TOWN OF CANDIA
NATURAL RESOURCES INVENTORY
AND
CONSERVATION PRIORITIES

Prepared for:
Town of Candia Conservation Commission

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(Maps revised June 2011)

Cover photograph – Large wetland complex associated with a tributary of the North Branch River adjacent to Merrill Road.

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ACKNOWLEDGEMENTS

Southern NH Planning Commission provided data for an up-to-date account of conserved lands in Candia. Don Dollard of Dollard and Associates provided digitized parcel data for our base mapping effort. A special thanks to all participants at the community forums and public presentation. Last but not least, sincere and grateful appreciation is also extended to the Candia Conservation Commission for their dedicated assistance, hard work, and participation throughout the entire course of this project:

Candia Conservation Commission members:

Susan Wilderman, Chair
Elizabeth Kruse, Vice Chair
Ellie Davidson
Debra Levesque
Dennis Lewis
Judi Lindsey
Joe Miele
Richard Snow, Alternate/Treasurer/Selectmen's Rep
Pat Larkin, Secretary

Ed Fowler, previous Chair

INTRODUCTION

Population Growth and Development

Currently, New Hampshire's population is growing at a rate that is twofold that of the other New England states. The population has doubled in the forty years leading up to the turn of the century in 2000, and there was a rise in population of 17.2% between 1990 and 2004 alone. This rate of growth is followed by VT (10.4%), RI (7.7%), ME (7.3%), MA (6.7%), and CT (6.7%). Furthermore, it has been projected that the state will experience an increase of 23% from 1997 to 2020. New Hampshire's development pressure will tax the state's natural resources if not managed with diligence.

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

Natural Resources and Conservation Planning

One of the first steps in planning for growth and development is to conduct a natural resources inventory (NRI). This effort helps to better understand what natural resources are within a town and where they are located. As such, an NRI is simply a list and description of the natural elements found within and adjacent to a town (or even a watershed or larger region). These can include such elements as wetlands, lakes, rivers, forests, wildlife, plants, and soils. These data can be created from using existing sources or from more detailed studies that have been developed over time.

New Hampshire statues mandate that communities shall create an NRI. This is generally the responsibility of Conservation Commission, whose purpose is "for the proper utilization and protection of natural resources and for the protection of watershed resources" of the town. In particular, RSA 36-A:2 continues to state that "Such commission shall conduct researches into its local land and water areas [and] … shall keep an index of all open space and natural, aesthetic or ecological areas within the city

or town … with the plan of obtaining information pertinent to the proper utilization of such areas, including lands owned by the state or lands owned by a town or city. It shall keep an index of all marshlands, swamps and all other wetlands in a like manner…"

An NRI can serve as the basis for developing a conservation plan from which innovative land use planning can be adopted for the protection of various resources, including habitats and biological diversity. Biological diversity, or biodiversity, refers to the variety, variability, and complexity of life in all its forms and includes various ecological processes (e.g., nutrient cycling, flooding, fires, wind events, and succession) that have helped to shape them over time.

Biodiversity includes various levels of ecological organization such as individual species and their genes that have evolved over time, as well as the many intricate plant and wildlife populations. It refers to even higher levels of organization including the assemblage of ecological communities and even entire ecosystems, such as wetlands, woodlands, and rivers. Therefore, the concept of biodiversity engenders all levels of biological organization and the interactions of all living organisms within their physical environments (e.g., bedrock, soil, and water). It is at the heart of this understanding of the dynamics of biodiversity that we seek to develop protection strategies, helping to ensure a healthy environment for humans, as well as all other life forms.

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

This form of land use planning is not a static directory but one that is ever-changing. It is a vision that should be based on the principles of conservation biology and incorporates the current ecological structure of a given area (e.g., a town, a watershed, or an entire region). Thus, conservation planning strives to incorporate the socio-economic fabric of our world with that of the ecological structure. This effort can help build more

sustainable, more resilient New Hampshire communities into the future as a result of implementing comprehensive land use planning that includes our natural environment and built infrastructure.

The need for this type of informed land use planning is becoming more evident. Ecosystems and their constituents have long been susceptible to long-term degradation from overexploitation and misuse of natural resources. This has led to a precipitous decline in several species, some even resulting in extinction altogether. It has also led to the loss of critical habitats. While the past few decades certainly have seen a positive change in resource management and protection, there has been a distinct rise in conservation planning efforts within this past decade, especially in New Hampshire.

Statement of Purpose

The Candia Natural Resources Inventory (NRI) and Conservation Priorities project was initiated in October 2009. The purpose of this project was to conduct baseline research, mapping and analyses on existing natural resources data to update the Natural Infrastructure section of the 2004 Candia Master Plan and provide basic guidance for open space planning. The overall scope was to craft an updated NRI that identifies basic conservation priorities to be used in proactive town-wide planning and educational purposes, affording an opportunity to blend our local and regional socio-economic fabrics with that of its ecological structure.

The main goals of this project were to: 1) solicit involvement through community outreach and engage residents in two open forums to address issues of growth and development in Candia, 2) map significant natural resources using the most up-to-date, readily available data in combination with basic data refinement using aerial photography interpretation, 3) analyze natural resources data to determine conservation focus areas, 4) present the findings of the project at a public informational session, and 5) prepare a final report with NRI maps and basic recommendations for future conservation planning initiatives.

Community Outreach and Education

In cooperation with Moosewood Ecological, the Candia Conservation Commission held two community forums to engage the town's residents into the public planning process. The first was held on November 5, 2009. This forum introduced the overall project background to the community, including the goals of each of the components. It also facilitated a discussion on growth and natural resources protection. This discussion focused on identifying the strengths and challenges of Candia's natural resources and its working landscape, as well as began to list some of Candia's most significant natural areas. The results of the community forum are located in Appendix A.

The second forum was held on June 15, 2010. It provided an update of the project, including the results of the first community forum. The evening then continued with the theme of growth and natural resources protection. This included discussions that centered on identifying the natural resources that are most important to Candia and which natural resource topics would participants like to learn more about. Some of the topics to learn more about included the importance of water resources, geocaching as a means to attract families into wild areas, gardening for wildlife, regional biodiversity and its significance in Candia, wildlife habitat management, and the overall importance of natural resources in general. This discussion was then followed by an exercise that ranked natural resources for protection. The results of the ranking exercise were used in the co-occurrence analysis to assist with prioritizing areas for conservation (see Table 1, p.13).

To assist in finalizing the project, a public presentation was held on August 17, 2010, to discuss the findings of the NRI. Topics included water, ecological, agricultural, and forest resources, as well as general conservation focus areas identified for Candia. The many uses of an NRI were also illuminated during the presentation.

Review of Existing Information

A variety of existing reports, maps, and other information were consulted for the project, especially to assist in the identification of conservation focus areas (CFAs). These materials also assisted in gaining a better understanding Candia's landscape and

the region in which it resides. The following documents were reviewed during this project:

- Town of Candia Open Space Plan (2001)
- Kinnicum Pond and Moose Meadow Natural Resources Assessment (2002)
- Proposed Priority Lands for Conservation in Candia (2001)
- Raymond and Candia Headwaters of the Lamprey River (2001)
- North Branch River Natural Resources Assessment (1999)
- Forest Management Plan for the Candia Town Forestlands (2004)
- NH Wildlife Action Plan (2005; 2010 revised)
- Bear-Paw Regional Greenways Conservation Plan (2008)
- Land Conservation Plan for NH' Coastal Watersheds (2006)
- Candia Master Plan (2004)

In addition, close communication with the Southern NH Regional Planning Commission (SNHRPC) was established in the beginning of this project. This was an essential part of the process as we transitioned from the development of the NRI into the drafting of the open space plan by SNHRPC. Joint presentations to the community also aided in this transition.

Candia's Physical Landscape Setting

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

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

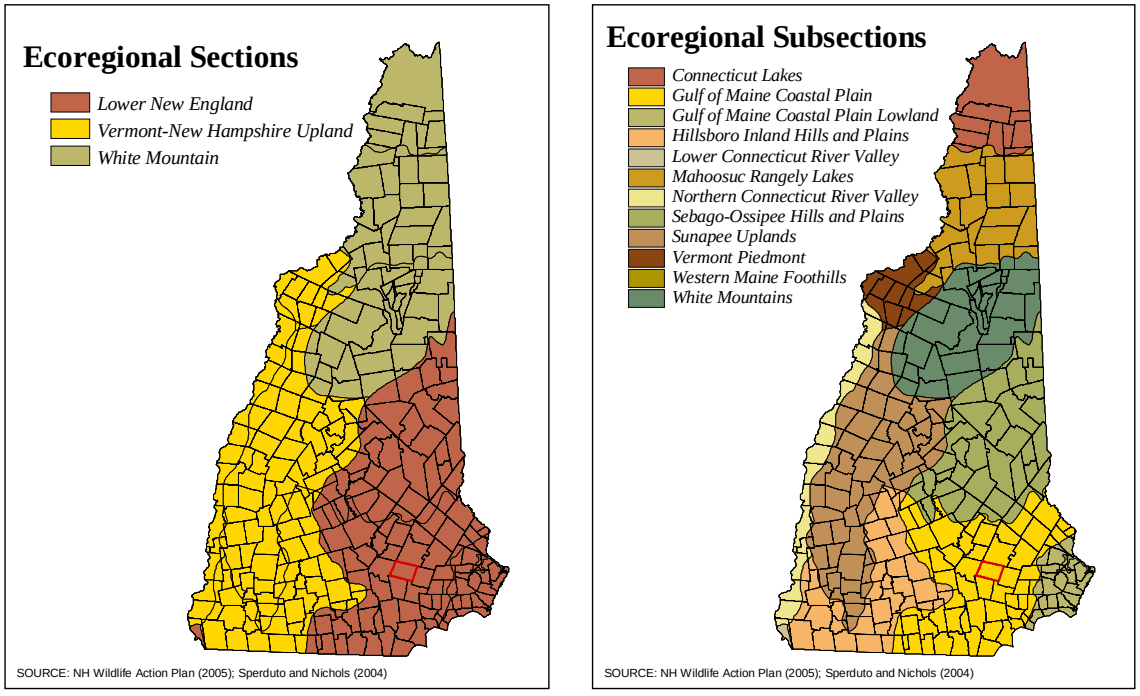


Figure 1. Ecoregions of New Hampshire. These maps show the distribution of ecoregional sections (*left*) and subsections (*right*) and how the town of Candia (outlined in red) fits into this big picture. Moosewood Ecological LLC.

The town of Candia can be viewed from a watershed perspective as well. It straddles two major watershed groups, including the Tidal and Non-tidal Coastal watersheds (Figure 2). These watersheds provide a broad-scale, comprehensive approach for the protection of aquatic ecosystems and were used in developing the New Hampshire Wildlife Action Plan (2005). These two groups represent the dividing line between the

Merrimack River and the Piscatiqua River watersheds. These watersheds will be refined into smaller units in the *Water Resources* section below.

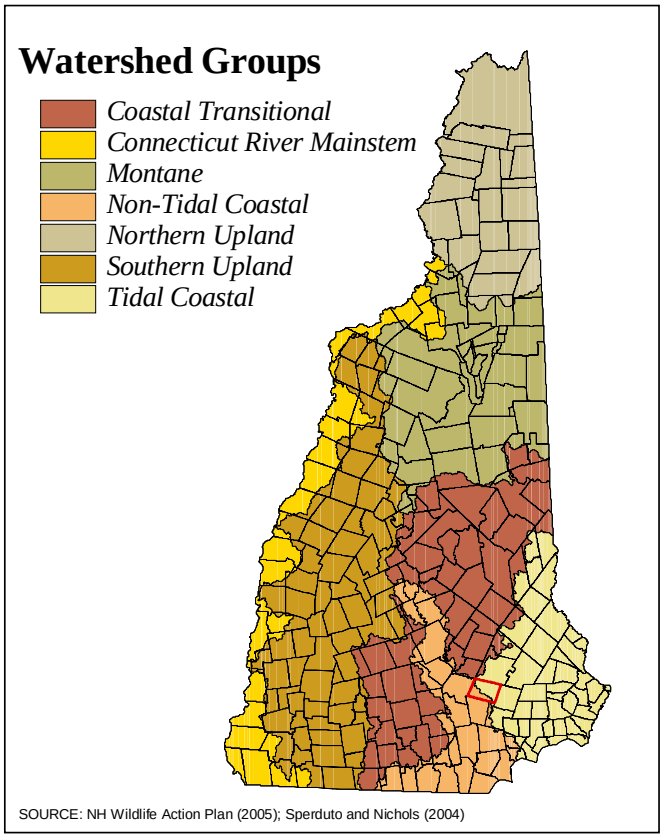
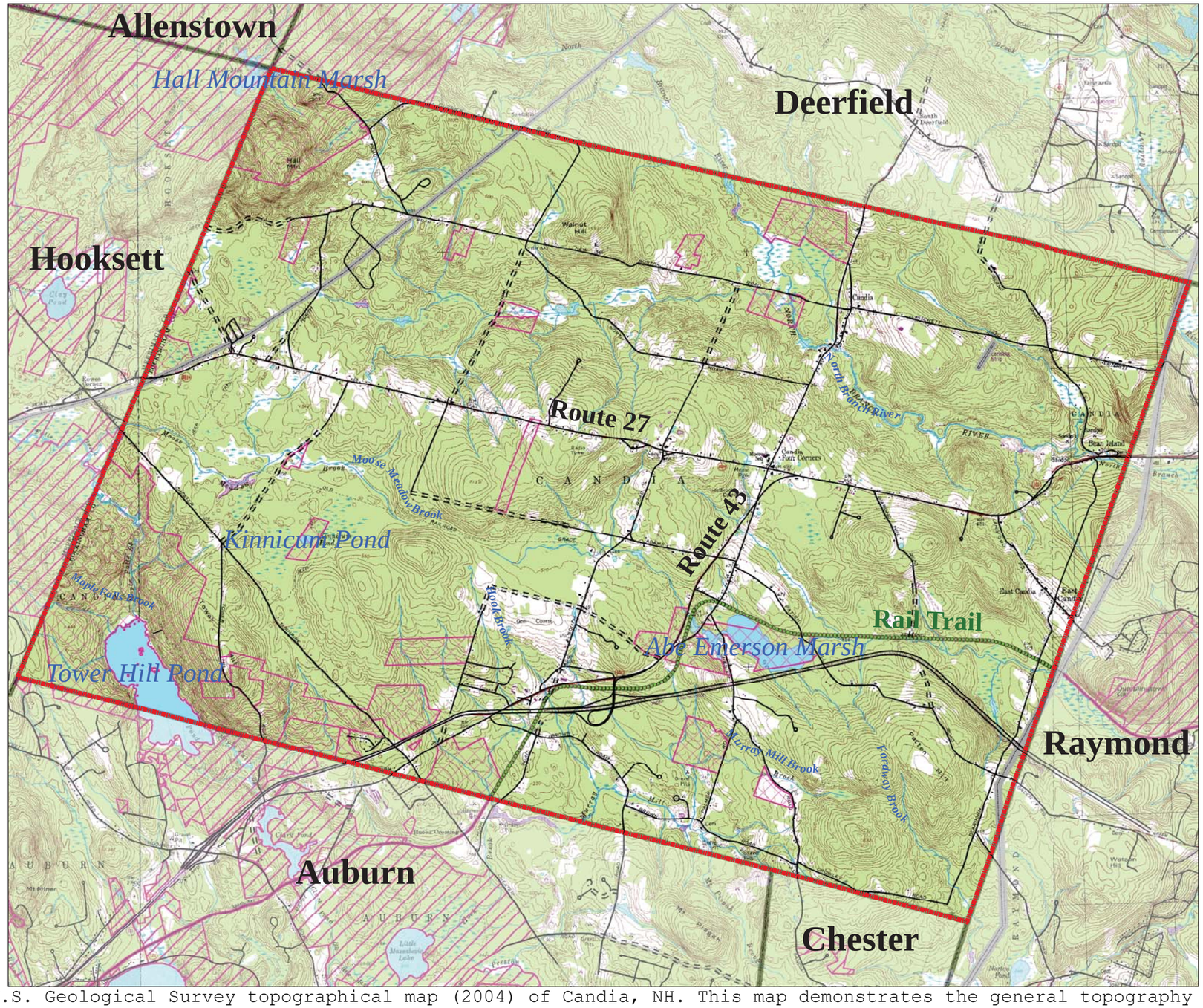


Figure 2. Major watershed units of New Hampshire. This map shows the distribution of major watershed groups and Candia's (outlined in red) relationship to the Connecticut River Mainstem watershed. Moosewood Ecological LLC.

Candia covers approximately 30.6 square miles, or 19,557 acres, of mostly forested and hilly terrain (Figures 3 and Figure 4). Its topography is highly variable, ranging from approximately 200 feet along the North Branch River to 941 feet atop Hall Mountain in Bear Brook State Park. As such, the landscape is further characterized by the rolling hills of Tower Hill, Patten Hill, and Walnut Hill. Extensive wetland systems grace sections along the North Branch River and its tributaries, as well as Moose Meadow Brook and Murray Hill Brook. These varying landforms offer great diversity for wildlife and plant communities alike.

The Parcel Base map (Figure 5) provides an opportunity to better understand how Candia's landscape has been parcelized. The parcel base map demonstrates the relative size and distribution of lots throughout the town. This data can be very informative when helping to identify conservation focus areas (CFAs). To better understand acreage and ownership, as well as tax parcel and lot number, refer to the paper maps located in the Town Office.

Candia Natural Resource Inventory
Topography Map



- Candia Boundary
- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- Streams
- Conservation and Public-owned Lands
- Conserved Lands in Adjacent Towns

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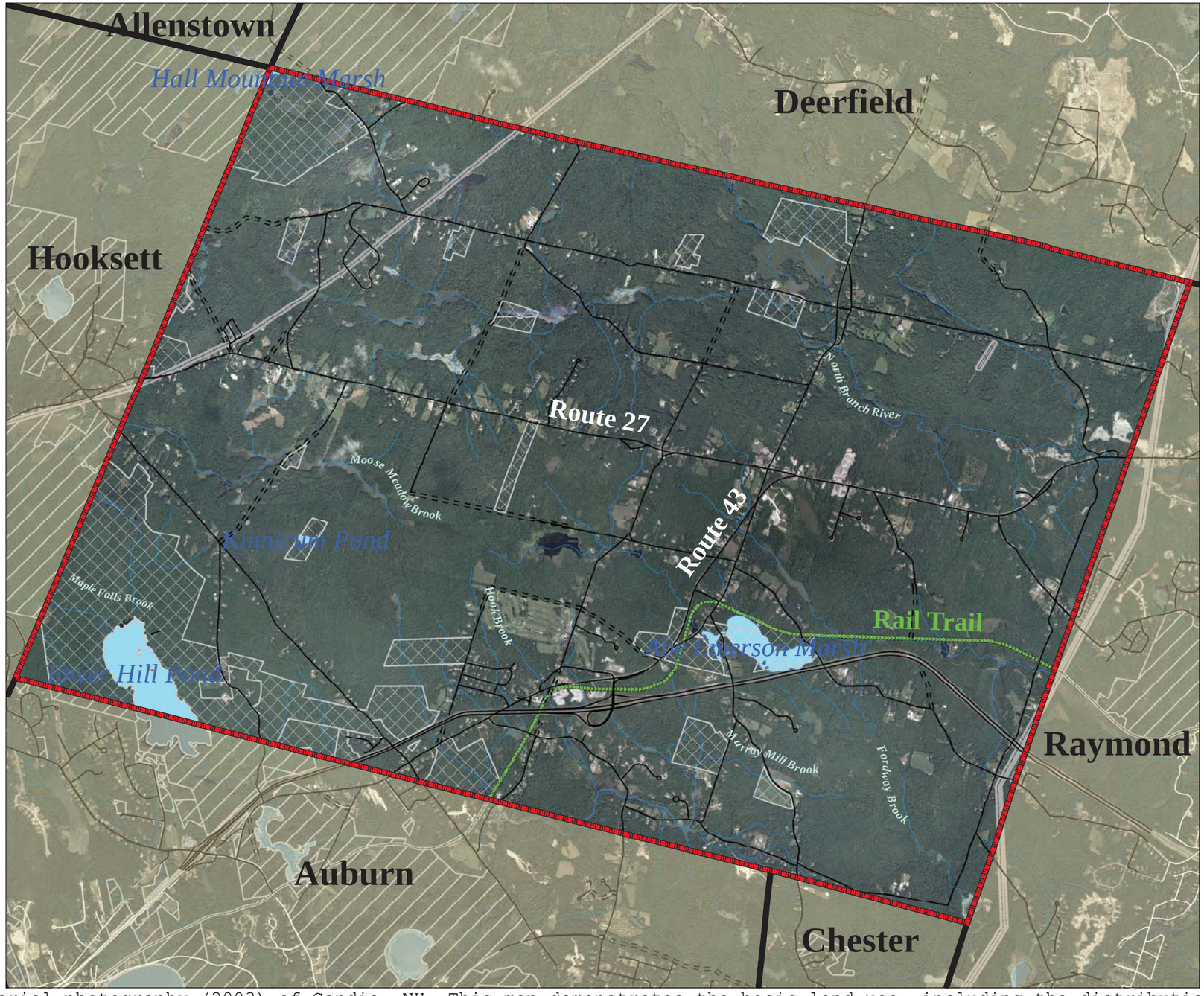
Latest Map Revision: June 29, 2011

Figure 3. U.S. Geological Survey topographical map (2004) of Candia, NH. This map demonstrates the general topography and general land use, including the distribution of transportation systems, general developed areas, conserved and public-owned lands (pink hatching), ponds, lakes, streams, and larger wetlands.

Candia Natural Resource Inventory
Aerial Map



- Candia Boundary
- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- Streams
- Conservation and Public-owned Lands
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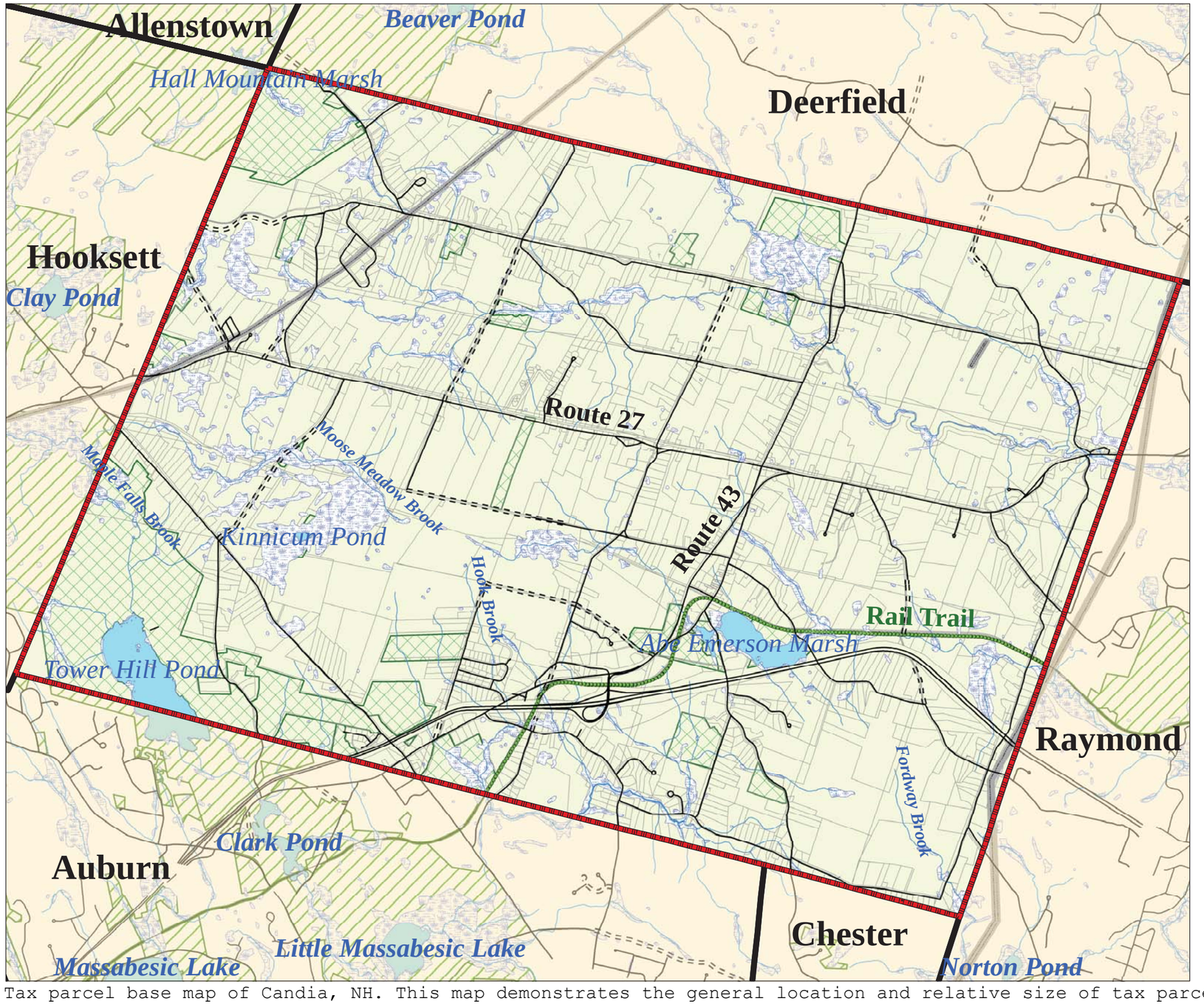
Figure 4. Aerial photography (2003) of Candia, NH. This map demonstrates the basic land use, including the distribution of transportation systems, developed areas, conserved and public-owned lands (grey hatching), fields, forested areas, ponds, lakes, streams and larger wetland systems.

Candia Natural Resource Inventory
Parcel Base Map



- Candia Boundary
- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- Streams
- National Wetlands Inventory
- Town Parcels
- Conservation and Public-owned Lands
- Conserved Lands in Adjacent Towns

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CANDIA NEW HAMPSHIRE

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Map is to be used for planning purposes only. This is not a survey map. Accuracy of data to be verified by end user. Use of this map constitutes agreement with terms of the Moosewood Ecological GIS Data Disclaimer. This map was created using ArcView 10 from ESRI with data supplied by NH GRANIT.

Latest Map Revision: June 29, 2011

Figure 5. Tax parcel base map of Candia, NH. This map demonstrates the general location and relative size of tax parcels.

Limitations of Data and GIS Disclaimer

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

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

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

Methods for Natural Resources Inventory (NRI)

A variety of spatial data were incorporated into a series of natural resources maps using a geographical information system (GIS). These data were then assembled into the following themes:

Water Resources

Ecological Resources

Agricultural Resources

Forest Resources

Conserved Lands

The majority of the data were gathered from a variety of existing sources, while a few data layers were developed specifically for this project (Appendix B). All data were analyzed and manipulated for integration into a total of eight natural resources maps using ArcGIS (Version 9.3).

Two data layers were created for this project. These include steep south-facing slopes and riparian buffers. Steep south-facing slopes were created using digital elevation models (DEMs). Slopes greater than 15% and those with southeast, south, and southwest aspects were analyzed and selected from the dataset. These two data layers were then combined to determine the locations where they co-occur, resulting in the identification of steep, south-facing slopes. Riparian buffers were selected by buffering all surface waters and wetlands by 200 feet.

Limited roadside surveys and aerial photography interpretation were conducted to help verify existing or additional medium-scale habitats. These included general wetland and forest types mapped as part of this project.

Methods for Identifying Conservation Priorities

A simple weighted co-occurrence model was created in a GIS to aid in prioritizing areas for conservation. Nineteen data layers, representing the four main themes outlined above (*Water Resources*, *Ecological Resources*, *Agricultural Resources*, and *Forest Resources*) were ranked according to their importance during the second forum (Table 1).

Once the data sets were prepared and ranked accordingly a co-occurrence analysis was performed. This analysis demonstrates “hotspots” where natural resources co-occur

or overlap. The resulting data was then combined with an ecological interpretation of various landscape-level attributes to identify general Conservation Focus Areas (CFAs). This process evaluated the distribution of "hotspots," especially those concentrated within close proximity to one another, with the distribution of unfragmented lands, general locations of rare species and exemplary natural communities, high quality examples of ecologically significant habitats, proximity to conservation lands, wildlife movement and habitat connectivity, and current land use, including degree of land parcelization.

Table 1. Natural resources ranking for inclusion in the co-occurrence analysis.

Natural Resources Datalayer	Ranking
Surface Waters (ponds, lakes, streams)	1
Important Forest Soils (IA, IB, IC)	1
Unfragmented Lands	2
Active Farmlands	2
Prime Farmland Soils	2
Farmland of local Importance	2
Farmland of Statewide Importance	2
Talus Slope (WAP)	1
Peatlands (WAP)	1
Marshes (WAP)	1
Forest Floodplains (WAP)	1
Grasslands (WAP)	1
Hemlock-Hardwood-Pine Forest (WAP)	1
Appalachian Oak-Pine Forest (WAP)	1
Forested Wetlands	1
200-foot Riparian Buffer	1
South-facing slopes	1
Wetlands (NWI and hydric soils composite)	2
Stratified Drift Aquifers	2

RESULTS AND DISCUSSION

Natural Resources Inventory

Water Resources

Water resources represent some of our most fragile ecosystems and are particularly sensitive to certain types of land use. Water resources comprise a variety of natural features, which include both surface and groundwater elements. Such features include our streams and rivers, ponds and lakes, wetlands, and groundwater aquifers. In terms of their importance for conservation, these resources provide a variety of ecological functions and societal values, including:

- Water quality maintenance
- Flood control
- Wildlife and fisheries habitat
- Drinking water sources
- Recreation
- Visual quality and aesthetics
- Rare and endangered species habitat and natural communities
- Groundwater recharge and discharge
- Sediment and shoreline stabilization
- Educational and scientific value
- Overall biological diversity of Candia

Wetland resources, as with all natural resources, do not adhere to political units, such as parcels, towns, and state boundaries. Instead, they are dictated by the physical features of our landscape that form watersheds. Watersheds can be mapped at various scales and are dependant upon the stream or drainage basin that is in question. These can include large rivers such as the Piscatiqua River basin down to even the smallest tributary. As such, one can create a series of nested subwatersheds that express various scales of information found within each. For example, the small stream on the northeast side of Hall Mountain forms its own subwatershed. This small stream flows into an

unnamed tributary of the North Branch River and forms its own subwatershed. In turn, the North Branch River is a subwatershed of the Lamprey River watershed that eventually flows into the Piscatiqua River, which covers many towns in southeastern New Hampshire.

Watersheds typically form reasonable ecological units from which land use planning and management can be most beneficial. They can be very effective in better understanding land use impacts on our natural resources, including water quality and quantity, flooding, soil erosion, wildlife habitats, natural communities, rare species, and aquatic wildlife, including fisheries. As such, they form easily identifiable units that can be used in various types of conservation planning efforts. For the purposes of this project four main watershed units have been mapped for Candia (Table 2 and Figure 6).

Table 2. Summary of watersheds mapped for Candia.

HUC 12 Watersheds	Area in Candia (acres)
Cohos Brook	7,020
Lamprey River	11,917
Exeter River	174
Suncook River	146

SOURCE: USDA Natural Resources Conservation Service and NH Department of Environmental Services watersheds from GRANIT.

Wetlands and Surface Water Resources

The Wetlands and Surface Waters Resources map demonstrates the distribution of wetlands, watercourses (rivers and streams), and waterbodies (ponds and other surface water impoundments) in Candia (Figure 6). This map also shows which watershed these resources reside, as well as those areas that are permanently protected.

Wetlands generally include familiar places such as marshes, wet meadows, beaver impoundments, swamps, fens, bogs, streams, ponds, and lakes. As noted above, they perform a variety of ecological functions and values that benefit humans. They also serve as ecologically significant habitats for wildlife and plants, which is discussed in the *Ecological Resources* section below. In New Hampshire, wetlands are defined by RSA

482-A:2 as “an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soils conditions.” They are further defined by three particular elements, including hydrophytic vegetation, hydric soils, and wetlands hydrology. As such, wetlands are regulated by the New Hampshire Department of Environmental Services Wetlands Bureau as defined in RSA 482-A:2.

The US Fish and Wildlife Service National Wetlands Inventory (NWI) and US Department of Agriculture’s (USDA) Natural Resources Conservation Service (NRCS) hydric soils were mapped to better understand the potential extent of wetlands within Candia. These combined datasets provide for a more balanced approach at wetlands mapping.

The NWI is a hierarchal system of classification that was designed to map wetlands throughout the conterminous United States as a means to determine wetlands loss over time. It also serves as a systematic method for comparing wetlands within a defined geographic location (i.e., town or watershed). The NWI provides some very useful information including the type of wetland as well as its hydrology, associated plant communities, water chemistry, and other modifiers such as human dams and beaver influence.

Candia contains two main wetland ecosystems mapped by the NWI, covering about 1,588 acres or 8% of the total area of the town. These include lacustrine and palustrine wetlands (Table 3). A third NWI wetland ecosystem (riverine) also exists in Candia and includes all rivers and smaller stream drainages. However, only larger riverine wetland ecosystems (i.e., Merrimack River) have been mapped by NWI. As such, rivers and streams are discussed later in this section.

Lacustrine wetlands generally refer to ponds and lakes greater than 20 acres that are located in a topographic depression (with or without an existing dam) or along a dammed river. These wetland systems lack a substantial cover (<30%) of trees, shrubs, and herbaceous plants (i.e., grasses, sedges, and wildflowers). Lacustrine systems may include other smaller waterbodies if the shoreline is formed by wave action or lined with

bedrock, or if the water depth exceeds 6.6 feet. Candia's lacustrine wetlands are estimated to cover approximately 185 acres.

Table 3. Summary of National Wetlands Inventory and hydric soils in Candia.

Wetlands Description		**Size (acres)**
National Wetlands Inventory		
Palustrine Emergent Marsh		200.2
Palustrine Scrub-Shrub Swamp		205.4
Palustrine Forested Swamp		805.9
Palustrine Unconsolidated Bottom		181.9
Palustrine Aquatic Bed		9.1
Lacustrine		185.1
	Total	*1,587.6*
Hydric Soils		
Very Poorly Drained		1,231.8
Poorly Drained		3,081.7
	Total	*4,313.5*
Wetlands Composite		
NWI and Hydric Soils		*3,284.7**

SOURCE: USDA Natural Resources Conservation Service soils and US Fish and Wildife Service National Wetlands Inventory datasets from GRANIT

*Total estimated acreage of wetlands when combining hydric soils and National Wetlands Inventory together into one data layer.

Palustrine wetlands make up the majority of wetlands distributed throughout New Hampshire. As such, Candia typifies this general trend. Palustrine wetlands are primarily dominated by vegetation and do not meet the criteria as a lacustrine wetland. These are, for practical purposes, wetlands that most people recognize as marshes, swamps, beaver impoundments, and bogs. These can even include vernal pool complexes.

Five main classes of palustrine wetlands are located in Candia. These include:

1. *emergent marshes* - dominated by herbaceous plants such as grasses, sedges, rushes, and wildflowers;
2. *scrub-shrub swamps* - dominated by shrubs such as highbush blueberry, winterberry, northern wild raisin, arrowood, and alder as well as small trees;
3. *forested swamps* - dominated by mature trees such as red maple, hemlock, spruce, and fir; and
4. *unconsolidated bottom* - open waterbodies with mucky or sandy substrates and less than 30% vegetative cover.
5. *aquatic bed* – dominated by plants that grow on or below the surface of open water, including plants such pond lilies.

Palustrine systems make up approximately 1,403 acres or roughly 88% of NWI in Candia (Table 3). The majority of the palustrine wetlands are represented by forested swamps (57%) followed by scrub-shrub swamps (15%) and emergent marshes (14%). The largest and most structurally diverse wetland complexes can be found along the various river and stream drainages, including North Branch River and its tributaries, as well as Moose Meadow Brook. However, many smaller wetlands are found in isolated basins and may represent some unique plant communities and wildlife assemblages.

Hydric soils are wetland-related soil types and represent those that take on anaerobic (oxygen-deprived) conditions as a result of seasonal saturation, flooding, or ponded water. These have been mapped by the USDA NRCS and when combined with the NWI provide a more complete perspective of the potential array of wetlands in Candia. Included are poorly drained soils and very poorly drained soils.

Poorly drained soils are those that drain water very slowly. For this reason the soil is wet for extended lengths of time and is periodically saturated during the growing season. Poorly drained soils are not always associated with jurisdictional[1] wetlands and

[1] Jurisdictional wetlands refer to wetlands that possess all three criteria (wetland soils, wetland plants, and hydrology) that define wetlands and are regulated by the NH Department of Environmental Services under RSA 482-A.

need field verification. In comparison, very poorly drained soils include soils that also drain water very slowly, but result in free water at or on the surface during the majority of the growing season. Generally, very poorly drained soils are associated with jurisdictional wetlands of the state. It is important to display both NWI and hydric soils data to help understand potential gaps that may exist, especially as it pertains to forested wetlands that can be difficult to map using aerial photography interpretation alone.

Hydric soils are widely distributed throughout Candia, accounting for approximately 4,314 acres or 22% of the town (Table 3). Very poorly drained soils comprise nearly 30% of hydric soils. These are mostly found in association with palustrine wetlands and as a result are mapped beneath the NWI. In contrast, poorly drained soils represent about 70% of the hydric soils in Candia. They are mostly found in association with palustrine wetlands, along perennial streams, and extending into areas of slow ephemeral drainages due to broad topographic relief.

When these two wetland datasets are combined into a single wetland composite, it was estimated that Candia contains approximately 3,285 acres of wetlands, or 17% of the town. This estimate provides a better representation of wetlands coverage across the town. However, it should be noted that NWI can typically underestimate wetlands acreage while hydric soils, and in particular poorly drained soils, can tend to overestimate total coverage.

The remaining surface water resources include areas that are typically known as waterbodies and watercourses. In Candia, these represent the various ponds and streams distributed throughout the town. Not only do they provide a multitude of human benefits such as fishing, hunting, boating, swimming, and nature watching, they are also extremely significant for diverse wildlife and plants that depend upon these resources for part or all of their life cycle needs. Generally, major threats to surface water resources include potential water quality degradation and habitat loss due to adjacent land uses, including unsustainable forestry and agricultural practices and land conversion associated with various types of developments.

Candia has four waterbodies scattered throughout the town, representing 213 acres (Table 4). These waterbodies have been recognized and labeled as such by the state

of New Hampshire and/or the US Geological Survey (USGS). They range in size from roughly 3 acres (Kinnicum Pond) to nearly 157 acres (Tower Hill Pond). Three of the waterbodies are included on the NH Department of Environmental Services (NH DES) Consolidated List of Waterbodies subject to the Comprehensive Shoreland Protection Act under RSA 483-B.

Table 4. Summary of waterbodies in Candia.

Name	Size (acres)
Tower Hill Pond	157
Hall Mountain Marsh	23
Unnamed on North Branch trib	30
Kinnicum Pond	3

SOURCE: USGS topography and GRANIT hydrogrpahy datasets and NH DES RSA 483-B.

Waterbodies in **bold type** are jurisdictional designations by NH DES and subject to the Comprehensive Shoreland Protection Act under RSA 483-B.

Watercourses include all perennial and intermittent streams. There are approximately 66 miles of watercourses that have been mapped in Candia. Six have been identified by the U.S. Geological Survey by name (Table 5), while many others are left unnamed. Of the many watercourses, one is included on the NH DES Consolidated List of Waterbodies subject to the Comprehensive Shoreland Protection Act under RSA 483-B, including North Branch River.

Table 5. Summary of watercourses in Candia.

Name	Length (miles)
North Branch River	4.7
Murray Mill Brook	2.6
Moose Meadow Brook	2.5
Maple Falls Brook	2.6
Hook Brook	1.9
Fordway Brook	1.2

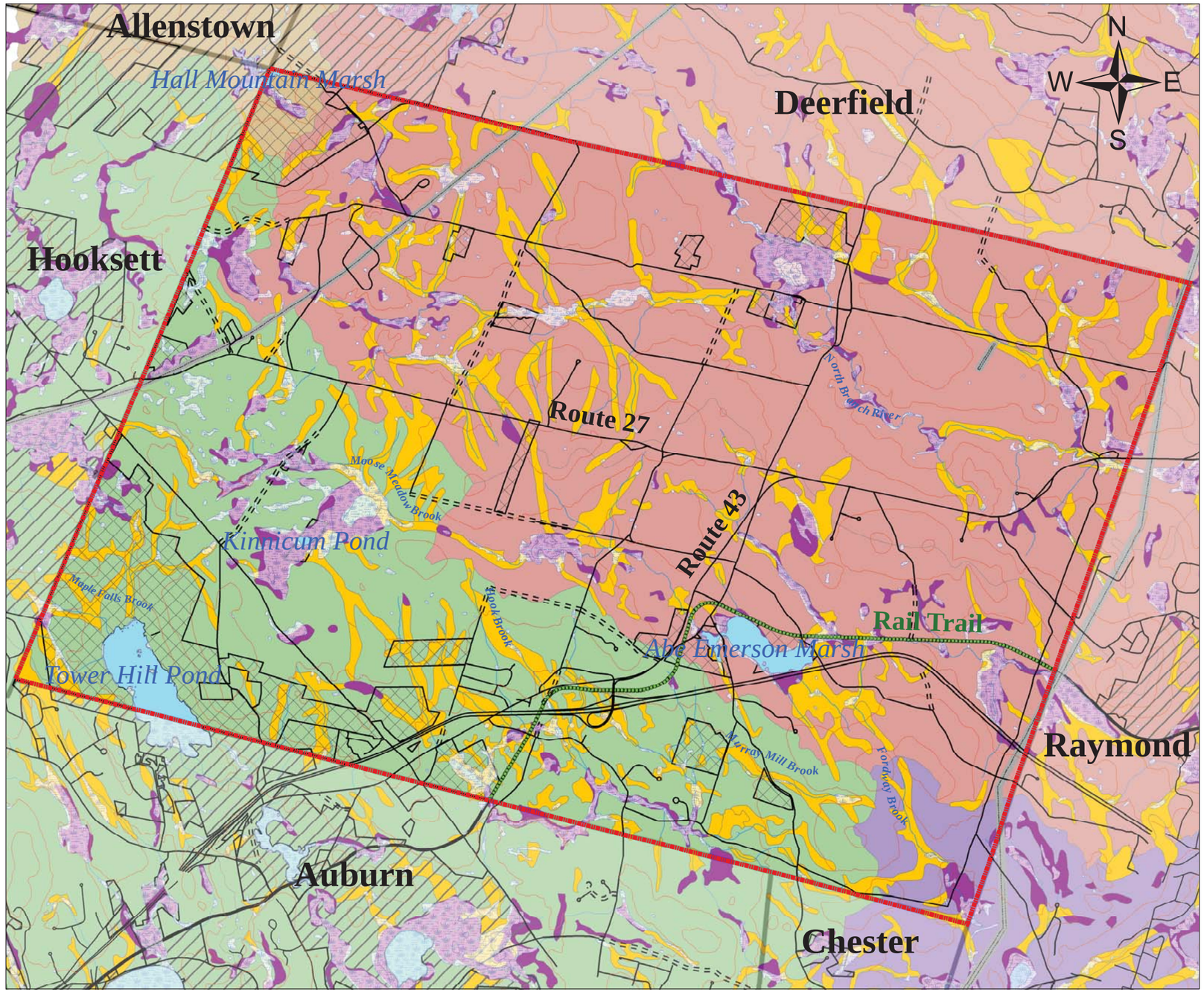
SOURCE: USGS topography and GRANIT hydrogrpahy datasets.

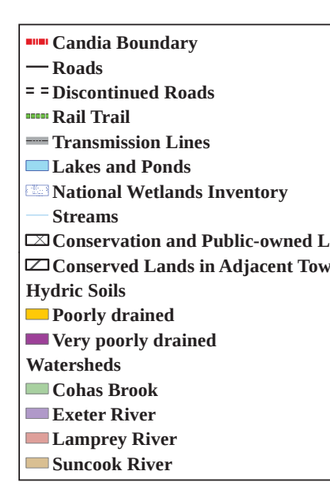
Watercourses in **bold type** are jurisdictional designations by NH DES and subject to the Comprehensive Shoreland Protection Act under RSA 483-B.

The Comprehensive Shoreland Protection Act (RSA 483-B) is a state statute that was prepared to protect water quality for designated public waters. The Act establishes minimum standards for various setbacks from the reference line based on land use within the designated 250-foot buffer. For most new construction, as well as land excavating and filling, a state permit may be required (certain exemptions apply). As such, all great ponds (waterbodies >10 acres), fourth order streams or higher, and state designated rivers have been identified by the NH DES as those waterbodies and watercourses that are subject to the Act.

For more details on the Act, as well as certified administrative rules, refer to the NH DES at http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm.

Candia Natural Resource Inventory
Wetlands and Surface Water Resources Map





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Latest Map Revision: June 29, 2011

Figure 6. Wetlands and surface waters of Candia, NH. This map demonstrates the distribution of waterbodies (ponds), watercourses (streams and rivers), wetlands (National Wetlands Inventory and hydric soils), and watersheds.

Groundwater Resources

Groundwater resources are stored in two main types of aquifers and can serve as sources for drinking water. Aquifers can be located within saturated areas of sand and gravel deposits or in fractured bedrock. In the past as glaciers melted they left behind layers of coarse sediments including sand and gravel. The space between these sediments provides opportunity for groundwater storage and flow. Groundwater stored in *stratified drift aquifers* of this kind can serve as an excellent source for drinking water. Locating and protecting these geologic features can help to ensure a supply of clean drinking water for the community as these areas are vulnerable to contamination.

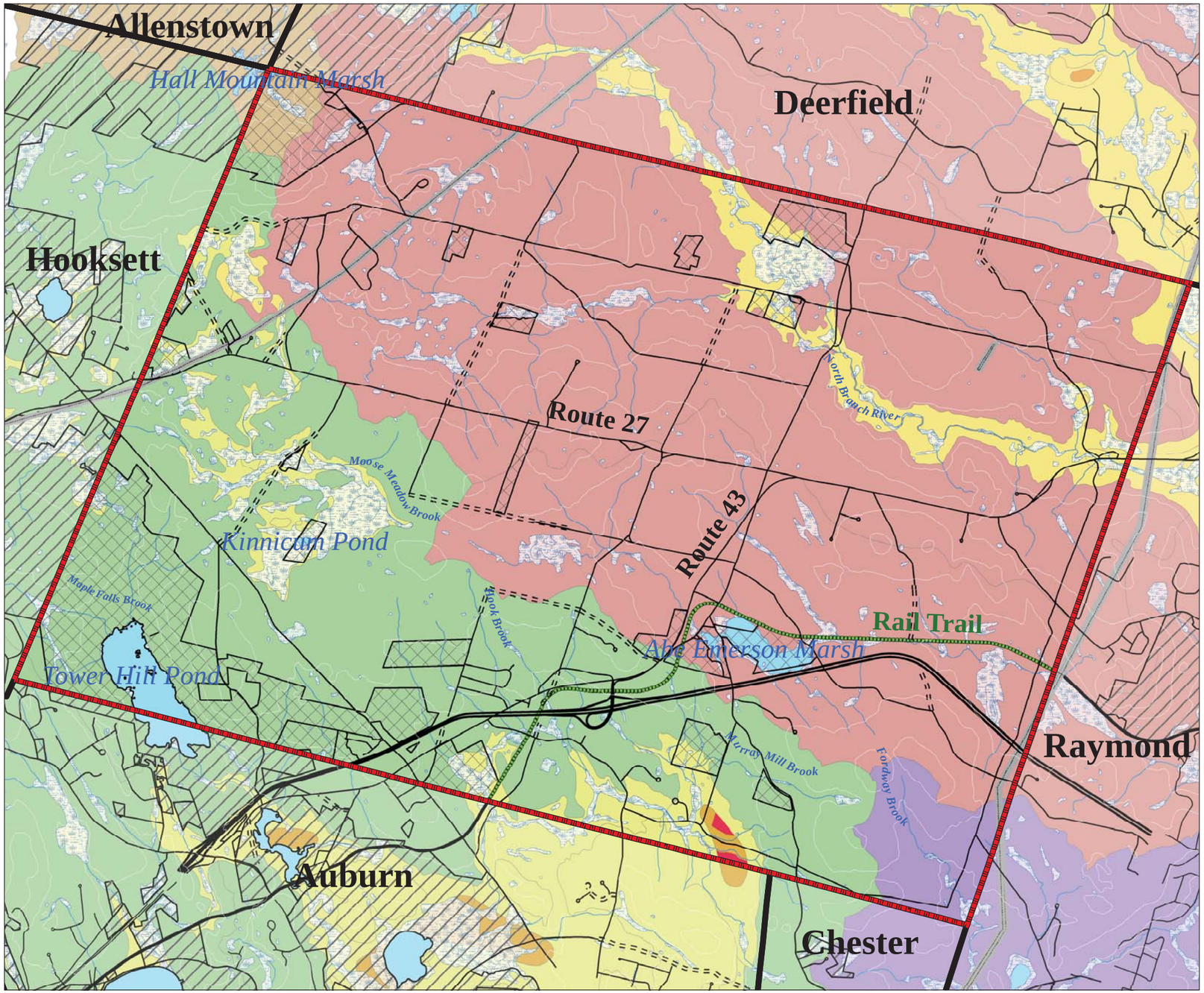
Candia contains approximately 1,860 acres of stratified drift aquifers distributed in three main locations, including, (Figure 7). The largest contiguous aquifer is located along the North Branch River and its associated wetlands. The other two locations are found along Moose Meadow Brook and Hook Brook.

Aquifers are divided into categories based on *transmissivity*, or the rate at which water moves through an aquifer and is measured in square feet per day (ft^2/day). Therefore, higher rates of transmissivity correspond to a potentially higher yield of groundwater. Most of the aquifers in Candia have a transmissivity rate of 2,000ft^2/day or less. However, one small section (approximately 39 acres) has been estimated at 2,001-4, 000ft^2/day. It is located along Hook Brook at the southern boundary.

While transmissivity takes into account the quantity of water moving through an aquifer system its does not reflect the quality of the source. To assist in addressing this issue and to identify potential future public water supplies for communities, the NH Department of Environmental Services (NH DES) prepared a Potential Favorable Gravel Well Analysis (PFGWA). This technique analyzed stratified drift aquifers, affording the opportunity for town planners and water suppliers to determine quantity and quality constraints on aquifers. In doing so, NH DES buffers out all known and potential contamination sources and examines potential well yield to identify the most suitable areas for potential community wells. In effect, NH DES is encouraging communities to take proactive measures at protecting their most significant groundwater resources. As such, the higher yielding aquifer system along Hook Brook has been identified by the

PFGWA. It was estimated that this site could produce approximately 75 gallons per minute.

Candia Natural Resource Inventory
Groundwater Resources Map



Candia Boundary
Roads
Discontinued Roads
Rail Trail
Transmission Lines
75 GPM
Lakes and Ponds
National Wetlands Inventory
Streams
Conservation and Public-owned Lands
Conserved Lands in Adjacent Towns
Aquifer Transmissivity
0 - 2000
2001 - 4000
Watersheds
Cohas Brook
Exeter River
Lamprey River
Suncook River

N
W E
S

0 0.5 1 Miles

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Latest Map Revision: June 29, 2011

Figure 7. Groundwater resources of Candia, NH. This map demonstrates the distribution of stratified drift aquifers by transmissivity rates and the location of potentially favorable gravel well analysis (PFGWA) identified by the NH Dept. of Environmental Services.

Ecological Resources

In general, ecology is the field of science that studies organisms and their environments. This includes interactions within and between species, within habitats (i.e., for mating, breeding, and feeding) and even at the cellular level. Therefore, developing a better understanding of ecological resources is accomplished on several levels, or scales. These include genes, species, populations, communities, ecosystems, and even the larger landscape that includes human land use within the natural environment.

For effective conservation planning and protection of human health and welfare, it is essential to better understand the distribution, composition, structure and function of ecological attributes on these many scales. Having this foundation of knowledge can greatly inform us on how land use may affect our natural resources and better prepare us for a more sustainable style of community planning. This section attempts to develop a basic understanding of these concepts in relation to Candia and build upon the current foundation of collective knowledge on critical wildlife habitats, exemplary natural communities, rare species, and the unfragmented landscape.

Candia's diverse terrain is characterized by a variety of ecologically significant habitats (ESHs) that provide much needed resources to help maintain the town's biodiversity. In turn, this diverse landscape supports a wide range of wildlife and plants, including common and infrequent species and a variety of species of conservation concern, as well as uncommon habitat types.

ESHs include *important wildlife habitats* and *exemplary natural communities*. These areas function as 1) habitats for rare species and other species of conservation concern; 2) rare or declining habitats and natural communities in New Hampshire; and 3) connectivity to other habitats within a largely undisturbed forested landscape. For the purposes of this project, the following ESHs were considered as significantly important for the protection and maintenance of biodiversity:

1. wildlife habitats as mapped by the NH Fish and Game Wildlife Action Plan, including marshes, peatlands, open waterbodies, floodplain forests, talus slopes, hemlock-hardwood-pine forests, lowland spruce-fir forests, Appalachian oak-pine forests, northern hardwood-conifer forests, and grasslands;
2. additional wildlife habitats including streams, riparian buffers, and steep south-facing slopes;
3. exemplary natural communities as defined by the NH Natural Heritage Bureau;
4. large unfragmented forest blocks with embedded wetlands and other habitats lumped in close proximity to one another; and
5. critical wildlife habitats and natural communities supporting rare species

Important Wildlife Habitats

The NH Fish and Game Department, in cooperation with several other agencies, organizations, and individuals, produced the NH Wildlife Action Plan in 2005. This document was designed as a planning and educational tool for federal, state, and municipal governing bodies, conservation commissions, land trusts, other conservation organizations, and private landowners, as well as the general public. Its purpose was to promote the conservation and management of NH's biological diversity. This includes providing strategies for informed land use decisions and land management planning. This can help to ensure that an adequate representation of various wildlife habitats are maintained across our landscape, whereby keeping common species common in NH and working to prevent the loss of our rare species.

The following descriptions represent important habitats that were mapped for the NH Wildlife Action Plan (noted with an asterisk*), as well as other fine-scale habitats predicted to occur based on analysis of remote data. Species listed in **bold type** have been identified by the NH Wildlife Action Plan as species of greatest conservation concern. A total of 12 important wildlife habitats have been mapped and summarized for Candia (Table 6 and Figure 8). Two additional habitats have also been described below but have

not been mapped by the NH Wildlife Action Plan. These include shrublands and vernal pools, which are best mapped using high resolution aerial photographs and confirmed by conducting site visits.

Table 6. Summary of important wildlife habitats of Candia.

Wildife Habitat Type	Size	% of Town
Marsh and Shrub Wetlands*	691.3 acres	3.5
Peatlands*	341.2 acres	1.7
Floodplain Forests*	6.6 acres	0.03
Forested Wetlands	805.9 acres	4.1
Ponds^	367 acres	1.9
Rivers and Streams	66.4 miles	n/a
Riparian Areas	4,795.1 acres	24.5
Hemlock-Hardwood-Pine Forests*	11,017.4 acres	56.3
Appalachian-Oak-Pine Forests*	6,995.2 acres	35.8
Ridge or Talus Slopes*	14.9 acres	0.08
Steep South-facing Slopes	5 acres	0.02
Grasslands*	1,214.4 acres	6.2

Source: GIS Slope and Riparian Buffer Analysis (Moosewood Ecological 2009); NH Fish and Game Department Wildlife Action Plan (2005); USGS topography, NH hydrography and US Fish and Wildife Service National Wetlands Inventory datasets from GRANIT.

*Wildlife habitats mapped as part of the NH Fish and Game Wildlife Action Plan (2005).
^Ponds were identified using NWI palustrine unconsolidated bottom and lacustrine wetlands.

Marsh and Shrub Wetlands*

Marsh and shrub wetlands can offer some dramatic variations in plant communities. Various grasses, sedges, and rushes, dwarf shrubs, pond lilies, pickerel weed, wild flowers, and other herbaceous plants, as well as open water, typify Candia's marshes. In contrast, shrub swamps are dominated by common shrubs such as highbush blueberry, maleberry, winterberry, mountain holly, wild raison, arrowood, chokeberry and speckled alder. Shrub swamps may also contain a mixture of herbaceous plants and sparse sapling trees, depending upon the density of the shrub layer and degree of wetness.

These habitats perform significant ecological functions and hold great value to humans and wildlife alike. Functions include storage of floodwaters, wildlife habitats,

water quality maintenance of surface and groundwater resources, sediment trapping, reducing impacts of excess nutrients and toxicants, shoreline stabilization, erosion control, and habitat for rare species and natural communities. Societal values also can be attributed to our wetlands such as education and scientific research, visual aesthetics, recreation (i.e., fishing, hunting, and boating), and historical value.

Many wetlands are widely known to have diverse plant and animal communities. This is mainly due to the fact that wetland ecosystems contain a wide variety of smaller habitats. This in turn provides many organisms with all or part of their life cycle needs. Robust bird communities can be found in marsh and shrub wetlands. Waterfowl (i.e., wood duck, **American black duck**, mallard, common merganser, and Canada goose), **American bittern**, **least bittern, great blue heron**, **American woodcock,** red-winged blackbird, northern kingbird, tree swallow, belted kingfisher, song sparrow, swamp sparrow, gray catbird, and common grackle, as well as various warblers such as common yellowthroat and yellow warbler. These species commonly breed and nest in wetlands or along the wetland edge. Many waterfowl also use wetlands and open waterbodies extensively during spring and fall migration.

Mammals such as river otter, mink, beaver, and muskrat rely heavily upon marsh and shrub wetlands for feeding and denning sites within or adjacent to the wetland. Other mammals known to use these wetlands include raccoon, state endangered **New England cottontail**, ermine, long-tailed weasel, **bobcat**, white-tail deer, **moose**, and **bear**.

Many amphibians and reptiles are common to marsh and shrub wetlands. Green frog, bullfrog, pickerel frog, spring peeper, wood frog, American toad, spotted salamander, and red-spotted newt can be frequently observed in these wetland habitats. Common reptiles include painted and snapping turtles. However, marsh and shrub wetlands also provide critical habitat for more secretive and less abundant species such as **northern leopard frog, Jefferson salamander, ribbon snake**, **eastern smooth green snake**, and northern water snake. Aquatic wildlife such as fish and macroinvertebrates are also integral of and dependant upon these wetland ecosystems, representing a significant part of the complex food cycle.

The interface between wetlands and their adjacent uplands form the riparian zone, which further adds complexity and diversity to both the ecological structure and composition. This zone is used by a wide range of semi-aquatic and terrestrial species for breeding, nesting, and feeding, or as connectivity to other significant habitats. The riparian zone can also be very beneficial for aquatic species such as fish and macroinvertebrates that benefit from the shading characteristic of overhanging tree canopies. These trees help to maintain cooler streams temperatures upon which many species need for long term survival.

It was estimated that approximately 53% of wetland acreage in the contiguous forty eight states was lost between 1780 and 1980[1]. The widespread devastation of loss and conversion has left a substantial mark; 117 million acres were filled, drained, or flooded. New Hampshire is fortunate to have had a conservative history of wetland loss.

Between 1780 and 1980 it was estimated that approximately nine percent of the New Hampshire's wetlands have been lost through destruction and/or alteration. The level of loss during these two centuries was the second lowest of the fifty states. However, marsh and shrub wetlands are still vulnerable to human alterations through direct disturbance within the wetland or more often within the adjacent uplands. Threats include habitat loss and conversion, fragmentation, introduction of non-native invasive plants, haphazard use of off-highway recreational vehicles (OHRV), and compromised water quality due to ineffective riparian buffers.

The marsh and shrub wetland complexes are composed of three main wetland classes originally mapped by the NWI (see Water Resources section above for description), including emergent marshes, unconsolidated bottoms, and shrub swamps. Each of these wetland classes are dictated by topographic setting, hydrologic regimes, soil development, nutrient availability, wildlife influence (e.g., beaver damming), and plant community composition. The only major wetlands not included in this habitat type are peatlands and forested swamps. These are described below as their own distinct habitat types.

[1] Dahl (1990). Wetlands losses in the U.S. from 1780-1980.

The marsh and shrub wetlands comprise approximately 691 acres in Candia. They are widely distributed along the North Branch River and its tributaries, as well as other major streams, including Moose Meadow Brook and Murray Mill Brook. The wetlands associated with these brooks represent some of the most significant examples of this habitat in Candia.

Peatlands*

Wetlands can be lumped into two categories: peatlands and non-peatlands. The marsh and shrub habitats previously discussed are considered non-peatlands. Peatlands have been separated as a distinct habitat type due to its unique species composition, sensitivities to changes in pH (level of acidity), and potential to contain rare species and exemplary natural communities.

Peatlands are a type of wetland that is generally characterized by acidic conditions with little groundwater input and limiting nutrients, which dramatically slows down decomposition rates of plant material. This slow decomposition results in the accumulation of peat over time. Most of the peatlands in New Hampshire are technically defined as fens. Many of these open fens have been traditionally referred to as bogs, however. Peatlands are classified into three wetland classes, including open emergent peatlands, shrub thickets, and forested wetlands.

The NH Wildlife Action Plan has estimated that approximately 341 acres of peatland habitat exist throughout Candia. These peatlands are scattered throughout the town in roughly 38 locations. Most of these exist as small isolated basin swamps while a few peatlands are found along streams, including the Kinnicum Pond and Moose Meadow peatland system.

Peatlands are significant mostly in terms of their rare plant and natural community diversity. However, the state endangered **ringed boghaunter**, a type of dragonfly, is strongly associated with peatland habitats. Many of the same species that are associated with the marsh and shrub wetlands can also be found in association with open and shrub peatlands, including **eastern smooth green snake**, **ribbon snake**, **Jefferson's salamander**, **northern leopard frog**, state endangered **New England cottontail**, and

bobcat. Peatlands and non-peatlands can often be part of the same mosaic of plant communities within large wetland complexes, especially those associated with slow moving streams. Kinnicum Pond serves as a great example of such a complex.

Peatlands are sensitive to excess loading of nutrients, sedimentation, and toxicants associated with certain adjacent land uses such as development, which can change their water chemistry, altering both plant and animal communities. Excess flooding as a result of incompatible adjacent land use planning, as well as damming by beavers, can also dramatically alter peatland habitats. As such, threats to these habitats include fragmentation, habitat loss and conversion, altered hydrology, nonpoint source pollution, unsustainable forestry and agricultural practices, haphazard use of off highway recreational vehicles (OHRV), and introduction of non-native, invasive plants.

Floodplain Forests*

Floodplain forests perform a variety of significant ecological functions. They help to store floodwaters and reduce overall flow rates that can lessen potential flooding downstream; maintain water quality by buffering adjacent land uses associated with excess nutrients, sedimentation, and toxicants; control erosion; and host many habitat types. Floodplains can be characterized as a mosaic of habitats that can greatly vary in structure, owing to its rich biological makeup. They can include both upland and wetland communities such as forests and open woodlands, meadows, oxbow marshes, shrub thickets, vernal pools, and seeps. This interaction between wetland and upland communities forms the riparian zone. These habitats in turn support wonderfully diverse wildlife communities for breeding, nesting, feeding, and migration.

Floodplain forests provide habitat for many migratory and year-round resident birds. Waterfowl (i.e., wood ducks and mallards using vernal pools), American redstart, Baltimore oriole, **red-shouldered hawk**, Cooper's hawk, **American woodcock**, **veery**, and **wood thrush** use these dynamic habitats. Amphibians include spring peeper, wood frog, spotted salamander, green frog, pickerel frog, gray tree frog, and American toad. More importantly, floodplains are critical for **Jefferson's salamanders** and **northern leopard frog**, as well as some reptiles considered as species of conservation concern,

including **wood turtle** and **ribbon snake**. Semi-aquatic mammals using river systems readily depend upon these riparian forests. Signs of river otter, muskrat, beaver, and mink can typically be observed using intact floodplain forests.

Many of New Hampshire's major and minor floodplain forests have been converted to other land uses such as agriculture or residential, commercial, and industrial developments. This fact exemplifies the great significance of protecting the remaining intact examples if we are going to conserve the various wildlife and plant communities that reside within these habitats. As such, threats to the long term stability and ecological integrity of floodplains include fragmentation, habitat loss and conversion, altered natural disturbance due to damming, and the introduction of non-native invasive plants that can out-compete native species, potentially altering wildlife communities as well.

Candia's major floodplain forests were found along the North Branch River and one of its tributaries. These two areas, according to the NH Wildlife Action Plan, span less than 7 acres in the northeast corner of town. Other minor floodplain forests may also be found along smaller streams, especially where the topography becomes broader and streams segments meander.

Forested Wetlands

Forested wetlands, or swamps, represent another major class of wetland habitats, covering approximately 806 acres in Candia. Forested wetlands are hydrologically connected to marsh and shrub wetlands or exist as isolated basin swamps. In Candia, these may be commonly found as red maple- or hemlock-dominated swamps. However, locally significant and rare types may include black gum-red maple basin swamp, red maple-black ash swamp, pitch pine-heath swamp, and Atlantic white cedar-leatherleaf swamp.

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

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

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

Waterbodies and Watercourses

The waterbodies and watercourses of Candia have been discussed above in terms of their importance as surface water resources for humans mainly. However, these natural resources also have great significance for providing critical habitats for diverse wildlife. The NH Wildlife Action Plan has identified a variety of important wildlife for the Tidal and Non-tidal watersheds. These include, but not limited to, **alewife**, state endangered **American brook lamprey**, **American eel**, **American shad**, **Atlantic Salmon**, **banded sunfish**, **blue-back herring**, **brook trout**, **burbot**, state threatened **bridle shiner**, **rainbow smelt**, **redfin pickerel**, **sea lamprey**, state and federally endangered **shortnose sturgeon**, **slimy sculpin**, **swamp darter**, and **tessellated darter**.

Threats to the ponds and streams of the Tidal and Non-tidal Upland watersheds generally include altered natural flow regimes as a result of dams that can inhibit migration of semi-aquatic and aquatic species (particularly fish), nonpoint source pollution (especially sedimentation and stormwater runoff) from land development and unsustainable forestry and agricultural practices within or adjacent to the resources, and the spread of invasive species.

Riparian Areas

Riparian areas form the interface between uplands and wetlands, including ponds rivers, and streams. They provide a wide range of natural services that are essential in maintaining biodiversity and proper ecological functions. These include services such as:

- various biogeochemical processes that result in the breakdown of living and non-living materials that support a thriving soil community, providing food web support and nutrients for plant growth;
- buffering properties for point and nonpoint source pollution (i.e., sedimentation, excess nutrients, toxicants) from upland land use;
- providing optimal shading by the tree canopy that is required for streams to maintain cold temperatures needed by fish and aquatic macroinvertebrates (large water bugs);
- contribution of organic debris (i.e., large woody debris or downed trees, smaller woody limbs and twigs, and leaf litter) within the riparian area and adjacent wetland ecosystems;
- reducing the effects of downstream flooding by storing rising water levels in floodplains;
- wildlife corridors for safe movement between various habitats for mammals, birds, reptiles, and amphibians; and
- important breeding, feeding, and nesting habitats for terrestrial, aquatic, and semi-aquatic wildlife.

Riparian areas have been mapped using a 200-foot buffer around intermittent and perennial streams, as well as all surface waters and wetlands. This area totals approximately 4,795 acres or roughly 25% of the town. This estimate helps to provide insights into the distribution and coverage that this critical area represents along Candia's wetland and aquatic habitats.

Hemlock-Hardwood-Pine Forest*

The hemlock-hardwood-pine forest ecosystem is often considered to be a northern transitional hardwood forest situated between the northern hardwood-conifer forests typical of the northern half of New Hampshire and the Appalachian oak-pine forests that reside in the southern most portion of the state. Coniferous and mixed forests typify this ecosystem and are composed of various mixtures of eastern hemlock, American beech,

red oak, white pine, and red maple. Other hardwoods are present but less abundant include sugar maple, white ash, hop-hornbeam, and black cherry. According to the NH Wildlife Action Plan, hemlock-hardwood-pine forests cover over 11,000 acres in Candia, or approximately 56% of the town.

Species diversity for the hemlock-hardwood-pine forests in New Hampshire totals 140 vertebrates throughout New Hampshire, including 15 amphibians, 73 birds, 39 mammals, and 13 reptiles. These include a variety of important wildlife such as **American woodcock**, state threatened **bald eagle**, **northern goshawk**, **Canada warbler**, **cerulean warbler**, **Cooper's hawk**, **eastern towhee**, **purple finch**, **red-shouldered hawk**, **ruffed grouse**, **veery**, **wood thrush**, **blue-spotted salamander**, **Jefferson's salamander**, **ribbon snake**, **smooth green snake**, **wood turtle**, **eastern pipistrelle**, **eastern red bat**, **northern myotis**, **silver-haired bat**, **bear**, **moose**, and **bobcat,** as well as many migratory and wintering birds.

Some of the major direct threats to these forests include the construction of new roadways that fragment the remaining forested blocks, exposing wildlife to increased road mortality and decreasing core forest habitat needed by certain area sensitive species, such as **bobcat**, ovenbird, scarlet tanager, and some raptors. Other threats are associated with habitat loss and conversion due to land use planning, leading to new roadways and associated forest fragmentation. These elements also lend themselves to exposure pathways for the colonization of non-native, invasive plants that can alter species composition and diversity of native trees, shrubs, and other plants. Lastly, non-native forest pests such as the hemlock wooly adelgid and the Asian long-horned beetle poses serious risks to forest health as can other introduced pathogens.

<u>Appalachian Oak-Pine Forest*</u>

According to the NH Wildlife Action Plan, the Appalachian oak-pine forest represents nearly 7,000 acres of forestland in Candia. This forest type is characterized mainly as hardwood and hardwood-dominated mixed forest types. Common hardwood species include white oak, black oak, red oak, hickories, and red maple. Other hardwoods present but less abundant may include sugar maple, white ash, hop-hornbeam, American

chestnut, and chestnut oak. Coniferous species usually include white pine with some occasional eastern hemlock and even less abundant pitch pine.

Species diversity for the Appalachian oak-pine forest in New Hampshire accounts for approximately 104 vertebrates. These include 8 amphibians, 67 birds, 17 mammals, and 12 reptiles. Diverse wildlife communities can be observed in these upland forests. Typical birds include many species of raptors such as red-tailed hawk, **red-shoulder hawk**, Cooper's hawk, broad-winged hawk, **northern goshawk**, and barred owl, as well as many Neotropical migratory birds (i.e., scarlet tanager, **veery**, ovenbird, black-throated green warbler) and other resident songbirds. Mammals can include **deer**, **moose**, **bear**, **bobcat**, coyote, fox, fisher, snowshoe hare, eastern cottontail, red and gray squirrels, as well as other smaller members of the rodent family.

Other rare and important wildlife that may also exist in these upland forests includes **American woodcock**, state threatened **bald eagle**, state threatened **black racer**, state endangered **Blanding's turtle**, **blue-spotted salamander, Canada warbler, cerulean warbler, Eastern box turtle,** state threatened **eastern hognose snake, eastern pipistrelle, Eastern towhee, Jefferson's salamander, marbles salamander,** state endangered **New England cottontail, northern myotis, ribbon snake, ruffed grouse, silver-haired bat, smooth green snake, spotted turtle,** state endangered **timber rattlesnake, wild turkey, veery, whip-poor-will, wood thrush** and **wood turtle**.

The same threats listed for the hemlock-hardwood-pine forests also apply to the Appalachian oak-pine forests.

Ridge/Talus Slopes* and Steep South-facing Slopes

Rocky ridges can be found along outcroppings associated with ridgelines and summits. Talus slopes are often associated with cliffs and steep slopes of mountains. These two habitats have been lumped together into one data layer by the NH Wildlife Action Plan. In Candia, this habitat was associated with one location adjacent to the North Branch River, totaling nearly 15 acres.

Steep south-facing slopes were also analyzed to expand the potential locations of smaller talus slopes with southern exposures. Covering approximately 5 acres, this

habitat was located on the south face of Hall Mountain just outside of Bear Brook State Park.

Ridges, talus slopes, and other south-facing slopes can serve as primary habitat as snake hibernacula for species such as the state endangered **timber rattlesnake** and state threatened **black racer**. They can also serve as critical habitat for **bobcat, bear,** and state endangered **common nighthawk.** These areas are known to support various unique natural communities that are uncommon or rare in the state.

Grasslands*

Typical plant composition for upland grasslands includes various grasses and sedges, goldenrods, asters, meadowsweet, and milkweeds. Medium- to large-sized shrubs and young trees may also be present but are in very low abundance. Management within each type of grassland habitat varies depending upon the type of land use but all must be maintained in a fashion that prevents the establishment of shrubs and trees. If not regularly maintained grasslands will succeed into shrublands, and eventually develop into a forest, as did most of New Hampshire's grasslands when agricultural lands were abandoned.

These extensive grasslands provide critical open habitat for both common and uncommon wildlife that can greatly contribute to Candia's diversity, particularly birds, insects, and reptiles. Species of conservation concern associated with grassland habitats include **eastern meadowlark**, **vesper sparrow**, state threatened **grasshopper sparrow**, **northern harrier**, **American kestrel**, **American woodcock**, **upland sandpiper**, **horned lark**, **wood turtle**, and **eastern smooth green snake**. Also associated with grasslands is the **northern leopard frog**, especially grasslands in close proximity with floodplain forest complexes.

Grasslands and their associated wildlife have been in decline due to the mass abandonment of agriculture within the last 100-150 years. When farming and open land was more prevalent grassland species thrived in the state. However, grassland bird populations are declining more rapidly than any others in the northeast[2]. Other threats to

[2] Sauer et al. (2003)

grasslands are habitat loss and conversion due to land use planning. Without the presence of grassland habitats certain species would not remain a part of Candia's landscape, resulting in lower biodiversity overall.

Grasslands mapped by the NH Wildlife Action Plan were estimated to account for approximately 1,214 acres, representing 176 patches throughout Candia. These range in size from about 2 acres to nearly 115 acres. These upland habitats may include features such as hayfields, pastures, cropland, and/or other types open fields (i.e., landfill, athletic fields).

A variety of other small- and medium-scale important wildlife habitats also exists in Candia and should be considered during land use planning. These include, but not limited to, shrublands and vernal pools. These two additional habitats have not been mapped as part of the NH Wildlife Action Plan or this project due to logistical constraints. As such, these are best mapped on a site-by-site basis and in conjunction with high resolution aerial photography. However, a brief description of each has been included since they do function as significant habitat for various species of conservation concern.

Shrublands

Shrublands are typically characterized by a combination of shrubs and young shrub-like trees that dominate this habitat. Mixed grasses, sedges, and forbs are generally present and interspersed throughout but less abundant overall. These upland areas can include utility right-of-ways, reverting sand and gravel pits (i.e., along North Branch River), old farmlands, and patch cuts created by forestry projects. Certain shrub swamps may also function as critical shrubland habitat for a subset of wildlife. As noted above, grasslands will naturally succeed into shrublands if not maintained, and likewise, shrublands will eventually revert to forests. Each of these areas (except shrub swamps) must be managed appropriately in order to maintain this habitat structure and support its various wildlife communities.

As with grasslands, upland shrubland habitats are significant for many types of birds and reptiles. They serve as primary and secondary habitats for breeding, nesting, and feeding for many animals. Species of conservation concern that use shrublands include **golden-winged warbler**, **eastern towhee**, **ruffed grouse**, **whip-poor-will**, **American woodcock**, **eastern smooth green snake**, **wood turtle**, **bobcat**, and the state endangered **New England cottontail**. The latter three species can also be associated with certain shrub swamps as well.

Similar to grasslands, shrubland habitats have been declining in the state. During the abandonment of farms, grasslands succeeded into shrublands and were once widespread throughout the state. However, most of these shrublands have succeeded into forests or were cleared for developments, which rapidly reduced the size and distribution of this critical habitat that negatively impacted its wildlife communities. Other threats to this habitat type include fragmentation, habitat loss and habitat conversion due to land use planning; haphazard use of off-highway recreational vehicle (OHRV) activities; and establishment of non-native, invasive plants, including honeysuckles, buckthorn, autumn olive, Asian bittersweet, and swalloworts. Invasive species can be quite aggressive, resulting in a change in plant composition from native species to one dominated more with invasive species.

Vernal Pools

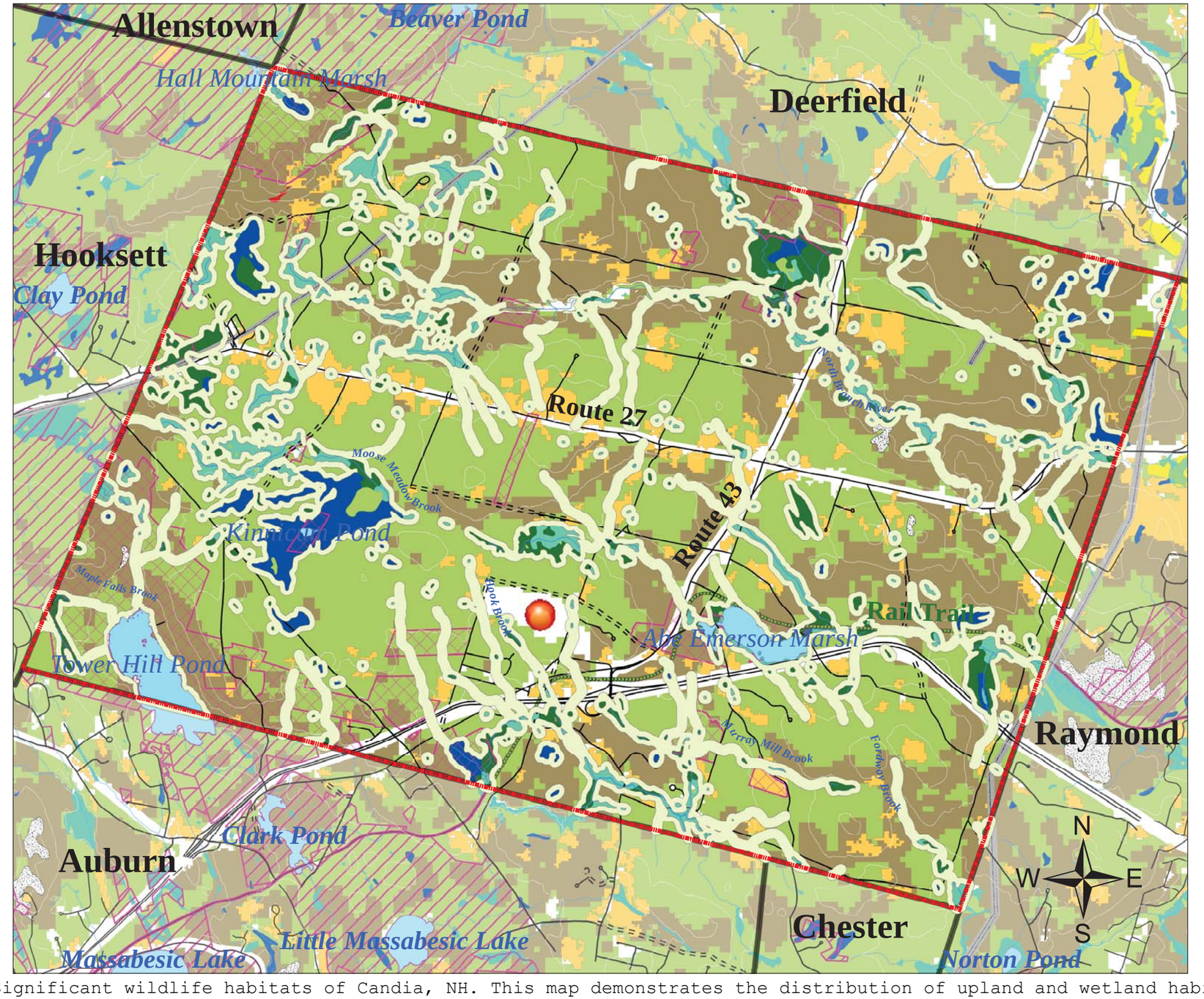
Vernal pools are listed in the NH Wildlife Action Plan as an important habitat type but have not been mapped at the state level. These habitats are more easily mapped at the town-level where adequate aerial photography exists or at the site-specific level. As such, at least two vernal pools have been mapped by Moreno (2004) in the Candia Town Forest located on Flint Road. Other potential vernal pools were also observed during this project from roadside observations. It is expected that a significant number of additional vernal pools exists throughout Candia. Sites where these critical habitats can often occur include saddles along ridges and tops of hills and mountains, headwaters of drainages, floodplains, and broad areas of generally flattened topography.

Vernal pools are typically referred to as temporary or seasonal woodland pools that are found within upland or floodplain forests. These woodland pools fill typically with water in the spring and fall, and partially or even completely dry out in the summer, preventing fish populations from persisting. Vernal pools are isolated in small basins and are not associated with a permanent inflow or outflow of water.

Vernal pools are critical for the long-term survival of many obligate species of amphibians, reptiles, and macroinvertebrates. Species considered as obligate or strongly associated with vernal pools include **ribbon snake**, **Jefferson's salamander**, **blue-spotted salamander**, state endangered **marbled salamander**, spotted salamander, wood frog, fingernail clams, and fairy shrimp. **Bobcat** and state endangered **New England cottontail** may also be found using this habitat for feeding and/or cover from predation.

The main threats to vernal pools are those associated with various development activities within and adjacent to this habitat, resulting in habitat loss and conversion. Fragmentation created by roadways can bisect a complex of vernal pools within close proximity from one another. This effect can result in high road mortality and lower genetic diversity, essentially isolating populations of amphibians. Unsustainable forestry practices adjacent to vernal pools can have negative effects within upland habitats, as well as alterations in hydrology from the removal of the forest canopy. This can result in increased transpiration rates that can effectively cause the pools to dry out more rapidly and consequently desiccating egg masses before they can fully develop to maturity.

Candia Natural Resource Inventory
Significant Wildlife Habitats Map



- Candia Woods Golf Course
- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- Streams
- Conservation and Public-owned Lands
- Conserved Lands in Adjacent Towns
- Steep South-facing Slopes
- Forested Wetlands
- Marsh and Shrub Wetlands
- 200 Ft. Buffers

NH WAP Habitats

- Rocky Ridge or Talus Slope
- Peatland
- Floodplain Forest
- Marsh and Shrub Wetlands
- Grasslands
- Appalachian Oak-Pine Forest
- Hemlock-Hardwood-Pine

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Latest Map Revision: June 29, 2011

Figure 8. Significant wildlife habitats of Candia, NH. This map demonstrates the distribution of upland and wetland habitats that express especially high and/or unique biodiversity attributes, including rare or declining habitats.

Exemplary Natural Communities and Rare Species

Natural communities, as defined by the New Hampshire Natural Heritage Bureau (NH NHB), are combinations of distinct plant assemblages, their physical environments, and the ecological processes that affect them. Essentially, they are ecological units that are repeated on the landscape. Natural communities include both uplands and wetlands such as forests and woodlands, talus slopes, shorelines, marshes, forested swamps, peatlands, floodplains, and aquatic systems. Natural communities act as the compliment to wildlife habitats but from a plant perspective. It is a way of providing more detail regarding the various plant communities that form a broader habitat type (e.g., many types of natural communities can make up the marsh and shrub wetland habitat).

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

The NH NHB, a bureau within the Department of Resource and Economic Development's Division of Forest and Lands, is responsible for locating, tracking, and facilitating the protection of rare and imperiled plants and rare and exemplary natural communities. They have developed an extensive classification system for natural communities in New Hampshire and have ranked each according to rarity in the state, as well as globally. As such, the NH NHB maintains a list of known rare elemental occurrences (i.e., rare species and exemplary natural communities) for each town in the state and provides locational data for such occurrences that are documented for public conservation lands. However, data on rare elemental occurrences on private properties are not released by the NH NHNB unless permission has been granted by the landowner.

The NH NHB has documented two exemplary[1] natural communities for Candia, which includes two wetland communities (Table 7 and Figure 9). The bulblet umbrella-

[1] Exemplary natural communities include almost all rare types of natural communities, as well as high quality examples of those that are more common in the state. The NH NHB regards exemplary natural communities as priorities for conservation.

sedge open sandy pond shore (approximately 8 acres) was documented in Tower Hill Pond on October 16, 2007. It was regarded as having good quality, condition, and landscape context and scored a conservation rank of "B" on a scale of A to D. It has also been noted by the NH NHB as having a very high importance for protection. This designation was based on a combination of 1) how rare the species or community is and 2) how large or healthy its examples are in that town. Please contact the NH NHB for more information on setting protection priorities. The kettle hole bog system is considered as an historical elemental occurrence, meaning it was observed more than 20 years ago. As such, its current condition is unknown and therefore should be field verified. It was observed within the larger Kinnicum Pond swamp.

This list of exemplary natural communities has been cross-referenced to their associated WAP habitat for direct comparisons. This affords the opportunity to view Candia in a more ecological perspective, integrating biological diversity and conservation planning with considerations for both wildlife habitats and natural communities that together form ecologically significant habitats (ESHs). In addition, this is not a comprehensive list of exemplary natural communities that may be found in Candia. It only represents those that have been observed and documented by the NH NHB. It is highly likely that Candia contains many other exemplary communities.

Table 7. List of known exemplary natural communities in Candia.

Natural Community Types	Associated Wildlife Habitat
Open Wetlands and Riparian Communities	
Open Peatlands	
Kettle hole bog system*	peatlands
Open emergent marshes, shrub thickets, and aquatic beds	
Bulblet umbrella-sedge open sandy pond shore	marsh and shrub wetlands

Source: Sperduto and Nichols (2004); NHNHB (2010)

*Historical record greater than 20 years

Currently, there are seven known rare wildlife occurrences that have been documented by the NH NHB (Table 8 and Figure 9). This list includes an historical great blue heron rookery, meaning that it was observed more than 20 years ago. The state endangered Blanding's turtle, state threatened spotted turtle, state threatened northern

black racer, and state threatened common loon have been observed on conservation lands, while the remaining species were documented on private properties. Several individuals of Blanding's turtle were documented at three different sites in Candia, including many adults and one young turtle. In addition, the NH NHB regards all elemental occurrences in Table 8 as having a very high importance for protection, excluding the heron rookery and the brook floater. These designations are based on a combination of 1) how rare the species or community is and 2) how large or healthy its examples are in that town. Please contact the NH NHB for more information on setting protection priorities.

The list of rare wildlife does not suggest that other rare wildlife species do not exist in town but only that they have not been formally documented by the NH NHB. Candia has a strong potential to support other rare wildlife, as well as others of conservation concern. See the habitat descriptions in the *Important Wildlife Habitats* section above for some examples of species that may be potentially present in Candia.

Table 8. List of known rare wildlife in Candia.

Species	Rarity Rank
Birds	
common loon	S2
great blue heron rookery	
Reptiles	
Blanding's turtle	S1
northern black racer	S2
smooth green snake	SC
spotted turtle	S2
Invertebrates - Mollusks	
brook floater	S1

Source: NH Natural Heritage Bureau database (January 2010)

S1 - State Endangered
S2 - State Threatened
SC - Special Concern

A total of five rare plants have been documented by the NH NHB to occur in Candia (Table 9 and Figure 9). Two species (downy false foxglove and prostrate tick trefoil) were documented on conservation lands, while the remaining elemental

occurrences were observed on private properties. Three species (barren strawberry, featherfoil, and prostrate tick trefoil) are considered by the NH NHB as having a very high importance for protection; the downy false foxglove is considered as a high importance for protection. These designations are based on a combination of 1) how rare the species or community is and 2) how large or healthy its examples are in that town. Please contact the NH NHB for more information on setting protection priorities. Lastly, the slender blue flag is considered an historical observation since it was documented more than 20 years ago. This species was presumably observed on private lands since its location and description was not released by NH NHB. It is likely that this species still remains and other rare plants exist in Candia.

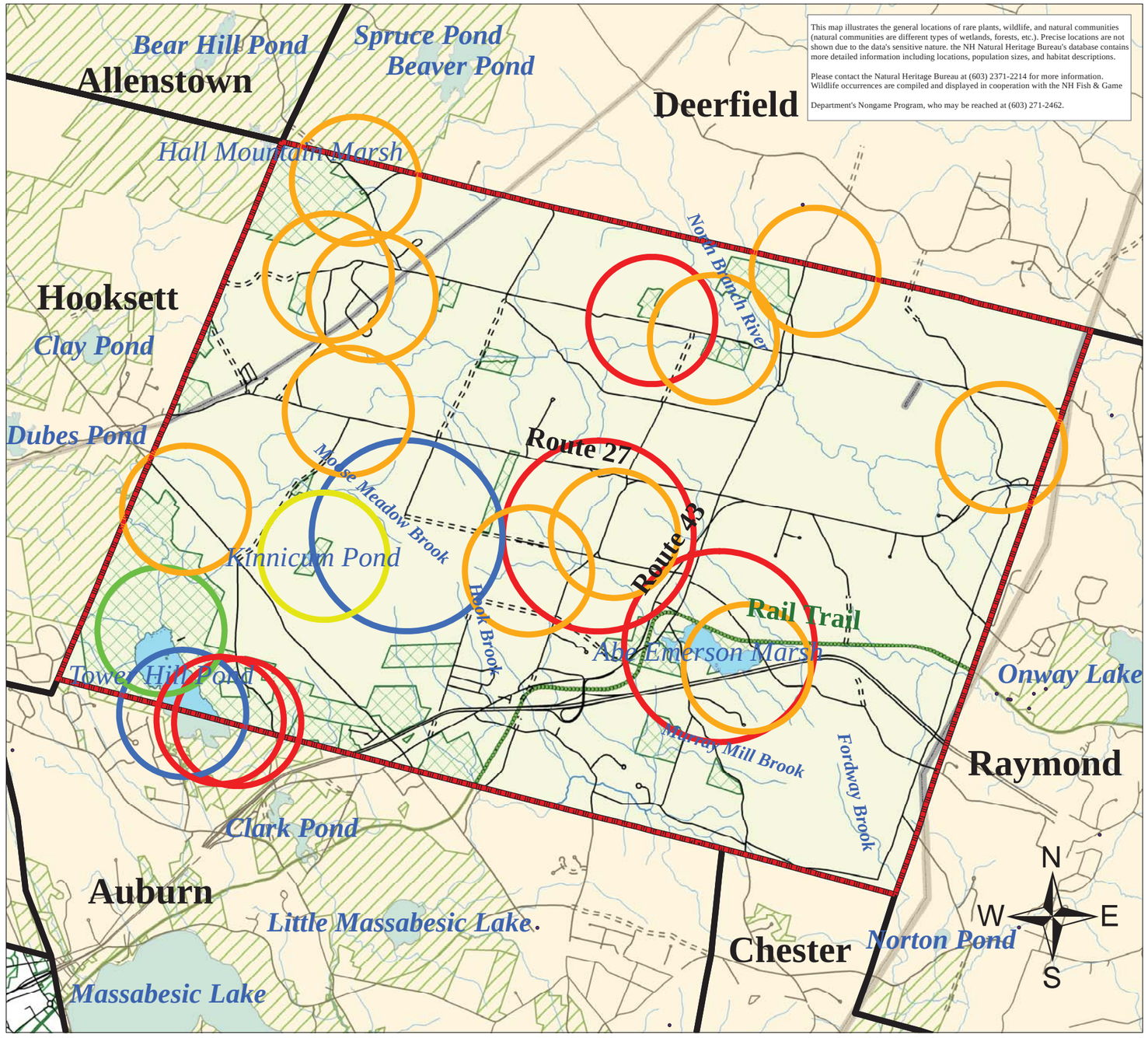
Table 9. List of known rare plants in Candia.

Species	Rarity Rank
barren strawberry	S1
downy false foxglove	S1
featherfoil	S1
prostrate tick trefoil	S2
slender blue flag	S2

Source: NH Natural Heritage Bureau database (January 2009)

S1 - State Endangered
S2 - State Threatened

Candia Natural Resource Inventory
Rare Wildlife, Plants, and Natural Communities



This map illustrates the general locations of rare plants, wildlife, and natural communities (natural communities are different types of wetlands, forests, etc.). Precise locations are not shown due to the data's sensitive nature. the NH Natural Heritage Bureau's database contains more detailed information including locations, population sizes, and habitat descriptions.

Please contact the Natural Heritage Bureau at (603) 2371-2214 for more information. Wildlife occurrences are compiled and displayed in cooperation with the NH Fish & Game Department's Nongame Program, who may be reached at (603) 271-2462.

- Candia Boundary

NH Natural Heritage

- Candia - Bird Species (1.0 mi. Dia Buffer)
- Candia - Plant Community (1.0 mi. Dia Buffer)
- Candia - Plant Community System (1.0 mi. Dia Buffer)
- Candia - Plant Species (1.0 mi. Dia Buffer)
- Candia - Reptile Species (1.0 mi. Dia Buffer)
- Candia - Bird Species (1.5 mi. Dia Buffer)
- Candia - Plant Species (1.5 mi. Dia Buffer)
- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- Streams
- Conservation and Public-owned Lands
- Conserved Lands in Adjacent Towns

0 0.5 1 Miles

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Latest Map Revision: June 29, 2011

Figure 9. Rare species and exemplary natural communities of Candia, NH. This map demonstrates the approximate location of rare wildlife and plants and exemplary natural communities that are known to exist. This does not reflect a comprehensive survey of such rare elemental occurrences.

Unfragmented Landscape

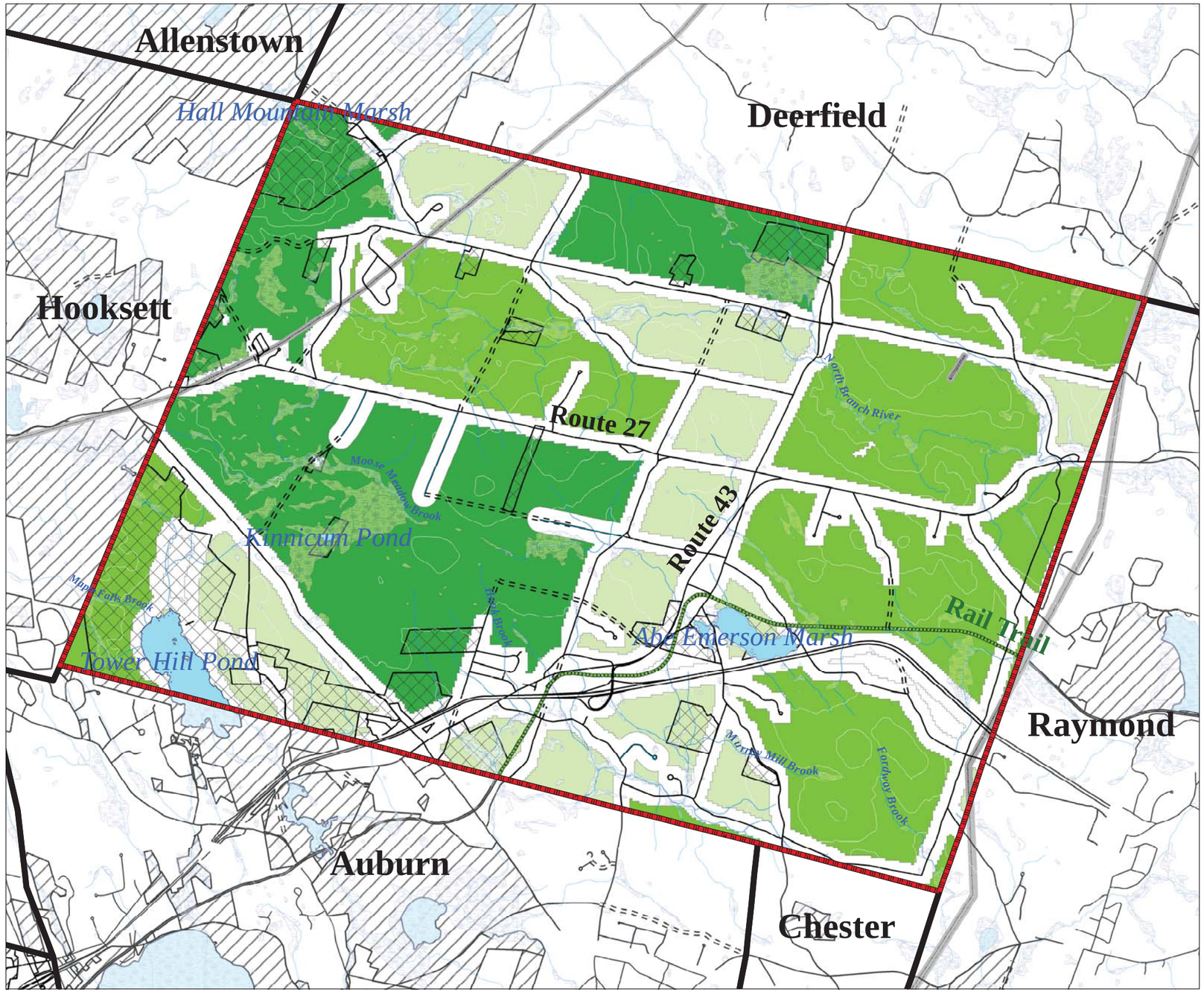
Fragmentation is an effect of human land use that divides our landscape into discrete blocks of land. This division of land occurs when roadways are created to support our built infrastructure (i.e., residential, commercial, industrial, and institutional developments). The continuous development of new roadways and fragmentation into large forested blocks can eventually create a mosaic of smaller unfragmented forest blocks that can no longer support robust biological communities. Furthermore, many types of wildlife need large unfragmented lands in order to survive and successfully reproduce, including bear, bobcat, and even small warblers such as the ovenbird.

When discussing fragmentation it is important to look at the big picture. Since our natural resources do not observe our political boundaries we must take into account the pattern and distribution of unfragmented blocks within Candia as well as the adjacent communities. This approach provides a better perspective for understanding species presence and ecological integrity of our landscape in light of our development patterns.

For the purposes of this project, fragmenting features were defined as 500 feet on either side of existing roadways, including all state and town roads but excluding Class VI roads and trails, as well as private driveways. This is the area where most developments occur in relation to roadways. Unfragmented blocks of land includes a variety of natural habitats such as forests, wetlands, streams, and ponds but also can include human-modified areas such as agricultural lands and shrublands.

Candia is characterized by approximately 25 unfragmented blocks of land greater than 25 acres, ranging in size from 45 acres to nearly 3,000 acres (Figure 10). This totals more than 13,000 acres of unfragmented blocks throughout the town. However, for conservation planning its best to consider their size and shape and how these unfragmented blocks extend into adjacent communities, especially as a means to collaboratively work on mutual conservation projects. To better understand the significance of the unfragmented landscape and associated wildlife, see Appendix C. This chart lists the habitat requirements of various wildlife species, as well as what you could expect to find within certain size ranges. This is an important tool to understand potential species of Candia and how fragmentation can impact species composition.

Candia Natural Resource Inventory
WAP Unfragmented Lands Map



- Roads
- Discontinued Roads
- Rail Trail
- Transmission Lines
- Lakes and Ponds
- National Wetlands Inventory
- Streams
- Conservation and Public-owned Lands
- Conserved Lands in Adjacent Towns

Unfragmented Lands
- Less Than 100 Acres
- 100 to 499 Acres
- 500 to 2500 Acres
- Greater Than 2500 Acres

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CANDIA NEW HAMPSHIRE

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Figure 10. Unfragmented lands of Candia, NH. This map shows the distribution and size range of unfragmented, contiguous forest patches with embedded wetlands. Roads, excluding Class VI, and private driveways serve as fragmenting features.

Agricultural Resources

Agricultural resources include important farmland soils that were determined to be the most productive for various agricultural activities. Not only are these resources important for food production, but they can function as critical wildlife habitats as well. Active farmlands also provide an aesthetic quality that helps to define the rural character of New Hampshire; a characteristic that many communities revere and seek to preserve.

These elements have been recently reinforced with the local foods movement across America that seeks to promote and support local farming activities. One such effort that has been underway for the past three years is the Monadnock Farm and Community Connection (MFCC), a program that is administered by the Cheshire County Conservation District in the southwest corner of the state. This program seeks to increase community awareness about the importance of local agriculture, which can in turn stimulate agricultural production in the region. To this end MFCC has engaged community volunteers, farmers, service providers and other professionals to better understand the mechanisms needed to help achieve this vision. One method in which this is being accomplished is through the volunteer-based work of three committees, including the Agricultural Inventory Committee, Infrastructure Committee, and Education Committee, that are working together with the MFCC Steering Committee.

In particular, the Agricultural Inventory Committee (AIC) has been working to gather baseline documentation on Cheshire County's existing and potential agriculturally-based activities using existing coarse-filter data. The Agricultural Resources and Land Use Mapping project was designed to better understand the distribution and type of current farmlands in the County, as well as areas of productive farmland soils and their current land use (i.e., active farmland, fallow farmland, managed grassland, forested, developed, protected open space). As such, this effort has focused on maintaining an ongoing list of active farms in each of the 23 towns in Cheshire County. Similar efforts could take place in Candia, as well as Rockingham County.

The results of this work may be used in a variety of formats, including:

- assisting towns and Agricultural Commissions with town-specific farmland data;
- informing our regional community on where to purchase local farm-related products;
- prioritizing the best agricultural lands on a town- and county-wide basis for conservation;
- incorporating agricultural information into the master planning process; and
- developing innovative land use planning techniques for agricultural lands on a local level.

In response to the Farmland Protection Policy Act of 1981[1], agricultural soils were mapped by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Based on a variety of physical and chemical properties (i.e., drainage, texture, hydric regime, pH, erodibility factor), these soils have been identified as being among the most productive lands for many types of farming practices. These include prime farmland soils, farmland soils of statewide significance, and farmland soils of local significance. Each is defined below by the USDA NRCS:

Prime Farmland

- Soils that have an aquic or udic moisture regime and sufficient available water capacity within a depth of 40 inches to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- Soils that are in the frigid or mesic temperature regime.
- Soils that have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches.
- Soils that have either no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to New Hampshire to be grown.

[1] As defined by the USDA NRCS: "The Farmland Protection Policy Act of 1981 was established to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses, and to assure that Federal programs are administered in a manner that, to the extent practicable, will be compatible with state, unit of local government, and private programs and policies to protect farmland."

- Soils that have a saturation extract less than 4 mmhoc/cm and the exchangeable sodium percentage is less than 15 in all horizons within a depth of 40 inches.
- Soils that are not frequently flooded during the growing season (less than a 50% chance in any year or the soil floods less than 50 years out of 100.)
- The product of the erodibility factor times the percent slope is less than 2.0 and the product of soil erodibility and the climate factor does not exceed 60.
- Soils that have a permeability rate of at least 0.06 inches per hour in the upper 20 inches.
- Soils, that have less than 10 percent of the upper 6 inches consisting of, rock fragments larger than 3 inches in diameter.

Farmland of Statewide Importance

Land that is not prime or unique but is considered farmland of statewide importance for the production of food, feed, fiber, forage and oilseed crops. Criteria for defining and delineating farmland of statewide importance are determined by a state committee chaired by the Commissioner, New Hampshire Department of Agriculture, Markets and Food, with members representing the University of New Hampshire Cooperative Extension, New Hampshire Association of Conservation Districts and the New Hampshire Office of State Planning. The NRCS State Soil Scientist serves on this committee in an advisory capacity. The original criteria were established on June 20, 1983. It was updated on December 7, 2000.

Soils of statewide importance are soils that are not prime or unique and:

- Have slopes of less than 15 percent
- Are not stony, very stony or bouldery
- Are not somewhat poorly, poorly or very poorly drained
- Includes soil complexes comprised of less than 30 percent shallow soils and rock outcrop and slopes do not exceed 8 percent.
- Are not excessively drained soils developed in stratified glacial drift, generally having low available water holding capacity.

Farmland of Local Importance

Farmland of local importance is farmland that is not prime, unique or of statewide importance, but has local significance for the production of food, feed, fiber and forage. Criteria for the identification and delineation of local farmland are determined on a county-wide basis by the individual County Conservation District Boards. The original criteria were established on June 20, 1983. Updates are noted according to the county initiating the update. The criteria for soils of local importance in Rockingham County are as follows:

- Soils that are poorly drained, have artificial drainage established and are being farmed.
- Specific soil map units identified from the NRCS county soil survey legend, as determined by the Conservation District Board.

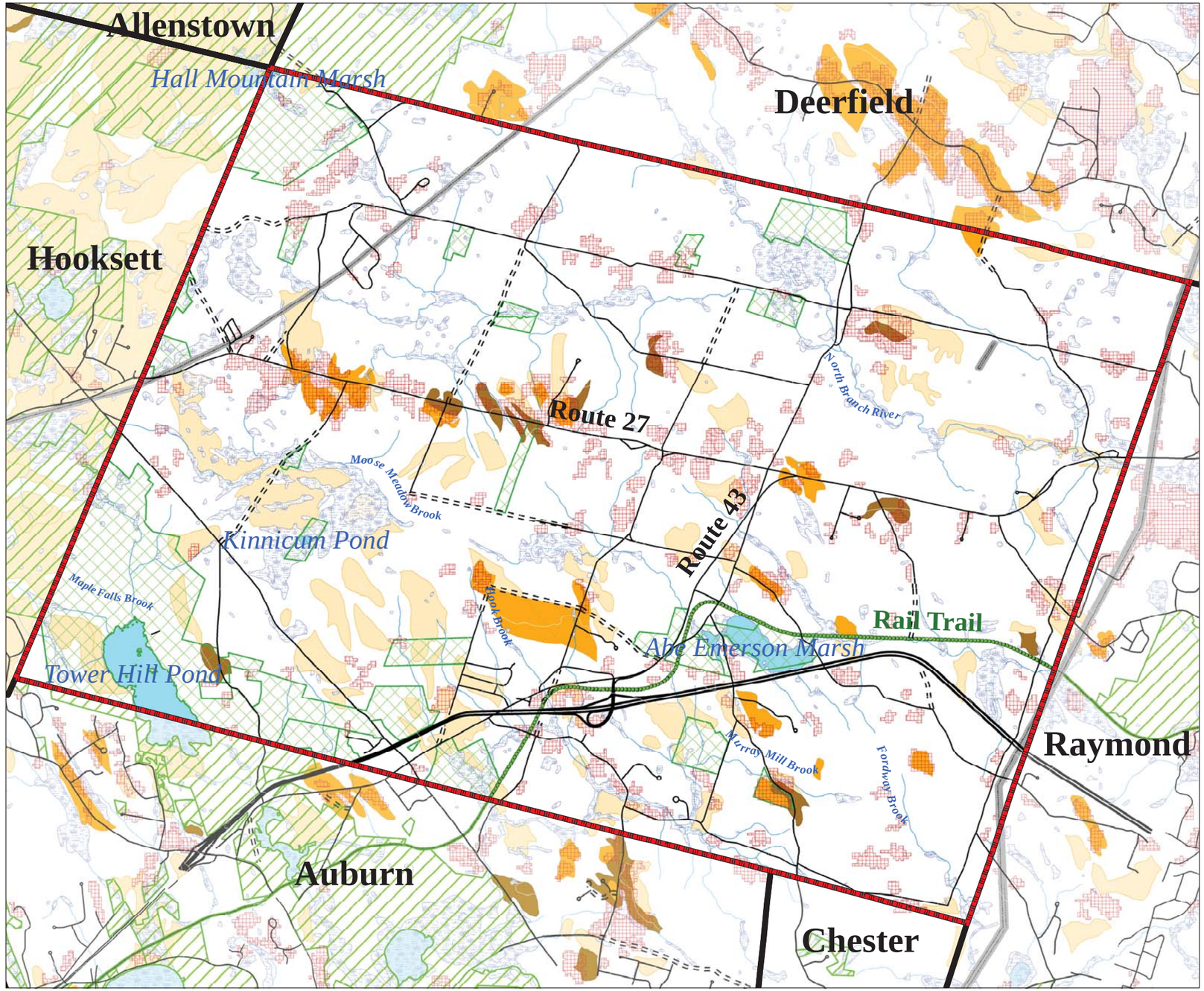
Agricultural soils cover approximately 2,182 acres, or roughly 11% of Candia (Table 10 and Figure 11). These soils are widely distributed throughout the town. Prime farmland soils make up about 19% of the total acreage of agricultural soils while farmlands of local and statewide significance total approximately 81% of these soils. From the map one can begin to understand which of these soils are in current farmland practices and which are currently conserved. These data can provide a first phase in agriculturally-based land use planning.

Table 10. Summary of significant agricultural soils in Candia.

Agricultural Resource Type	Size (acres)	% of Town
Agricultural Soils		
Prime Farmlands	406.2	2.1
Farmlands of Statewide Signficance	157.1	0.8
Farmlands of Local Signficance	1,618.6	8.3
Agricultural Land Use		
Pastures and Hayfields	1,489.6	7.6
Row Crops	3.6	0.02

SOURCE: GIS Analysis (Moosewood Ecological 2010) of USDA Natural Resources Conservation Service soils, Land Cover, and NH Wildlife Action Plan grasslands datasets from GRANIT

Candia Natural Resource Inventory
Agricultural Resources Map



Candia Boundary
Roads
Discontinued Roads
Rail Trail
Transmission Lines
Active Farmlands
Lakes and Ponds
National Wetlands Inventory
Streams
Conservation and Public-owned Lands
Conserved Lands in Adjacent Towns
Agricultural Soils
Prime farmland soils
Farmland of statewide importance
Farmland of local importance

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Latest Map Revision: June 29, 2011

Figure 11. Significant agricultural resources of Candia, NH. This map shows the distribution of prime farmland soils and other significant farmland soils, as well as active farmlands.

Forest Resources

Forest resources within New Hampshire are significant for many reasons. They provide sources of employment, a multitude of forest products, promote local economies, recreation and tourism, and provide substantial habitats for wildlife and plants, as well as diverse ecological functions (i.e., nutrient cycling, carbon sequestration, water quality maintenance through sediment trapping). For these reasons, it is important to maintain large tracts of forest lands and to better understand where some of the best forest soils exist in Candia.

The USDA NRCS has mapped the distribution of important forest soils and have classified them according to their capacity to grow trees. These soils signify areas as providing the most productive lands for timber production. The NRCS has identified three soils groups within this category and have described each as follows:

Forest Soil Class IA

This group consists of the deeper, loamy textured, moderately well, and well-drained soils. Generally, these soils are more fertile and have the most favorable soil moisture relationships. The successional trends on these soils are toward stands of shade tolerant hardwoods, i.e., beech and sugar maple. Successional stands frequently contain a variety of hardwoods such as red oak, beech, sugar maple, red maple, white birch, yellow birch, aspen, and white ash in varying combinations with red spruce, hemlock, and white pine. Hardwood competition is severe on these soils. Softwood regeneration is usually dependent upon persistent hardwood control efforts.

Forest Soil Class IB

The soils in this group are generally sandy or loamy over sandy textures and slightly less fertile than those in group IA. These soils are moderately well and well drained. Soil moisture is adequate for good tree growth, but may not be quite as abundant as in group IA soils. Soils in this group have successional trends toward a climax of tolerant hardwoods, predominantly beech. Successional stands, especially those which are heavily cutover, are commonly composed of a variety of hardwood

species such as red oak, red maple, aspen, paper birch, yellow birch, sugar maple, and beech, in combinations with white pine, red spruce, balsam fir, and hemlock. Hardwood competition is moderate to severe on these soils. Successful softwood regeneration is dependent upon hardwood control.

Forest Soil Class IC

The soils in this group are outwash sands and gravels. Soil drainage is somewhat excessively to excessively drained and moderately well drained. Soil moisture is adequate for good softwood growth, but is limited for hardwoods. White pine, red maple, aspen, and paper birch are common in early and mid-successional stands. Successional trends on these coarse textured, somewhat droughty and less fertile soils are toward stands of shade tolerant softwoods, i.e., hemlock and red spruce. Hardwood competition is moderate to slight on these soils. Due to less hardwood competition, these soils are ideally suited for softwood production. With modest levels of management, white pine can be maintained and reproduced on these soils. Because these soils are highly responsive to softwood production, especially white pine, they are ideally suited for forest management.

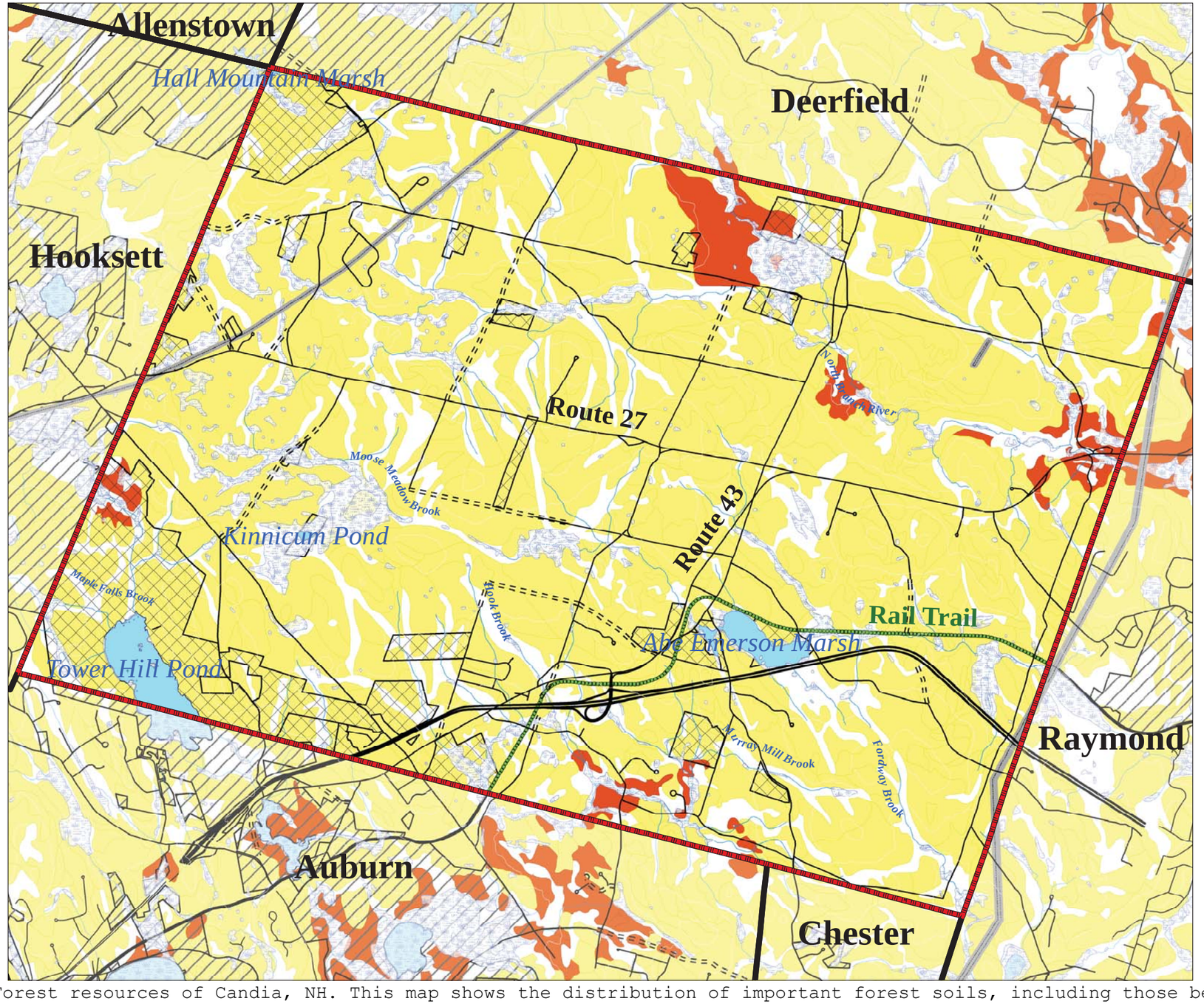
Significant forest soils cover approximately 14,855 acres, or 76% of Candia (Table 11 and Figure 12). Groups IA and IB make up the majority of the area (96%) and are most ideally suited for hardwoods. Group IC appear to be more restricted to stream drainages where outwash sands and gravels were deposited by glacial activity about 11,000 years ago. Group IC soils types are suited for softwood production, mainly white pine.

Table 11. Summary of significant forest soil resources in Candia.

Forest Soil Type	Size (acres)	% of Town	Primary Productivity
Group IA	4948.1	25.3	northern hardwoods
Group IB	9366.4	47.9	hardwoods
Group IC	540.8	2.8	pine, spruce, and hemlock

SOURCE: GIS Analysis (Moosewood Ecological 2010) of USDA Natural Resources Conservation Service soils dataset from GRANIT

Candia Natural Resource Inventory
Forest Resources Map



Candia Boundary
Roads
Discontinued Roads
Rail Trail
Transmission Lines
Lakes and Ponds
National Wetlands Inventory
Streams
Conservation and Public-owned Lands
Conserved Lands in Adjacent Towns
Forest Soils
Group IA and IB
Group IC

N
W E
S

0 0.5 1 Miles

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Latest Map Revision: June 29, 2011

Figure 12. Forest resources of Candia, NH. This map shows the distribution of important forest soils, including those best suited for hardwood and softwood production.

Conserved and Unprotected Open Space Parcels

Candia has a total of 10 tracts of conserved lands and 9 unprotected open space parcels, totaling 2,115 acres or approximately 11% of the town (Table 12 and Figure 13). The 10 tracts of conserved lands represent various levels of protection and ownership from public lands to private ownership. Nine out of the ten conserved lands are permanently protected. However, the Manchester Water Works lands have some form of protection since it is water supply lands. This level of protection could possibly change if Tower Hill Pond was discontinued as a water supply. Most of the unprotected open space parcels are owned by the town except the Natt Emerson tract. This property is owned by the Society for the Protection of NH Forests and abuts Abe Emerson Marsh protected by NH Audubon. *Please note that all conservation lands are not open to the public. Please inquire with the Town for a list of conserved lands that are open for public use.*

Table 12. Summary of conserved and unprotected public open space parcels in Candia.

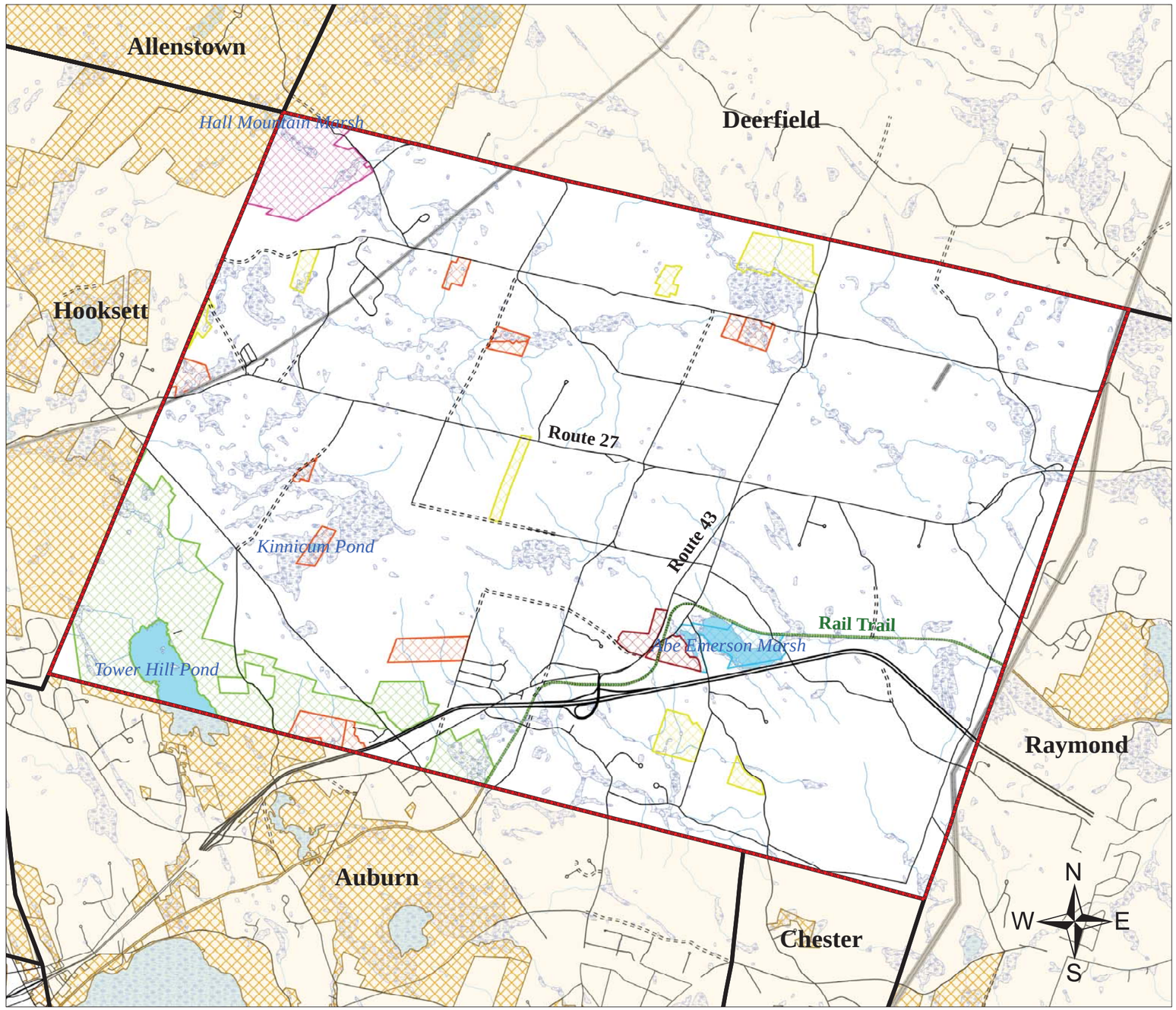
Open Space Parcels	Acres in Candia	Protection Level	Primary Protecting Agency
Abe Emerson Marsh	105.5	Permanent conservation land	NHA
Bear Brook State Park	292.4	Permanent conservation land	DRED
Natt W. Emerson Tract	34.1	Unprotected lands	not applicable
Manchester Water Works Land	1125.8	Water supply land	Town of Hooksett
Conserved Open Space (other)*	271.4	Permanent conservation land	various
Unprotected Open Space	286.2	Unprotected lands	not applicable

SOURCE: GRANIT Conservation Lands database (2009), Southern NH Planning Commission (2010), and Candia Conservation Commission (2011).

* Other conserved lands including public and privately-owned properties.

DRED = NH Department of Resources and Economic Development
NHA = NH Audubon

Candia Natural Resource Inventory
Conservation and Public-owned Lands



Candia Boundary
Surrounding Towns

Roads
Rt101
Discontinued Roads
Rail Trail
Transmission Lines
Lakes and Ponds
National Wetlands Inventory
Streams

Conservation and Public-owned Lands
Bear Brook State Park
Manchester Waterworks
NH Audubon Conservation Lands
Unprotected Open Space
SPNHF Conservation Lands
Conserved Open Space
Conserved Lands in Adjacent Towns

0 0.5 1 Miles

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Figure 13. Conservation and public-owned lands of Candia, NH. This map shows the distribution of conserved and unprotected open space parcels.

Priorities for Conservation

Co-occurrence Analysis and Landscape-level Considerations

To continue the process of identifying Candia's most significant areas in town, a co-occurrence model was generated in a GIS (Figure 14). A co-occurrence model is an analytical tool that uses spatial data to determine where various levels of natural resources occur in unison, or where they overlap. This analysis, in its simplest form, demonstrates low, medium, and high levels of co-occurring resources to assist in the identification of "hotspots" for conservation. Essentially, it helps to prioritize conservation planning efforts to help maximize economic, social, and ecological benefits.

While the co-occurrence model is an effective tool for an initial analysis it should be used in combination with an ecological interpretation of Candia's landscape to aid in the identification of conservation focus areas (CFAs). It should consider many landscape-level attributes, including wildlife movement and habitat connectivity, ecological reserve design and proximity to protected lands, unfragmented lands, development pressure, land ownership patterns, and current land use. It should also incorporate the presence and distribution of rare species and the clustering effect of ecologically significant habitats (ESHs) that occur in close proximity to one another.

These landscape-level considerations aid in a more comprehensive approach that recognizes large-scale habitats and ecological processes within the built and natural environments. When these elements are considered in combination with the distribution of currently protected lands then a more successful conservation plan can be prepared to help maximize and sustain biodiversity protection for the long-term.

One major landscape-level consideration includes the size and distribution of unfragmented lands in Candia (Figure 10). These areas are defined by the surrounding human infrastructure (roads and developed areas) and can negatively affect species survival rates, including mortality or lowered rates of breeding success. The degree of severity of fragmentation depends upon many aspects, such as the size and shape of unfragmented block, the species or community in question, the extent of loss of natural habitats, intensity of human use, and colonization of invasive species.

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

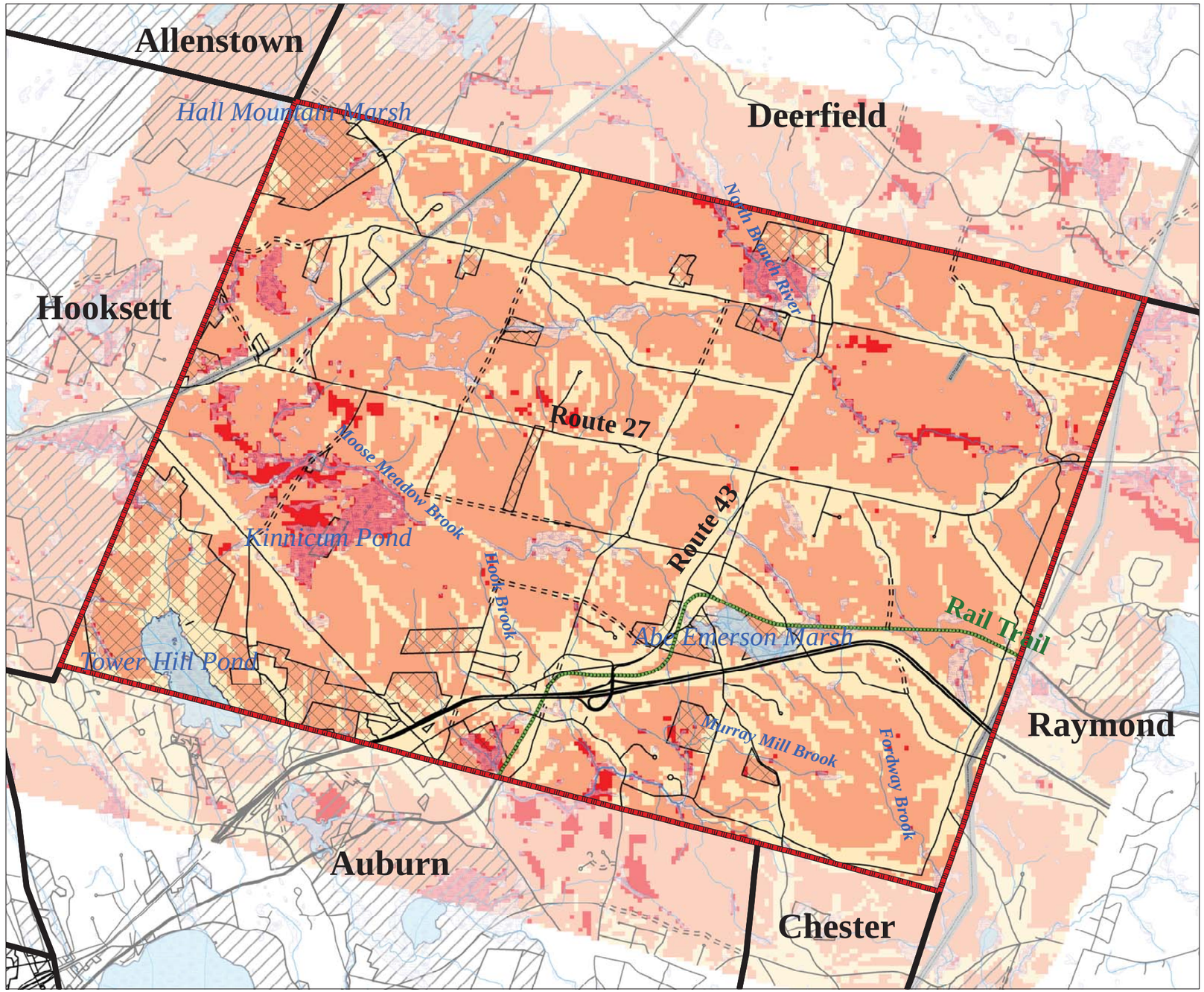
Another function of large landscapes considers wildlife movement and habitat connectivity. By maintaining connectivity between critical habitats it may be possible to provide permanent wildlife corridors within the built environment. Wildlife travel corridors function as areas that one or many species may use to move from one habitat to another. This movement can be based on traveling to various areas for feeding, breeding, nesting, or shelter. Wildlife must be able to travel safely throughout the landscape in order to meet their biological needs. Many depend upon a variety of habitats for their survival and may utilize many natural features for travel. These may include features such as riparian zones of wetlands, ponds, and streams, ridgelines, utility right-of-ways, and forest patches acting as a safe route between two or more habitats. A variety of wildlife can be associated with these corridors, including otter, muskrat, fox, coyote, bobcat, deer, moose, fisher, mink, beaver, and bear.

Corridors are not only significant for mammals but equally as important for amphibians, reptiles and migratory birds. Both amphibians and reptiles begin to move from their wintering habitats to their respective breeding and nesting grounds in the spring. This is the time of year that most mortality can be noticed as these species travel across roadways in search of suitable habitats. This affect can often be exacerbated as the same individuals must return back to their wintering habitats. Thus, there is a great significance in maintaining habitat connectivity, as well as understanding where these patterns of movement are taking place. This latter point can be a very important educational tool for community education and awareness about corridors across

roadways. It can provide a means to adjust transportation patterns to help eliminate potential road mortality.

Another consideration to take into account when developing priorities for conservation is the distribution of currently protected lands (Figure 13). This affords the opportunity to understand how various fine- and large-scale ecological attributes are arranged on the landscape and how they coincide with protected areas to best prioritize for conservation initiatives. This informed land use planning effort helps to determine how Candia can link significant areas with those parcels that have development constraints, as well as how and where to create larger reserves. These are the basic ideas of ecological reserve design that help to maximize conservation values and ensure that representative ecologically significant habitats (ESHs) are included for protection strategies.

Candia Natural Resource Inventory
Co-occurrence Map



Candia Boundary
Roads
Discontinued Roads
Rail Trail
Transmission Lines
Lakes and Ponds
Streams
National Wetlands Inventory
Conservation and Public-owned Lands
Conserved Lands in Adjacent Towns

VALUE
0 - 3
4 - 7
8 - 11
12 - 14

N
W E
S

0 0.5 1 Miles

CANDIA NEW HAMPSHIRE

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Latest Map Revision: June 29, 2011

Figure 14. Co-occurrence analysis of ecological data for Candia, NH. This map shows hotspots where ecological attributes overlap. The darker red coloration indicates greater overlap, or co-occurrence, of these resources. Conversely, the lighter the shade of red indicates fewer co-occurrences.

Conservation Focus Areas (CFAs)

In consideration of the co-occurrence analysis, clustering effect of diverse habitats, and other landscape-level attributes of Candia, a total of five large-scale primary CFAs have been identified as having high priorities for conservation (Figure 15). Through this analysis, these primary CFAs represent some of the best areas to expand upon conservation initiatives in Candia due to their associated natural resources and contributions to biological diversity. The five primary CFAs include:

- Tower Hill Pond area
- Kinnicum Pond area
- Murray Mill Brook wetlands and riparian corridor
- North Branch River wetlands and riparian corridor
- Fordway Brook watershed

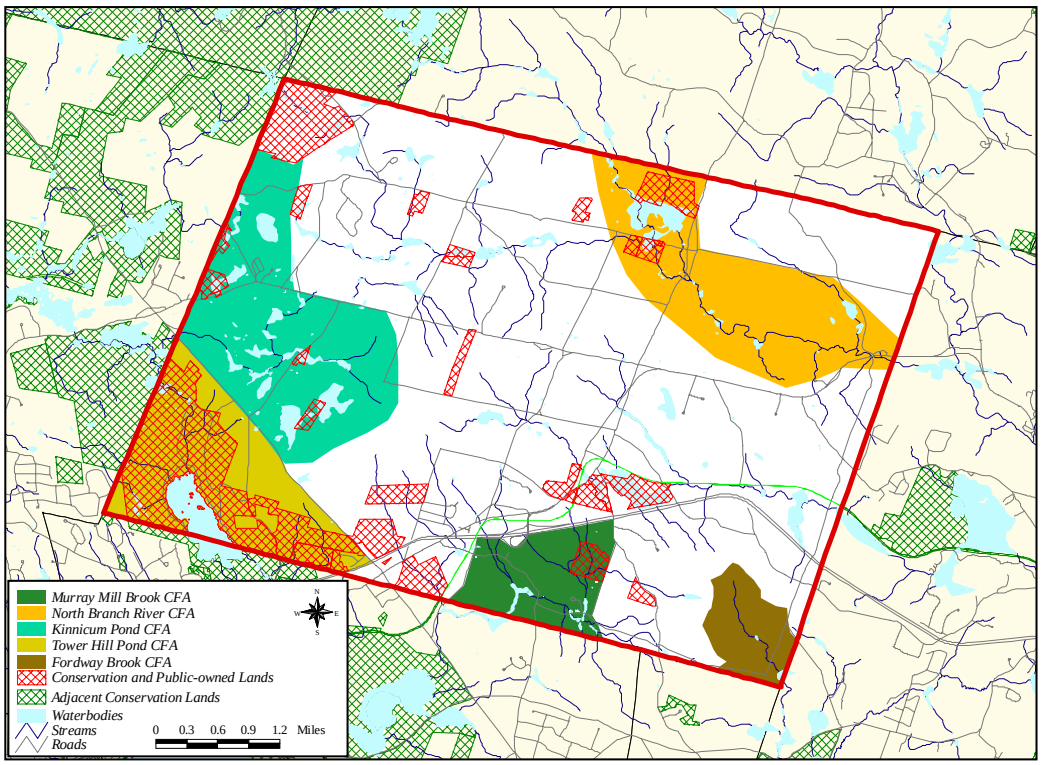

Figure 15. Primary Conservation Focus Areas (CFA) in Candia, NH. This map shows the general area of each of the proposed CFAs.

The identification of these areas as having the highest priorities for conservation is also supported by other regional and state conservation plans, including the Bear-Paw Regional Conservation Plan (2008), Land Conservation Plan for NH's Coastal Watersheds (2006), and NH Wildlife Action Plan (2010 revised). The Wildlife Action Plan (2010 revised) rankings have identified priorities for conservation on a state-wide scale and are applicable for regional conservation planning as well. They are also helpful in town-wide planning but should be used as a guide while incorporating co-occurrence analyses, important landscape attributes, and site-specific assessments. This is because at the town-level one can incorporate more specific and detailed data that might not have otherwise been considered for the state rankings.

It should not be construed that these are the only areas worthy for natural resources protection. Many other areas in town, especially those that may contain rare species and habitats, also deserve attention. Rather, these areas represent some of the best places to further conservation efforts on a large scale. It is also believed that these CFAs may offer the best economic return in terms of natural services supplied, such as maintaining clean water, reducing flood hazards, and providing exceptional wildlife habitat. Refined analyses and on-site ecological investigations may provide data that can identify future priorities that the Town can add to this list of priorities. As such, identifying priorities for conservation is a continual process that should be refined over time.

RECOMMENDATIONS

The information provided herein, including the various maps, should be used when considering the adoption of various land use planning techniques. The data used to develop such information represents the most current, readily available data to better understand Candia's natural resources. As such, there are some basic guidelines that the Town can use to promote innovative and informed land use planning.

- protect large unfragmented blocks, especially those with high quality habitats located within close proximity of one another and with limited barriers for wildlife movement;
- protect known rare species populations;
- protect representative examples of ecologically significant habitats for known rare species;
- protect rare and representative examples of natural communities;
- protect intact wetland and stream riparian buffers and promote the restoration of degraded areas;
- support voluntary and regulatory approaches at natural resources protection;
- build upon existing contiguous protected lands;
- connect protected lands and other critical habitats with upland, aquatic, and/or riparian corridors;
- better understand wildlife movement patterns to identify and design the most effective conservation corridors; and
- promote community education and outreach regarding Candia's biodiversity and the importance of long-term protection strategies

The following general recommendations have been provided based on the findings of the natural resources inventory. These are considered as the next action steps that Candia should consider as they proceed with community land use planning.

1. Prepare a parcel-based GIS ecological assessment model to rank parcels according to their natural resource values.
2. Conduct field-based NRI to verify the NH Wildlife Action Plan habitats and to document species presence (with an emphasis on species of conservation concern), rare and exemplary natural communities, and fine-scale critical wildlife habitats (i.e., vernal pools). Special emphasis may focus on high priority parcels after the parcel-based assessment model has been completed.

3. Conduct a town-wide comparative evaluation of wetlands to better understand those that possess exceptional high functionality. This effort could be performed in conjunction with Recommendation #2 for better efficiency in data collection and better value for services provided.
4. Incorporate the NRI and subsequent Open Space Plan (currently being prepared by the Southern NH Planning Commission) into the town's Mater Plan.
5. Conduct an audit of current zoning regulations to better understand if and how they protect critical natural resources. This effort can illuminate certain land use planning techniques that the Town might want to consider adopting in an effort to develop informed land use decisions for a more sustainable future. This could identify ways to use land more efficiently, encourage more compact development, and allocate specific areas for conservation and development.
6. Continue to work with adjacent communities on similar conservation initiatives of common interest. It is helpful to meet with the Conservation Commission within each of the adjacent communities to build strong relationships and create open lines so communication, as well as to inform these communities about Candia's conservation planning efforts.
7. Continue with community outreach and education regarding Candia's natural resources and conservation planning. Topics could include and expand upon those identified during the second community forum as outlined above.

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APPENDIX A

COMMUNITY FORUM I RESULTS

Candia Natural Resources Inventory
Forum I Activity Results

November 5, 2009
Candia Town Hall
Candia, NH

Evening activities hosted by the Candia Conservation Commission and Moosewood Ecological LLC

Activity 1 - Strengths and Challenges Discussion

Guiding Questions:

1.) What are the strengths of Candia's natural resources and working lands (forestry and agriculture)?

2.) What are some of the challenges and concerns facing these resources?

For both questions consider the social, political and physical characteristics of Candia

Results:

Strengths

- **Much open/forested land available**
- **Prime agricultural soils**
- **Many wetlands supporting diverse functions (wildlife, clean water, flood control)**
- **Significant stratified drift aquifers**
- **Large unfragmented blocks**
- Steep slopes
- Diverse wildlife that helps to maintain healthy ecosystems
- **Active and functional Conservation Commission**
- **Lands supervised by Conservation Commission**
- Trails/open land and potential to connect with regional network
- Agricultural group
- Interest in forming an Agricultural Commission
- Agricultural heritage

- Not yet overly developed
- Importance of headwater streams
- Outdoor recreation – access to Bear Brook, Manchester Water Works lands, railroad bed network
- Stone walls – historical heritage
- Town Forests
- Natural beauty
- **Water**
- Biodiversity
- Proximity to Bear Brook, Tower Hill, Lake Massabesic
- **Rural character and willingness to maintain as such**
- **Topography**
- Access to major roads, cities, beach, mountains, airport
- Community spirit
- Hobby Farms

Challenges

- **Commercial/industrial zone on steep slope to North Branch River**
- **3-acre zoning**
- **No conservation subdivision**
- Public involvement – difficult to communicate/educate
- **Lack of communication between boards**
- Steep slopes
- **No soil- or water-based zoning**
- Lack of commercial/industrial businesses
- Transient population – younger people moving away
- Lack of connection to the land
- **Lack of appreciation or understanding of importance of natural resources**
- **No town administrator – lack of government continuity**
- Rocky soils
- Small amount of permanently protected lands
- Need to map and maintain trail network
- Development pressure
- Maintaining rural character
- Architectural standards
- Encourage volunteerism
- Limited farming potential – thin, rocky soils
- Lack of understanding of importance of wetlands
- Lack of local meeting place (diner, café)
- **No central community place**
- Limited amount of common land
- **Respect for private property rights**
- Lack of community water and sewer
- **Controlling tax burden on large land owners**

Activity 2 - Candia's Significant Natural Areas

Guiding Questions:

1.) What are some of Candia's most significant natural areas?
2.) What makes them so special?

Results:

- Kinnicum Pond: large unfragmented block and fen
- Emerson Marsh
- Sochas Pond
- Rail Road beds
- New Boston Road wetlands: habitat and flood control
- Ward Brook wetlands: habitat and flood control
- Northwest corner: rattlesnake habitat, steep slopes, wetlands, Bear Brook State Park, Blanding's turtles
- Candia-Deerfield town line area: state recognized valuable area
- Fogarty Road area: historical sites
- Moose Meadow
- Southeast corner: 3 watersheds, part of Coastal Plan, esker, steep slopes
- Southwest corner: Manchester Water Works, Tower Hill Pond
- Current/past farmlands not subdivided
- Northeast corner: river, trails, large parcels
- North Branch River

APPENDIX B

GIS DATA SOURCES

Appendix B. Basic GIS Data and Sources for Candia NRI Maps.

Basic Data Layer	Source(s)	NRI Theme Maps
Town Boundaries	United States Geological Survey	all
Roads	NH Deptartment of Transportation	all
Conservation Lands	Society for the Protection of NH Forests	all
Watersheds	US Dept. of Agriculture Natural Resources Conservation Service and NH Dept. of Environmental Services	Water Resources
Surface Waters (ponds and streams)	United States Geological Survey	all
National Wetlands Inventory (NWI)	US Fish and Wildlife Service	all
Hydric Soils	US Dept. of Agriculture Natural Resources Conservation Service	Water Resources
Stratified Drift Aquifers	United States Geological Survey	Water Resources
Potentially Favorable Gravel Well Analysis	NH Dept. of Environmental Services	Water Resources
WAP Wildlife Habitats	NH Fish and Game Dept.	Ecological Resources
Riparian Areas	Moosewood Ecological	Ecological Resources
Steep, South-facing Slopes	Moosewood Ecological	Ecological Resources
Active Dams	NH Dept. of Environmental Services	Ecological Resources
Rare Species and Natural Communities	NH Natural Heritage Bureau	Ecological Resources
Unfragmented Lands	NH Fish and Game Dept.	Ecological Resources
Agricultural Soils	US Dept. of Agriculture Natural Resources Conservation Service	Agricultural Resources
Forest Soils	US Dept. of Agriculture Natural Resources Conservation Service	Forest Resources

APPENDIX C

HABITAT BLOCK SIZE REQUIREMENTS FOR WILDLIFE

Habitat Block Size Requirements For Wildlife

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