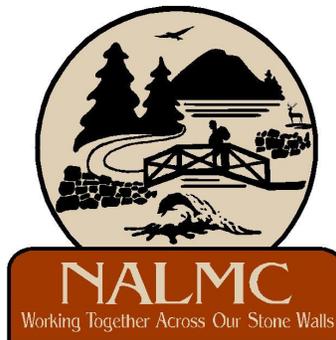


An Ecological Assessment
of the
Northwood Area Land Management Collaborative
(NALMC) Neighborhood

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Prepared for:
Northwood Area Land Management Collaborative



Prepared by:
Ellen J. Snyder
Ibis Wildlife Consulting
Newmarket, New Hampshire

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---Ellen Snyder, *Ibis Wildlife Consulting*

Executive Summary

The Northwood Area Land Management Collaborative (NALMC) is an informal group of private and public neighbors in Northwood, New Hampshire. One of the key themes of the Collaborative is for individual landowners to understand their ownership in relation to the natural features and resources that stretch across multiple ownerships. Through a grant from the NH Charitable Foundation, the Collaborative was able to fund this Ecological Assessment to provide a common understanding to all who are interested in the NALMC neighborhood.

Much of the NALMC region is within the headwaters of the Lamprey River. The focus area for this ecological assessment includes the headwaters sub-watershed boundary within Northwood plus a ½ mile extension beyond the watershed. The focus area encompasses 6,080 acres.

The NALMC focus area sits atop a major watershed divide – waters drain east into the Lamprey and Isinglass Rivers in the coastal watershed and west into the Merrimack River watershed. All waters from this area eventually reach the Gulf of Maine. The Lamprey River gets a good start here in headwater streams on the slopes of Saddleback Mountain. It then flows out of Meadow Lake then meanders through the Betty Meadows wetland. This large, dynamic, beaver-influenced wetland hosts uncommon plants, peatlands known as fens, and a diverse dragonfly community.

One of the most important features of the NALMC region is that it supports a very large block (more than 4,000 acres) of unfragmented habitat. This large undeveloped area, mostly free of paved roads and development, supports interconnected wetlands and uplands and secure areas for wide-ranging wildlife such as moose, bear, fisher, and bobcat. It also provides enough space for animals with large territories such as northern goshawk and Blanding's turtle.

The NALMC area is in a transition zone between the seacoast and lakes regions. To the south grow oaks and hickories and other hardwoods. To the north the forests shift to mixes of hemlock, red oak, northern hardwoods (sugar maple, yellow birch and American beech), and spruce and fir. If you peer into the forest you will notice a mix of trees and forest types, with hemlock, white pine, red oak, and red maple generally dominant throughout.

Scattered throughout the forest are rocky ridges and wooded talus slopes; semi-rich sugar maple forests; stands of dense hemlock or pure white pine; black gum trees, some more than 500 years old, growing in perched wetlands; beaver flowages and fens; vernal pools, and headwater streams. A cluster of early successional habitat—fields, young forest, shrubs—on the west side of the focus area supports a raft of different plants and animals not found in the mature forest. The environmental health of the region appears to be good, with good water quality, few invasive plants and forest pests, minimal impervious surface, and little erosion.

Trails and woods roads snake through the forest, offering recreational access into this surprisingly large region of undeveloped land. A large and central portion of the NALMC neighborhood encompasses several public lands including Northwood Meadows State Park and Forest Peters Wildlife Management Area. This creates a unique opportunity for NALMC to model land stewardship techniques on a mosaic of public and private lands.

The Collaborative has a wealth of collective knowledge, experience, and interests among the state, community, and private landowner participants. This “community capital” can be tapped to help understand and implement best practices for land stewardship that help protect the shared values for the region. This ecological assessment can serve as a springboard for continued and enhanced work across boundaries on collaborative, voluntary, and community-based land stewardship.

Chapter 1 Introduction

Northwood Area Land Management Collaborative

The Northwood Area Land Management Collaborative (NALMC) is an informal group of private and public neighbors in the Town of Northwood, New Hampshire. The Collaborative shares information and ideas and works together across property boundaries to create and maintain trails, manage wildlife habitats, protect ecological features, host workshops, and support stewardship of local farms and forests. Recognizing that individual landowner goals vary, everyone benefits from a common understanding of the wildlife, woodlands, waters, and other features of the “NALMC neighborhood.”

The Collaborative encourages landowners to get to know their land and empowers them to learn about and seek available assistance to help sustain the resources on their land. Northwood Meadows State Park and Forest Peters Wildlife Management Area encompass a large central portion of the NALMC neighborhood. This creates a unique opportunity for NALMC to collectively model land stewardship techniques on a mosaic of public and private lands.

Similarly, the University of New Hampshire’s Saddleback Mountain, Northwood Town Forest, Coe-Brown Northwood Academy lands, and privately-owned Harmony Hill Farm are an active part of the Collaborative and expand the opportunities to partner on trails, interpretive programs, and on-the-ground management activities. Since wildlife and water cut across political boundaries and hikers and bikers enjoy long, looping trails, the NALMC neighborhood offers the chance to protect and manage the land and water and create unique outdoor experiences.

The Collaborative also desires to serve as a model for others, encouraging “neighborhoods” in other parts of the state and beyond to work across boundaries on collaborative, voluntary, and community-based land stewardship.

The Northwood Area Land Management Collaborative, or NALMC, got its start in the fall of 2006, when Carl Wallman, owner of Harmony Hill Farm, met with New Hampshire Fish and Game’s Jim Oehler to coordinate management efforts. Carl wanted to ensure that the wildlife habitat improvements that he was implementing on his Farm complimented the management and habitats on the adjoining Northwood Meadows State Park and Forest Peters Wildlife Management Area. Carl recognized that his land was not an island unto itself, that wildlife travel across property boundaries, and that few species could be fully supported by the habitats provided on his land alone. This led to more discussions, including with UNH Cooperative Extension Wildlife Specialist Matt Tarr, to pursue the idea of collaborative management by engaging more landowners in the surrounding area.

The NALMC Neighborhood

Since NALMC grew out of conversations around management of Harmony Hill Farm, Forest Peters Wildlife Management Area, and Northwood Meadows State Park, these lands form the central core of the NALMC neighborhood. This collaborative effort fans out from there to include other interested landowners, which to date also include the Town of Northwood (Town Forest), University of New Hampshire (Saddleback Mountain), Coe-Brown Northwood Academy, and landowners Jeff and Laurie Lalish, and Gregg Pitman. These are the founding members of the Collaborative (Map 1).

A Steering Committee formed in 2007; it meets periodically to discuss common interests, plan events, and collaborate on projects. NALMC welcomes anyone who owns land in the neighborhood or is interested in the region to participate in the Collaborative. You can learn more about NALMC by visiting the website at www.nalmc.net. People can participate by attending workshops, volunteering for trail projects, hosting events, sharing information with friends and neighbors, and more.

In addition to this Ecological Assessment, some of the events and projects organized or supported by the Northwood Area Land Management Collaborative include:

- ***Hemlock Woolly Adelgid Research***

NH Fish and Game and the Division of Forests and Lands are partnering with the U.S. Forest Service to initiate research on forest management strategies to minimize the potential effects of hemlock woolly adelgid, an exotic pest that threatens hemlock trees.

- ***Northwood Community Garden***

This project was initiated in 2007 by two NH Master Gardeners. Volunteers maintain and harvest two garden plots that provide fresh locally-grown food directly to people in need in the local area.

- ***Prescribed Burn***

NALMC hosted a prescribed burn of fields on Harmony Hill Farm to benefit the habitat and to provide fire training for 40 local firefighters; the largest grassland fire training in NH.

- ***Maple-Sugaring Potluck***

NALMC sponsored a neighborhood potluck at the Peck's Farm on Blakes Hill Road. Neighbors collected and boiled sap, enjoyed sweet dark maple syrup and other good food, and shared stories and ideas.

- ***5-Mile Trail Loop***

NALMC's first collaborative project was to create a 5-mile loop trail through Northwood Meadows State Park and Harmony Hill Farm.

- ***Wildlife Habitat Openings***

Two forest openings covering 8 acres were created on Northwood Meadows State Park near Old Mountain Road to benefit wildlife. The cuts were marked by foresters in the Division of Forests and Lands and logged by J.C. Eames Timber Harvesters in 2007.

- ***Trail Blazing***

Coe-Brown Northwood Academy students -- the Young Environmental Advocates -- cleared and blazed the trail on the Northwood Town Forest Parsonage Lot that leads to a scenic view atop Saddleback Mountain.

- ***Discovery Day at Northwood Meadows State Park***

NALMC and the Town of Northwood hosted a Discovery Day at Northwood Meadows State Park to celebrate the 20th anniversary of the park and honor M. Edward Burt, the former owner of the lands that are now the state park.

Purpose of the Ecological Assessment

One of the important themes of NALMC's effort is for individual landowners to understand their ownership within the larger context of the neighborhood and beyond. Specifically, NALMC participants wanted to understand their location in relation to the watersheds, extensive forests, diverse wildlife habitats, and unique plant communities that stretch across multiple ownerships. They determined that an ecological assessment of the region would provide a common understanding to all who are interested in the NALMC neighborhood. To this end NALMC obtained a grant from the New Hampshire Charitable Foundation to gather information and prepare an ecological description of the region.

Much of the region lies within the headwaters of the Lamprey River watershed; the river gets its start in the foothills of Saddleback Mountain. Therefore, the upper Lamprey River watershed boundary within Northwood plus a ½ mile extension beyond the watershed boundary was chosen as the focus area for this ecological assessment (Map 1). This encompasses 6,080 acres, nearly 4,000 of which are free of paved roads and other development.

This document is the Ecological Assessment. It describes the NALMC neighborhood – its ecology and culture -- in text and through maps. The assessment is a compilation of all existing information on the ecology, culture, and recreation within the NALMC focus area. It provides a scientific basis for potential future management actions as well as a compelling story of the area's history, beauty, and natural diversity, that is worthy of long-term stewardship.

We hope that this ecological story of the neighborhood inspires people to explore and learn more about the region, encourages more cross boundary projects, and helps identify future collaborative projects that will reap benefits across the NALMC region. Whether we live or work in the neighborhood and hike, hunt or study nature here, we all value this place. NALMC brings together many different individual perspectives to capture the collective wisdom of everyone who cares about the future of this region.

The next three chapters in this report describe the ecological and cultural features of the focus area. Chapter 2 describes the ecology of the region, Chapter 3 describes the recreation and cultural features, and Chapter 4 provides a more in depth description of specific properties that are publicly owned or for which the landowner has willingly shared information about their land stewardship. Chapter 5 includes a series of recommendations based on this ecological assessment. These recommendations are intended to stimulate cross boundary conversations and community-based networking, and to continue the collaborative spirit conveyed in the NALMC vision and mission.

Chapter 2 Ecology of the NALMC Region

The Setting

Sitting atop Saddleback Mountain is a great place to see and imagine the past and present. At 1,143-feet it is the highest point in the NALMC neighborhood. Trees may block your view, yet you can still picture the scene before you. Looking north and northwest are the foothills of the lakes region, 30 miles to the east is the Atlantic Ocean. To the south and southeast the Lamprey River flows more than 50 miles before emptying into the Great Bay Estuary (Map 2). The Lamprey River gets its start below your feet, on the slopes of Saddleback Mountain.

This region of the state is known as the Gulf of Maine Coastal Plain. The NALMC neighborhood is in the upper elevations of the watersheds within this coastal plain. All surface waters in this area eventually drain into the Gulf of Maine, taking various paths depending on the location within the landscape. Much of the surface water in the neighborhood flows within the Lamprey River watershed. Water flowing off the eastern slope of Saddleback Mountain also reaches the Lamprey River, but travels first via the Bean and North Rivers. The southeast corner of the focus area forms the headwaters of the Pawtuckaway Pond sub-watershed. The northern tip of the neighborhood drains into the Isinglass River, which flows to the Cocheco River, then to the Piscataqua River, before finally reaching the Atlantic Ocean in Portsmouth. In the northern and western reaches of the neighborhood surface waters drain west into the Little Suncook River watershed, which flows to the Merrimack River (Map 3).

Spread out below your mountaintop perch is a largely forested landscape, dotted with lakes and wetlands, with ribbons of streams and rivers and patches of hayfields and forest openings. Trails and woods roads snake through the forest, offering recreational access into this surprisingly large region of undeveloped land.

This setting, part-way between the seacoast and the lakes region, is in a transition zone. To the south grow oak and hickories and other hardwoods. To the north the forests shift to northern hardwoods (sugar maple, yellow birch and American beech) and spruce and fir. If you peer down into the forest you may notice that the NALMC neighborhood has a mix of forest types, with hemlock, white pine, red oak, and red maple generally dominant throughout. Forests make up 85% of the focus area. Wetlands and open lands each make up about 7% of the area, while developed areas cover less than 2% (based on 2001 statewide land cover data).

A very, very long history of geologic changes – mountain building, erosion, and glaciations – has literally shaped the hills, slopes, and valleys of this landscape. The surface deposits of glacial till (mixtures of sand, silt, clay, gravel, and stone dumped by glaciers) and underlying bedrock created by these geologic events influences the soils, nutrients, and water that occur here. Collectively these physical features affect the distribution of the plants and animals that we observe.

Considering the long expanse of geologic time, human influences in this area are relatively recent, and most dramatic in the last 250 years. Despite this short tenure, the current forest condition is largely a reflection of land use during this recent period. The stonewalls that parallel Old Mountain Road and lead up and down hills and valleys tell the story of land cleared for pasture and fields from the late 1600s to the mid-1800s. The remnants of old mills in the woods and near streams recalls a time when resources were extracted and processed locally. Roads, trails, and dams, some old, some new, remain in use.

The forests have reclaimed much of the land that was once cleared for agriculture and these forests are maturing. Given the many different ownerships within the NALMC neighborhood, the current condition of the forest varies across these ownerships based on differing land use and wood cutting histories and practices. However, much of the forest is in the mid-successional stage (50-100 years), with little very young forest and no really old forests. The exception is several, small wetlands known as basin swamps that support black gum trees hundreds of years old.

Topography and Soils

Elevations range from about 515 feet along the Lamprey River to 1,143 feet atop Saddleback Mountain. Exposed rock faces are found along the high southeastern slopes of Saddleback Mountain. Steep wooded hillsides, some with rock outcrops, blanket the mountain slopes. As you follow small tributary streams from the flats along the Lamprey River corridor up the mountain ravines, you will walk past sheer, moist rock faces covered in mosses and ferns. Water drips off these rock walls, trickling down to the streams and groundwater. Small waterfalls are interspersed with slow moving pools of water along the length of these small headwater streams.

The topography on the western side of the NALMC neighborhood rises more gently up to Blakes Hill at about 773 feet, rising to over 800 feet within the Forest Peters WMA and up to Gulf Hill west of Blakes Hill Road. Headwater streams drain east into the Lamprey River or west into Northwood Lake or Harvey Lake. Wooded talus slopes (loose rock piles below outcrops) are found along the mid-slopes. In the northern reaches, the ridge along Route 4 forms part of the Merrimack River/Coastal watershed divide.

Bedrock, surficial glacial till deposits, slope, and topography strongly affect soil types. The NALMC neighborhood supports a diversity of soil types, formed primarily from glacial till and the wetland soils formed from organic material. Glacial till is the dominant parent material in the hills and low mountains of this region (USDA 1994).

Table 1 lists the dominant soil types within the region (USDA 1994). Most of the soil types are very stony and steep. Oak and pine grow reasonably well on these soils, which are reflected in the dominant forest types across the region. Only 363 acres are considered poorly drained soils, which underlie wetlands. Approximately 541 acres or 9% are considered "farmland soils," either prime farmland soils (238 acres), soils of statewide importance (129 acres) or soils of local importance (174 acres). These farmland soils are primarily found beneath the existing grasslands and other fields in the Blakes Hill region, near Route 4, and in the northeast corner of the NALMC focus area. Appendix C includes a complete table of all the soil types and associated soils map for the area.

Table 1. Major soil types within the ecological assessment focus area
(from the 1994 Soil Survey of Rockingham County, USDA).

Soil #	Soil Name	Acres	Drainage	Parent Material
140D	Chatfield-Hollis-Canton complex, 15-35% slope, very stony	1,379	Well-drained	Glacial till
140C	Chatfield-Hollis-Canton complex, 8-15% slope, very stony	1,201	Well-drained	Glacial till
43C	Canton gravelly fine sandy loam, 8-15% slope, very stony	564	Well-drained	Glacial till
43D	Canton gravelly fine sandy loam, 15-25% slope, very stony	245	Well-drained	Glacial till
140B	Chatfield-Hollis-Canton complex, 3-8% slope, very stony	228	Well-drained	Glacial till
67C	Paxton fine sandy loam, 8-15%, very stony	182	Well-drained	Glacial till
447B	Scituate-Newfields complex, 3-8% slope, very stony	169	Moderately well-drained	Glacial till
343D	Canton gravelly fine sandy loam, 15-35% slope, extremely boulder	161	Well drained	Glacial till
295	Greenwood mucky peat	153	Very poorly drained	Organic material
66B	Paxton fine sandy loam, 3-8% slope, prime farmland soil	147	Well-drained	Glacial till
97	Greenwood and Ossipee soils, ponded	134	Very poorly drained	Organic material
66C	Paxton fine sandy loam, 8-15% slope, statewide importance	129	Well-drained	Glacial till
43E	Canton gravelly fine sandy loam, 25-35% slope, very stony	124	Well-drained	Glacial till
129B	Woodbridge fine sandy loam, 3-8% slope, very stony	117	Moderately well-drained	Glacial till

Unfragmented Landscape

Unfragmented forest blocks are large areas of habitat with few or no roads, houses, or other development. In southeastern New Hampshire, blocks of 1,000 acres or more are considered regionally significant and blocks of 500-1,000 acres may also be locally significant. A large unfragmented block of forest typically supports more interior forest species (e.g., scarlet tanager, wood thrush), is better at sustaining natural processes (such as nutrient cycling, water cycles, clean air), is more resilient to natural disturbances (such as ice storms), and often supports a diversity of large and small habitat patches in close proximity to each other. Large unfragmented lands also allow plants and animals to adapt to changing environmental conditions, giving them space to shift their territories.

The New Hampshire Fish and Game Department (NHFG) identified development (residential, commercial, or industrial) as one of the most significant risk factors to the State's wildlife and habitats (NHFG 2006). Development causes the fragmentation of habitat into small, unconnected parcels. Songbirds, small mammals, and other wildlife species are more susceptible to mid-sized predators such as fox, raccoon, and skunk in small blocks of habitat. These "generalist" predators adapt better than other

species to a fragmented landscape. Habitat blocks crisscrossed with residential roads and houses expose wildlife to high rates of road mortality, increase conflicts with humans and pets, result in increased contaminated runoff, and offer more opportunities for invasive plants to spread to natural areas.

In the 2006 Wildlife Action Plan, NH Fish and Game mapped the areas of the state that supported “highest quality wildlife habitat.” Map 4 includes a map of the NALMC region showing the extent of such habitat as mapped in the Wildlife Action Plan. More details on the wildlife plan and the statewide mapping is available at http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm.

One of the unique and most important features of the NALMC region is that it supports a very large block of unfragmented habitat. This large undeveloped area supports interconnected wetlands and uplands and secure areas for wide-ranging wildlife such as moose, bear, fisher, and bobcat. It also provides enough space for animals with large territories including northern goshawk and Blanding’s turtle. In its 2008 Conservation Plan, Bear-Paw Regional Greenways highlighted the Saddleback Mountain area as a 3,890-acre unfragmented forest block (Bear-Paw 2008). This unfragmented block is bounded by Route 4 to the north, Route 43 to the east and south, and Harmony Rd/Winding Hill Rd/Blakes Hill Rd to the west.

In 2002, Bear-Paw Regional Greenways completed a natural resource inventory of its region and prepared a “co-occurrence” map. The occurrence of multiple natural resource features is usually considered to have relatively higher conservation value because of the diversity of features there. For example, a co-occurrence analysis can identify where unfragmented habitat, undeveloped shoreline, wetlands, south-facing slopes, and other features occur together. Map 4 shows the co-occurrence of these natural features and others for the NALMC region as identified by Bear-Paw.

Conserving lands in perpetuity is one of the most effective ways to maintain large, blocks of unfragmented habitat. Conserved lands account for about 34% (or 2,071 out of 6,080 acres) of the NALMC ecological assessment focus area. These include public lands owned in fee and a few private lands protected through conservation easements. Table 2 lists those lands protected within the focus area. One of the key goals of the Bear-Paw Regional Greenways is to promote a conservation corridor that links the largest blocks of conserved land, including the triangle formed by the Northwood Meadows area, Pawtuckaway State Park, and Bear Brook State Park (See Bear-Paw 2008 for more details).

Conservation Easements

A landowner has a bundle of rights to use and modify the property that they own. A conservation easement is a legal agreement between a landowner and a conservation organization, agency, or municipality that transfers some of these rights (typically the “development rights”) to the organization that holds the easement. Typically a conservation easement is granted in perpetuity and therefore the development rights are extinguished forever, preserving the land as open space. The easement conveyed through a deed, applies to the land regardless of who may own it in the future.

Land under easement is still privately owned and managed in accordance with the terms of the easement (some publicly owned lands also have easements held by another entity). Each easement is crafted to fit the features of the property to be protected, the needs of the landowners, and the goals of the entity accepting the easement. Easements are used to provide permanent protection from subdivision or other development or uses that could degrade or destroy ecological, scenic, or other natural resources. Easements often provide for continued farming, forestry, wildlife management, and recreation. Easements don’t always require public access; although often landowners allow this access. Some grant sources require public access as part of funding a conservation easement project.

Table 2. Conserved lands within the ecological assessment focus area.

Name	Owner	Type	Acres
Northwood Meadows State Park	State of New Hampshire	Fee ownership	666
Forest Peters Wildlife Management Area	State of New Hampshire	Fee ownership	456
Northwood Town Forest: Parsonage Lot	Town of Northwood	Fee ownership	190
Northwood Town Forest: Lalish Lot	Town of Northwood	Fee ownership	82
Northwood Town Forest: Deslaurier Lot	Town of Northwood	Fee ownership	24
Town of Northwood Land	Town of Northwood	Fee ownership	9
Town of Northwood Land	Town of Northwood	Fee ownership	10
Saddleback Mountain	University of New Hampshire	Fee ownership	265
Coe-Brown Northwood Academy	Coe-Brown Northwood Academy	Fee ownership	52
Deerfield Town Forest: McNeil Conservation Area	Town of Deerfield	Fee ownership	47
Yeaton Lot	Town of Deerfield	Fee ownership	18
Kathryn Williams Conservation Easement	Kathryn Williams	Conservation Easement held by Town of Deerfield	~40
Harmony Hill Farm	Carl Wallman	Conservation Easement held by Society for the Protection of NH Forests	164
Johnson Revocable Living Trust	Charles Johnson	Conservation Easement held by Society for the Protection of NH Forests	48

Saddleback Mountain Conservation Focus Area

In 2006, The Nature Conservancy, Society for the Protection of New Hampshire Forests, and the Rockingham and Strafford Regional Planning Commissions published *The Land Conservation Plan for New Hampshire's Coastal Watersheds* ("The Coastal Plan") (Zankel et al. 2006). New Hampshire's coastal watersheds span 990 square miles or approximately 525,000 acres and 46 towns, including much of the NALMC region. The authors identified 75 Conservation Focus Areas that comprise over 190,000 acres or 36% of the coastal watersheds that are of exceptional significance for living resources and water quality.

Almost the entire NALMC region is within the Saddleback Mountain Focus Area (Map 4). This area was recognized for the following ecological features:

- large unfragmented forest ecosystem
- high quality streams
- presence of rare Blanding's turtles and ebony boghaunter dragonfly
- significant wildlife habitats -- grasslands, marsh, peatland, ridge/talus
- exemplary natural communities -- black gum - red maple basin swamp and poor level fen/bog system
- presence of prime farmland soils
- high connectivity between conserved lands

Watersheds, Rivers, and Streams

A watershed is an area of land where all of the surface water drains into the same basin or river. Every stream or river has an associated watershed. Watersheds can be large or small; smaller watersheds (or “sub-watersheds”) join to become larger watersheds. Watershed boundaries are defined by ridgelines or the highest points of elevation. In the NALMC region there are many sub-watersheds, starting with the smallest streams that drain off Saddleback Mountain to larger sub-watersheds including the headwaters-Lamprey River and Little Suncook River.

Surface waters, such as lakes and rivers, are recharged by rainfall and snowmelt as well as by groundwater. Some rivers receive half of their “base flow” from groundwater. Likewise groundwater is recharged through rainfall and snowmelt seeping into the ground and through leakage from lakes and rivers. This hydrologic connection between surface and groundwater is important to understand in order to protect water quality and quantity in the region.

A major watershed divide occurs in the NALMC neighborhood. This divide, which snakes along the western side of the focus area, delineates the New Hampshire coastal watersheds from the Merrimack River watershed (Map 3). If you live up on Blakes Hill along Winding Hill Road, the watershed divide may pass right through your property. These watersheds and sub-watersheds are described in more detail below. All of these waters eventually drain into the Gulf of Maine (Map 2).

New Hampshire Coastal Watersheds

Spanning 525,000 acres and 46 towns, New Hampshire’s coastal watersheds represent only 9% of the State, and yet they harbor many irreplaceable ecological features (Zankel et al. 2006). The Lamprey River watershed is the largest of the six watersheds that are collectively known as the “coastal watersheds.” The Lamprey River, in turn, has many sub-watersheds, including the headwaters-Lamprey River, a major focus of this ecological assessment.

The Lamprey River travels about 47 miles, through eight towns before it reaches the McCallen Dam and Great Bay Estuary in Newmarket. Its watershed encompasses 212 square miles or 135,680 acres, which includes most of Nottingham and Deerfield and portions of Northwood, Candia, Raymond, Epping, Lee, Durham, and Newmarket. It is the largest river that flows into Great Bay, one of the most significant inland estuaries along the entire East Coast.

Headwaters-Lamprey River Sub-Watershed

Most of the NALMC neighborhood lies within the upper, or “headwaters” Lamprey River sub-watershed. At several spots within the focus area you can see the beginnings of the Lamprey River. One might consider the formal beginning of the Lamprey River to be the outlet of Meadow Lake in Northwood Meadows State Park. Stand on the dam at the south end of the lake and watch the water begins its journey to the Atlantic Ocean. The Lamprey River gets a good start here as water flows down from Saddleback Mountain and the hills to the west in clear, cool headwater streams. The river then meanders through several large wetlands as it continues its path from Northwood into Deerfield and beyond.

On the Parsonage Lot trail to the top of Saddleback Mountain you will cross one of the headwater streams. As you walk Old Mountain Road, somewhere in the middle, you will come to the Lamprey River as it flows from one large wetland to another. Beavers have dammed the river here to make “their” pond larger and deeper. A consequence is the flooding of a short stretch of Old Mountain Road. Beavers have lived along the Lamprey, shifting their dams up and down the river for eons, undoubtedly long before the road was laid through this region.

Bean River Sub-Watershed

The eastern slopes of Saddleback Mountain flow into the Bean River. Once it gathers all its headwater streams, the Bean River flows about 7 miles to the junction with the North River in Nottingham. The North River continues for another 15 miles before it flows into the Lamprey River in the northeast corner of Epping.

Pawtuckaway Pond Sub-Watershed

The uppermost tip of this sub-watershed is within this focus area. It begins on the southern slopes of Saddleback Mountain. These headwaters flow into Back Creek, which meanders southeast before reaching Pawtuckaway Pond in Pawtuckaway State Park. From there waters flow down the Pawtuckaway River to the Lamprey River in Epping.

Bow Lake/Isinglass River Sub-Watershed

A smidgeon of the focus area is within the Isinglass River sub-watershed. North and west of Route 4, waters flow into Bow Lake, the headwaters of the Isinglass River. These surface waters reach coastal New Hampshire, via a different path. The Isinglass flows 15 miles before it reaches the Cocheco River near the Rochester/Dover town lines. The Cocheco River flows through Dover to the Salmon Falls/Piscataqua River, which forms the New Hampshire/Maine boundary all the way to Portsmouth Harbor. The entire length of the Isinglass River is a designated river within the State's Rivers Management and Protection Program. The Isinglass contributes directly to the City of Dover's drinking water supply and recharges many wells along its length.

Merrimack River Watershed

The Merrimack River begins with the confluence of the Pemigewasset and Winnipausaukee Rivers in Franklin, New Hampshire. From there it flows 110 miles south into Massachusetts where it turns northeast, eventually flowing into the Gulf of Maine in Newburyport, Massachusetts. The Merrimack River watershed encompasses south-central New Hampshire. As the largest and most central watershed in the state, it has had a significant cultural, economic, and ecological impact on New Hampshire.

Little Suncook River Sub-Watershed

A portion of the focus area for this ecological assessment takes in the headwaters of the Little Suncook River sub-watershed. These waters start gathering on the north, northwest, and western reaches of the NALMC neighborhood. They drain into the Little Suncook River, which gets its official start at the outlet to Northwood Lake. From there, the Little Suncook flows alongside Route 4 until it reaches the Suncook River near the Epsom Traffic Circle. The Suncook, which gets its start farther north in Gilmanton, flows southwest to the Merrimack River in Pembroke, or more precisely at the Village of Suncook.

Headwater Streams and Brooks

Many small streams flow down from Saddleback Mountain and other high points within the NALMC region. The health of the river downstream is dependent on the health of the smaller streams and wetlands in this headwaters region. Impervious surfaces – pavement, buildings, and other structures – cover less than 2% of the upper Lamprey River watershed in the focus area. This is important in maintaining the quality of water flowing downstream since an increase in impervious surfaces is related to declines in water quality, greater flooding, and more downstream erosion.

Small headwater streams may make up 80 percent of the stream network in a region and include both seasonal and year-round streams. Headwater streams may begin as trickles, seeps, or depressions that

overflow and are often not named or mapped. Yet, the quality and integrity of these headwater streams is critical to downstream habitats.

The upper reaches of watersheds store water, recharge groundwater, and reduce the intensity and frequency of floods. Small streams are a critical link between land and water. Not only are they linked to upstream and downstream portions of the watershed, but water flowing from the land into the stream carries insects, leaves, soil, branches, and other material that are the start of a food chain. This exchange between land and water occurs in a transition zone along the edges of stream channels, called a riparian area. Maintaining connectivity between stream channels, stream bottoms and banks, and the riparian area is important to protect water quality and aquatic habitats. Much of the cleansing action and nutrient cycling in a stream occurs in saturated sediments, at the interface between stream water and the channel bottom and stream bank (American Rivers and Sierra Club 2007).

Several of the small streams or brooks are named streams, others are unnamed. Some of the named streams are described below.

Tucker Brook

Not far from the entrance to the Northwood Meadows State Park, Tucker Brook flows under Route 4 and into the Park. A small fire pond near the Park gate drains into Tucker Brook. From there the Brook flows under the main park road (known as Dashingdown Road) through a spillway and the remains of an old mill site, and then into Huckins Meadow. Tucker Brook then flows under Harmony Road into Harvey Lake, which eventually flows into Northwood Lake (Burt 1994). This Brook is within the Little Suncook River watershed and is therefore part of the larger Merrimack River drainage.

Bear Brook

Bear Brook begins high up on the side of Saddleback Mountain on the Town of Northwood's Parsonage Lot. It flows northwest through the southern region of the State Park, and onto the Forest Peters WMA where it drains into the Lamprey River.

Mountain Brook and Parson's Brook

Burt (1994) named two streams that originate from the northern, lower slopes of Saddleback Mountain and that parallel and cross back and forth along Old Mountain Road. The two brooks join up near the junction with Dashingdown Road and Old Mountain Road. As the brook continues downstream, it flows in the road bed. The exact stream bed of these two brooks may have been modified over time by the construction and use of Old Mountain Road, as the current location of the brooks does not exactly follow the topographic gradient.

In Summary

That is the story of water flowing out of the headwaters of the NALMC neighborhood. It is here that the surface waters get their start on a long, meandering journey. As you drive along Route 4 in Epsom and see the Little Suncook River rushing alongside or drive down through Deerfield, Epping, or Newmarket crossing the Lamprey River, think about how these waters began as small seeps and trickles up in the NALMC neighborhood. The importance of the Northwood Area Land Management Collaborative becomes clear; given the role it can play in helping sustain water quantity and quality within the headwaters region.

Lakes, Ponds, and Wetlands

The largest bodies of open water in the focus area include a portion of Harvey Lake, the eastern tip of Northwood Lake, Meadow Lake in the heart of the region, Demon Pond which drains into Meadow Lake, Tudor Wildlife Pond in the northeast corner, and several other unnamed beaver-influenced ponds. Except for Harvey and Northwood Lakes, all of the interior open water bodies have undeveloped shorelines.

Meadow Lake

The 30-acre Meadow Lake was created in 1975 by Edward Burt. He cleared the original wetland of trees and installed a dam with a water control structure such that the water level could be adjusted and drawn down completely if desired. The water level is maintained at a depth of 8-10 feet. Since Meadow Lake was created, wetland vegetation has taken hold along the shoreline. As described by Sperduto and Sperduto (1996) this offers an opportunity for visitors to see “classic wetland succession” as it progresses over time and from the shoreline out to open water. Wetland shrubs growing along the shore include sweet gale, leatherleaf, maleberry, winterberry, arrowwood, and highbush blueberry among others. Sperduto and Sperduto (1996) identified at least six species of sedges growing among the shrubs or along the shore, including the somewhat uncommon lake sedge (*Carex lacustris*). Meadow Lake is a popular fishing spot and the trails around the lake are extremely popular with walkers, especially those with dogs.

Demon Pond

Known in early records as “Demon Swamp,” this pond was named for the Demmons, a family that once lived in the area. As the beavers have come and gone and come back again, the ecology of this pond has fluctuated between open water and dense vegetation (Burt 1994). Presently the beavers are active so Demon Pond is in the pond stage. Demon Pond straddles Northwood Meadows State Park and the abutting Coe-Brown Northwood Academy land.

Harvey Lake

The 116-acre Harvey Lake is part of the Merrimack River Watershed. Tucker Brook enters from the east; waters drain out of Harvey Lake into the Little Suncook River sub-watershed. The Lake is bounded by Route 4 to the north, Harmony Road to the east and south, and a community of residential homes and camps along the western shore. The Harvey Lake beach is open to town residents only; otherwise there is no public access. NH Fish and Game lists Harvey Lake as a warm water eutrophic lake (high in nutrients and low in oxygen, which leads to algal blooms) that supports largemouth bass, eastern chain pickerel, brown bullhead, and white perch.

Wetlands

The variety and extent of wetland natural communities is one of the defining ecological features of the NALMC focus area. Central to this network of emergent marshes, scrub-shrub wetlands, seepage and basin swamps, acidic fens and vernal pools, is the 100+ acre Betty Meadows wetland ecosystem that stretches from the outlet of Meadow Lake south into the heart of the Forest Peters Wildlife Management Area. In a 1996 study of Northwood Meadows and Forest Peters, Sperduto and Sperduto (1996) tallied 166 plant species in the wetland areas; another 89 plant species were found in upland areas. Wetlands are rich habitats that provide a number of critical ecological functions such as flood control, pollutant filters, shoreline stabilization, sediment retention and erosion control, food web productivity, wildlife habitat, recreation, and education. A complete list of plants documented by several different property-specific studies within the focus area is included in Appendix A.

Open Wetlands

Beaver-Influenced Wetlands/Emergent Marshes and Scrub-Shrub Wetlands

Beaver are a key species in wetland systems. Plant and animal habitats undergo a cycle of change over many years or decades in response to beaver activity. This industrious rodent builds dams on perennial streams, flooding one or more acres upstream. This provides access to food, protection from terrestrial predators and shelter in winter, including underwater access to their lodge. Beaver feed on aquatic plants (e.g., water lily, duck potato, waterweed, pondweed, and duckweed) and shoots, twigs, leaves, roots, and bark of woody plants (e.g., aspen, willow, birches, witch hazel). They fell trees to get access to the tender leaves, twigs, and bark.

Eventually beavers abandon their pond, either when preferred food plants become scarce or when silt and organic matter accumulation makes them too shallow. With beaver gone, the dam begins to break and the pond drains. In the nutrient rich muck, herbaceous plants flourish, forming “beaver meadows.” Over time, shrubs and trees begin to dominate the area, eventually creating ideal habitat again for beaver. Beaver-influenced wetlands are dynamic, cycling through successional stages from flooded stream (pond) to marsh, shrubland, sapling, and swamp, and then back to pond when the beaver return.

Other wildlife that benefit from beaver-created habitats, also cycle through these changing habitat conditions. Wood ducks, tree swallows, flycatchers, woodpeckers, great blue herons, and other birds nest in the standing trees that are killed or injured by beaver flooding surrounding uplands. Emergent and floating-leaved wetland plants attract invertebrates that are favored by wood ducks and other waterfowl when they are rearing their young broods. Ducklings feed mostly on larvae of flies, caddisflies, mayflies, and other insects. Adult ducks eat the seeds of bur reed, sedges, pondweeds, and other aquatic plants, as well as insects and other invertebrates. Painted turtles, frogs, red-spotted newt, and river otter also use the emergent marshes. Shrubby wetland edges are home to song sparrow, common yellowthroat, swamp sparrow, catbird, and red-winged blackbird.

Betty Meadows Wetland Complex

Betty Meadows is a dynamic beaver-influenced system and as such is not uncommon in New Hampshire. However, its large size and relatively pristine condition, without paved roads crossing it, is unusual for this part of the state. In addition, the wetland is imbedded within the extensive forested, and largely undeveloped, NALMC neighborhood, providing added protection to the water quality and plant communities of Betty Meadows (Sperduto and Sperduto 1996).

The Betty Meadows wetland includes “peatland” habitat as identified by the NH Wildlife Action Plan (NHFG 2006) and by Sperduto and Sperduto (1996); this is described in more detail below under “fens.” In addition to the peatland, the Betty Meadows wetland contains a mix of emergent marsh, meadow marsh (such as tussock sedge meadows), and tall shrub thickets. Red maple swamps border much of the wetland (Sperduto and Sperduto 1996).

Other Beaver-Influenced Wetlands

Most of the other open water wetlands in the NALMC region have been influenced by beaver. Evidence of their chewing is readily evident along the shores of these ponds and marshes. The connectivity of these wetlands is what is unique in this area. These wetlands are connected through headwater or tributary stream drainages. Beaver can move up and down the stream to find appropriate habitat. Other wildlife such as turtles, salamanders, and larger mammals such as mink and black bear also use streams as movement corridors. In most other places such a large network of streams and wetlands would often be fragmented by roads.

Fens

Peatlands are a wetland type whose soils are “peat”—partially decayed remains of dead plants. Peatlands can be described by their topography (flat or level, on slopes, or raised), by their water and nutrient characteristics, and by their vegetation. In general most New Hampshire peatlands are flat, have low nutrient content, high acidity, and are dominated by peat mosses, heath shrubs, and sedges. The terms “bog” and “fen” are used to describe two broad types of peatlands. New Hampshire’s peatlands receive water and nutrients from some combination of upland runoff, stream or lake overflow, and groundwater seepage, in addition to rainwater. In New Hampshire, most peatlands are fens (Sperduto and Nichols 2004). Fens contain a diversity of sedges and non-heath shrubs absent in bogs; bogs are more nutrient poor and dominated by heath shrubs and peat mosses. Bogs occur in peatlands or portions of peatlands that receive very limited runoff from the surrounding landscape. New Hampshire’s bogs are floristically very similar to the true rain-fed bogs in more northern and maritime parts of North America (Sperduto, personal communication 2009).

The New Hampshire Wildlife Action Plan mapped several areas of peatlands within the NALMC focus area (Map 5). The NH Natural Heritage Bureau further defines this as a streamside fen associated with a slow-moving section of the Lamprey River. Extensive areas of *sweetgale – meadowsweet - tussock sedge fen* occur in a mosaic with emergent marshes and tall shrub thickets (NHNHB 2009). Other plants that occur in the sluggish margins of Betty Meadows include sundews, orchids, pitcher plant, along with many sedges, ferns, and shrubs. In addition to this streamside fen, Sperduto and Sperduto (1996) described a 2-acre *acidic graminoid fen* (dominated by grasses and sedges) at the base of Saddleback Mountain.

Forested Wetlands

Sperduto and Sperduto (1996) identified several types of forested wetlands on Northwood Meadows State Park and Forest Peters WMA. These include basin swamps, such as black gum - red maple basin swamps; seepage swamps and forest seeps, streamside wetlands dominated by red maple, and vernal pools. Forest seeps are like miniature swamps. They typically occur as small inclusions within the upland forest, found along headwater streams or other areas where groundwater seeps out of the hillside. Black gum swamps and vernal pools are described in more detail below.

Black Gum Swamps

Some of the oldest living trees in New Hampshire grow in the NALMC neighborhood. Several black gums older than 500 years grow within the region. Black gum, sometimes called black tupelo, is uncommon in the state. The tree occurs from Maine to Michigan and south to Texas and Florida. In New Hampshire it occurs primarily in the southern and southeastern parts of the state, and it grows primarily in a specific wetland type, known as a *black gum - red maple basin swamp* (Sperduto et al. 2000).

Black gum-red maple basin swamps are typically shallow depressions perched on a hillside or a small pocket on the flats. These basins have small watersheds that are isolated from perennial (year-round flows) drainages, have little seepage or surface water flow, and support acidic, nutrient-poor, stagnant conditions. Black gum and red maple are the dominant tree species. Highbush blueberry and winterberry are the common shrubs in the understory, and sphagnum moss grows in dense mats beneath (NHNHB 2009). The NALMC neighborhood has many of these relatively small (< 1 acre) black gum - red maple basin swamps (Map 5). The topography in the neighborhood is ideal for the formation of black gum – red maple basin swamps, and more black gum swamps may be discovered in the future.

The black gum has several traits that enable the plant to sustain its long life. It produces root and stump sprouts from a clonal root system. This feature likely stabilizes the tree and enables it to sustain high winds and severe weather of hurricanes and ice storms that have hit this area many times in the past centuries. Black gum is shade tolerant and can out-compete more sun-loving trees. Wood from a black gum is difficult to split and warps when drying so it was not a favorite of loggers. Maybe that is why beaver seemed to have passed over this species as well. That many black gums in New Hampshire grow in isolated basin swamps perched on hillsides may also make them less appealing and accessible to beaver. As a result of these traits, we find pockets of old growth black gum in Northwood today (Sperduto et al. 2000).

The Latin or scientific name for black gum is *Nyssa sylvatica*, which translates to “wood nymph of the forest.” This is a more fitting name, whereas “gum” provides no meaning, since the tree produces no gum-like substance. Black gum has a distinct growth form. The top brittle limbs break under high winds and heavy ice, but the strong trunk with lower, horizontal branches remains. Over time the tree takes on a gnarled look with a jumble of branches at the top (Sperduto et al. 2000).

Individual black gum trees have survived centuries. Given their unique growing conditions, changes to their environment could negatively affect this species. Unplanned development, invasion of non-native species, changes to flooding and drainage patterns, runoff of pollution that affects nutrient levels and water quality, and shifts in the behavior of beavers or loggers that could gnaw or cut down centuries old trees (Sperduto et al. 2000).

Vernal Pools

Vernal pools are ephemeral wetlands that fill in spring from rainfall, snowmelt, or rising groundwater (Tappan 1997, Kenney and Burne 2001). Some pools also fill in the fall after autumnal rains. These pools are typically small in size, ranging from less than 1/10th acre to more than 2 acres. Size, however, is not always an indicator of the quality or productivity of a vernal pool. Most vernal pools completely dry out by the end of summer and therefore cannot support fish populations, which makes these pools safe for breeding amphibians such as wood frog, spotted and blue-spotted salamanders. The length of time that a pool retains water is known as its “hydroperiod.” Most vernal pool breeders need about four months to complete their reproductive cycle. Pools that retain water for longer periods are also important, especially in drought years, when some pools may dry up too soon.

Vernal pools vary in the animals that are present, yet most are characterized by the presence of at least one “indicator species”, one that depends on vernal pool habitat for successful reproduction. Vernal pool indicator species include fairy shrimp (small crustaceans), wood frog, spotted salamander, and blue-spotted and Jefferson salamanders. Higher elevations tend to support fewer vernal pools compared to low-lying areas. NALMC’s location in the upper elevations of three sub-watersheds, provides for few suitable sites for vernal pools. A handful of vernal pools are documented in the focus area (Map 5).

Upland Habitats

Upland habitats in the NALMC focus area include several forest types, grasslands, clearings, talus slopes, and cliffs. Forests are the dominant upland habitat type (about 85% of the area), and are primarily in a mid-successional stage (50-75 years old). Much of the forest is considered mixed wood (hemlock-beech-oak-pine). There are some pure stands of hemlock, white pine, and red oak, and stands of mixed softwoods and mixed softwoods and hardwoods. The four most common tree species in the overstory are white pine, red oak, hemlock, and red maple. White birch and American beech are prominent in some

stands. Scattered occurrences of other tree species include red pine, yellow birch, black birch, sugar maple, white ash, black cherry, red spruce, and pitch pine.

Forests have reclaimed much of the land that was once cleared for farming and homesteading. The return of the forests has led to a return of forest dwelling animals, which have expanded or continue to expand back into historic ranges. These include moose, black bear, fisher, beaver, pileated woodpecker, and forest-dwelling hawks and owls. As the forests have matured and continued on their natural path of succession, the amount of early successional (or open country) habitat has declined from the peak during farming days around the mid-1800s.

Hemlock-Beech-Oak-Pine Forest

As described earlier, the dominate forest type in the NALMC region is hemlock-beech-oak-pine. This is the most common broad forest type in New Hampshire, occurring mostly below 1,500 feet in elevation from the White Mountains south. It covers about fifty percent of the state; however, this forest type is severely fragmented given its distribution in the heavily developed southern region of New Hampshire (NHFG 2006).

The current forest condition is a result of local soil conditions as well as past land uses that included pasturing and logging. Variations in soils, slope, and aspect affect plant species found at a given site. White pine and red oak are abundant in this forest type, particularly on sandy, rocky soils and old fields. The old-field white pine stands that are prevalent in central New England are a successional example of this forest type. Sugar maple and yellow birch occur occasionally, particularly along drainages or for sugar maple in semi-rich soils. Common herbaceous plants in the forest understory include starflower, wild sarsaparilla, wintergreen, Canada mayflower. Woody plants include witch hazel, black birch, black cherry, ironwood, maple-leaved viburnum, and black huckleberry (NHFG 2006). The extensive interior forest supports many breeding “interior forest birds” such as scarlet tanager, ovenbird, wood thrush, veery, hermit thrush, black-and-white warbler, black-throated-green warbler, and goshawk.

Hemlock Forest

Eastern hemlock is the most shade-tolerant and one of the most long-lived tree species in Eastern North America. Its adaptation to shade explains why you find dense stands and canopies of hemlock. The dark understory and acidic soils are less hospitable to other plants that require at least some sunlight. Hemlock grows on moist, acidic soils with good to poor drainage. Hemlock forests occur in ravines along streams, on hummocks in vernal pools or shrubby wetlands, and scattered among more upland areas among pines and oaks.

A good example of a hemlock forest can be seen along the Huckins Orchard Trail as it meanders from Dashingdown Road to West Road north of Meadow Lake. Some of the plants growing on the forest floor under the hemlock include starflower, wood anemone, Canada mayflower, New York fern, wild sarsaparilla, sessile-leaved bellwort, and southern ground cedar. Few shrubs or tree saplings grow here, making for a very open understory. Scattered among the hemlock in the canopy or sub-canopy is an occasional red maple, sugar maple, white birch, white ash, black birch, white pine, American beech, or yellow birch.

Hemlock forests are important to several species of wildlife. The dense canopy provides ideal winter cover for white-tailed deer and porcupine. The black-throated green warbler and blackburnian warbler are common in hemlock forests. Hemlock-shaded streams have lower summer temperatures, which is important to aquatic organisms.

Hemlock – Cinnamon Fern Forest

Sperduto and Sperduto (1996) documented several pockets of *hemlock - cinnamon fern forest*. This forest type fall somewhere between an upland hemlock forest and a low-lying seepage forest, and supports a mix of upland and wetland species. Spicebush (*Lindera benzoin*) is an uncommon shrub that was found in this community (Sperduto and Sperduto 1996).

Semi-Rich Mesic Sugar Maple Forest

Rich mesic forests are hardwood forests growing on soils with relatively high levels of moisture, mineral nutrients, and high-quality organic matter. These forests grow at a faster rate and may have about twice as many species of herbs and shrubs as other forest types. The dominant tree is usually sugar maple. Semi-rich mesic forests are very similar, but species diversity and productivity tend to be lower, probably due to a combination of less moisture, organic matter, and/or soil nutrients. Fewer herb and shrub species indicative of rich conditions are found, and those restricted to very rich conditions are absent, such as maidenhair fern and blue cohosh. Rich organic matter and sediments that support rich and semi-rich mesic forests often accumulate on or below steep slopes: in ravines, drainages, talus slopes, and below cliffs. These forests are uncommon in New Hampshire and large, undisturbed examples are rare (from NHNHB 2002).

Sperduto and Sperduto (1996) identified several small patches of *semi-rich mesic sugar maple forest* on Northwood Meadows State Park. The tree species found on these sites included sugar maple, white ash, American beech, and yellow birch. Understory herbaceous plants included white baneberry (*Actaea pachypoda*), roundleaved violet (*Viola rotundifolia*), and alternate-leaved dogwood (*Cornus alternifolia*); these plants are uncommon elsewhere in the focus area.

Ridge and Talus Slopes

Forested talus slopes are found throughout the focus area on the slopes of Saddleback Mountain and the other hilltops. Although they are a small part of the forest, they often have a distinct set of plants among the jumble of rocks or among the rock outcroppings. Sperduto and Sperduto (1996) noted several plants as only occurring in this habitat type, including hop hornbeam (*Ostrya virginiana*) and red-berried elder (*Sambucus pubens*). Some of the upper slopes of Saddleback Mountain have exposed ridges or rock outcrops. Rock outcroppings can vary from dry to moist, and depending on the extent of rock outcropping may offer habitat for porcupine or bobcat.

Early Successional Habitats

Early successional habitat includes grasslands, shrublands and old fields, young regenerating forests, and forest openings. It currently comprises about 7% of the ecological assessment focus area, although not all is created or maintained to benefit wildlife (Map 5). Some of this includes fields mowed for hay, or gravel pits, or edges of roads. Another 25 acres of early successional habitat is to be created in Fall 2009 on the Forest Peters Wildlife Management Area.

This habitat is by its nature dynamic and transitional. The proportion of the landscape in an early successional stage varies over time depending on natural and human disturbances. Weather events such as hurricanes, ice storms, and tornadoes create large scale openings in the forest. The 2008 tornado just west of the NALMC region created a wide, long strip of “early successional habitat.” Local and regular winds and rains and disease cause single trees to fall, creating small openings in the forest. Beavers and fire also set back mature forest to a younger age. Some early successional habitat is left to naturally succeed toward mature forest. Other areas – such as grasslands or log landings -- are purposely maintained as “permanent openings.”

Several NALMC landowners are actively managing for early successional habitats. Harmony Hill Farm maintains grasslands for wildlife and has created patches of young forest of many acres each. The NH Division of Forests and Lands, which is responsible for managing much of Northwood Meadows State Park, created two forest openings in the Park in 2007 to benefit wildlife. One is 6 acres. The other is a 1-2 acre opening that serves as a log landing and was the original borrow pit created when Ed Burtt made the park roads. Several other private landowners, mostly along or near Winding Hill Road, have fields, gravel pits, or other disturbed areas. These too can provide some benefit, such as nesting areas for turtles.

Many wildlife species associated with early successional habitats are in decline, as their habitats have declined through natural succession or human development. This habitat was at its peak during the 1700 and 1800s as settlers cleared land and then abandoned their land. Historically (pre-settlement) the amount of early successional habitat across a largely forested New England varied from a high of perhaps 20% along the coast to as little as 1-3% in northern forests. The NALMC region falls somewhere in between and may have supported 5-10% early successional conditions. A major difference today is that coastal areas are now densely populated and highly fragmented by development. The few patches of early successional habitat that remain are often not large enough to support wildlife populations (Oehler et al. 2006).

Bobolinks and eastern meadowlarks require large grasslands (such as on Harmony Hill Farm) for successful nesting. Other species, such as ruffed grouse, American woodcock, and chestnut-sided warbler, require young generating forest. Forest-dwelling animals such as black bear, white-tailed deer, wild turkey, and many birds also benefit from forest openings. Here is where they find insects, berries, and other food sources. Dense young growth, which comes in after a disturbance, creates thick cover for squirrels, rabbits, hares, and other small animals that are prey for larger animals. Natural disturbances will continue to create some of this habitat condition. But given human development patterns in other areas, the public and private landowners within the NALMC neighborhood have an opportunity to work together in identifying where and how much early successional habitat would provide the most benefit.

A landscape approach is particularly important for this habitat type since without active management, natural succession will carry it toward a different habitat condition, mostly toward mature forest. It is important to identify places where the forests will be left to mature, and in some cases left to natural disturbances over a long period of time. Early successional habitat can be located elsewhere, perhaps clustered together.

Wildlife Habitat Features

Wildlife need food, water, cover, and space to live and reproduce--collectively known as their *habitat*. Each species has unique habitat requirements, and the presence of a given species in an area varies depending on the availability of the habitat features that they depend on. Wildlife food resources include aquatic and upland plants, fruits, seeds and nuts, insects and other animals, and nectar. All wildlife require water, almost daily, yet aquatic organisms clearly depend on it more than upland species. Cover provides protection from weather and predators and sites for nesting, resting, travel, and other activities. The juxtaposition of food, water, and cover determines the wildlife community that occurs in a given area.

An area with many different kinds of food, water, and cover typically supports a greater diversity of wildlife. This reflects *habitat structure*, an important concept in understanding the distribution and abundance of wildlife. The components of habitat structure and their presence or lack thereof in the NALMC neighborhood are discussed below.

Horizontal vegetation diversity

This refers to the horizontal arrangement of different plant communities (including type and age) in a given area. Areas with aquatic habitats and non-forest habitats such as fields as well as forest are more horizontally diverse than an area that is just forested. For instance, a relatively flat 1,000-acre mature hardwood forest has less horizontal vegetation diversity than another 1,000-acre habitat with diverse topography that supports a mix of emergent wetland, shrubs, and upland mixed forest. Likewise, a 500-acre forest that has a mix of tree ages that includes a grassy opening, young forest, saplings, and mature, old trees is more diverse than a 500-acre forest with just sapling/pole-sized trees. A wetland that has concentric rings of open water, emergent marsh, shrub thicket, and tall trees is more horizontally diverse than an open water pond with a sandy shore that extends to lawn.

Looking at the NALMC neighborhood in its entirety, the horizontal vegetation diversity includes the following different habitats:

- Maturing mixed hardwood/softwood forest communities; comprises a majority of the horizontal structure
- Wetland complexes that include open water-emergent marsh-scrub shrub, and swamp communities
- Wetland basins such as black gum swamps, fens, vernal pools
- Headwater and other stream drainages
- Steep slopes, rocky outcrops, talus slopes
- Grasslands
- Forest openings

Habitat management can change and enhance horizontal diversity through diversifying the age, size, and structure of forest habitats. For instance, the NH Division of Forests and Lands created two wildlife habitat openings in the forest near Old Mountain Road to diversify the mostly forested Northwood Meadows State Park. Harmony Hill Farm has also diversified the horizontal structure with several clearcuts that removed the forest overstory and exposed blueberry barrens and other young growth. Natural disturbances, including beaver and storm events, are also important drivers of horizontal diversity. However, maximizing horizontal diversity everywhere is not typically the goal. Extensive areas of mature forest are important to some wildlife species. And other areas may be sensitive to disturbance, such as wetlands and the semi-rich sugar maple forest.

Vertical vegetation diversity

Vertical diversity refers to the extent of layering within a forest or other habitat. Layering within a forest includes the arrangement of ground cover (lichens, moss, ferns, and herbaceous plants), vines and shrubs, and trees (including sizes and ages). A greater variety of vertical layers creates a greater diversity of habitats, which often leads to a greater diversity of wildlife. These layers provide cover from predators, nest and den sites, foraging surfaces, food sources, shade, and more. Vertebrate wildlife typically responds more to vegetation structure than to the presence of specific plant species. Vertical and horizontal structure that is varied, lush, and “messy” is a boon to wildlife. Forests with little ground cover, dead wood, shrubs, and understory have fewer wildlife species. Patches of forests that have little vertical diversity, such as a hemlock forest, remain important parts of the NALCM region. However, if the entire area were a dense hemlock forest, then the area would have little vertical diversity.

This region, like most parts of New England, is still recovering from the period of intense agriculture and natural reforestation. Some areas in the NALMC neighborhood have been heavily logged more recently. A natural disturbance such as a single tree fall occurs fairly frequently and affects a small area. Larger disturbances, such as ice storms, have more widespread effects. Unlike more developed areas, beavers are less restricted in their movements in this region and therefore are important creators of natural

disturbance. This mix of natural and human disturbance, some planned, some not, creates vertical diversity. Active management, through planned selective habitat management or forestry, can serve to emulate natural disturbance in locations that provide ideal wildlife habitat while ensuring that sensitive areas are left alone.

Food resources

The availability of food resources for wildlife is a key component of their habitat needs, and often varies seasonally. Breeding birds depend on a flush of insects to feed their young nestlings, while later in summer and into fall and winter they switch to berries, nuts, and seeds. Deer, moose, and other browsers rely on herbaceous vegetation during the growing season and woody growth in winter. Larger mammals such as coyote, fox, and fisher prey on other animals as well as eating fruits when available. Seeds are favorites of squirrels, nuthatches, siskins, mice, and voles. Hawks and owls need a healthy population of red squirrels, snowshoe hare, and other small mammals.

Fruits, nuts, and seeds from woody plants that are food for wildlife are collectively known as “mast.” Hard mast includes the array of nuts and seeds, which are typically high in fat, carbohydrates, and protein, a food source that is both high in energy content and available into the winter. Soft mast includes fruits and berries such as cherries, dogwoods, blueberries, winterberry, grapes, and the fleshy fruits of other trees, shrubs, and vines. Soft mast is more perishable and is often high in sugar, vitamins, and carbohydrates. These fruits are a source of moisture for wildlife during drought years, and are a crucial energy source for some migrating songbirds.

A diversity of hard and soft mast producing trees, shrubs, and vines is important. Different mast species are available at different times of year, which is critical to wildlife. Also, some species, such as oak only produce heavy acorn crops every 2 to 10 years, and this varies among oak species. Peak acorn production occurs when red oak are 19-22 inches in diameter at breast height (dbh); white oak at 24-30 inches dbh. White oak acorns have less tannin and hence are more palatable to wildlife than red or black oak acorns. Birches, maples, ashes, and basswood are also used by seed-eating wildlife (New Hampshire Forest Sustainability Standards Work Team 1997).

The NALMC neighborhood is not overly abundant in food resources such as hard and soft mast. Red oak is the most common mast tree. American beech is also a valuable hard mast tree, and is abundant in some stands within the region. White and black oak are uncommon as is black cherry. The region has a healthy supply of white pine and hemlock, a source of seeds for some birds and mammals. Soft mast species include highbush blueberry, viburnums, winterberry, elderberry, raspberries; these are most abundant around the Betty Meadows wetland. Emergent marshes and shrubby marsh edges are also habitats that provide abundant insects. The upland forest currently produces little soft mast (fleshy fruits) for wildlife. Harmony Hill Farm provides the most abundant soft mast, among its blueberry barrens, young regenerating forests, and wetland and field edges.

Cavity and other nest trees

Nearly two-dozen birds and mammals depend on tree cavities for nesting, roosting, or denning. Bats roost and the brown creeper nests under the loose bark of standing trees and bats will roost. These species require a range of cavity tree size classes and rely on a mix of dead or partially dead standing trees (called “snags”) as well as live trees with cavities. Woodpeckers, chickadees, and red-breasted nuthatch are primary excavators (i.e., they make the holes), while others use existing holes.

The NALMC neighborhood has cavity trees scattered throughout, although the number of large trees is limited, chiefly because of past land use. Some of the wildlife species found in the neighborhood and their required tree cavity sizes measured as diameter at breast height are listed below (Tubbs et al. 1986):

<8"	6-12"	12-18"
black-capped chickadee	hairy woodpecker	great-crested flycatcher
downy woodpecker	red-breasted nuthatch	northern flicker
tufted titmouse	white-breasted nuthatch	
winter wren	brown creeper	
<hr/>		
>18"		
wood duck	fisher	
pileated woodpecker	raccoon	
gray squirrel	barred owl	
red squirrel	porcupine	

The NALMC focus area is home to several species of breeding hawks and owls (“raptors”) with large home ranges. These include northern goshawk, broad-winged hawk, red-tailed hawk, red-shouldered hawk, and perhaps others. These birds require nest sites that are limited in our forested landscapes because of past land uses. Because of their poor form raptor nest trees are often removed during timber stand improvements or go unnoticed during logging operations. Hawks and owls are often sensitive to human disturbance and habitat changes near nest sites during the breeding season, which extends from mid-February to July (Mariko Yamasaki, U.S. Forest Service, personal communication).

Northern goshawks build large stick nests in mature forests on large white pine branches near the trunk and in forked branches of mature hardwoods. Broad-winged and red-tailed hawks nest near forest openings or field edges, while red-shouldered hawks nest near water or wetlands. Landowners can survey for raptor nest trees prior to any major land management activities to ensure that such trees are left

Dead and down woody material

Dead and down woody material (sometimes called “coarse woody debris”) on the forest floor is important for many reasons. Woody debris in various stages of decay includes logs, stumps, branches, upturned roots, and tree falls. These features provide wildlife habitat, serve as nurse logs for regenerating plants, and contribute to nutrient cycling. As with cavity trees, the larger the fallen log or stump the greater the biodiversity value. Decaying wood supports many insects and other invertebrates, which are food sources for shrews, woodpeckers, and black bears, and habitat for a variety of bryophytes, lichens, and fungi. Snakes, fisher, and weasels hunt among the woody debris. Many species including mice, voles, salamanders, snakes, chipmunks, red squirrels, weasels, black bear use coarse woody debris for cover, den sites, and escape areas. The winter wren nests in upturned tree roots. Mosses, fungi, and lichen are often associated with decaying wood. Fallen logs and other woody debris are also important in aquatic environments. Turtles, mink, otter, and waterfowl bask on this wood and fish find cover in woody debris.

As with cavity trees, the NALMC focus area is low in large coarse woody debris. This is not atypical in New England forests that are recovering from past agriculture and intensive logging. The size of coarse woody debris is related to past land use since large trees and dying trees are often removed before they reach the stage of decaying on the ground. The amount and size of woody debris is naturally increasing as New Hampshire forests are maturing, assuming not all is removed.

Wildlife Occurrences

New Hampshire is home to more than 500 species of vertebrates—amphibians, birds, fish, mammals, and reptiles, and thousands more species of invertebrates such as insects, snails and clams. Collectively these are considered “wildlife.” The New Hampshire Wildlife Action Plan (NHFG 2006) lists 127 wildlife species of “greatest conservation concern.” Of these, at least 30 are known to occur in the NALMC region.

This ecological assessment compiled a list of all wildlife species documented within the NALMC focus area (see Appendix A). No systematic surveys of wildlife have been conducted in the region, so this list of species can be augmented over time. These occurrences were documented in the Northwood Meadows State Park Master Plan (NH DRED 1996), during forest stand inventories by the NH Division of Forests and Lands of the State Park and Forest Peters WMA, during fieldwork as part of this ecological assessment, and in reports by the NH Natural Heritage Bureau.

Amphibians

Anecdotal observations of ten amphibian species for the region include American toad, bull frog, gray tree frog, green frog, pickerel frog, northern red-back salamander, red-spotted newt (and their immature stage red eft), spotted salamander, spring peeper, and wood frog. No systematic survey has been conducted.

Birds

Birds are the most diverse group of vertebrate wildlife found within the region, with 123 species documented. The area is significant for forest interior birds such as wood thrush, ovenbird, and scarlet tanager and birds with large territories such as goshawk. The ridgetops formed by Saddleback Mountain are likely an important migration corridor for hawks in the fall. River corridors and associated wetlands are also known to be important for migrating songbirds; twenty warbler species have been recorded for the region.

Fish

No fish surveys have been done in the region. A 1983 fish survey of the Lamprey River in Deerfield recorded common sunfish, white sucker, chain pickerel, fallfish, and longnose dace. New Hampshire Fish and Game stocked 300 rainbow trout into Meadow Lake in 2008 and 2009. The lake is not ideal habitat for trout since it has little cover that maintains cool summer water temperatures as required by trout. Large-mouth bass appears to be a common catch by anglers on Meadow Lake.

Mammals

This large, unfragmented habitat block is particularly important to wide-ranging mammals. Some find all of their habitat needs within the region; others may travel beyond. The lack of roads provides important protection from road mortality and other disturbance.

Documented occurrences of 22 mammal species include small mammals such as shrews and moles up to larger mammals including river otter, bobcat, and moose. See Appendix for a complete list of mammals. The ideal time to document the mammal community is in winter, when tracks, scat, and other sign is more visible.

Reptiles

Reptiles are often secretive or in some cases uncommon, and are therefore difficult to document. Nine species of reptiles are reported for the NALMC region including several observations of the rare

Blanding's turtle. Other reptiles include wood turtle (also rare), painted turtle, snapping turtle, and five species of snakes.

Invertebrates

Although no formal surveys of the region have been conducted, several targeted efforts have revealed that the Betty Meadows wetland complex in particular, supports a diverse dragonfly community. Other wetlands, including some of the black gum basin swamps also support a mix of dragonflies. Known occurrences within the NALMC focus area include the rare ebony boghaunter. A total of 65 dragonfly species have been documented and are listed in Appendix A. Fifteen species of moths and butterflies are also listed for the region.

Rare Plants and Animals and Exemplary Natural Communities

The New Hampshire Natural Heritage Bureau (NHNHB) finds, tracks, and facilitates the protection of rare plants and exemplary natural communities. They also maintain information on rare wildlife in cooperation with the NH Fish and Game Department. Natural Heritage defines a natural community as "recurring assemblages of plants and animals found in particular physical environments." Each type of natural community has a unique set of environmental conditions that support certain species adapted to those conditions. Exemplary natural communities include nearly all examples of rare types and high-quality examples of common types (Sperduto and Nichols 2004). A full list of the 407 plant species documented in the NALMC region is in Appendix A.

Rare Wildlife

Three species documented as occurring within the NALMC focus area are state listed as rare wildlife species. These include the Blanding's turtle (endangered), wood turtle (special concern), and ebony boghaunter dragonfly (special concern) (Table 3). These species are described in more detail below.

Rare Plants

Two rare plants are known to occur in the region: *Gaylussacia dumosa* (dwarf huckleberry) and *Sphagnum flavicomans*. Both of these species are coastal plain species in New England.

Exemplary Natural Communities

Two exemplary natural communities are found here.

Black gum - red maple basin swamp

The NALMC region has at least two examples of exemplary *black gum - red maple basin swamps*. These sites are structurally diverse swamps with many black gums that are hundreds of years old. The high quality of the habitat combined with its location within a large undeveloped landscape ranks these specific sites as exemplary. As the name suggests black gum and red maple are co-dominant in the canopy.

Medium level fen system

This exemplary natural community system is associated with the Betty Meadows wetlands complex in the Northwood Meadows State Park and Forest Peters Wildlife Management Area. Two fen communities dominate this peatland system: *sweet gale-meadowsweet-tussock sedge fen* is along a slow-moving section of the Lamprey River with emergent marsh and tall shrubs mixed in; *highbush blueberry-sweet gale-meadowsweet shrub thicket* is located in a small basin at the base of Saddleback Mountain, and is dominated by *Sphagnum* moss.

Table 3. Rare species found within the ecological assessment focus area.

Species Common Name	Scientific Name	Status
PLANTS		
Peat moss	<i>Sphagnum flavicomans</i>	State endangered
Dwarf huckleberry	<i>Gaylussacia dumosa</i>	State threatened
ANIMALS		
Blanding's turtle	<i>Emydoidea blandingii</i>	State endangered
Ebony boghaunter dragonfly	<i>Williamsonia fletcheri</i>	State special concern
Wood turtle	<i>Glyptemys insculpta</i>	State special concern

Environmental Health

Environmental health can be measured in several ways, such as the quality and quantity of surface and groundwater, erosion, amount of impervious surface, quality of air, presence of forest pests or invasive species. The NALMC focus area seems to have relatively high environmental health related to these measures. Some environmental stressors such as mercury deposition, air pollution, extreme weather events, and climate change are large in geographic scope and largely outside the influence of local land use decisions.

Given the location of the NALMC focus area in a headwaters region and in a largely undeveloped, unfragmented block of habitat, there is little data on environmental health measures. One would expect such an area to be free of many environmental health stresses that are prevalent in more developed areas of the state. Below is a summary of what data are available.

Water Quality and Quantity

The University of New Hampshire Water Resources Research Center established a long-term study of the Lamprey River basin in 1999, primarily to study the effects of suburbanization on water quality. This long-term study is referred to as the Lamprey River Hydrologic Observatory (see <http://www.wrrc.unh.edu/lrho/about.htm>). Many water quality studies are underway in the basin, along with regular monitoring of surface water. The nearest sampling site to the NALMC region is at the Lamprey River where it flows under Blakes Hill Road in Deerfield. A monthly sample is collected. Field measurements include pH, dissolved oxygen, temperature, and conductivity. Additional lab analysis looks at levels of nitrogen, nitrate, ammonium, and phosphate, among other parameters. The water quality at this site is relatively good, given its location high in the watershed.

These UNH researchers are studying the long-term changes in water quality associated with changes in land use, human population growth, and changes in ecosystem functions over time. Some of their results to date show a strong influence of population density on nitrate in stream water and also groundwater. Monthly average nitrate concentration is increasing in the Lamprey River, perhaps a result of increasing suburbanization. They have documented that road salt (sodium chloride) applications to roads and parking lots is ending up in streams and groundwater. Watersheds with more impervious surfaces have higher stream and groundwater sodium and chloride concentrations. These higher concentrations in turn can have detrimental effects on the health of humans and aquatic life (www.wrrc.unh.edu/lrho/index.htm). Again, this data has not yet been collected within the NALMC region, but we might assume that the water quality trends are better than in the more suburban reaches of the watershed.

New research is starting this summer in the NALMC region in the Betty Meadows wetland that begins at Meadow Lake and continues south through the Forest Peters Wildlife Management Area. The primary objective of this research is to better understand the role that these wetlands play in providing base flow to the Lamprey River. Earlier studies have looked at the contributions of lakes and ponds to base flow, which suggested that other sources such as wetlands may be important to base flow (Matt Davis, UNH Department of Earth Sciences, personal communication).

A few places in the focus area show signs of erosion. This includes Old Mountain Road, which has significant erosion from long-term vehicle traffic on this unmaintained road. Several headwater streams crisscross the road and in some places the stream channel flows down the road bed. Likely the construction and use of the road has changed some flow patterns over time. The presence of lots of water, rocky soils, and lack of maintenance are causing rutting and runoff along this dirt road. An extension of the Saddleback Mountain Road built by Ed Burt climbs up a steep section of the mountain to the top where it meets the Parsonage Trail. The steep section is showing signs of erosion.

Invasive Plants

An "invasive species" is defined as a species that is non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2001). One report estimates the economic cost of invasive species in the U.S. at \$137 billion every year (Pimentel et al. 2000). Up to 46% of the plants and animals federally listed as endangered species have been negatively impacted by invasive species (Wilcove et al. 1998, National Invasive Species Council 2001).

Invasive species typically have certain traits that give them an advantage over most native species. These traits include producing many offspring, early and rapid development, and being adaptable and highly tolerant of many environmental conditions, including ability to compete in disturbed settings. Studies show that invasive plants can reduce natural diversity, impact endangered or threatened species, diminish wildlife habitat, affect water quality, stress and reduce forest and crop production, damage personal property, and cause health problems.

The New Hampshire Invasive Species Act states that "*no person shall knowingly collect, transport, sell, distribute, propagate or transplant any living or viable portion of any listed prohibited invasive plant species including all of their cultivars, varieties, and specified hybrids.*" Appendix B includes the list of prohibited species referenced in this Act. For more information on New Hampshire's invasive species program see www.nh.gov/agric/divisions/plant_industry/plants_insects.htm and www.nh.gov/agric/divisions/plant_industry/documents/booklet.pdf.

Invasive plant species are transported by humans and wildlife; many were planted purposefully in the past for wildlife, erosion control, or as landscape plantings. Others came in via international commerce. Many invasive plants appear first in disturbed areas such as along roadsides and trails, in gravel pits, or edges of fields. They can be moved along roadways by plowing or other roadwork. The NALMC region is relatively free of invasive plant species, probably because of the relative lack of disturbance and large openings throughout. A few individuals or clumps of invasive plants are present. These include bush honeysuckles (*Lonicera spp.*) at the edge of the State Park parking lot on Route 4 and a few scattered locations along Dashingdown Road. The bush honeysuckle and Oriental bittersweet (*Celastrus orbiculatus*) occurs in some field edges on Harmony Hill Farm. Japanese Barberry (*Berberis thunbergii*) and European Barberry (*B. vulgaris*) were documented on the UNH Saddleback Mountain property (Perron 2004) and on Harmony Hill Farm (Van de Poll 2002). A few stems of multiflora rose (*Rosa*

multiflora) were also found on Harmony Hill Farm in 2002. A detailed field inventory of invasive species was not conducted so there may be other populations and other invasive species in the NALMC region.

Forest Pests

New Hampshire is the second most forested state in the U.S. by percent of total area. The health of these forests is affected by air pollution, urban sprawl, introduced insects and diseases, extreme weather events, wildlife, and demand for wood products. The New Hampshire Division of Forests and Lands monitors the condition of the state's forests and in particular monitors the presence of forest insect pests and diseases. A few of these pests that have the potential to occur in the NALMC region are described here.

Hemlock Woolly Adelgid

The hemlock woolly adelgid (*Adelges tsugae*), a small, sap-sucking insect native to Japan and China, became established in the U.S. in the 1920s, and on the East Coast in 1951. It is now established in 12 Eastern states from North Carolina to Maine, and has caused widespread mortality of hemlocks. The adelgid is spread through the transportation of infected nursery stock as well as by wind, birds, and mammals. Homeowners and nurseries cannot bring hemlock seedlings or trees from adelgid-infested states into New Hampshire, Maine and Vermont without an inspection permit certifying they are pest-free. The eastern hemlock (*Tsuga canadensis*) has shown little or no resistance to the adelgid (from NH Division of Forests and Lands website). Hemlock woolly adelgid was first detected in Rockingham County in 2001. More infestations were found in Hillsborough County in 2006 and in Strafford County in 2008. The closest infestation to the NALMC region was found in Epsom in 2002 (and may have been there earlier), which was eradicated. It re-appeared on Northwood Lake in 2008.

Regular visual inspection of hemlock is the most effective means of determining whether or not a tree is infested with adelgid. For most of the year the dry, white "wool" produced by the adelgid on the twigs is quite conspicuous in contrast to the dark green needles. It is particularly noticeable on the undersides of the young twigs. A new infestation could be difficult to detect during July through September when adelgids are small dormant nymphs with very little "wool" associated with them. However, periodic examination of hemlocks throughout the year would minimize the chance of a new infestation being overlooked. Further evidence of an adelgid infestation is the thinning or grayish-green (not red or yellow) color of the needles on some branches. Usually by the time these symptoms appear, the tattered "wool" of a previous adelgid generation is also present on the branches (from University of Rhode Island Landscape Horticulture Program).

Hemlock woolly adelgid is difficult to control since it is a non-native insect. Mechanical, cultural, biological, and cultural controls are being investigated and tried. Guidelines for managing hemlock stands prior to widespread infestations are available. Maintaining healthy stands of hemlocks (free of other stressors) helps the hemlock tree better tolerate an adelgid infestation if it occurs (see Ward et al. 2004).

The NH Division of Forests and Lands, NH Fish and Game, and the U.S. Forest Service are partnering on a research project within the NALMC region to study the potential effects of forest management on adelgid. The goal of the project is to study the effectiveness of different silvicultural strategies on protecting hemlock from adelgid infestations. This study will take place on the Forest Peters WMA.

Other Forest Pests

Several other non-native forest insect pests are monitored by the NH Division of Forests and Lands. These include the **emerald ash borer** (*Agrilus planipennis*) which continues to spread in the Midwest and threatens New Hampshire's ash trees, although it has not yet been found here. The state is monitoring this species statewide through several methods including prism traps designed to attract and capture adult beetles. One of these prism traps is at the entrance to Northwood Meadows State Park. The emerald ash

borer appears to be transported on firewood. To reduce the spread of the emerald ash borer and the **Asian long-horned beetle** (*Anoplophora glabripennis*), the movement of firewood of all types and species into state-owned properties, under the administration of the Department of Resources and Economic Development, from sources outside New Hampshire State boundaries is prohibited; unless it is prepackaged firewood clearly marked with place of origin and labeled “kiln-dried” (www.nhdfi.org/forest-health/regulated-pests.aspx). The closest infestations of emerald ash borer are in western Pennsylvania and New York. An area infected by the Asian long-horned beetle was discovered in Worcester, Massachusetts in 2008, although it was believed to have arrived 10 years earlier.

Climate Change

Global climate changes will affect natural disturbance patterns over time (Lorimer and White 2003). The greatest effects of climate change will be on regional air and water temperatures, precipitation patterns, storm intensity, and sea levels. These effects are predicted to result in an increase of freeze-free periods, decreased snow cover, increased storm intensities and frequencies, increased likelihood and frequency of droughts, damaging ozone, and an increase in the spread of invasive species and disease (NHFG 2006). The resulting effects on wildlife and habitats are expected to be variable and species-specific, with a predicted general trend of ranges shifting northward. The uncertainty about the future effects of climate change requires landowners and land managers to be flexible and adaptable in managing lands to maintain healthy ecosystems in light of that unpredictability (Inkley et al. 2004).

The NALMC neighborhood with its extensive wetland system embedded within a large unfragmented forest set within the upper elevations of the Coastal and Merrimack River watersheds is significant. This connectivity of aquatic and upland habitats across varied topography (east to west and north to south) will be important to wildlife and natural communities in the face of climate change. Warmer climates and changes in weather patterns will put added stress on our environment. Species will need to adapt and seek out suitable habitats as conditions change.

Chapter 3 History, Recreational Features, and Cultural Resources

Land Use History

Several historical accounts of Northwood provide images of how the NALMC region was first settled (Cogswell 1972, Hill and Sargent 1991, Bailey 1992). This human history is important to include here since people have shaped the landscape over the last 250 years and before and therefore have affected the current ecological condition of the region. Also, current and future landowners will continue to shape the area through their land management decisions.

According to the historical records, Indian tribes were living in the area well before the 1600s and were trying to maintain their claim to the territory. This was a source of conflict as European settlers expanded out from the seacoast region. The Government of New Hampshire granted the Nottingham Township in 1722 as an outpost that could serve as a buffer against Indian uprisings. This included modern day Nottingham, Deerfield, and Northwood (Bailey 1992). Townships were divided up by divisions and then ranges and lots, which can be studied further elsewhere (see Bailey 1992). The first homes were built in Northwood around 1763; it was considered the “great north woods” at the time. Northwood incorporated as a separate town in 1773. In 1775, 313 people resided in Northwood (Northwood Historical Society 2009); the year-round population in 2003 was 3,803 (Northwood Master Plan 2004).

The “Concord to Portsmouth Turnpike” (Route 4) was built around 1800. For the next two centuries the Town’s fortunes fluctuated, mostly due to forces beyond its control. At various times lumbering (especially white pine), shoemaking, and poultry farming were important economic activities in town. According to an account in Bailey 1992, farmers in the 1800s considered Northwood “a hard town for farmers. Its soil was cold and stubborn.” More recently tourism and serving commuters are key economic drivers. The Coe-Brown Northwood Academy, a private secondary school for residents of Northwood, Strafford and surrounding towns, was founded in Northwood in 1867.

Settlers built homes and farmsteads along Old Mountain Road on the southeast side of Saddleback Mountain beginning in the late 1700s. The slopes were cleared for pasture and some crops. The slopes and summits were explored for game and blueberries. Trees were cut for lumber and firewood. Saddleback Mountain was said to be “the first land that a sailor would sight when coming into Portsmouth Harbor” (Hill and Sargent 1991). Saddleback Mountain was clearly an important feature in the early days of settlement by the “mountain-minded” people (Hill and Sargent 1991).

Old Mountain Road, which extends in a nearly straight line from Route 43 to Blakes Hill Road, laid out in 1803, was believed to be an old Indian trail (Hill and Sargent 1991). Northwood has designated much of Old Mountain Road as a Class VI Road, subject to gates and bars. Mountain Avenue, now known as Route 43, was built in 1893 (Bailey 1992).

Today there is only one house on the Class VI portion of Old Mountain Road. No other houses or other structures remain, except for some old foundations and stone walls. Bailey (1992) includes a map showing the location of grave markers of early settlers; several are along Old Mountain Road as far as Betty Meadows. Burt (1994) noted that “In the 1800s Mountain Road was heavily used and served many houses...Some of the area on both sides of Mountain Road was farmed, and the land not farmed was pastured.”

On the west side of the NALMC neighborhood, the first road to Blake’s Hill (named for an early settler family) was laid out in 1774. Winding Hill Road was built in 1777. The oldest house still remaining on

Blake's Hill was built by a Blake. Since 1969 it has been owned by Carl Wallman as part of Harmony Hill Farm (Bailey 1992).

Importance to the Town of Northwood

The 2004 update to the Northwood Master Plan recognized the significance of Northwood as “a hill town at the headwaters of the Lamprey, Isinglass, and Merrimack River watersheds.” The Plan further stated that Northwood is unusual because it does not live downstream from any other community in any of its watersheds. Because the town is hilly and located at the headwaters of several watersheds, there are many sensitive areas and resources in need of protection...”

The Master Plan continues, “The federal designation of the lower Lamprey River as a National Wild and Scenic River continues to play an important role in Northwood. The Northwood Meadows area of Northwood is the headwaters of the Lamprey River. While the designation at this time applies only to the river from the Epping/Lee town downstream to the tidal reaches in Newmarket, this locally initiated federal action has raised awareness of the importance of conserving this valuable resource. There will also be an effort by the downstream communities to work with all communities in the watershed to cooperatively manage the river” (Town of Northwood 2004).

In addition, the Master Plan specifically mentioned that the Town is a member of the Bear-Paw Regional Greenways, a non-profit, grassroots land trust established in the mid 1990s to identify and protect regionally significant lands (Map 4). The Master Plan stated that “Several areas of Northwood are recognized as areas of regional significance.” One of the areas of significance listed in the Master Plan is the Northwood Meadows/Saddleback Mountain Area. The Master Plan recommended “continued efforts to protect land within this area through conservation, as well as through protective ordinances that impose development constraints applicable to this area....,” and stated a “desire to keep any new roads out of the area recognizing existing commitments made by past town meetings regarding the extension of the Class V portion of Mountain Road” (Town of Northwood 2004).

History of Northwood Meadows State Park

Edward Burt provides a wonderful history of the lands that now comprise Northwood Meadows State Park. He begins his story in the 1880s describing rock picking, stone walls built along lot lines, dams and mill sites, foundations, tanning pits, pastures and marsh hay, teams of oxen and horses, logging. He continues his history and remembrance up through his tenure on the land (Burt 1994). Mr. Burt is personally responsible for the creating most of the access roads/trails in the State Park, built by his own hard work and bulldozers when he still owned the land. His son trucked in the gravel for the roads.

Burt (1994) writes that large hardwoods growing on the hillside on the west side of Meadow Lake were girdled and white pines were planted in the 1940s and after. This was the practice at the time when white pine was worth more than hardwoods. According to Burt's accounts, the area around Meadow Lake was heavily logged in the 1940s.

For 23 years Ed Burt spent all his “weekends, holidays, spare time, and money [he] didn't have” on the lands that came to be known as Northwood Meadows State Park. He began acquiring parcels in this area in 1967, accumulating 11 different tracts over the next ten years. Mr. Burt built the present-day road system and created Meadow Lake, using all his own equipment and earth-moving skills. Beginning in the early 1980s he began looking for a buyer for the property, desiring a recreational focus, but most inquiries were for residential developments, which he did not want to see happen on this property. In 1989, the

Burtts began a lengthy negotiation process with the New Hampshire Land Conservation Investment Program (LCIP). On August 30, 1990, the Burtts transferred ownership of their 662-acre property to the State. Northwood Meadows State Park was officially established and opened to the public in 1991.

Public Access and Trails

The most prominent access point to the NALMC region is Northwood Meadows State Park. The parking lot is on the south side of Route 4 about 2.8 miles west of the junction of Rtes. 4/9/43/202 in Northwood, about halfway between Concord and Portsmouth. The parking lot is situated just off a busy Route 4 with space for a dozen or more cars. Although not marked as such, a small parking area for a couple cars is located at the end of the Class V portion of Old Mountain Road on the eastern side of the region (Map 6)

Old Mountain Road

Old Mountain Road is an original town road that bisects the NALMC neighborhood running east from Route 43 west to Winding Hill Road. The approximately 2 mile stretch of the Class VI portion is a non-maintained public road subject to gates and bars. There are no gates at either end so 4-wheel drive motorized vehicles can and do travel the length of this road.

The public can also park at Harmony Hill Farm on Winding Hill Road and walk the NALMC trail or walk along Old Mountain Road. From the south, Saddleback Mountain Road leads from Route 43 north into the UNH property, but a gate prevents motorized vehicles from continuing on. The public can walk from this point onto the UNH lands and continue on into the interior of the neighborhood. Very few of the privately owned lands are posted “no trespassing,” so possibly, if asked, landowners would grant permission to walk across their land.

Woods Roads/Trails

In addition to Old Mountain Road which functions as a pedestrian trail, there are over 5 miles of woods roads, which also serve as trails, within Northwood Meadows State Park alone (Map 6). Other publicly owned parcels and some private lands have additional formal or informal trails. As noted above, Ed Burt built and named most of the woods roads in the State Park. These and other trails in the Neighborhood are described below. All of these trails are open to pedestrians for hiking, x-country skiing, snowshoeing, and mountain biking. The “roads” are also open for snowmobiling and horse-back riding. Motorized bikes and all-terrain vehicles are not allowed on the public lands, except for Old Mountain Road, and are presumably not allowed on private lands except by permission.

Dashingdown Road

This State Park gravel road extends about 2 miles beginning at the Park entrance on Route 4 and runs along the eastern boundary of the State Park to Old Mountain Road. Starting at the Route 4 entrance gate, it is approximately 0.6 miles to the junction with West Road; Dashingdown Road continues straight past a portable toilet and kiosk, continuing another 1+ mile to Old Mountain Road. This junction is marked by a large orange metal gate.

Huckins Orchard Trail

From the Route 4 entrance gate, about 0.2 miles down Dashingdown Road, the white-blazed Huckins Orchard Trail leaves right. This xx-mile trail meanders through a hemlock forest and ends at West Road, just north and west of Meadow Lake.

Handicap-Accessible Trail

The Saddleback Mountain Lions Club created a handicap-accessible trail that leads from Dashingdown Road to Meadow Lake.

West Road

From the junction with Dashingdown Road, West Road runs southwest by the north end of Meadow Lake and then parallels the western side of the lake.

Lake Drive

Lake Drive is a spur road off of West Road that swings down and follows the western shoreline of Meadow Lake.

Lake Trail

This trail begins near the junction of Dashingdown and West Roads. About 100 feet down West Road from the junction, the Lake Trail is on the left. It continues along the east side of Meadow Lake with beautiful views down the lake. A picnic table at a scenic overlook is located on this trail. The trail continues then curves north and descending to the south side of Meadow Lake where it crosses the dam and meets Lake Drive.

Foot Path

A narrow foot leads from the southern end of Lake Drive and meanders along the west side of the Betty Meadows wetland south to Old Mountain Road. It meets the Road just west of where the Lamprey River flows across Old Mountain Road.

Demon Pond Path

Approximately one mile from the junction of Dashingdown and West Roads, a short foot path leads left from Dashingdown Road to Demon Pond. The path entrance is marked by a large, pointed granite rock “standing upright.”

Saddleback Mountain Road/Trail

This is also known locally as the “snowmobile trail.” It begins across from the junction of Dashingdown Road and Old Mountain Road. This road climbs steadily and after 0.7 miles reaches the 1,057-foot summit of Saddleback Mountain on the Parsonage Lot and intersects with the Parsonage Lot pedestrian trail.

Parsonage Lot Trail

Approximately 900 feet east of the junction of Dashingdown Road and Old Mountain Road, the Parsonage Trail heads south, first crossing a small stream, and the slowly climbing to one of the Saddleback Mountain high points. This trail is on the Northwood Town Forest Parsonage Lot and was recently maintained by Coe-Brown Northwood Academy students. Unlike many of the other trails in the region, this trail is a narrow foot path that is suitable for walking, and less suitable for mountain bikes. From the end of the Parsonage Trail, another foot path continues south into Deerfield where it meets up with the Saddleback Mountain Road on the University of New Hampshire Saddleback Mountain property. A view to the northwest was made possible by several view cuts in the 1980s and 1990s.

NALMC 5-Mile Loop Trail

NALMC's first project was the development of a 5-mile loop trail through Northwood Meadows State Park and Harmony Hill Farm, and along Old Mountain Road. This trail, which includes portions of some trails listed above, leads through a variety of wildlife habitats including hardwood forests, early successional habitats, grasslands, mixed forests, and near vernal pools and other wetlands.

Other Cultural Features

In addition to the portable toilet, kiosk, and picnic table mentioned above, the State Park has several fishing piers along the western shore of Meadow Lake. There are few other recreational amenities within the NALMC focus area.

The University of New Hampshire owns and operates a radio tower atop Saddleback Mountain. The Northwood Town Transfer Station is located just east of the State Park on Route 4. The most developed section of the focus area is along Route 4, encompassing the town center, some businesses and residences. The area along and west of Harmony Road and Winding Hill Road is the most populated with rural residences and lakeside homes and camps.

Farms

Harmony Hill Farm was an active farm until about 1994. Owner Carl Wallman raised black angus cattle as breed stock for 25 years. As part of this operation he established and maintained over 70 acres of pasture. Those fields are now maintained as grasslands, primarily to benefit wildlife including grassland nesting birds. At the present time there are no active farms within the ecological assessment focus area. The Harmony Hill Farm grasslands are mowed after July 15th by the Matras Brothers, owners of the original Johnson Dairy Farm north of Route 4.

Chapter 4 Property-Specific Descriptions

Northwood Meadows State Park

The NH Division of Parks and Recreation (within the Department of Resources and Economic Development) developed a 15 year Master Plan for the Park in 1996 (NH DRED 1996). Northwood Meadows was purchased by the State with Land Conservation Investment Program (LCIP) funds, and was assigned to the Division of Parks and Recreation for management. The original vision for the park was to enhance year-round recreational opportunities and promote interpretation and outdoor education.

The 1996 Master Plan summarized the ecological and recreational features and the potential for protection, interpretation, and recreational development. The ecological features highlighted in the Plan are the result of the fieldwork by Sperduto and Sperduto (1996). The forests that dominate the Park uplands are representative of the flora found on the acidic soils and bedrock underlying the uplands of southeastern and south-central New Hampshire. The extensive beaver flowage-wetland system that is known as Betty Meadows and forms the headwaters of the Lamprey River is a central feature of the Park, ecologically and aesthetically. Within the Park's forested landscape are several ecological features of note – 1st order streams that drain to the Lamprey River, moist forests and seepage swamps, black gum basin swamps, talus and ledge areas on steep slopes, and acidic fens. Wildlife occurrences of significance include nesting goshawks, a Blanding's turtle population, and a rich diversity of dragonflies (NH DRED 1996).

Sperduto and Sperduto (1996) documented 255 plant species and 20 different plant community types on the combined state-owned Northwood Meadows State Park and Forest Peters Wildlife Management Area. They also identified several plant communities that they considered to be “exemplary” – those which are uncommon in the state or those which are large and/or pristine. These included black gum swamp, acidic graminoid fen, and seepage swamps, which although small, are relatively uncommon in New Hampshire and these examples were in good condition. They also recognized the beaver wetland complex. Although beaver are common, this is one of the few large, contiguous wetland systems in the region. A majority (166 of 255 species) of the plant species recorded by the Sperdutos were located in wetland habitats, highlighting the significance of these interconnected and intact wetland systems.

The 1996 Master Plan recommended that reserve areas be identified within the Park where natural processes prevail and harvesting and development activities occur outside a reasonable buffer. The Plan suggested that the reserve area could include the exemplary natural communities and one to several adjoining sub-watersheds that contain various upland and wetland characteristics of the Park. This would include all wetlands and water bodies including seasonal streams and pools.

The Master Plan provides a detailed assessment of the existing road and trail network. A major emphasis in the plan was to create a “trails park,” along with camping, boating, swimming, and other related recreation. The 1996 Master Plan has yet to be implemented. A few years ago the Park was de-staffed and a gate erected at the entrance to prohibit motorized, wheeled vehicles. The Park remains extremely popular for hiking, running, dog-walking, mountain biking, fishing, snowmobiling, snowshoeing, and other pedestrian outdoor activities. The lack of infrastructure and routine mowing and other maintenance in many ways has created a unique park experience and allowed vegetation to reclaim some areas, as seen alongside the gravel roads.

The NH Council of the Telecom Pioneers has been active in the Park with many volunteer activities including periodic clean-ups, brush clearing, maintaining fishing piers, and plantings near the park

entrance. Recently a new handicap accessible trail north of Meadow Lake was completed by the Saddleback Mountain Lions Club. The Crank Pullers Snowmobile Club routinely maintains trails within the Park, and in particular spent a lot of time clearing trails from recent winter ice storm damage. Volunteers and visitors seem to be keeping the Park free of trash.

The Division of Forests and Lands has a general mission and stewardship goals and a management overview for properties under their stewardship responsibility, including the State Park. They use several publications such as “Good Forestry in the Granite State” and “Best Management Practices for Forestry” as guidelines for their management. NH Fish and Game and the Division of Forests and Lands work closely together to manage properties; all ecological concerns are addressed before any activities occur on state land. Before any projects take place a written letter is sent to all abutting landowners of that state property. Landowners have 3 weeks in which to provide input before any on the ground work takes place (Bryan Comeau, NH Division of Forests and Lands, personal communication).

In 1993 and 1994, the NH Division of Forests and Lands conducted a forest stand inventory of the State Park and Forest Peters WMA. Although no overall management plan has been prepared for either property, the Division of Forests and Lands implemented a forest harvest in 2007 to create 8 acres of wildlife openings. A 6-acre opening north of Old Mountain Road reclaimed an old pasture, and will be maintained as an upland opening for soft mast-producing shrubs. Maintenance techniques will include prescribed burning on a 3-5 year cycle if funding and personnel are available. A 2-acre opening was centered on an existing log landing and borrow pit used by Ed Burt when he created the road system.

The State Park is open to public use, including snowmobiles and horses. It is closed to all other motorized vehicles. For special events, such as the July 11, 2009 Discovery Day, the gate is open and vehicles are permitted to use some roads.

Forest Peters Wildlife Management Area

The 456-acre Forest Peters Wildlife Management Area (WMA) is owned and managed by the New Hampshire Fish and Game Department. The State purchased this property on September 10, 1991 from Pearl I. Peters and Seth F. Peters. It has 1,600 feet of frontage on the Class VI Old Mountain Road and 9,000 feet of frontage on Winding Hill Road, a Class V gravel town road. The Lamprey River flows 7,700 feet through the WMA.

The State has not done any management on Forest Peters since the acquisition in 1991. NH Fish and Game in collaboration with the NH Division of Forests and Lands and the U.S. Forest Service will implement a series of cuts in 2009 to enhance wildlife habitat and to initiate a 10-year study of hemlock woolly adelgid.

Based on the 1993-1994 forest stand inventory, the WMA was identified as having approximately 60 acres of wetlands, an additional 50 acres as inoperable or inaccessible for management, and 48 acres are being set aside for the hemlock woolly adelgid research. That leaves 250 acres available for forestry and habitat management. Generally, these state lands are managed on a stand-by-stand basis over a long-period of time (such as 100+ years).

The state’s management prescriptions take into account that habitat structure composition in the surrounding landscape. Given the lack of early successional habitat in the landscape, they have planned several clearcuts to create 25 acres of early successional habitat for wildlife to be completed in Fall 2009. In another 15 years an additional 25 acres will be regenerated. At that time the original acreage regenerated will be in a sapling stage while the newly regenerated area will be in a seedling stage. Cutting

cycles like this will occur over the 105 year rotation within the 250 acres to eventually reach the final forest structure goals. The 48 acres of hemlock involved in research will remain in that use for a period of at least 10 years. The goal of the habitat management is a balance of young forest habitats, pole-timber, sawtimber, and old growth forest throughout the property.

Forest Peters is open to dispersed pedestrian recreational activities. There are no formal trails so snowmobiling is only allowed where there is no damage to vegetation, and all-terrain vehicles are prohibited.

University of New Hampshire Saddleback Mountain

The 277-acre UNH Saddleback Mountain property is located at the end of Saddleback Mountain Road, which is accessed off Route 43, 4.6 miles south of Route 4 in Deerfield, New Hampshire. After 0.5 miles on Saddleback Mountain Road, the UNH property begins. The road continues as a dirt road, closed to unauthorized vehicles beyond. Pedestrian traffic is welcome. The road continues through the UNH property, ending at a New Hampshire Public Television broadcast tower atop Saddleback Mountain. A private landowner also uses this road to reach their home on land that abuts the radio tower. A walking trail continues on to Northwood's Parsonage Lot. All-terrain vehicles, snowmobiles, horses, fires, and camping are not permitted.

UNH's Saddleback Mountain straddles the Deerfield/Northwood Town lines. Most of the property boundaries are marked by stone walls. To the north and west the UNH land abuts the Northwood Town Forest Parsonage Lot, Northwood Meadows State Park, and Forest Peters WMA. Charles M. Dale deeded this property to the University in 1958.

A forest stewardship plan was completed for this property in 2004 (Perron 2004). The plan stated the following four stewardship goals that guide the management of this property:

- To advance undergraduate and graduate education
- To facilitate basic and applied research
- To extend university research findings to the general public
- To raise revenue from extraction of renewable resources, including timber

Previous timber harvests have provided revenues to support the UNH Office of Woodlands and Natural Areas, which manages Saddleback Mountain and other UNH properties. The purpose of the 2004 stewardship plan was to provide better information on the biological and physical features of the property that could then inform future education, research, and outreach activities.

This property is 98% forested; a mix of white pine, hemlock, oak, and other hardwoods. Sugar maple and black birch seem more abundant here than on other lands within the region. The remaining two acres are wetlands—three small wetlands in the northwest region of the property: a forested wetland, a scrub-shrub wetland, and a shallow marsh. The property has stonewalls throughout, indicating a history of cleared land and pasture, probably prior to 1850. The soils are well-drained and stony. The terrain is steep and rugged in places (Perron 2004).

Northwood Town Forest

Northwood designated Town Forests in 1989 (although the town acquired these parcels much earlier), with management responsibilities delegated to the Northwood Conservation Commission. Town objectives are to manage for a productive woodlot, which includes upgrading access road, control pests and invasive species, protect wildlife habitats, and improve and maintain low impact recreation.

The Northwood Town Forest consists of four separate parcels: Parsonage, School, Giles, and Deslaurier. Two of these town forest parcels are within the focus area; the 186-acre Parsonage Lot and the 29-acre Deslaurier Lot. Charlie Moreno, a licensed forester, completed a forest management plan of the Town Forest for the Conservation Commission in 1990. The Town hired another forester (Robert Graves III) to update the Plan in 2009.

The 186-acre Parsonage Lot parcels lies on the western slope of Saddleback Mountain and has 1,000 feet of frontage on the Class VI portion of Old Mountain Road. A narrow foot path starts at Old Mountain Road and ascends to over 1,000 feet to a scenic vista with views to the northwest that were enhanced with several view cuts made in the 1980s and 1990s. The 1990 Forest Management Plan by Charlie Moreno noted that the Parsonage Lot was still recovering from previous heavy cutting, most recently in the 1960s and 1970s. The boundaries are well marked by stonewalls; the lines were painted in 1990.

Access for forest management would be via Old Mountain Road, which is in poor condition with ruts and erosion. Saddleback Mountain Road is private and leads to the property from the south. An old logging road along the western half of the property would need to be upgraded for management access. Steep slopes and stream crossings add cost to woods road construction or upgrade. The dominant tree species on the Parsonage Lot are red maple, white pine, hemlock, white birch, yellow birch, and red pine with a mix of other hardwoods (Moreno 1990). Much of the forest is 50-75 years old; however several pockets of older growth (100-150 year old trees) in areas with steep topography or other limitations that prevented logging. The latter include a small (2 acres) stand of hemlock (Graves 2009). Most of the town forest lands were pastured at one time (Moreno 1990a).

The Parsonage Lot hosts the beginning of two headwater streams. Bear Brook begins high up on the side of Saddleback Mountain on the Town of Northwood's Parsonage Lot. It flows northwest through the southern region of the State Park, and onto the Forest Peters WMA where it drains into the Lamprey River. Parsons Brook (named by Burt 1994) originates from the northern, lower slopes of Saddleback Mountain, draining down to Old Mountain Road, crossing back and forth along Old Mountain Road, before reaching the Betty Meadows wetland. Several small beaver flowages are associated with this stream on the Parsonage Lot.

The 29.8-acre Deslaurier Lot is located east of the Parsonage Lot, on the south facing slope of Saddleback Mountain. The Lot is quite inaccessible as it has no direct access from any road. The boundaries are not well-documented. Both the 1990 and the 2009 forest management plans recommended no active management at this time given the difficult access. The Lot supports a high proportion of red oak, along with white pine and red maple. The forest is 35-65 years old; the youngest is a stand that was heavily cut 35 years ago. A small wetland supports black gum trees.

So far none of the logging on the Town Forest has been according to a forest management plan as there has been no harvesting since the first Plan was written by Moreno (1990a). The Town is currently interviewing licensed foresters to implement the forest management plan.

Other Town Lands

The Town of Northwood owns several other parcels within the focus area. Two 9 to 10-acre parcels are located on the western side of the focus area, each with frontage on Blakes Hill Road/Winding Hill Road). Both support some important wildlife habitats and plant communities, including upland forests and peatlands.

Coe-Brown Northwood Academy

Charlie Moreno completed a forest management plan in December 1990 for the 51-acre Coe-Brown Northwood Academy “Meade Lot” that abuts Northwood Meadows State Park on the eastern boundary (Moreno 1990b). The Meade Lot is landlocked without any direct access to a public road, although the western and southern borders are close to the State Park’s Dashingdown Road. The property is well-marked by corner granite monuments and the boundaries were recently blazed. There are no trails and the only access is through the State Park, which is closed to vehicles (except for management).

The dominant tree species are red oak, red maple, hemlock, and white pine, with a mix of other hardwoods including beech, paper birch, black birch, and aspen. The Lot was heavily cut in 1957, although a stand of red oak was left intact. The Coe-Brown land has some significant beaver-influenced wetlands, including a portion of Demon Pond, and headwater streams that flow into Meadow Lake.

Harmony Hill Farm

The 211-acre Harmony Hill Farm is located on both sides of Blakes Hill Road/Winding Hill Road with some frontage on Harmony Road. The Farm is located at the height of land, between 620 and 733 feet. The parcel west of Winding Hill Road is within the headwaters-Lamprey River sub-watershed. The 116-acres north of Winding Hill Road and east of Harmony Road are mostly within the Merrimack River watershed.

For 25 years the owner Carl Wallman raised black angus cattle as breed stock. When he bought the farm in 1969 there were only 13 acres of open fields. He created and maintained another 55 to 60 acres for hayfield and pasture, with cost-share assistance from the Soil Conservation Service (now known as the Natural Resource Conservation Service-NRCS). Carl sold most of the cattle in 1994, and now maintains the openings as grasslands and other habitats primarily to benefit wildlife. In 1989, he cleared two areas— 24 acres and 7 acres—with the intention of creating more hayfields and pasture. Time passed and in 2002, after he sold the cattle, Carl obtained a Wildlife Habitat Incentive Program (WHIP) grant from the NRCS to cut-back the 7-acre opening to create a blueberry barren and to create patches of young, regenerating forest in the 24-acre cut.

On December 31, 2001 Carl conveyed a conservation easement on 116 acres of the Farm to the Society for the Protection of New Hampshire Forests. The purpose of the easement was to protect a majority of the land from development in perpetuity and to preserve the natural habitats and native species that occur on the property. On December 30, 2004 the conservation easement deed was expanded to include a total of 164 acres and some provisions of the deed were updated. These conservation easement deeds can be viewed online at the Rockingham County Registry of Deeds. See Book 3701 Page 2592 and Book 4418 Page 0496.

In 2002, Carl engaged Rick Van de Poll of Ecosystem Management Consultants to prepare a habitat assessment of the 211-acre farm. Van de Poll (2002) identified 21 habitat types on the property. These

included the habitats around the house and garden; 72 acres of open fields; pastured woodland; wet meadow, hedgerows, cleared woodland/blueberry barrens; young forest (“cleared shrub-sapling meadow”); mixed hardwoods; mixed woods; pine forest; hemlock forest; and 11 wetland types. The wetlands, which included a black gum swamp and basin swamp forest, were identified as significant habitat areas by Van de Poll (2002) (Map 5).

Harmony Hill Farm has perhaps the greatest diversity of habitats of any ownership within the focus area. In addition, several nearby landowners also maintain grasslands or croplands, which create a complex of “early successional habitat.” The large block of grassland supports many pairs of nesting bobolinks. This habitat type is becoming uncommon in the state.

Given that this is the largest area of open land in the entire ecological assessment focus area it is not surprising that Harmony Hill Farm also has the most invasive plant species compared to other lands within the region. Invasive are adapted to disturbed areas and birds easily move the fruits and seeds around edge habitats (edges of fields and woods). Van de Poll (2002) documented several invasive plants on the Farm including autumn olive and multiflora rose across the road from the farmhouse; Japanese and European barberry were found along Blakes Hill Road; hedgerows of bush honeysuckles occur in around the grasslands. Oriental bittersweet was detected during a site walk as part of this 2009 ecological assessment. Since 2006, the Coe-Brown Northwood Academy student environmental group, the Young Environmental Advocates, have helped remove invasive plants on Harmony Hill Farm.

Chapter 5 Opportunities for Collaborative Stewardship

The Northwood Area Land Management Collaborative has a wealth of collective knowledge, experience, and interests among the state, community, and private landowner participants. This generates constructive debate and promotes creative thoughts. This “community capital” can be tapped to help understand and implement best practices for land stewardship, both individually and collectively. Taken together and over time these actions will help protect the shared values for the region.

The following recommendations are intended to generate more conversation and to serve as a springboard for further collaborative efforts. These ideas stem from the results of the ecological assessment described in Chapters 1-4. They are grouped in the following categories:

- Environmental Stewardship
- Habitat and Forest Management
- Recreation, Education, and Interpretation
- Land Conservation

Environmental Stewardship

Chapter 2 highlights several aspects of “environmental health” that are pertinent to the NALMC region. These include water quantity and quality, erosion, air quality, presence of forest pests or invasive species. These issues transcend individual properties and in some cases impact or are impacted by areas well beyond the NALMC neighborhood. NALMC’s location within the headwaters of three major sub-watersheds encompassing a nearly 4,000 acre unfragmented block of habitat accounts for the region’s relatively good environmental health. However, there are pressures, such as development, invasive species, air pollution, and climate change that are or will affect the region’s environmental health. NALMC can help monitor and perhaps minimize or prevent degradation, and in some cases enhance the health of the environment.

Here are three potential areas for NALMC involvement and/or leadership:

Water Quality Monitoring

Little water quality data is available from the NALMC neighborhood, perhaps because it is assumed that because it is high in the watershed and development is minimal that the water quality is good. Several groups are involved in water quality monitoring and research in the Lamprey River watershed. The Lamprey River Watershed Association (LRWA) coordinates a **volunteer water quality monitoring** program for the Lamprey River. Currently there are no monitoring sites within the NALMC neighborhood. To become involved contact the LRWA at www.lrwa-nh.org.

The University of New Hampshire conducts research using the Lamprey River Hydrologic Observatory (see www.wrrc.unh.edu/lrho/about.htm) as the study area. Research is being conducted in the Lamprey watershed by a multitude of researchers; some of whom are initiating research on the upper Lamprey River in the NALMC neighborhood. Research findings have been presented at UNH annually with the LRWA co-hosting the event. Although intended as a researcher-to-researcher event, valuable information can be gained by those with shared interests in the watershed. NALMC could propose follow-up events such as hosting evening educational programs in Northwood and invite one or more speakers from this research team. NALMC could consider a lead role in this event, including ideas for topics and speakers that address issues of interest to NALMC. This might include land management around headwater streams, invasive species control, and creating trails that are sensitive to the habitats and waterways.

A subcommittee of the Lamprey River Watershed Association is preparing a nomination of the Lamprey River for designation in the **NH State River Management and Protection Program**. A small stretch (in Lee and Durham) is currently designated in the state program. NALMC can help support this nomination by endorsing the effort as a group and by encouraging the Town of Northwood to support the designation.

Invasive Species and Forest Pests

Invasive plant species have become one of the most challenging management issues facing landowners and land managers. Fortunately the NALMC neighborhood is relatively free of invasive plant species and forest pests. However, there are some, and this is a management issue where collective action is important and useful. NALMC is already involved in the **hemlock woolly adelgid** issue via the research that is to embark on Forest Peters WMA this fall. In addition, all landowners within the neighborhood can be surveying hemlock trees to monitor for the arrival of this insect pest. The adelgid was documented not far in Epsom in recent years, so a watchful eye could help stem the spread. The NH Division of Forests and Lands has lots of information available on this and other insect pests.

Eleven state and federal agencies and nonprofit organizations formed an alliance called the **Coastal Watershed Invasive Plant Partnership** to work collaboratively on invasive species control. The mission is *to protect the ecological integrity of natural habitats and economic vitality of managed lands in New Hampshire's coastal watershed through activities that reduce the threat of invasive plants*. Some members of NALMC may be members of this Partnership. For more information see <http://des.nh.gov/organization/divisions/water/wmb/coastal/cwipp/index.htm>.

NALMC could host a **field workshop** on invasive plant identification and control. Thereafter NALMC could form a corps of volunteers willing to annually monitor (or as they walk trails) invasive species. Landowners could assist each other with control efforts. Since few invasive plants have become established thus far, it is a good opportunity to control those plants that are growing in the neighborhood. In other words, NALMC could be very effective at removing existing plants and preventing new infestations. Once established, large infestations of invasive species are very difficult to control. The LRWA is conducting a pilot project on eradicating Japanese knotweed, an invasive plant found along many stretches of the river downstream from the NALMC region.

Erosion

Within the NALMC region, erosion is primarily an issue associated with some trails and roads. In particular, the **Class VI portion of Old Mountain Road** is showing severe signs of erosion. By state statute, a Class VI road is “subject to gates and bars,” meaning that the Town of Northwood can erect gates at either end that would prevent motorized vehicles (except snowmobiles) on this stretch of road. Landowners with frontage would still have vehicle access. When a town designates a road as Class VI, it can no longer invest any town funds in upgrading or maintaining the road. Given these current conditions, the road will likely continue to deteriorate with severe rutting, runoff, siltation, and possibly impacts to downstream water quality.

Several of NALMC's founding participants and a handful of other private landowners have frontage on Old Mountain Road. If this road is needed to access any of these parcels for forest management, then the road may need to be improved for such purposes. Landowners, whether public or private, may assume some liability for that road upgrade. Old Mountain Road is also a key link in the network of recreational trails. It would be beneficial to all involved and interested in this area to begin discussing all the options for restoring, maintaining, or otherwise managing Old Mountain Road, as it will continue to deteriorate over time without some intervention. The group may want to research the feasibility and desirability of reclassifying all or parts of the road as a Class A Trail, which might allow more flexibility in making improvements to the “trail.”

Visit the NH Office of Energy and Planning website to learn more about Class VI Roads (for example see <http://www.nh.gov/oep/resourcelibrary/referencelibrary/c/classviroads/index.htm>). For a definition of Class A Trail see <http://www.gencourt.state.nh.us/rsa/html/xx/231-a/231-a-1.htm>. These classifications can be confusing and any discussions of the Class VI Old Mountain Road may benefit from the NH Municipal Association (see <http://www.nhlgc.org/LGCWebsite/index.asp>).

Habitat and Forest Management

The original idea for the Northwood Area Land Management Collaborative stemmed from several conversations initiated by Carl Wallman, owner of Harmony Hill Farm. Carl wanted to ensure that the wildlife habitat improvements that he was implementing on his Farm complimented the habitats on the adjoining Northwood Meadows State Park and Forest Peters Wildlife Management Area. Carl recognized that his land was not an island unto itself, that wildlife travel across property boundaries, and that few species could be fully supported by the habitats provided on his land alone. This is one of the central themes of the Collaborative—to work together across property boundaries on land management.

The lands within the NALMC neighborhood have a long history of human intervention; some activities were done according to management plans, although most were not. In the last 20 years, more landowners in the area (both public and private) have been gathering more information about their respective ownerships to better guide their management decisions. Ideally this involves thinking ahead to what the future forest would look like under different management scenarios and sometimes it involves looking at what habitats or forest types are missing from the landscape and what is unique within the region.

The implementation of specific management activities, however, is still largely on a stand-by-stand basis within a single ownership. Although challenging, more collaborative land management planning and implementation across boundaries could be a new paradigm for public and private owners working together within a larger landscape. This collaboration could involve discussions about the following concepts:

- What areas could be maintained or allowed to progress to old growth forest conditions, allowing natural processes to affect those areas. Should areas of “ecological reserves” be designated on public ownerships? Are public or private ownerships best able to provide old growth habitat conditions?
- How much early successional habitat is ideal within the NALMC neighborhood and where should it be located to maximize benefits while maintaining other important ecological features?
- How best to protect the water quality and natural community features along headwater streams, and maintain connectivity to downstream wetland habitats?
- What should happen with the Class VI portion of Old Mountain Road given the number of landowners with frontage, the potential importance of this road for management access, the extensive use of the road for recreation, and the current erosion and rutting that is degrading the road?
- Can NALMC encourage landowners to adopt best management practices and follow the guidelines of “Good Forestry in the Granite State” when planning and implementing forest management?

- Can or should NALMC develop some voluntary over-arching management guidelines or plan for the NALMC neighborhood?

Recreation, Education, and Interpretation

Recreation is an important element of the NALMC neighborhood, particularly within the Northwood Meadows State Park. The roads created by Ed Burtt, Old Mountain Road, the Parsonage Lot trail, and the 5-mile loop trail created by NALMC form the core of this trail network that links the State Park to abutting lands. Volunteers, such as the Crank Pullers Snowmobile Club, Coe-Brown Northwood Academy students, NALMC members, and likely many others, are key to maintaining many of these trails.

The original vision for the State Park was to have much more intensive recreational use, at least between the entrance on Route 4 and Meadow Lake. The lack of state funding has resulted in a different experience for visitors, one that is more remote, less developed, and offers a greater opportunity to see and learn about natural habitats, plants, and wildlife. NALMC should play a key role in whatever discussions and ideas emerge for the management of the State Park over the coming decades, especially providing a perspective of the Park within the context of the 4,000+ acre NALMC neighborhood.

As noted in the report by Sperduto and Sperduto (1996), the NALMC neighborhood “harbors a subtle beauty, a variety of communities, and a human history...” worthy of interpretation to enrich visitor experiences. NALMC could advance education and interpretation about the region in several ways.

- Create and erect information kiosks at key entrance points to the region, such as at the east entrance off Old Mountain Road and at Harmony Hill Farm.
- Help create and maintain educational and interpretive materials for the kiosks. This could include a map of the region showing trails and key features; highlights of management activities, public uses allowed and prohibited, etc.
- Develop interpretive signs and/or brochure for one or more trails that describes ecological and cultural/historical features of the NALMC neighborhood. Interpretive themes could include the landscape setting in the upper Lamprey River watershed, history of pastures and woodlots, transition zone between northern and southern forest, dynamic, beaver-influenced and interconnected wetland system and headwater streams, black gum swamps and fens.
- Consider new trails that lead to interpretive sites, such as a boardwalk to Betty Meadows, a trail to one black gum - red maple swamp. These trails should be pedestrian only and be carefully located and designed; consider opportunities to make them handicap-accessible.
- Consider establishing a regular educational workshop series, perhaps an evening once a month. This could be seasonal and involve occasional weekend field trips or coffee house. The Weeks State Park Association in Lancaster, NH has hosted a summer program for many years and offers a nice example; see <http://www.nhstateparks.org/uploads/WeeksSummerPrograms09.pdf>. Topics could include invasive plants, forest pests, early successional habitat, old growth, black gums, beavers, land conservation, dragonflies, water quality, and much more.

- Increase educational materials on the NALMC website such as links about invasive plants, forest pests, Lamprey River Watershed Association and Lamprey River Hydrologic Observatory. Develop a relationship with these groups to encourage and promote in the headwaters region.
- Consider hosting “biothons” or other inventories or research within the focus area. Biothons are one day volunteer events that catalog all the plants and animals on a given property.
- Build on the emerging interest of the Wah-Tut-Ca Scout Reservation in becoming involved in NALMC. The Scout Reservation has a large ownership on the west side of the NALMC region. Multiple potential opportunities exist to partner on land management, building or maintaining trails and other infrastructure, outreach and education, and ecological inventories.

Land Conservation

Regional and local conservation plans all identify the NALMC neighborhood as highly significant, in large measure because it is a large, unfragmented block of habitat that supports the headwaters of the Lamprey River. The Bear-Paw Regional Greenways Conservation Plan, the Town of Northwood Master Plan and Natural Resource Inventory, The Coastal Plan, and the NH Wildlife Action Plan include all or part of this region as a priority for conservation.

Lands are conserved for public benefit through public fee ownership (such as the State Park, Wildlife Management Area, and Town Forest) and through conservation easements on private lands. About 34% of the ecological assessment focus is conserved. Public ownership does not ensure that a parcel is conserved; it depends on the source of funds used for the acquisition and the language contained within the acquisition documents.

Private landowners in the NALMC neighborhood who are interested in learning more about land conservation can look in several places. They can talk with their neighbors who have conserved their land through conservation easements and read the corresponding easement deeds. Bear-Paw Regional Greenways (www.bear-paw.org/) has staff and Board members that meet regularly with individual landowners to discuss land conservation ideas and options. All land conservation is voluntary and is tailored to the needs of the landowner and the entity that a landowner might choose to work with. Sometimes there is a tax benefit to the landowner in conserving their land.

Bear-Paw Regional Greenways served as the fiscal agent for the grant that funded this ecological assessment. A continued relationship between the Collaborative and Bear-Paw would be beneficial in sharing information about voluntary land conservation opportunities and funding sources for land stewardship.

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