of riparian buffers to be distributed to landowners whose properties are adjacent to the Merrimack River, Souhegan River, and Baboosic Brook, as well as other streams in town. This brochure should focus on restoration and management efforts that landowners can initiate on their properties to enhance stream and riparian ecosystems. The brochure should also include sources for technical information and potential financial assistance.

The Town should also assist willing landowners to acquire information about developing land management practices for known and future locations of species of conservation concern. This measure will allow landowners to become stewards of rare and uncommon species and actively participate in their conservation. A packet of information regarding the species general life history and recommended land

management practices should be provided to willing landowners. A list of contacts should accompany the packet so landowners can contact the appropriate persons, agencies, and organizations for more information. The Conservation Commission should encourage the landowner to have a land management plan prepared by a professional that addresses goals and recommendations for appropriate actions.

GOAL 5: To provide an action plan indicating what should be addressed, by whom, and when for the next five and ten years. For example:

Responsible Party	Task	Timeline for Completion
Community Development Dept. Conservation Commission	Goal 1, Objective A	Year 1
Planning Board Community Development Dept.	Goal 2, Objective A	Years 1-2
Conservation Commission	Goal 2, Objective B	Annually
Conservation Commission Horse Hill Nature Preserve Subcommittee Grater Woods Subcommittee	Goal 2, Objective C	Year 1 with annual monitoring
Conservation Commission	Goal 2, Objective D	Annually
Conservation Commission	Goal 2, Objective E	Annually
Conservation Commission	Goal 2, Objective F	Years 1-5
Conservation Commission	Goal 2, Objective G	Years 2-3
Conservation Commission	Goal 2, Objective H	Years 2-3
Conservation Commission	Goal 2, Objective I	Annually
Planning Board	Goal 3, Objective A	Year 1-2
Conservation Commission	Goal 4, Objective A	Annually
Conservation Commission	Goal 4, Objective B	Annually

Merrimack has a wonderful array of habitats that host diverse communities of wildlife and plants. These include ecologically significant areas such as high quality and unique examples of habitats, exemplary natural communities, habitats for rare and endangered species, wildlife road crossings, and Merrimack's last remaining large unfragmented forests and wetlands. To better understand where these ecologically significant areas are located and to devise a list of Conservation Focus Areas the Merrimack Biodiversity Conservation Plan was created.

The "Plan" can serve as an ecological vision of how Merrimack can incorporate biodiversity planning into its current land use planning process. The "Plan" can be used to help address many conflicting issues between biodiversity conservation and land development by:

- Promoting the conservation of Merrimack's most ecologically significant areas,
- Directing development projects to areas with less critical habitats, including areas of degraded habitats and other major human alterations to the landscape,
- Recommending on-site natural resource assessments for ecologically significant areas and rare species,
- Guiding voluntary conservation planning efforts,
- Recommending policies in Merrimack's Master Plan, and
- Creating regulatory protection of various ecological features in Merrimack's zoning ordinances and subdivision regulations

Planning for the protection of biological diversity is an ongoing process as more is learned from scientific research and the effects of land use. Fortunately, today land use planners are better equipped with various tools to assist with informed decision making. One such tool is the Merrimack Biodiversity Conservation Plan. As such, the "Plan" should be viewed as a work in progress. It should be updated every 10 years to reflect new data, including on-site assessments, additional conservation lands, new regulatory policies, and regional conservation priorities as the natural and developed landscape evolves over time.

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APPENDIX A

VOLUNTEER OBSERVATIONS PACKET

Greetings Volunteers!

First of all, we would like to thank you for participating in our Conservation Planning project. Your gracious assistance is truly valuable!

Attached you will find several documents, including:

- US Geological Survey topographic map
- Observation form
- Critical Habitats list
- NH Fish and Game Wildlife Action Plan list of species of conservation concern
- Merrimack's known occurrences of rare species and natural communities from the NH Natural Heritage Bureau

The latter 3 documents are examples of some of the major features that we would like to know more about, although all observations are welcomed.

Instructions:

1. Please use the attached Topographic Map and Observation Form to record your observation(s)
2. Write the Observation # on the Topographic Map in the general location of the observation(s)
3. *If you are using more than 1 map to report observations*, please label a Map # on both the Observation Form and the Topographic Map so we are clear which observation goes with which map
4. Answer the four questions in as much detail as needed and feel free to use the back of the Observation Form if you need additional room

Special Note:

- Please only submit observations gathered from your property, public lands (such as Grater Woods, Horsehill), or from roadside observations (such as amphibian migration zones).
- Please do not enter private property of other citizens. Observations gathered on private property will not be accepted. We must respect private property landowner rights.

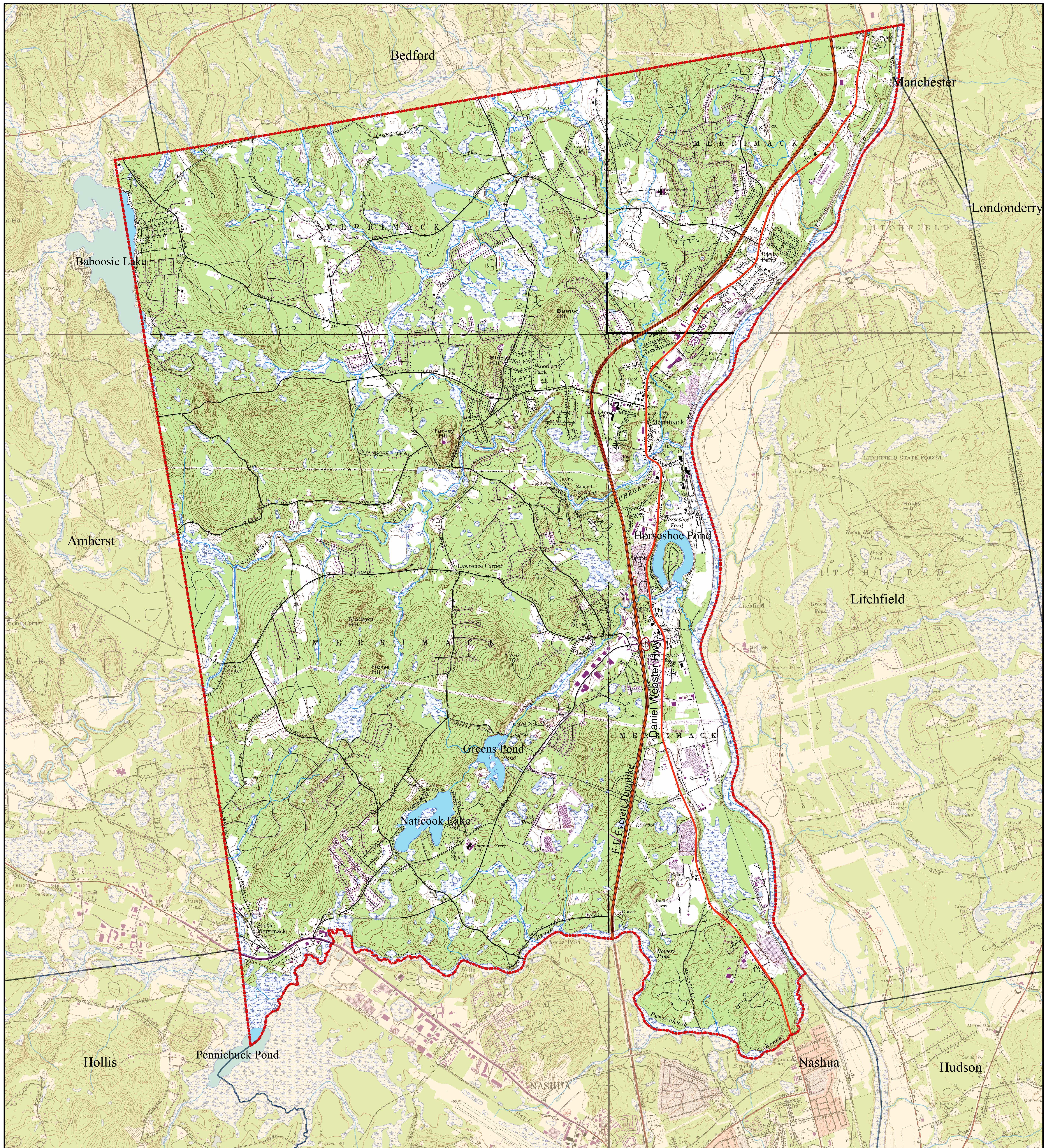
If you have any questions about the project or would like to be informed about future workshop trainings, presentations, or other ways to assist please contact Andy Powell, Merrimack Conservation Commission Chair at awpowell@myfairpoint.net.

Sincerely-

Merrimack Conservation Commission

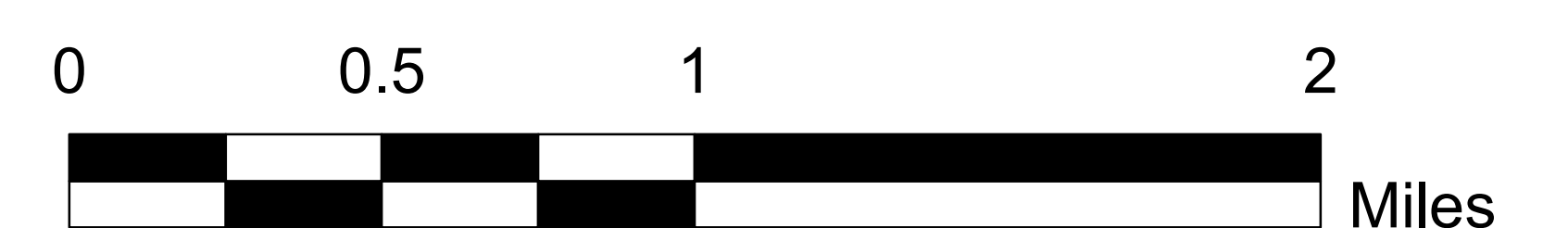
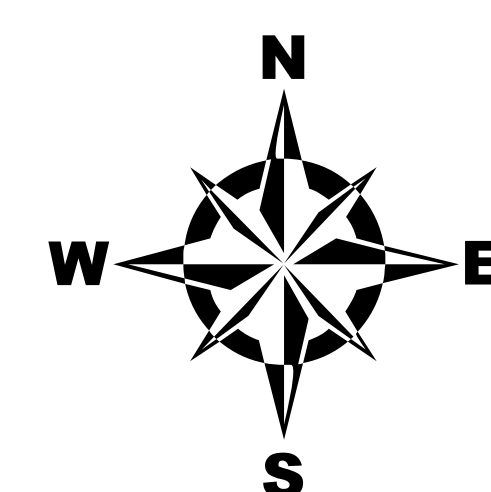
Merrimack Conservation Plan

Topographic Base Map



Jeffrey N. Littleton, M.S.
Conservation Ecologist
(603) 363-8489
Moosewood Ecological LLC
Innovative Conservation Solutions for New England

- F E Everett Turnpike
- Town of Merrimack
- Merrimack Roads
- Daniel Webster Hwy
- Major Merrimack Waterbodies
- National Wetlands Inventory
- Streams and Rivers



Map is to be used for planning purposes only. Accuracy of data to be verified by end user. Use of this map constitutes agreement with terms of the Moosewood Ecological GIS Data Disclaimer. This map was created using ArcView 9.2 from ESRI with data supplied by NH GRANIT.

Name: _____

Map# _____

Observation # **1**

- 1.) Wildlife or other significant observation (plants, habitats, significant landscape feature).
- 2.) General Location
- 3.) Season of Observation
- 4.) Notes on observation, examples: # of individuals, activity observed (feeding, evidence of breeding, basking, singing, etc.), type of observation (sight, browse, scat, track, etc.)

Please write your Observation # (above) at the appropriate location on the Map. Please include the Map # on the observation form if you are submitting more than 1 map. These shared observations are appreciated and allow the conservation commission to better understand Marlow's natural resources.

Name: _____

Map# _____

Observation # **2**

- 1.) Wildlife or other significant observation (plants, habitats, significant landscape feature).
- 2.) General Location
- 3.) Season of Observation
- 4.) Notes on observation, examples: # of individuals, activity observed (feeding, evidence of breeding, basking, singing, etc.), type of observation (sight, browse, scat, track, etc.)

Please write your Observation # (above) at the appropriate location on the Map. Please include the Map # on the observation form if you are submitting more than 1 map. These shared observations are appreciated and allow the conservation commission to better understand Marlow's natural resources.

Critical Wildlife Habitats

- Species of conservation concern
- Talus slopes
- Rocky ridges
- Bedrock outcroppings
- Vernal pools
- Caves
- Potential denning sites
- Peatlands
- Amphibian/mammal migration routes
- Shrub swamps
- Heron rookeries
- Turtle nesting areas
- Large hard mast stands
- Intact floodplain forests
- Rich or unusual forests
- Migratory waterfowl stopover areas
- Snake hibernacula
- South-facing slopes
- High-quality intact streams
- Marshes

TABLE 2-1. Species of greatest conservation concern. E = NH endangered (List revised 2001), T = NH threatened (List revised 2001), SC = NH species of special concern (List revised 2000), RC = Regional conservation concern (Therres 1999), FE = Federally endangered (current 8/05), FT = Federally threatened (current 8/05), BGP = Only included in the New Hampshire Big Game Management Plan (Appendix E)

TAXA		
Invertebrates	Fish (continued)	Birds (continued)
Freshwater molluscs	Swamp darter	Nelson's sharp-tailed sparrow, SC
Brook floater, E, RC	Tessellated darter	Northern goshawk
Dwarf wedgemussel, E, FE	Amphibians	Northern harrier, E, RC
Eastern pondmussel, RC	Blue-spotted salamander, RC	Osprey, T
Insects	Fowler's toad, SC	Palm warbler
Barrens itame	Jefferson salamander, SC, RC	Peregrine falcon, E
Barrens xylotype	Marbled salamander, E	Pied-billed grebe, E, RC
Broad-lined catopryrha	Mink frog	Piping plover, E, FT
Cobblestone tiger beetle, T	Northern leopard frog, SC, RC	Purple finch
Cora moth	Reptiles	Purple martin, E
Frosted elfin butterfly, E	Black racer	Purple sandpiper
Karner blue butterfly, E, FE	Blanding's turtle, SC, RC	Red shouldered hawk, SC
Persius duskywing, E	Eastern box turtle, RC	Roseate tern, E, FE
Phyllira tiger moth	Eastern hognose snake, T, RC	Ruffed grouse
Pine barrens zanclognatha moth, T	Ribbon snake, RC	Rusty blackbird, SC
Pine pinion moth, T	Spotted turtle, SC, RC	Salt marsh sharp-tailed sparrow, SC, RC
Puritan tiger beetle, FT	Smooth green snake, SC	Seaside sparrow, SC
Ringed boghaunter, E	Timber rattlesnake, E, RC	Sedge wren, E, RC
Sleepy duskywing	Wood turtle, SC, RC	Semipalmated sandpiper
White Mountain arctic	Birds	Spruce grouse
White Mountain fritillary	American bittern, RC	Three-toed woodpecker, T
Vertebrates	American black duck	Turkey, BGP
Fish	American pipit, SC	Upland sandpiper, E, RC
Alewife	American woodcock	Veery ²
American brook lamprey, RC	Arctic tern, T	Vesper Sparrow
American eel	Bald eagle, E, FT	Whip-poor-will, SC, RC
American shad	Bay-breasted warbler	Willet, SC
Atlantic salmon	Bicknell's thrush, SC, RC	Wood thrush ²
Atlantic sturgeon, RC	Black guillemot, SC	Mammals
Banded sunfish, RC	Canada warbler ² , RC	American marten, T
Blueback herring	Cerulean warbler, RC	Black bear, BGP
Bridle shiner, RC	Common loon, T	Bobcat, SC
Burbot	Common nighthawk, T	Canada lynx, E, RC, FT
Eastern brook trout	Common tern, E, RC	Eastern pipistrelle, SC
Finescale dace	Cooper's hawk, T	Eastern red bat, SC, RC
Lake trout	Common moorhen	Eastern small-footed bat, E, RC
Lake whitefish	Eastern meadowlark	Hoary bat, SC, RC
Northern redbelly dace	Eastern towhee	Indiana bat, FE
Rainbow smelt	Golden eagle, E, RC	Moose, BGP
Redfin pickerel	Golden-winged warbler, SC, RC	New England cottontail, SC, RC
Round whitefish, RC	Grasshopper sparrow, T	Northern bog lemming, SC, RC
Sea lamprey	Great blue heron	Northern myotis
Shortnose sturgeon, E, FE	Horned lark	Silver-haired bat, SC, RC
Slimy sculpin	Least bittern, SC	White-tailed deer, BGP
Sunapee trout, E	Least tern, E, RC	Wolf, FT

¹In addition to the above species of greatest conservation concern, a non-breeding birds profile was completed to assess concentrated wintering and migratory areas of New Hampshire.

²Canada warbler, veery, and wood thrush assessments were incorporated into matrix forest habitat profiles (See Appendix B).



Town	Species or Community Name	Listed? Federal	State	# reported last 20 Town	State
Merrimack					
	Natural Communities - Terrestrial				
	Pitch pine - scrub oak woodland	--	-	Historical	16
	Natural Communities - Palustrine				
	Moderate-gradient sandy-cobbly riverbank system	--	-	Historical	10
**	Pitch pine - heath swamp	--	-	1	2
**	Red maple floodplain forest	--	-	3	15
**	Sand plain basin marsh system	--	-	2	16
*	Silver maple - false nettle - sensitive fern floodplain forest	--	-	2	22
**	Swamp white oak basin swamp	--	-	1	4
	Plants				
	Bald Spike-rush (<i>Eleocharis erythropoda</i>)	--	E	Historical	4
**	Bird's-foot Violet (<i>Viola pedata</i>)	--	T	1	12
	Blunt-leaved Milkweed (<i>Asclepias amplexicaulis</i>)	--	T	Historical	12
	Butterfly Weed (<i>Asclepias tuberosa</i>)	--	E	Historical	7
	Common Sandbur (<i>Cenchrus longispinus</i>)	--	E	Historical	11
	Goat's Rue (<i>Tephrosia virginiana</i>)	--	E	Historical	6
	Low Bindweed (<i>Calystegia spithamea</i>)	--	E	Historical	8
	Philadelphia Panic Grass (<i>Panicum philadelphicum</i>)	--	E	Historical	8
	Siberian Chives (<i>Allium schoenoprasum</i>)	--	E	Historical	7
	Skydrop Aster (<i>Symphyotrichum patens</i>)	--	E	Historical	9
***	Smooth Bidens (<i>Bidens laevis</i>)	--	E	1	2
	Stiff Tick Trefoil (<i>Desmodium obtusum</i>)	--	E	Historical	2
	Virginian Mountain Mint (<i>Pycnanthemum virginianum</i>)	--	E	Historical	3
	Wild Garlic (<i>Allium canadense</i>)	--	E	Historical	5
**	Wild Lupine (<i>Lupinus perennis</i>)	--	T	1	27
	Wild Senna (<i>Senna hebecarpa</i>)	--	E	Historical	10
	Wright's Spike-rush (<i>Eleocharis diandra</i>)	--	E	Historical	3
	Vertebrates - Mammals				
***	New England Cottontail (<i>Sylvilagus transitionalis</i>)	--	E	2	20
	Vertebrates - Birds				
**	Grasshopper Sparrow (<i>Ammodramus savannarum</i>)	--	T	1	12
**	Vesper Sparrow (<i>Pooecetes gramineus</i>)	--	-	1	12
	Vertebrates - Reptiles				
**	Blanding's Turtle (<i>Emydoidea blandingii</i>)	--	E	3	119
**	Eastern Hognose Snake (<i>Heterodon platirhinos</i>)	--	E	2	23
**	Wood Turtle (<i>Glyptemys insculpta</i>)	--	-	1	114
	Vertebrates - Fish				
**	Banded Sunfish (<i>Enneacanthus obesus</i>)	--	-	1	29
**	Swamp Darter (<i>Etheostoma fusiforme</i>)	--	-	1	13
	Invertebrates - Insects				
	Karner Blue Butterfly (<i>Lycaeides melissa samuelis</i>)	E	E	Historical	5
	Persius Dusky Wing (<i>Erynnis persius persius</i>)	--	E	Historical	6

Listed? E = Endangered T = Threatened W = Special concern (watch list) M = Monitored

Flags **** = Highest importance
 *** = Extremely high importance
 ** = Very high importance
 * = High importance

These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact the Natural Heritage Bureau at (603) 271-2214 to learn more about approaches to setting priorities.

APPENDIX B

WILDLIFE ACTION PLAN HABITAT SUMMARY SHEETS

**INSERT HABITAT SUMMARIES FROM NH WILDLIFE ACTION
PLAN (2005; CHAPTER 3)**

Appalachian oak-pine forests	p.3-9
Hemlock-hardwood-pine forests	p.3-10
Grasslands	p.3-15
Shrublands	p.3-16
Pine Barrens	p.3-20
Floodplain forests	p.3-22
Marsh and shrub wetlands	p.3-23
Peatlands	p.3-24
Vernal pools	p.3-26
Coastal transition watersheds	p.3-27
Non-tidal coastal watersheds	p.3-31

APPENDIX C

NH NATURAL HERITAGE BUREAU RARE SPECIES AND NATURAL COMMUNITIES



Town	Species or Community Name	Listed? Federal	State	# reported last 20 Town	State
Merrimack					
	Natural Communities - Terrestrial				
	Pitch pine - scrub oak woodland	--	-	Historical	16
	Natural Communities - Palustrine				
	Moderate-gradient sandy-cobbly riverbank system	--	-	Historical	10
**	Pitch pine - heath swamp	--	-	1	2
**	Red maple floodplain forest	--	-	3	15
**	Sand plain basin marsh system	--	-	2	16
*	Silver maple - false nettle - sensitive fern floodplain forest	--	-	2	22
**	Swamp white oak basin swamp	--	-	1	4
	Plants				
	Bald Spike-rush (<i>Eleocharis erythropoda</i>)	--	E	Historical	4
**	Bird's-foot Violet (<i>Viola pedata</i>)	--	T	1	12
	Blunt-leaved Milkweed (<i>Asclepias amplexicaulis</i>)	--	T	Historical	12
	Butterfly Weed (<i>Asclepias tuberosa</i>)	--	E	Historical	7
	Common Sandbur (<i>Cenchrus longispinus</i>)	--	E	Historical	11
	Goat's Rue (<i>Tephrosia virginiana</i>)	--	E	Historical	6
	Low Bindweed (<i>Calystegia spithamea</i>)	--	E	Historical	8
	Philadelphia Panic Grass (<i>Panicum philadelphicum</i>)	--	E	Historical	8
	Siberian Chives (<i>Allium schoenoprasum</i>)	--	E	Historical	7
	Skydrop Aster (<i>Symphyotrichum patens</i>)	--	E	Historical	9
***	Smooth Bidens (<i>Bidens laevis</i>)	--	E	1	2
	Stiff Tick Trefoil (<i>Desmodium obtusum</i>)	--	E	Historical	2
	Virginian Mountain Mint (<i>Pycnanthemum virginianum</i>)	--	E	Historical	3
	Wild Garlic (<i>Allium canadense</i>)	--	E	Historical	5
**	Wild Lupine (<i>Lupinus perennis</i>)	--	T	1	27
	Wild Senna (<i>Senna hebecarpa</i>)	--	E	Historical	10
	Wright's Spike-rush (<i>Eleocharis diandra</i>)	--	E	Historical	3
	Vertebrates - Mammals				
***	New England Cottontail (<i>Sylvilagus transitionalis</i>)	--	E	2	20
	Vertebrates - Birds				
**	Grasshopper Sparrow (<i>Ammodramus savannarum</i>)	--	T	1	12
**	Vesper Sparrow (<i>Pooecetes gramineus</i>)	--	-	1	12
	Vertebrates - Reptiles				
**	Blanding's Turtle (<i>Emydoidea blandingii</i>)	--	E	3	119
**	Eastern Hognose Snake (<i>Heterodon platirhinos</i>)	--	E	2	23
**	Wood Turtle (<i>Glyptemys insculpta</i>)	--	-	1	114
	Vertebrates - Fish				
**	Banded Sunfish (<i>Enneacanthus obesus</i>)	--	-	1	29
**	Swamp Darter (<i>Etheostoma fusiforme</i>)	--	-	1	13
	Invertebrates - Insects				
	Karner Blue Butterfly (<i>Lycaeides melissa samuelis</i>)	E	E	Historical	5
	Persius Dusky Wing (<i>Erynnis persius persius</i>)	--	E	Historical	6

Listed? E = Endangered T = Threatened W = Special concern (watch list) M = Monitored

Flags **** = Highest importance
 *** = Extremely high importance
 ** = Very high importance
 * = High importance

These flags are based on a combination of (1) how rare the species or community is and (2) how large or healthy its examples are in that town. Please contact the Natural Heritage Bureau at (603) 271-2214 to learn more about approaches to setting priorities.

APPENDIX D

POTENTIAL NATURAL COMMUNITIES

Natural Community Types	Distribution Status	State Ranking
Wooded Uplands		
<i>Northern and transition hardwood - conifer zone</i>		
Hemlock forest	1	S4
Beech forest	1	S4
Hemlock - white pine forest	1	S4
Hemlock - beech - northern hardwood forest	1	S4
Hemlock - beech - oak - pine forest	1	S5
Semi-rich mesic sugar maple forest	1	S3S4
Rich mesic forest	1	S3
<i>Oak - pine zone</i>		
Dry red oak - white pine forest	1	S3S4
Dry Appalachian oak - hickory forest	1	S1S3
Pitch pine-Appalachian oak	1	S1
Pitch pine-scrub oak woodland	1	S1S2
Red oak - pine rocky ridge	1	S3S4
Appalachian oak - pine rocky ridge	1	S3
Chestnut oak forest/woodland	1	S1S2
Mesic Appalachian oak - hickory forest	2	S2S3
Appalachian oak - mountain laurel forest	2	S3
Red oak - hickory wooded talus	1	S1S2
Red oak - black birch wooded talus	1	S3S4
Rich sugar maple - oak - hickory terrace forest	2	S1
Semi-rich Appalachian oak - sugar maple forest	1	S2S3
Rich Appalachian oak rocky woods	1	S1
Rich red oak rocky woods	1	S2S3
Red oak - ironwood - Pennsylvania sedge woodland	1	S2
Wooded Wetlands and Floodplain Forests		
<i>Floodplain forests</i>		
Silver maple - wood nettle - ostrich fern floodplain forest	1	S2
Silver maple - false nettle - sensitive fern floodplain forest	1	S2
Sugar maple - silver maple - white ash floodplain forest	2	S1S2
Swamp white oak floodplain forest	1	S1
Red maple floodplain forests	1	S2S3

Natural Community Types	Distribution Status	State Ranking
<i>Boggy nutrient-poor swamps</i>		
Atlantic white cedar - yellow birch - pepperbush swamp	2	S2
Atlantic white cedar - leather-leaf swamp	1	S1
Atlantic white cedar - giant rhododendron swamp	1	S1
Red maple - <i>Sphagnum</i> basin swamp	1	S4
Black gum - red maple basin swamp	1	S1S2
Black spruce - larch swamp	2	S3
Swamp white oak basin swamp	not predicted	S1
Pitch pine - heath swamp	1	S1S2
<i>Minerotrophic swamps</i>		
Red maple - black ash - swamp saxifrage swamp	1	S2
Red maple - lake sedge swamp	1	S3
Red maple - sensitive fern swamp	1	S3S4
Seasonally flooded Atlantic white cedar swamp	2	S2
Seasonally flooded red maple swamp	1	S4S5
Hemlock - cinnamon fern forest	1	S4
Red maple - red oak - cinnamon fern forest	1	S3S4
<i>Forest seeps</i>		
Acidic <i>Sphagnum</i> forest seep	3	S3S4
Subacid forest seep	1	S3S4
Circumneutral hardwood forest seep	2	S3
<i>Vernal pools</i>		
Vernal woodland pool	1	S3
Vernal floodplain pool	1	S2
Open Wetlands and Riparian Communities		
<i>Open river channels, riverbanks, and floodplains</i>		
Riverweed river rapid	1	S2S3
Cobble - sand river channel	2	S3S4
Herbaceous sandy river channel	1	S4
Willow low riverbank	3	S3
Twisted sedge low riverbank	3	S3S4
Herbaceous low riverbank	1	S3S4
Herbaceous riverbank/floodplain	1	S2S4
Herbaceous - wooded riverbank/floodplain	1	S4
Blue joint - goldenrod - virgin's bower riverbank/floodplain	1	S3S4
Alder alluvial shrubland	3	S3

Natural Community Types	Distribution Status	State Ranking
<i>Open river channels, riverbanks, and floodplains (cont'd.)</i>		
Alder - dogwood - arrowood alluvial thicket	1	S4
Meadowsweet alluvial thicket	1	S3?
Alluvial mixed shrub thicket	2	S4
Acidic riverbank outcrop	1	S3
Acidic riverside seep	1	S1
Dry river bluff	1	S2?
<i>Open emergent marshes, shrub thickets, and aquatic beds</i>		
Tall graminoid emergent marsh	1	S4
Mixed tall graminoid - scrub shrub marsh	1	S4S5
Short graminoid - forb emergent marsh/mud flat	1	S4
Oxbow marsh	1	S3
Medium-depth emergent marsh	1	S4
Cattail marsh	1	S4
Deep emergent marsh - aquatic bed	1	S4S5
Aquatic bed	1	S4S5
Herbaceous seepage marsh	1	S3
Highbush blueberry - winterberry shrub thicket	1	S4
Oxbow buttonbush swamp	1	S3
Buttonbush basin swamp	1	S4
Sweet gale - speckled alder shrub thicket	1	S3
Bulbet umbrella-sedge open sandy pond shore	1	S2
Water lobelia aquatic sandy pond shore	1	S1S2
Meadowsweet - robust graminoid sand plain marsh	1	S3S4
Meadow beauty sand plain marsh	1	S1
Three-way sedge - manna-grass mud flat marsh	1	S2S3
Spike-rush - floating-leaved aquatic mud flat	1	S1
Sharp-flowered manna-grass shallow peat marsh	1	S1
<i>Cliff seeps</i>		
Cliff seep	1	S3S4
<i>Open peatlands</i>		
Liverwort - horned bladderwort mud-bottom	1	S3
<i>Sphagnum rubellum</i> - small cranberry moss carpet	1	S3
Large cranberry - short sedge moss lawn	1	S3
Water willow - <i>Sphagnum</i> lagg	1	S3
Leather-leaf - sheep laurel dwarf shrub bog	1	S1S3
Leather-leaf - black spruce bog	1	S3

Natural Community Types	Distribution Status	State Ranking
<i>Open peatlands (cont'd.)</i>		
Bog rosemary - sweet gale - sedge fen	1	S3
Sweet gale - meadowsweet - tussock sedge fen	1	S4
Hairy-fruited sedge - sweet gale fen	1	S3
Highbush blueberry - mountain holly wooded fen	1	S3S4
Winterberry - cinnamon fern wooded fen	1	S4
Sweet pepperbush wooded fen	1	S2
Speckled alder wooded fen	1	S3S4
Highbush blueberry - sweet gale - meadowsweet shrub thicl	1	S4
Floating marshy peat mat	1	S3S4
Marshy moat	1	S4

Source: Sperduto and Nichols (2004)

Distribution Status code: 1 = natural community's primary distribution, 2 = natural community is occasional and relatively less abundant than its primary distribution, 3 = natural community may be present, but occurrence is currently undocumented

Natural communities observed in 2009 and/or previously observed by NH Natural Heritage Bureau (January 2009) are listed in **bold type**.

APPENDIX E

POTENTIAL WILDLIFE OF CONSERVATION CONCERN

Species of Conservation Concern	Ranking	Critical Wildlife Habitats		
Amphibians				
Jefferson & blue-spotted salamander	RC	Appalachian oak - pine forests Vernal pools	Hemlock - hardwood - pine forest Floodplain forest	Marsh and shrub wetlands
Fowler's toad	SC	Appalachian oak - pine forests Marsh and shrub wetlands	Hemlock - hardwood - pine forest	Pine barrens
Jefferson salamander	SC,RC	Appalachian oak - pine forests Marsh and shrub wetlands	Hemlock - hardwood - pine forest Vernal pools	Floodplain forest
marbled salamander	E	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Vernal pools
northern leopard frog	SC,RC	Grasslands	Floodplain forest	Marsh and shrub wetlands
Reptiles				
northern black racer	T	Appalachian oak - pine forests Shrublands	Hemlock - hardwood - pine forest Pine barrens	Grasslands
Blanding's turtle	E	Appalachian oak - pine forests Floodplain forest Vernal pools	Hemlock - hardwood - pine forest Marsh and shrub wetlands Streams, Rivers, Ponds ¹	Grasslands Peatlands
eastern box turtle	RC	Appalachian oak - pine forests Pine barrens	Hemlock - hardwood - pine forest	Shrublands
eastern hognose snake	E	Appalachian oak - pine forests Shrublands	Hemlock - hardwood - pine forest Pine barrens	Grasslands
ribbon snake	RC	Appalachian oak - pine forests Marsh and shrub wetlands	Hemlock - hardwood - pine forest Peatlands	Floodplain forest Vernal pools
smooth green snake	SC	Appalachian oak - pine forests Shrublands	Hemlock - hardwood - pine forest Pine barrens	Grasslands Marsh and shrub wetlands
spotted turtle	SC,RC	Appalachian oak - pine forests Marsh and shrub wetlands Streams, Rivers, Ponds	Hemlock - hardwood - pine forest Peatlands	Floodplain forest Vernal pools
wood turtle	SC,RC	Appalachian oak - pine forests Shrublands	Hemlock - hardwood - pine forest Floodplain forest	Grasslands Streams and Rivers

Species of Conservation Concern	Ranking	Critical Wildlife Habitats		
Birds				
American bittern	RC	Grasslands	Shrublands	Marsh and shrub wetlands
American black duck		Marsh and shrub wetlands		
American woodcock		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Grasslands
		Shrublands	Floodplain forest	Marsh and shrub wetlands
bald eagle	T	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Streams, Rivers, Ponds
common nighthawk	T	Appalachian oak - pine forests	Pine barrens	
eastern meadowlark		Grasslands		
eastern towhee		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Shrublands
		Pine barrens	Peatlands	
grasshopper sparrow	T	Grasslands		
great blue heron		Marsh and shrub wetlands		
least bittern		Marsh and shrub wetlands	Peatlands	
northern goshawk		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Appalachian oak - pine forests
osprey	T	Marsh and shrub wetlands	Streams, Rivers, Ponds	
red-shouldered hawk		Forested swamps	Hemlock - hardwood - pine forest	
		Floodplains		
ruffed grouse		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Shrublands
veery		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Floodplain forest
vesper sparrow		Grasslands		
wild turkey	BGP	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	
whip-poor-will	SC,RC	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Grasslands
		Shrublands	Pine barrens	
wood thrush		Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Floodplain forest
Fish				
alewife	RC	SurfaceWaters		
American brook lamprey		SurfaceWaters		
American eel		SurfaceWaters		
American shad		SurfaceWaters		

Species of Conservation Concern	Ranking	Critical Wildlife Habitats		
Fish (continued)				
<i>Atlantic salmon</i>		SurfaceWaters		
<i>Atlantic sturgeon</i>	RC	SurfaceWaters		
<i>banded sunfish</i>	RC	Marsh and shrub wetlands	SurfaceWaters ¹	
<i>blueback herring</i>		SurfaceWaters		
<i>bridle shiner</i>	RC	SurfaceWaters		
<i>eastern brook trout</i>		SurfaceWaters		
<i>redfin pickerel</i>		SurfaceWaters		
<i>sea lamprey</i>		SurfaceWaters		
<i>shortnose sturgeon</i>	E,FE	SurfaceWaters		
<i>slimy sculpin</i>		SurfaceWaters		
<i>swamp darter</i>		SurfaceWaters		
<i>tessellated darter</i>		SurfaceWaters		
Mammals				
<i>bear</i>	BGP	nearly all habitat types		
<i>bobcat</i>	SC	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Shrublands
<i>moose</i>	BGP	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Shrublands
		Marsh and shrub wetlands		
<i>New England cottontail</i>	SC,RC	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Shrublands
		Pine barrens	Marsh and shrub wetlands	
<i>white-tailed deer</i>	BGP	Appalachian oak - pine forests	Hemlock - hardwood - pine forest	Grasslands
		Shrublands	Pine barrens	Floodplain forest
Invertebrates				
<i>brook floater</i>	E,RC	SurfaceWaters		
<i>karner blue butterfly</i>	E,FE	Pine barrens		
<i>persius dusky wing</i>	E	Pine barrens		
<i>ringed boghaunter</i>	E	Marsh and shrub wetlands	Peatlands	
<i>wild indigo dusky wing</i>		Pine barrens		

SOURCE: New Hampshire Wildlife Action Plan (2005)

Ranking: E = NH endangered, T = NH threatened, SC = NH species of special concern, RC = regional conservation concern

FE = Federally endangered, FT = Federally threatened, BGP = Only included in the New Hampshire Big Game Management Plan.

Species in **bold type** have been observed in Merrimack.

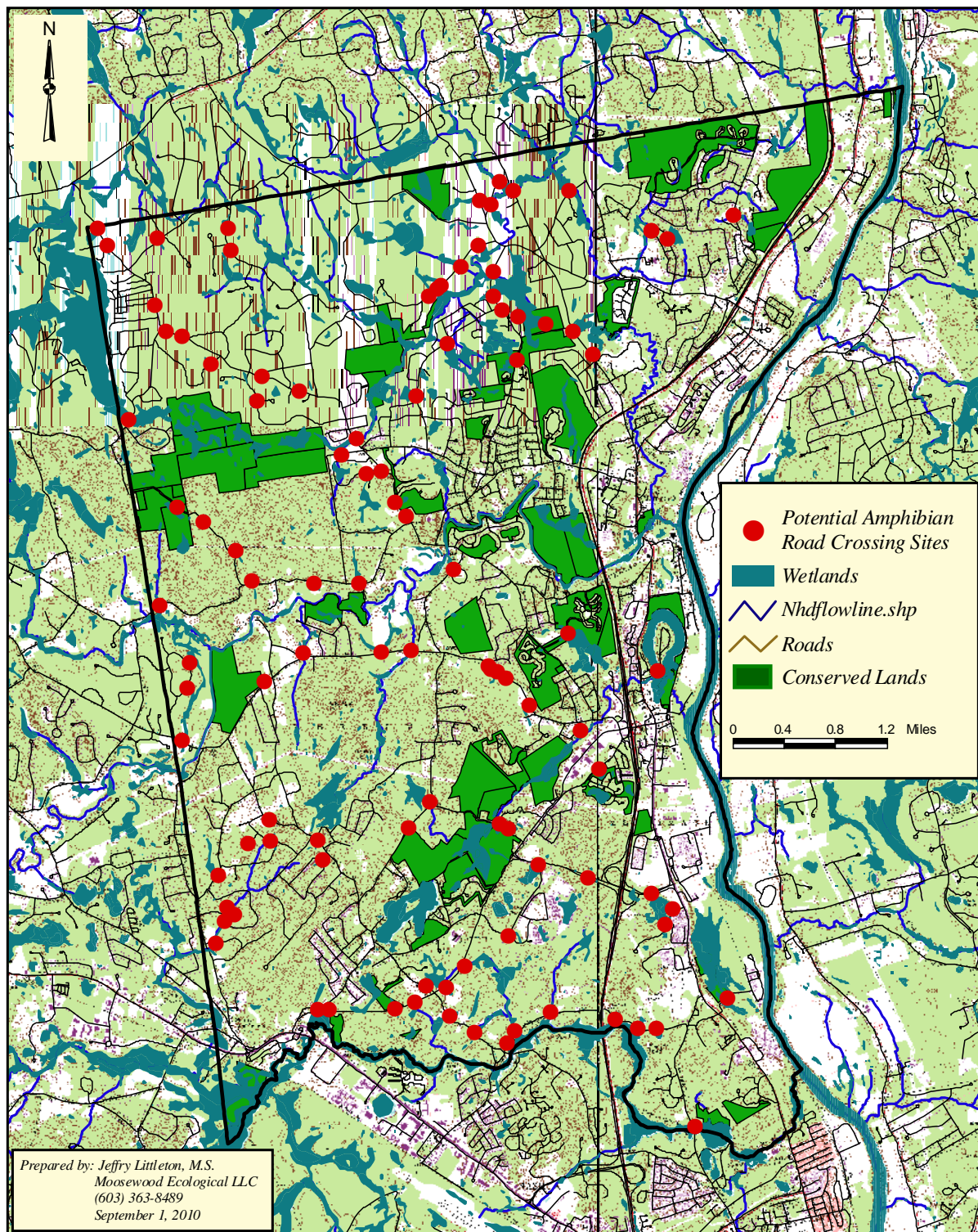
APPENDIX F

HABITAT BLOCK REQUIREMENTS FOR WILDIFE

1-19 Acres	20-99 Acres	100-499 Acres	500-2,500 Acres	>2,500 Acres
raccoon	raccoon	raccoon	raccoon	raccoon
	hare	hare	hare	hare
				coyote
small rodent	small rodent	small rodent	small rodent	small rodent
	porcupine	porcupine	porcupine	porcupine
				bobcat
cottontail	cottontail	cottontail	cottontail	cottontail
	beaver	beaver	beaver	beaver
				black bear
squirrel	squirrel	squirrel	squirrel	squirrel
	weasel	weasel	weasel	weasel
		mink	mink	mink
				fisher
	woodchuck	woodchuck	woodchuck	woodchuck
		deer	deer	deer
muskrat	muskrat	muskrat	muskrat	muskrat
			moose	moose
red fox	red fox	red fox	red fox	red fox
songbirds	songbirds	songbirds	songbirds	songbirds
		sharp-shinned hawk	sharp-shinned hawk	sharp-shinned hawk
			bald eagle	bald eagle
skunk	skunk	skunk	skunk	skunk
		Cooper's hawk	Cooper's hawk	Cooper's hawk
		harrier	harrier	harrier
		broad-winged hawk	broad-winged hawk	broad-winged hawk
			goshawk	goshawk
		kestrel	kestrel	kestrel
			red-tailed hawk	red-tailed hawk
		great-horned owl	great-horned owl	great-horned owl
			raven	raven
		barred owl	barred owl	barred owl
		osprey	osprey	osprey
		turkey vulture	turkey vulture	turkey vulture
		turkey	turkey	turkey
most reptiles	most reptiles	reptiles	reptiles	reptiles
	garter snake	garter snake	garter snake	garter snake
	ring-necked snake	ring-necked snake	ring-necked snake	ring-necked snake
most amphibians	most amphibians	most amphibians	amphibians	amphibians
		wood frog	wood frog	wood frog

APPENDIX G

POTENTIAL AMPHIBIAN ROAD CROSSING LOCATIONS



APPENDIX H

PARCEL-BASED ECOLOGICAL ASSESSMENT MODEL

Parcel-based Ecological Assessment Model Merrimack, NH

PROPERTY OWNER(S) _____

PARCEL ID NUMBER _____

GIS Ecological Assessment

I. Parcel Size

- | | |
|------------------|----------|
| a. <10 acres | 1 point |
| b. 10-49 acres | 2 points |
| c. 50-100 acres | 3 points |
| d. 101-199 acres | 4 points |
| e. >200 acres | 5 points |

II. NWI Wetlands

Percent Wetland Cover

- | | |
|--------------------|----------|
| a. no wetlands | 0 points |
| b. <10% wetlands | 1 point |
| c. 10-50% wetlands | 2 points |
| d. >50% wetlands | 3 points |

Number of Wetland Classes

- | | |
|----------------------|----------|
| a. no wetlands | 0 points |
| b. 1 class | 1 point |
| c. 2 classes | 2 points |
| d. 3 or more classes | 3 points |

Interspersion of Wetland Classes

- | | |
|-------------------------|----------|
| a. no wetlands | 0 points |
| b. low interspersion | 1 point |
| c. medium interspersion | 2 points |
| d. high interspersion | 3 points |

III. Surface Waters

Waterbodies (ponds)

- | | |
|--------------------------------|----------|
| a. no waterbodies present | 0 points |
| b. waterbody <10 acres present | 1 point |
| c. waterbody >10 acres present | 2 points |

Watercourses (streams)

- | | |
|--------------------------------------------------------------|----------|
| a. no watercourses present | 0 points |
| b. 1 or more intermittent streams | 1 point |
| c. 1 st or 2 nd order perennial stream | 2 points |
| d. 3 rd order perennial stream | 3 points |
| e. 4 th order or larger stream | 4 points |

IV. Ecologically Significant Habitats (ESHs)

- | | |
|----------------------------|----------|
| a. 1 type present | 1 point |
| b. 2 types present | 2 points |
| c. 3-5 types present | 3 points |
| d. 6 or more types present | 4 points |

V. Rare Elemental Occurrences (rare species and natural communities)

- | | |
|-------------------------------|----------|
| a. Potential elements present | 1 point |
| b. 1 known element present | 2 points |
| c. 2 known elements present | 3 points |
| d. >2 known elements present | 4 points |

VI. Top 25% Ranked Wildlife Action Plan Habitats

- | | |
|-----------------------|----------|
| a. none present | 0 points |
| b. <25% of property | 1 point |
| c. 25-50% of property | 2 points |
| d. >50% of property | 3 points |

VII. Wildlife Action Plan Priorities

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| a. property is not ranked | 0 points |
| b. mapped at least 50% or greater
as supporting landscape | 1 point |
| c. mapped at least 25% or greater
as highest ranked habitat in bio-
logical region, <i>or</i> mapped at least
25% total for supporting landscapes
and highest rank habitat in bio-
logical region | 2 points |
| d. mapped at least 25% or greater
as highest ranked habitat in NH
<i>or</i> mapped at least 25% total for
supporting landscapes, highest rank
habitat in biological region, and
highest ranked habitat in NH | 3 points |

VIII. Associated Unfragmented Block Size

- | | |
|------------------|----------|
| a. 10-100 acres | 1 point |
| b. 101-250 acres | 2 points |
| c. >250 acres | 3 points |

IX. Agricultural Resources

Percent Agricultural Soils

- | | |
|------------------------------|----------|
| a. no agricultural soils | 0 points |
| b. <10% agricultural soils | 1 point |
| c. 10-50% agricultural soils | 2 points |
| d. >50% agricultural soils | 3 points |

X. Forest Resources

Percent Forest Cover

- | | |
|------------------------|----------|
| a. no forest cover | 0 points |
| b. <10% forest cover | 1 point |
| c. 10-50% forest cover | 2 points |
| d. >50% forest cover | 3 points |

Percent Forest Soils

- | | |
|------------------------|----------|
| a. no forest soils | 0 points |
| b. <10% forest soils | 1 point |
| c. 10-50% forest soils | 2 points |
| d. >50% forest soils | 3 points |

XI. Proximity to Conserved Lands

- | | |
|-------------------------------------|----------|
| a. >1 mile to conserved lands | 1 point |
| b. 0.5-1 miles to conserved lands | 2 points |
| c. 0.1-0.5 miles to conserved lands | 3 points |
| d. adjacent to conserved lands | 4 points |

XII. Proximity to CFAs

- | | |
|--------------------|----------|
| a. not within CFA | 0 points |
| b. adjacent to CFA | 1 points |
| c. within CFA | 2 points |

XIII. Percentage of Parcel Currently Developed

- | | |
|---------------------------------------------------|----------|
| a. 50-75% developed | 1 point |
| b. 25-50% developed | 2 points |
| c. 10-25% developed | 3 points |
| d. <10% developed but some form
of development | 4 points |
| e. currently undeveloped | 5 points |

XIV. Parcel in Current Use

- | | |
|----------------------------|----------|
| a. not in current use | 0 points |
| b. enrolled in current use | 1 point |

GIS ASSESSMENT DATE _____

COMPLETED BY _____

GIS SUBTOTAL _____

Field Ecological Assessment

I. Additional Ecologically Significant Habitats not included in GIS

Assessment above

- | | |
|---------------|----------|
| a. 1 present | 1 point |
| b. 2 present | 2 points |
| c. 3 present | 3 points |
| d. >3 present | 4 points |

List types of ESHs and include approximate location or GPS coordinates and photographic documentation (attach as needed).

Type of ESH	Location or GPS Coordinates
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

II. Additional Rare Elemental Occurrences not included in GIS

Assessment above

- | | |
|------------------------------|----------|
| a. 1 known element present | 1 points |
| b. 2 known elements present | 2 points |
| c. 3 known elements present | 3 points |
| d. >4 known elements present | 4 points |

List each rare species and/or natural community and include its state and global rarity rank, approximate location or GPS coordinates, and photographic documentation (attach as needed).

Type of Elemental Occurrence and Rank

Location or GPS Coordinates

FIELD ASSESSMENT DATE

COMPLETED BY

FIELD SUBTOTAL

GIS SUBTOTAL

TOTAL COMBINED SCORE
