Natural Resource Inventory and Conservation Strategy

Town of Exeter, New Hampshire

March 2012

Neatline Associates
63 Nottingham Road
Deerfield, NH
www.nhgis.com

with

WEST ENVIRONMENTAL INC.

Ibis Wildlife Consulting

Acknowledgements

Neatline Associates wishes to thank the Exeter Conservation Commission for funding this project. We are also grateful to the many individuals, including Sara Callaghan, Mark West, and Ellen Snyder, who provided input and assistance. Thanks are especially due to the members of the committee that guided this work:

Don Briselden
Gwen English
Carlos Guindon
Maggie Matick
Kristen Murphy
Pete Richardson
Katherine Woolhouse

Disclaimer

This project and the GIS analyses it contains were conducted with the best data sets that were publicly available at the time of the project. Most of these data sources were developed by state and federal agencies (such as NH Department of Environmental Services, NH Department of Fish and Game, US Geological Survey, etc.) and were distributed by NH GRANIT, NH's statewide GIS clearinghouse. These datasets are developed at various scales, usually 1:24,000 or smaller, and are suitable for regional studies for planning purposes. In particular, the tax parcel boundaries, provided by Cartographic Associates, must be understood to be approximate and not legal boundaries. These and all data sets referenced in this project are not appropriate for site-specific purposes, legal boundary definition, regulatory interpretation or property conveyance purposes. Neatline Associates LLC makes no claims, no representations, and no warranties, express or implied, concerning the validity, reliability, or accuracy of these data and data products, including the implied validity of any uses of such data.

Contents

Executive Summary 1
Introduction 2
Purpose 2
Methodology 2
Natural Resource & Co-occurrence Mapping 3
Surface Water Resources 3
Drinking Water Resources 7
Wildlife 8
Agriculture 15
Forests 17
Full Natural Resource Composite 19
Development Analysis 22
Methodology 22
Development Patterns since 2005 22
Development Constraints Analysis 23
Analysis of Resource Risk 25
Methodology 25
Resource Risk 25
Conclusions and recommendations 27
Regulatory Controls 28
Non-Regulatory Controls 29
Appendix A. GIS Data Sources and Methodology 32
Co-occurrence Mapping Model 32
Development Analysis 36

List of Figures

Figure 1. Natural Resources Focus Areas: Percent of Land in Conservation 20
Figure 2. Recently subdivided parcels 23
Figure 3. Natural Resource Focus Areas: Development Potential 26

List of Tables

Table 1. Exeter's Named Streams 4

Table 2. Exemplary Communities and Rare Plants and Animals..... 12

Table 3. Important Agricultural Soils 16

Table 4. Summary of Focus Areas 21

Table 5. Summary of Core Composite Areas within the Focus Areas..... 21

Table 6. Acres of Available Land by Zoning District 24

Table 7. Focus Areas that are Available and Suitable for Development..... 27

List of Maps

Map 1. Water Resources

Map 2. Wildlife

Map 3. Agricultural Resources

Map 4. Forest Resources

Map 5. Conservation Lands

Map 6. Surface Water Sub-Composite

Map 7. Drinking Water Sub-Composite

Map 8. Wildlife Sub-Composite

Map 9. Wildlife Corridors

Map 10. Agriculture Sub-Composite

Map 11. Forest Sub-Composite

Map 12. Composite: All Resource Areas

Map 13. Development Potential

Map 14. High Resource and Development Risk

Executive Summary

This Natural Resource Inventory and Conservation Strategy was conducted in 2011 and early 2012 in order to provide the Town of Exeter with an up-to-date analysis of its natural resources and development risks, and to suggest strategies for improving the protection of its richest resource areas. The project resulted in 14 large format maps, a suite of geographic data, and this report.

The first phase of the project was the mapping of the town's natural resources, broadly categorized as water resources, wildlife, agricultural resources, forest resources, and conservation lands. These natural resources base maps are presented in Maps 1 – 5.

The natural resources were then analyzed through a series of co-occurrence analyses to determine where multiple important resources overlay each other. A sub-composite co-occurrence analysis was conducted for each of five resource areas: surface water, drinking water, wildlife, agriculture and forests. The most important regions for each resource – that is, those places where the most individual layers overlay each other – formed resource focus areas. For example, the wildlife focus areas are made of up of those places where important habitats occur, rare species have been found, and which the statewide wildlife study has ranked as important. The resulting focus areas from all five sub-composite analyses were compiled in a final co-occurrence analysis. The most important regions from this final co-occurrence represent the town's richest natural resource areas and form the core of the study's fourteen final focus areas. The natural resource co-occurrence analyses are presented in Maps 6 – 12.

This project also evaluated the town's development environment, reviewing which areas have been developed in recent years and which areas are currently available and likely candidates for future development (Map 13). It found that recent developments did not occur in any one part of town or on parcels with any particular suite of characteristics (such as size, sewer availability, etc.). Much of the town is, in fact, not available for further development, either because it is already developed or because it is in some form of conservation land. A significant portion of the remaining area is not conducive to development because it is wetland, shoreland, aquifer, or floodplain. The remaining areas – those that are available for development and have the appropriate physical characteristics – are likely to face significant development pressure as the town's population continues to grow.

Those areas where development is most likely were compared with the final natural resource focus areas to identify which resource areas are most at risk (Map 14). While a portion of each focus area is already in conservation, there are also a number of parcels with highly favorable development characteristics within most focus areas. Several of these high resource value/high development risk parcels are also adjacent to existing conservation land. These areas can be considered first priorities and key opportunities for future conservation efforts.

Finally, a number of recommendations are presented to help the town maximize the protections afforded its natural resources as it grows in the future. These include placing conservation easements on town-owned properties, expanding conservation efforts aimed at protecting public drinking water supplies, and evaluating the effectiveness of existing land use controls.

Introduction

Purpose

This project was initiated and funded by the Town of Exeter Planning Department and Conservation Commission to expand upon and update previous work, such as the 2004 Conservation and Preservation chapter of the Exeter Master Plan, the 2005 Prime Wetland Report, and others. Its purpose is to map the current conditions of the town's natural resources, identify resource-rich focus areas, evaluate development trends, and inform an updated strategy for implementing conservation planning.

Methodology

This project was divided into five broad sections:

- Natural Resource Mapping. Maps were prepared to illustrate the town's water resources, wildlife, agricultural resources, forest resources, and conservation lands (Maps 1 – 5)
- Co-occurrence mapping. Resource-rich focus areas were identified by conducting co-occurrence analyses of important natural resources. Five sub-composite co-occurrence maps were created to identify resource-specific focus areas for surface water, drinking water, wildlife, agriculture, and forests. The resource-specific focus areas identified by the sub-composite analysis were then combined in a final co-occurrence analysis to yield a full composite map and final focus areas. (Maps 6 – 12).
- Development Analysis. Lands that are available for development (not currently developed or in conservation) and suitable for development (are not wetlands, buffers around wetlands, or within the Shoreland Protection District) were identified. These lands were compared to the tax parcel boundaries and roads to locate parcels that have large areas that are both available and suitable for development, and then to locate which of these also have road frontage (Map 13).
- Development Risk Analysis. The final natural resource focus areas were compared with the lands that are available and suitable for development to identify those areas where resources are most at risk (Map 14).
- Conservation Strategies. Final focus areas were evaluated for their percentage of land in conservation, percentage of land available and suitable for development, and proximity to existing conservation land to identify the highest priority areas for conservation. Potential wildlife corridors were also identified, as well as those points where potential corridors cross roads resulting in wildlife fatalities.

Please see Appendix A for a complete description of the GIS methods used in this study.

Throughout its work on this project, Neatline Associates was guided by input from a project committee and the town's Natural Resource Planner. The committee's first meeting was in April 2011 to review the Natural Resource maps and to determine the inputs and weighting methodology for the co-occurrence analysis. At this time, the committee decided the specific components and criteria that would be used for the co-occurrence analysis. It agreed on using

the following sub-composites: Wildlife, Surface Water, Drinking Water Quality, Agriculture, and Forests. The committee also decided that it preferred to follow a simple co-occurrence methodology, generally assigning one "point" to each input, rather than weighting the inputs differently according to a complex set of preferences. It was felt that this method would be more transparent, easier to explain, and easier to replicate. The committee met again in September 2011 to review the first co-occurrence maps. In December 2011 Neatline presented the preliminary results to the Conservation Commission. The committee met again in February 2012 to discuss final revisions. A final public presentation of the results will be scheduled for April 2012.

Natural Resource & Co-occurrence Mapping

Surface Water Resources

The town of Exeter is uniquely rich in surface water resources, containing a tidal river, fresh water rivers and streams, and significant wetlands. Map 1 describes the town's surface waters as well as the drinking water resources, which are described in more detail in the next section. Map 6 illustrates the surface water resources sub-composite overlay. For a more thorough description of the town's water resources, please see the Water Resources chapter of the 2004 Master Plan Update.

Watersheds

Most of the town lies within the Salmon Falls-Piscataqua River major drainage basin. Three major subwatersheds within Exeter are part of this drainage basin: Piscassic River, Exeter River, and Squamscott River. A small portion (172 acres) of the southeastern corner of town falls within the Coastal drainage basin. Ash Brook flows southerly from Exeter as part of the Taylor River-Hampton River subwatershed within the coastal drainage.

Lakes & Ponds

While a number of small ponds dot the landscape, there are few larger bodies of open water. Only the Exeter Reservoir (26 acres), Colcord Pond (12 acres), and the Exeter Holding Pond (8 acres) exceed two acres. The Exeter Reservoir is an impounded water body on Dearborn Brook, which drains into the Squamscott River. The reservoir is used to augment the municipal water supply. The Exeter Holding Pond (aka Clemson Pond) is also impounded and within the Squamscott drainage. Colcord Pond is an impounded water body associated with the Little River. The other small ponds include the 1.0 acre Brickyard Pond in the Little River subwatershed and the 2.0 acre Jude's Pond in the Exeter River watershed; both are free-flowing.

Streams and Riparian Corridors

There are 18 named streams (totaling 30.7 miles) and 24 unnamed streams (totaling 28.6 miles) in the town. The largest are:

Table 1. Exeter's Named Streams

Sub-watershed	Name	Maximum Stream Order (in Exeter)	Length (Miles)
Piscassic River	Beech Hill Brook	1	1
	Fresh River	2	1.7
	Piscassic River	4	0.5
Little River	Scamen Brook	2	1
	Bloody Brook	3	2
	Dudley Brook	4	0.8
Exeter River	Cove Brook	2	1.6
	Perkins Brook	2	0.9
	Little River	4	6.2
	Great Brook	4	0.3
	Exeter River	5	5.9
Squamscott River	Dearborn Brook	2	1
	Rocky Hill Brook	2	1
	Norris Brook	3	1.7
	Wheelwright Creek	3	1
	Parkman Brook	3	0.1
	Squamscott	5	3.4
Coastal Drainage	Ash Brook	2	0.6

Stream order classifies streams according to their size and position in the watershed. A first order stream is the smallest "headwater" stream with no tributaries. When two first order streams come together they form a second order stream. When two second order streams converge, the downstream section is classified as a third order stream, and so on. The ordering of streams is best observed by looking at each subwatershed. For example, within the Piscassic River watershed, the first order Beech Hill Brook flows into the second order Fresh River, which in turn flows into the fourth order Piscassic River. The fourth order Little River and Great Brook both flow into the fifth order Exeter River. Several second and third order streams flow into the fifth order Squamscott River.

Streams and rivers, including the smaller brooks and creeks, provide important habitat for aquatic organisms as well as for upland wildlife. Water flowing from the land into a river or stream carries insects, leaves, soil, branches, and other material that are the start of a food chain. This exchange between land and water occurs in a transition zone along the edges of stream channels, called a **riparian area**. Maintaining connectivity between stream channels, stream bottoms and banks, and the riparian area is important to protect water quality and aquatic habitats.

In 2007, the Complex Systems Research Center at the University of New Hampshire completed a characterization of 2nd order and higher streams within the Piscataqua and Coastal drainages. A suite of anthropogenic factors, including land use, impervious surface coverage, and transportation infrastructure, within standard buffers around each stream segment were analyzed to identify the status of each stream. Each stream segment was buffered by 150' to support water quality analyses and by 300'to support habitat analyses. The buffer/land use composites were then categorized based on the degree to which each buffer was impacted by human activity. Stream segments were identified as Intact (<10% impacted), Mostly Intact (10-25% impacted), Somewhat Modified (25-50% impacted), or Altered (>50% impacted). The buffer characterizations are depicted on Map 1a. Some of the most intact stream buffers are found in the upper reaches of the Little River subwatershed. Town-wide, nearly 75% of the analyzed stream buffers are considered intact or mostly intact.

The water quality of the Exeter River is especially important as it is the primary municipal drinking water supply for the town. The Exeter/Squamscott Rivers and the Piscassic River (a short stretch of which flows through the northwest corner of the town) are "designated rivers" within the NH Rivers Management and Protection Program (RMPP). The primary benefits of the river designation include protections against locating a solid or hazardous waste site in the river corridor, some instream flow protective measures, promoting public interest and respect for the river and its stewardship, and a local advisory committee that helps guide multi-town river corridor planning. The upper section of the Exeter River was designated in the RMPP in 1995, with the lower section and the Squamscott River designated in 2011. The Piscassic River was included in the designation for the Lamprey River and its tributaries in 2011. The nomination reports that were prepared for these designations have extensive information about these rivers and can be viewed online at
http://www.des.state.nh.us/organization/divisions/water/wmb/rivers/desigriv.htm

Floodplains

Floodplains as shown on Map 1 correspond to areas of 100-year flooding as delineated by the Federal Emergency Management Agency (FEMA). The floodplain mapping along with the adoption of a town floodplain ordinance (which Exeter has done) allows a town to participate in the National Flood Insurance Program (NFIP), which in turn allows residents living in flood hazard areas to purchase flood insurance at low cost.

Floodplains are also ecologically important areas. The periodic floods that occur in these low-lying areas help recycle sediments and nutrients, creating rich soil deposits that often support unique plant communities. Undeveloped floodplains are also important in controlling erosion, buffering against catastrophic flooding, and serve as significant habitat and travel corridors for wildlife. The major floodplains in Exeter are associated with the major rivers: Piscassic, Little, Exeter, and Squamscott.

Wetlands & Prime Wetlands

In 1979, the U.S. Fish & Wildlife Service (USFWS) published a classification of wetlands and deepwater habitats (Cowardin et al. 1979) based on the types of plants (hydrophytes) and soils (hydric soils), and the frequency of flooding. The hierarchical classification starts with the major systems: lacustrine (lakes and ponds), palustrine (forested, scrub-shrub, emergent marsh), riverine (freshwater rivers and streams), estuarine (shallow tidal-influenced saltwater wetlands), and marine (deep water saltwater environments). The wetlands in Exeter are primarily palustrine and estuarine.

The approximately 230 acres of estuarine wetlands in Exeter are found along the fringes of the tidally-influenced Squamscott River. The approximately 1,880 acres of palustrine wetlands in Exeter include several types: open water, aquatic bed, emergent marsh, scrub shrub wetland, and forested wetland. Many of these are associated with river systems and some are a combination of wetland types. For instance, one contiguous wetland system may have open water edged with emergent marsh that is bordered by scrub-shrub or forested wetland.

In New Hampshire, wetlands that are designated as “prime wetlands” by a town are afforded extra protection under state law. A sub-set of wetlands are selected, evaluated, and mapped based on high values and function, typically by a wetland scientist. Forty-six wetlands were originally designated as prime wetlands in Exeter in 1985. The boundaries of these prime wetlands were further evaluated and updated in 2005 for the town by West Environmental, Inc. and Cartographic Associates using a more detailed analysis of aerial photography.

The 46 mapped prime wetlands in Exeter total 748.7 acres and range in size from 1.3 acres to 142 acres. Most of the prime wetlands are located in a few areas of town including: the tidal marshes along the Squamscott River, extensive freshwater wetlands along the Fresh River, the upper and lower reaches of the Little River, and in patches along the Exeter River.

Surface Water Composite and Focus Areas

The surface water resources sub-composite (Map 6) is an overlay of:

- All wetlands, including the National Wetlands Inventory, the National Hydrography Dataset, and the USGS Soils Survey’s very poorly drained soils. (Map 6a)
- 150-foot buffers around prime wetlands (Map 6b)
- 300-foot buffers around prime wetlands (Map 6b)
- 150-foot buffers around all streams, rivers, lakes, and ponds (Map 6b)
- 300-foot buffers around all streams, rivers, lakes, and ponds (Map 6b)
- FEMA 100-year floodplain (Map 6c)
- GRANIT’s 150-foot Stream Buffer Characterization where the buffer is considered “Intact” or “Mostly Intact” (Map 6c)

Each of these resource inputs received one point in the co-occurrence overlay. In order to avoid double-counting the wetland resources that were mapped by multiple sources, the different

datasets were merged together and any area that was considered wetland by any of these sources received just one point. The two different buffer distances, however, do overlap. For example, for a given feature such as a pond, the 150-foot buffer area includes the pond itself and the area within 150 feet of that pond. The 300-foot buffer area includes the pond and the area within 300 feet of the pond. Each of the buffer areas received one point, so that when these two buffers were overlain (added together), the pond and the area within 150 feet of it received a total two points, and the area from 150 feet to 300 feet of the pond received a total of one point.

To create the composite, each of the above input layers was added together. The resulting surface water composite has values ranging from 0 – 7, where higher values represent areas with higher resource importance. In order to further generalize or smooth the composite, each cell was given a new value: the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The resulting surface water focus areas cover about 5,500 acres, or 45% of the town.

Drinking Water Resources

Aquifers

The USGS and NH DES have mapped the aquifers in the Lamprey River and Lower Merrimack regions of New Hampshire. The maps they created are simplified surficial geology maps, showing the extent of stratified-drift deposits that contain sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Aquifers are further described based on their transmissivity – that is, the volume of water that flows through a cross-sectional area in a day. Based on personal communication with Rich Moore of New Hampshire's USGS office, this analysis was not limited to aquifers with high transmissivity. He explained that aquifer boundaries are easier to map than the transmissivity contours within them, which are frequently inferred between sparse data points. He also pointed out that a community well in a high transmissivity area could be located adjacent to a lower transmissivity area, and would therefore draw some of its water from that lower transmissivity area. Additionally, he suggested including not just the areas mapped as stratified drift aquifers, but those that are stratified drift over or beneath glacio-estuarine silts and clays.

In Exeter, there are two main aquifer regions in town: a stratified-drift deposit in the very southwestern corner of the town, and a stratified-drift deposit within or beneath glacio-estuarine silts and clays located in the southern-central portion of town (Map 1).

Source water protection areas

The NH Department of Environmental Services has delineated source water protection areas (SWPA) areas for nearly all sources of water for community and non-community, non-transient public water systems in the state. SWPAs include wellhead protection areas (WHPAs) for groundwater sources and watershed areas for surface water sources.

Wellhead protection areas

The area under which groundwater flows to a producing well is known as the wellhead protection area (WHPA). These areas represent a protective radius around community and non-community, non-transient drinking water supplies, as mapped by the NH Department of Environmental Service (DES). For bedrock wells producing less than 57,600 gallons in any 24-hour period, the WHPA is a circle whose radius depends on the maximum daily amount of water withdrawn from the well. For example, the town's smallest wellhead protection areas, such as the area for the United Methodist Church on Route 27 or the Building Block School on Route 111, have a radius of 1,300 feet, indicating a daily volume of less than 7,200 gallons. The largest areas, such as those for the Exeter Water Department or the Exeter River Mobile Home Park, have a radius of 4,000 feet, indicating a daily volume of 57,600 gallons or more. For small overburden wells within unconfined aquifers, the WHPA is typically calculated based on existing hydrogeological information.

Source water protection areas

Both the Exeter and Piscassic Rivers were mapped by NHDES as watershed source water protection areas. The mapped area encompasses the watershed upstream of the existing or potential drinking water intake pipe for the respective towns. Water from the Exeter River is the principal source for the municipal water system. Water is also taken from the Exeter Reservoir to augment the municipal water system during the winter months. Water from the river is diverted to the Town's water treatment plant through the Exeter River Pumping Station that is located near the confluence of the Exeter River and Little River. The Town of Newmarket has explored the use of water from the Piscassic River as a potential drinking water source, although it does not currently take water from the river.

Drinking Water Composite and Focus Areas

The drinking water sub-composite (Map 7) is an overlay of:

- Well-head protection areas from NH DES (Map 7a)
- Source water protection areas from NH DES (Map 7b)
- Any aquifer as mapped by the USGS and NH DES (Map 7c)

Each of the above resource inputs received one point, and the resulting composite has values ranging from 0 to 3, where higher values represent areas with higher resource importance. As with the surface water analysis, in order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The drinking water focus areas cover about 4,550 acres, or 35.5% of the town.

Wildlife

NH Fish and Game Wildlife Action Plan

In 2006 (with revisions in 2010), the NH Fish and Game Department (NHFG) released the first comprehensive state-wide analysis of wildlife habitats and a tiered ranking system to help

communities and organizations understand where the most valuable habitats are in the State. Known as the Wildlife Action Plan (WAP), these datasets are extremely useful for predicting the occurrence of a given habitat type and for evaluating a region's relative importance to wildlife.

According to the WAP data, Exeter is extremely rich in important wildlife habitat. A large contiguous block of highest quality habitat in the state lies in the northwestern corner of town, around the Fresh River, Piscassic River, and Beech Hill Brook; another swath follows the path of the Squamscott River; large blocks also surround Great Brook and the Cove at the southern end of town. A total of over 1,850 acres (14.5% of town) is ranked as Tier 1, or highest quality habitat in the state. An additional 1,150 acres (9% of town) is ranked as Tier 2, or highest quality habitat in the biological region. Exeter lies within the Gulf of Maine Coastal Lowland biological region (or ecoregion). A third tier – supporting landscape – covers an additional 6,600 acres (52% of the town). Supporting landscapes were identified in the WAP as upland areas around critical surface waters that if degraded, might affect the health and quality of the aquatic habitats.

The WAP also mapped sixteen habitat types across the state, habitats that wildlife species depend on. These included five broad forest types: hemlock-hardwood-pine, Appalachian oak-pine, lowland spruce fir, northern hardwood-conifer, and high elevation spruce-fir; three freshwater wetlands types: marsh and shrub wetlands, peatlands, and floodplain forests; three coastal habitats: salt marsh, dunes, and coastal islands; three steep slope habitats: alpine, cliff, and rocky ridge/talus slope; and two other small-scale habitats: pine barrens and grasslands.

Seven of the 16 habitat types are found in Exeter (Map 2). Most of the town is blanketed with Appalachian oak pine forest, with just a bit of hemlock hardwood pine forest. Imbedded within the forest types or occurring in open habitats are smaller scale habitats: grasslands, salt marsh, peatlands, marsh and shrub wetlands, and floodplain forests. Each of these is described in more detail below:

Appalachian oak-pine forests

Appalachian oak-pine forests are found mostly below 900 feet elevation in southern New Hampshire and along the Connecticut River in western New Hampshire. The nutrient-poor, dry, sandy soils and warm, dry, climate influences the typical vegetation including oaks, hickory, white pine, and sassafras. The nut-bearing oaks and hickories are important foods for grouse, turkey, black bear, small mammals, and many other birds. Traditionally, Appalachian oak-pine forests were influenced by frequent fires, which helps maintain a diverse age and structure of the forest help to promote wildlife diversity. Intense development pressure particularly in the southeast corner of New Hampshire has dramatically reduced naturally occurring fires and increased fragmentation of this forest type. Exeter has 9,090 acres of this forest type.

Hemlock-hardwood-pine forests

Hemlock-hardwood-pine forests are comprised of mostly hemlock, white pine, beech, and oak trees. Since this is a transitional forest, it can occur at different elevations and over different types of soil and topography, so the composition of vegetation can be variable. This forest type

is the most common in New Hampshire. White pine and hemlock are the dominant tree species in these forests. Other common species depending on site conditions include American beech, red oak, sugar maple, and white ash. Scarlet tanager, hermit thrush, blackburnian warbler, and black-throated green warbler are some of the commonly seen birds in hemlock-hardwood-pine forests. Exeter has 680 acres of hemlock-hardwood forest located primarily in small patches.

Grasslands

Grasslands are comprised of grasses, sedges, and wildflowers with little to no shrubs and trees. The most common grassland habitats are airports, capped landfills, wet meadows, and agricultural fields such as hayfields, pastures and fallow fields. Before European settlement grasslands in New Hampshire were likely only maintained by beaver and fires started by lightening and Native Americans. Today grasslands are an increasingly rare site as development, changes in farming, and natural succession have reduced this habitat across the state. The bobolink is a common bird sighting in many grasslands. Exeter has 940 acres of grasslands, scattered about the town and in larger blocks along the Squamscott River and in the upper part of the Exeter River watershed.

Salt Marsh

Salt marshes are grass-dominated tidal wetlands existing in the transition zone between ocean and upland. They are among the most productive ecosystems in the world and provide great habitat for many bird species including bitterns and egrets, salt marsh sparrow, seaside sparrow, and semipalmated sandpiper. Salt marshes help protect coastal areas from storm surges, but an estimated 30-50% of New Hampshire's original salt marsh habitat has been lost to development. The 200 acres of salt marsh in Exeter is located along the shores of the Squamscott River.

Floodplain Forests

Floodplain forests typically occur in low-lying, flood-prone areas along rivers. They are often associated with oxbows or old river channels. The periodic flooding, which leads to a recycling of nutrients and sediments create rich soil deposits for many native plants. Although natural disturbance is part of what makes these habitats so rich, the disturbance also benefits invasive plant species, thus it is common to find invasive plant populations along water courses. Red-shouldered hawks are often seen and heard in these forests where they nest and forage. Exeter has 1,360 acres of floodplain forest.

Peatlands

Peatlands, including bogs and fens, are saturated wetlands with layers of decaying plant material called peat. They are associated with acidic or stagnant water that is low in oxygen and typically low in nutrients. Peatlands also have distinctive plant communities including plants especially adapted to the growing conditions including Sphagnum moss, pitcher plant, and sundew, among many others. The peatlands in Exeter total 380 acres and are in small patches primarily in the northwest region of town.

Marsh and Shrub Wetlands

Marsh and shrub wetlands describe a variety of wetland types, including wet meadow that is dominated by sedges and grasses, marshes that support a mix of herbaceous plants that grow in shallow water, and shrub wetlands that support a mix shrubs and young trees. These wetlands provide a rich habitat for fish and wildlife, help maintain water quality by filtering pollutants, help with flood control, and provide recreational opportunities. Much of the 610 acres of marsh and shrub wetlands were identified as prime wetlands.

Natural Heritage Bureau Data

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

Map 2B illustrates the general locations of rare plants, wildlife, and natural communities that are documented by the NHB as occurring in Exeter. The precise locations are not shown due to the sensitive nature of some of the data and due to the NHB data release policy regarding private lands. The NH Natural Heritage Bureau's database contains more detailed information including locations, population sizes, and habitat descriptions. Individual landowners can contact the NHB for more precise information on species and communities documented on their lands. Since no comprehensive inventory of the state has been conducted, many landowners will likely have few if any documented occurrences on their property.

The following exemplary natural communities and rare plants and animals are documented for Exeter according to the Natural Heritage Bureau. Rare species are classified in the state as Endangered (E), Threatened (T), or Special Concern (SC). Some of the records are historical—the last sighting was more than 20 years ago. These historical populations may still be present, but field surveys are necessary to confirm their survival.

Table 2. Exemplary Communities and Rare Plants and Animals

Natural Communities – Palustrine
Hemlock – cinnamon fern forest
Low-gradient silty-sandy riverbank system
Swamp white oak basin swamp
Swamp white oak floodplain forest
Tall graminoid meadow marsh

Natural Communities – Estuarine
Brackish marsh
High brackish riverbank marsh
Low brackish riverbank marsh
Subtidal system

Plants	**State Rarity**	**Status**
Climbing Hempweed (*Mikania scandens*)	E	Historical
Large Bur-reed (*Sparganium eurycarpum*)	T	
Peat Moss (*Sphagnum contortum*)	T	
Robust Knotweed (*Persicaria robustior*)	E	Historical
Sharp-flowered Mannagrass (*Glyceria acutiflora*)	E	
Slender Blue Flag (*Iris prismatica*)	E	Historical
Small Spike-rush (*Eleocharis parvula*)	T	
Spongy-leaved Arrowhead (*Sagittaria montevidensis* ssp. *Spongiosa*)	E	
Vasey's Pondweed (*Potamogeton vaseyi*)	E	Historical
Water-plantain Spearwort (*Ranunculus ambigens*)	E	Historical
Vertebrates – Birds		
Common Moorhen (*Gallinula chloropus*)	SC	
Great Blue Heron (Rookery) (*Ardea 12arolina*)		
Least Bittern (*Ixobrychus exilis*)	SC	
Nelson's Sharp-tailed Sparrow (*Ammodramus 12aroli*)	SC	
Osprey (*Pandion haliaetus*)	SC	
Pied-billed Grebe (*Podilymbus podiceps*)	T	
Saltmarsh Sharp-tailed Sparrow (*Ammodramus caudacutus*)	SC	
Sora (*Porzana 12arolina*)	SC	
Vertebrates – Reptiles		
Blanding's Turtle (*Emydoidea blandingii*)	E	
Northern Black Racer (*Coluber constrictor constrictor*)	T	Historical
Spotted Turtle (*Clemmys guttata*)	T	

Most of the documented rare species and exemplary communities are associated with aquatic habitats: open water, emergent marsh, salt marsh, scrub shrub wetlands, forested wetlands,

and floodplain forests. A concentration of documented occurrences is found along the Squamscott River, in the Great Brook and Cove Brook subwatershed and along the adjacent stretch of the Exeter River, and in the north central region of town in the Boody Brook headwaters and Oakland Town Forest.

A guide to the *Natural Communities of New Hampshire* is available online from the NH Natural Heritage Bureau at http://www.nhdfl.org/library/pdf/Natural%20Heritage/Natural%20Community%20Manual_2nd%20Ed.pdf

Wildlife Composite and Focus Areas

The wildlife sub-composite (Map 8) is an overlay of:

- Important habitats: wetlands, grasslands, and steep south-facing slopes (Map 8a)
- Any areas considered highest-ranked habitat in the state or the biological region by the NH Fish & Game 2010 Wildlife Action Plan (Map 8b)
- Any area with a documented occurrence of a rare, threatened, or endangered species or community, as reported (and buffered) by the NH Natural Heritage Bureau (Map 8c).

Each of these resources received one point in the co-occurrence analysis. Before conducting the analysis, a habitat composite was made of wetlands, grasslands, and steep south-facing slopes. Wetlands comprised prime wetlands, very poorly drained soils, National Wetlands Inventory, National Hydrography Dataset, as well as floodplain forests, peat, marsh and salt marsh habitats from the WAP model. The grasslands predicted by the WAP model appeared too extensive and frequently covered areas that were residential developments. Therefore, grasslands (generally, old fields) were digitized from 2010 aerial photography. Steep south-facing slopes were derived from a USGS digital elevation model. The combination of all of these important habitat areas was considered one input to the co-occurrence analysis.

Any area with a documented occurrence of a rare, threatened, or endangered species or community also received one point in the co-occurrence analysis. In this dataset, as received from the NH Natural Heritage Bureau, observed locations of rare species and communities were randomly shifted by up to 500' in any direction and buffered by a half-mile or ¾-mile to indicate their level of precision (Map 2b). Therefore, the locations used in the co-occurrence were represented by somewhat large circles. Particularly through the eastern portion of town, especially along the path of the Squamscott River, there was much overlap between these buffered locations. It was decided *not* to account for the overlap in the co-occurrence analysis – that is, an area would receive one point for having an occurrence whether it had just one or had eight overlapping occurrences. One reason for this was to avoid skewing the analysis too strongly toward places with documented species or community occurrences. Another reason was due to a limitation of the data itself: the occurrences only mark the places where species or communities of interest have been found – the absence of occurrences in other places does not mean that species or communities of interest are not present there.

Each of the above resources was added together in the co-occurrence analysis, and the resulting composite values range from 0 to 3, where higher values represent areas with higher resource importance (Map 8). As above, in order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The wildlife focus areas cover about 5,300 acres, or 41% of the town.

Wildlife Corridors

In 2010, NH Audubon and NH Fish & Game released a Wildlife Connectivity Model for New Hampshire. To develop this dataset, the team evaluated landscape factors – land cover, distance to roads, distance to riparian areas, and slope – for 16 umbrella species: Blanding's turtle, spotted turtle, wood turtle, black racer, Eastern hognose, snowshoe hare, New England cottontail, porcupine, mink, otter, long-tailed weasel, fisher, American marten, bobcat, Canada lynx, and black bear. A "cost surface" was developed for each species to represent the relative difficulty that species would have moving through any unit of area. A high cost indicates it is very difficult for the species to move (because of a road, a river, slope or land cover type), while a low cost indicates the species can easily move through that bit of the landscape.
The quantitative Wildlife Connectivity Model was used in conjunction with qualitative first-hand knowledge of specific sites to identify potential corridors and pinch points or bottle-necks. Mark West of West Environmental Inc. (WEI) evaluated maps of the wildlife focus areas, the wildlife connectivity model, and aerial photos in order to identify potential wildlife corridors (Map 9). WEI had previously performed the Prime Wetland remapping project for Exeter (2005) and observed wildlife corridor use during that project and other work within the Town. WEI evaluated the location of connections which included both riparian corridors and upland forest connections of large unfragmented blocks. Connections to adjacent Towns were also included.

WEI also identified locations where wildlife corridors are bisected by roadways, affecting movement across the landscape. A good example is the Route 101 highway which has significant impact on several north/south corridors. WEI has observed a variety of road kill on this highway including mink, beaver, white-tailed deer and Blanding's turtle. Locations where large wetland complexes border this highway are especially damaging to wildlife movement. Smaller roads have less impact but also can result in mortality. Signage on these roads could help reduce roadkill. Traditional roadway culverts do not provide adequate connectivity and on the 101 highway would be ineffective.

Some habitat blocks, such as the area around the Exeter Reservoir and just east of Colcord Pond, are isolated by the surrounding roadways and development. These areas are similar to urban wildlife refuge areas and do not provide connectivity to other habitat areas.

Agriculture

Location of existing agricultural lands

For this study, existing agricultural lands were digitized from the 2010 1-foot resolution aerial photographs acquired by the NH Department of Transportation. Any lands that appeared to have an agricultural purpose were digitized. This included areas that appeared to be active row crops and orchards, as well as lands that might be maintained as pasture or mown once or twice a season for hay. Old fields that may have been maintained in the past and which have not yet transitioned to forest may also have been captured in this process.

Prime farmland soils

Important Agricultural Soils have been mapped by the Natural Resource Conservation Service (NRCS) as part of the Rockingham County Soil Survey. Several classes of farmland soils are identified in the soil database: prime farmland, farmland of statewide importance, and farmland of local importance. Prime farmland is the highest quality designation, and is typified by:

- Soils that have an appropriate moisture regime and sufficient available water capacity to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- Soils that are have an appropriate 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.
- Soils that have an appropriate saturation extract and sodium percentage.
- Soils that are not frequently flooded during the growing season (less than a 50% chance in any year or the soil floods fewer 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 refers to soils that while not meeting the criteria for *prime* farmland, have still been determined by a state committee to be of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. These soils:

- 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 refers to soils that are neither prime nor of statewide importance, but still have still been determined by the County Conservation District Board to have significance for production of food, feed, fiber, and forage. In Rockingham County, these soils may be:

- Poorly drained, with artificial drainage established and are being farmed
- Specific soil map units as determined by the Conservation District Board.

Exeter has significant farmland resources – more than 6,700 acres (more than half of the town's area) are considered important farmland soils. Approximately one third of those acres are in conservation, but slightly more than a third have already been developed.

Table 3. Important Agricultural Soils

Farmland Soil Class	Acres (within Exeter)	Percent of Town	Acres in Conservation	% in Conservation	Acres Already Developed	% Already Developed
All areas are prime farmland	1,313.2	10.2%	388.5	29.6%	669.7	51.0%
Farmland of local importance	4,546.6	35.5%	1,668.0	36.7%	1,420.7	31.2%
Farmland of statewide importance	900.4	7.0%	188.0	20.9%	376.2	41.8%
Total Important Farmland	6,760.3	52.8%	2,244.5	33.2%	2,466.7	36.5%

Agriculture Composite and Focus Areas

The agriculture sub-composite (Map 10) is an overlay of:

- Land in active (or recent) agricultural use (Map 10a)
- Prime farmland soils (Map 10b)
- Farmland soils of statewide importance (Map 10b)
- Farmland soils of local importance (Map 10b)

Active agricultural land and farmland soils of local importance each received one point, farmland soils of statewide importance received two points, and prime farmland soils received three points. Active agricultural land was digitized from 2010 1-foot resolution color aerial photographs. Any area that looked like it was actively maintained as a field (rather than a lawn) was deemed active agricultural land.

Each of the above resources was added together in the co-occurrence analysis. The resulting sub-composite values range from 0 to 4, where higher values represent areas with higher resource importance (Map 10). As with the other sub-composite analyses, in order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard

deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The agriculture focus areas cover about 4,750 acres, or 37% of the town.

Forests

Unfragmented Forest Blocks

The New Hampshire Fish and Game Department identified development (residential, commercial, or industrial) as one of the most significant risk factors to the State's wildlife and habitats. Development causes the fragmentation of habitat into small, unconnected parcels. Songbirds, small mammals, and other wildlife species are more susceptible to mid-sized predators such as fox, raccoon, and skunk in small blocks of habitat. These "generalist" predators adapt better than other species to a fragmented landscape. Habitat blocks crisscrossed with residential roads and houses expose wildlife to high rates of road mortality, increase conflicts with humans and pets, result in increased contaminated runoff, and offer more opportunities for invasive plants to spread to natural areas.

Unfragmented forest blocks are large areas of habitat with few or no roads, houses, or other development (such as intensive recreational uses). In southeastern New Hampshire, blocks of 1,000 acres or more are considered regionally significant and blocks of 500-1,000 acres are locally significant. A large unfragmented block typically supports more interior forest species (e.g., scarlet tanager, goshawk) and wide-ranging animals such as bear, moose, fisher, otter; is better at sustaining natural processes (such as nutrient cycling, water cycles, clean air), is more resilient to natural disturbances, and often supports a diversity of large and small habitat patches in close proximity to each other. Large unfragmented lands also allow plants and animals to adapt to changing environmental conditions (including climate change), giving them space to shift their territories or populations. Smaller sized unfragmented blocks, less than 500 acres, are also important for protecting water quality, forest management, and recreation.

To identify unfragmented forest blocks, roads (except for Class VI roads) were buffered by 500 feet. The acreage of the remaining blocks of land was calculated. For this analysis (as for the other overlays), lands within a two-mile radius of Exeter were all considered (see Map 4A). The analysis shows four blocks greater than 1,000 acres in Exeter; these blocks do extend into neighboring towns.

Important Forest Soils

Forest plant communities rely on the inherent soil nutrient cycling to provide the proper nutrients for healthy tree growth. The NRCS Soil Surveys indentify Important Forest Soils. These groupings indicate the relative productivity of soils and provide some prediction of the patterns of plant succession within a given soil group. These forest soil groups are shown on Map 4B and include:

> **IA -** This group consists of the more fertile, deeper, loamy textured, moderately well, and well-drained soils. The successional trends on these soils are toward stands of

hardwoods: beech, sugar maple, and the northern red oak. The soils in this group are well suited for production of high quality hardwood sawtimber and veneer.

IB - The soils in this group are generally sandy or loamy over sandy textures and slightly less fertile than those in group IA. Forests growing on these soils generally have successional trends toward climax hardwood forests of beech and/or oak. Soils in this group are well suited for the production of oak, predominantly northern red oak, in nearly pure stands or in combination with white pine.

IC - The soils in this group are derived from coarse textured, infertile glacial deposits of outwash sands and gravels. Due to less hardwood competition, these soils are well suited for softwood production, especially white pine. White pine can be maintained and reproduced on these soils with moderate levels of hardwood control.

IIA - This diverse group includes many of the same soils as in groups IA and IB. However, these mapping units have been separated because of physical limitations which make forest management more difficult and costly, i.e., steep slopes and bedrock outcrops.

IIB - The soils in this group are poorly drained. Productivity of these poorly drained soils is generally less than soils in the other groups. Due to poor soil drainage, forest management activities are limited.

NC - Several mapping units in the survey are either so variable or have such a limited potential for commercial production of forest products they have not been considered. Often an onsite visit would be required to evaluate the situation.

Forest Composite and Focus Areas (Map 11)

The forest sub-composite is an overlay of:

- Unfragmented blocks of 200-400 acres (Map 11a)
- Unfragmented blocks of 400-1,000 acres
- Unfragmented blocks of greater than 1,000 acres
- Blocks with >100 acres of important forest soils (groups IA, IB, and IIA) (Map 11b)

The largest blocks, those greater than 1,000 acres, received three points; blocks between 400 – 1,000 acres received two points, and blocks between 200 – 400 acres received one point. For this analysis (as for the other overlays), lands within a two-mile radius of Exeter were all considered. This ensured that large blocks of unfragmented land that straddled the town boundary were still considered and ranked appropriately for their size. Because of the range of sizes of forest blocks in Exeter, the cutoff for the mid-range of unfragmented blocks for this analysis was set at 400 acres, rather than 500 acres.

Because the intention for this portion of the study was to identify lands that were potentially useful for sustainable forest management, productive forest soils were also evaluated. However, it was determined that the present of productive forest soils in areas that were *not* large blocks of land was not relevant. The defining factor of whether an area would be economically feasible

for timber harvest would be the size of the block; within that block, the presence of important forest soils would contribute to a more productive forest. It was further decided that a significant presence of forest soils within the large block would be required. One hundred acres was selected as a threshold. Unfragmented blocks (of any size greater than 200 acres) containing at least 100 acres of important forest soils (groups IA, IB, or IIA) received one point.

The input layers were added together, yielding a forest sub-composite whose values ranged from 0 to 4, where the higher values represent areas with higher resource importance (Map 11). In order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. The forest focus areas cover about 5,050 acres, or 39% of the town.

Full Natural Resource Composite

To build the full natural resource composite – an overlay of all five of the sub-composites described above – the resource-specific sub-composite focus areas were all added together (Map 12). The resulting composite values range from 0 – 5, where higher values represent areas with higher resource importance. The composite was smoothed with a 5x5 cell rectangle. Initial high value areas were those cells that had a value one standard deviation above the mean or higher. These high value areas were buffered by 500 feet to incorporate the surrounding landscape. This surrounding area, or "supporting landscape", is important from a conservation perspective for maintaining the integrity of the high value areas in its interior. The final focus areas are therefore composed of the highest value portions of the full natural resource composite ("composite areas") together with their 500 foot buffer of supporting landscape. Focus areas smaller than 50 acres – typically the result of buffering very small (<5 acre) and isolated composite polygons – were eliminated. For ease of describing and interpreting the focus areas, the largest were broken down into smaller sections, usually at places related to major roads or watershed boundaries, and they were all named. The final focus areas cover about 5,900 acres within Exeter, or about 46% of the town.

A wide range of protection is afforded to the focus areas – some, like the Little River and Watson Road areas, are largely permanently protected already. Others, like the Cove and Dearborn Brook areas, are largely unprotected, and therefore at greater risk of development and impairment (Figure 1; Table 4). Table 5 details the acreage of the composite portion (i.e., the interior, highest resource value portion) of each focus area that is conserved. In general, the interior composite areas have higher rates of conservation than the larger focus areas – that is, the highest value areas are more likely to be protected than the supporting landscape around them. A notable exception is the Dearborn Brook focus area, which as a whole is only 17.2% conserved, and the highest value composite area at its core is only 7.5% conserved.

Figure 1. Natural Resources Focus Areas: Percent of Land in Conservation

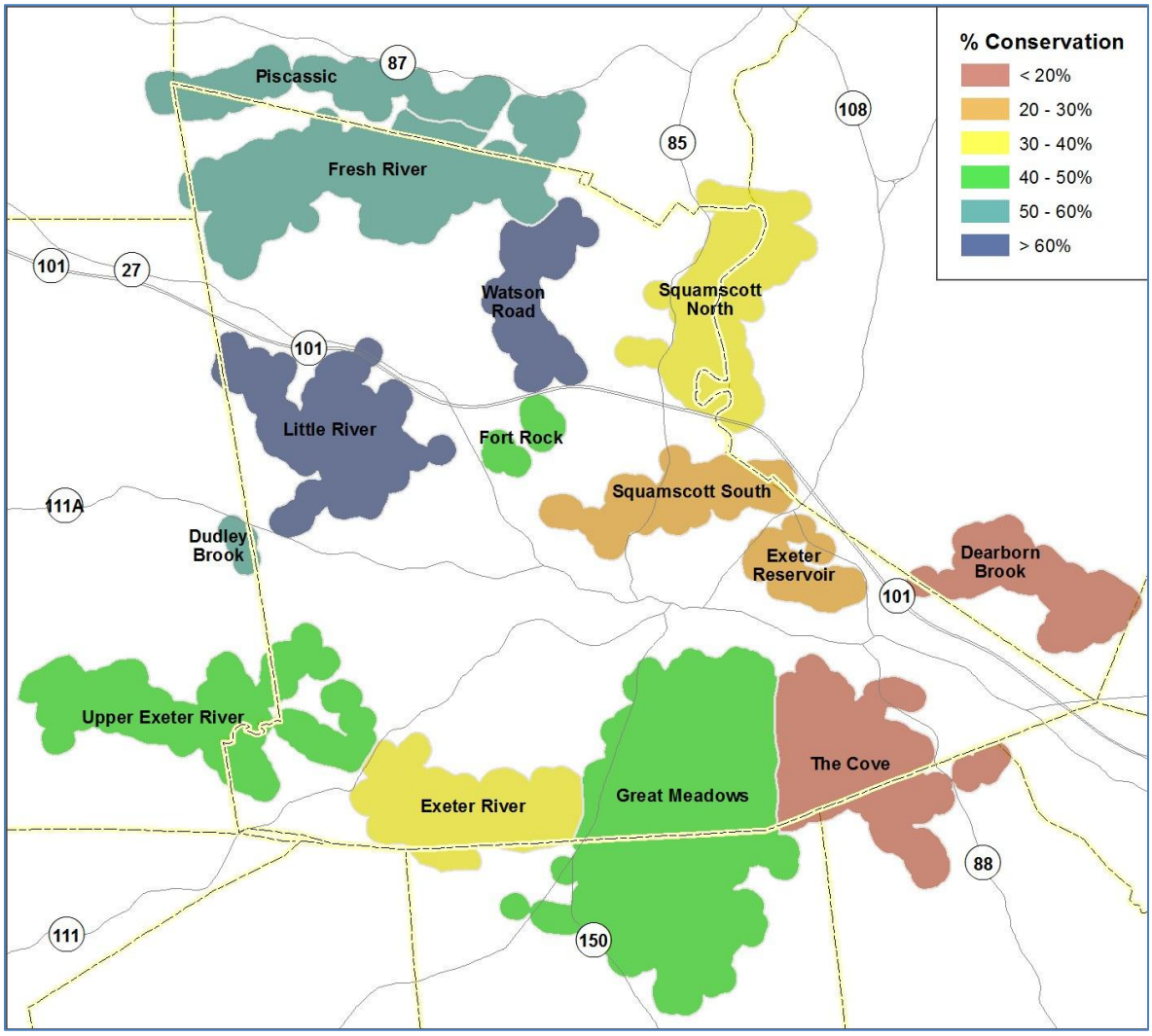


Table 4. Summary of Focus Areas

Name	Acres	Acres in Exeter	% in Exeter	% of Focus Area in Conservation	% of Exeter Portion in Conservation
The Cove	886.5	561.3	63.3%	17.8%	27.7%
Dearborn Brook	471.7	11.6	2.4%	17.2%	98.2%
Dudley Brook	56.6	8.9	15.7%	50.4%	33.6%
Exeter Reservoir	239.8	239.8	100%	23.1%	23.1%
Exeter River	626.8	568.8	90.7%	32.1%	35.4%
Fort Rock	121.4	121.4	100%	45.3%	45.3%
Fresh River	1237.3	996.1	80.5%	54.2%	62.5%
Great Meadows	1938.2	976.8	50.4%	49.9%	61%
Little River	802.0	791.0	98.6%	64.7%	65.6%
Piscassic	512.5	60.0	11.7%	54.4%	97.1%
Squamscott North	764.6	378.4	49.5%	35.1%	50.4%
Squamscott South	459.7	426.9	92.9%	26.3%	28.4%
Upper Exeter River	954.3	382.8	40.1%	47.7%	21.2%
Watson Road	397.9	397.9	100%	65.9%	65.9%

Table 5. Summary of Core Composite Areas within the Focus Areas

Name	Acres of Composite	Acres of Composite in Conservation	% of Composite in Conservation
The Cove	292.3	86.7	29.7%
Dearborn Brook	126.5	9.5	7.5%
Dudley Brook	1.4	1.2	89.6%
Exeter Reservoir	30.1	14.9	49.5%
Exeter River	227.8	113.7	49.9%
Fort Rock	8.7	5.3	61.7%
Fresh River	511.8	336.7	65.8%
Great Meadows	1201.0	752.0	62.6%
Little River	181.6	135.5	74.6%
Piscassic	135.2	69.3	51.3%
Squamscott North	335.7	148.0	44.1%
Squamscott South	76.1	27.5	36.2%
Upper Exeter River	302.3	168.5	55.7%
Watson Road	111.1	74.7	67.3%

The final focus areas generated from the total composite (the sum of the resource-specific sub-composites) are intended to be useful for interpreting which areas in Exeter contain some of the highest resource values, and for evaluating the protection levels and development risk those areas face. However, the results of the individual sub-composites may be useful for resource-specific purposes. For example, the Wildlife Focus Areas (in conjunction with the potential wildlife corridors and wildlife movement model) may be useful for highlighting important places to institute better signage and better road crossings for wildlife.

Development Analysis

Methodology

The third phase of this project was the analysis of development patterns and constraints in order to identify areas that are available and suitable for development. With the assistance of the Exeter Planning Department, Neatline reviewed properties that have been subdivided since 2005, to better understand their distribution throughout town, sewer availability, parcel size, and road frontage.

The next step of the development review was to conduct a constraints analysis to identify lands that are available and suitable for development. For this GIS analysis, portions of town are "erased" if they are not available for future development, that is, if they are already developed or are permanent conservation land. The remaining land is considered *available* for development. To identify land that is *suitable* for development, portions of town are "erased" if they are within wetlands, the buffers around wetlands, or within the Shoreland Protection District.

The GIS layers representing available land and suitable land were combined and then compared to the town's tax parcel boundaries to identify which parcels have a significant percentage of area that is both available and suitable. The availability and suitability for development was also compared to zoning classes to quantify which zoning classes have the most room for future development.

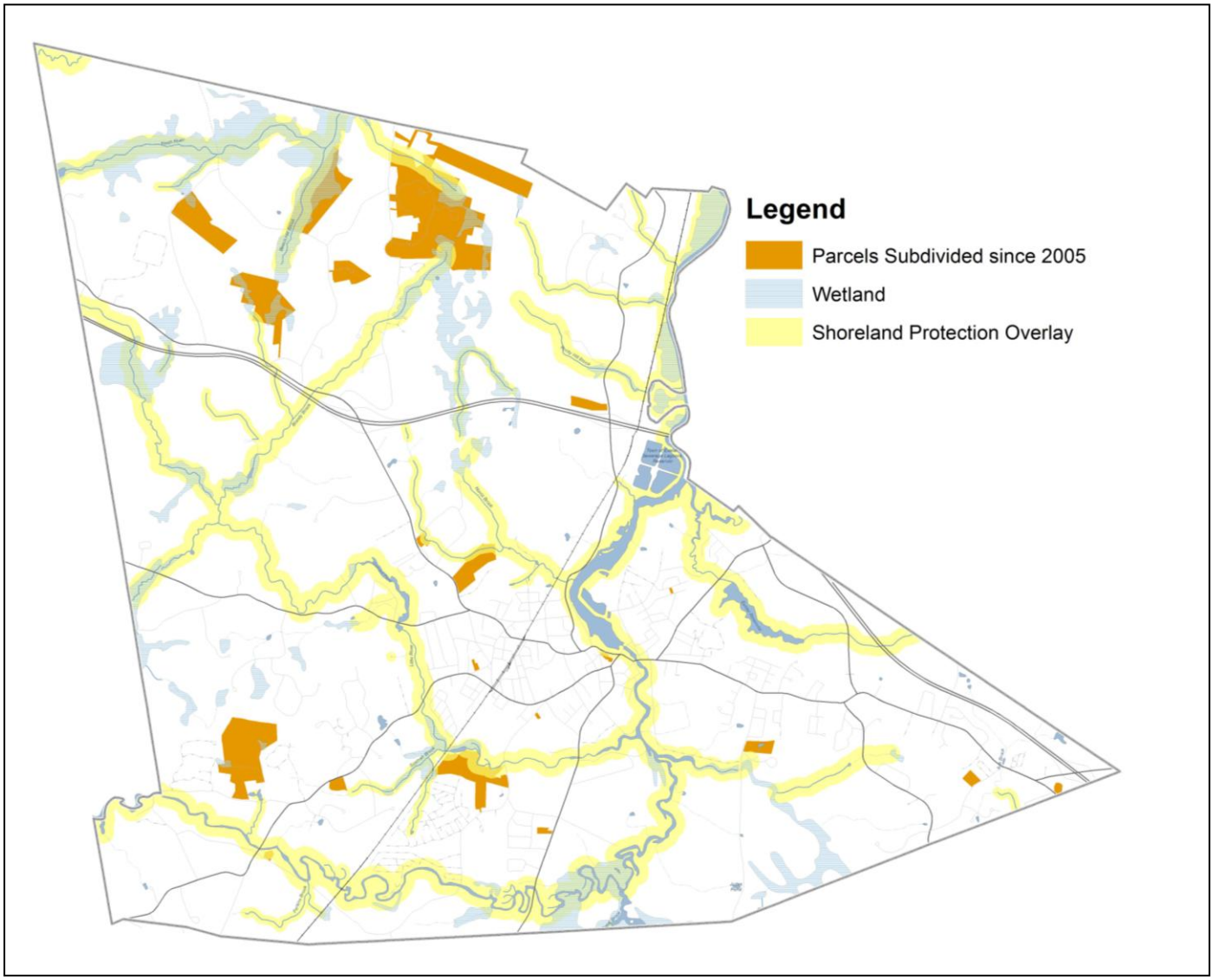
Finally, the parcels with high percentages of available and suitable land were evaluated for road frontage and to determine if they were an appropriate shape for future development (for example, a parcel might be available and suitable for development, but still be an awkward shape, such as very long and narrow, as to make development unlikely or difficult).

Development Patterns since 2005

With the help of the Exeter Planning Department, Neatline reviewed the properties that have been subdivided in recent years (Figure 2). These parcels have little in common – they range broadly in size (from the 65 acre Boulders subdivision to the 3.5 acre Wright Lane subdivision), and are scattered throughout the town rather than clustered around areas where sewer service is available. When compared to wetlands and the shoreland protection district, it is

clear that having significant portions of wetland and shoreland did not prevent parcels from being subdivided.

Figure 2. Recently subdivided parcels



Development Constraints Analysis

The development constraints analysis identified areas of town that are available and suitable for development. After areas that are either protected or already developed were removed from the analysis, the remaining land was considered "available" for development. The land was further evaluated for its suitability for development – that is, whether is wetland, within wetland buffers, or within the Shoreland Protection District.

The results of the constraints analysis are displayed in Map 13. The conservation land (green) and already developed land (gray) are unavailable for development. The present of wetlands

(blue), shoreland (lavender), aquifers (yellow), and floodplain (peach) further restrict the future development potential. The red areas represent those portions of town that are both available for development and suitable for development.

It is important to note, however, that this rendering is not definite. Some of the areas that are considered conservation land, such as the large Phillips Exeter Academy parcels in the southern section of town, are not permanently protected, and could become available for development in the future. Additionally, development is not completely restricted or permanently prevented on areas that are considered not suitable for development.

The available land areas were also compared to the zoning districts. The results, tabulated below, show that the zoning classes R-1 (Single family), R-2 (Single family), RU (Rural), and I (Industrial) contain the largest acreages of available/suitable land.

Table 6. Acres of Available Land by Zoning District

Zoning District		Total Available	Suitable	Not Suitable
C-1	Central Area Commercial	0.0	0.0	0.0
C-2	Highway Commercial	25.3	8.6	16.8
C-3	Epping Rd. Highway Commercial	149.4	50.6	98.9
CT	Corp. Technology Park	94.6	26.5	68.1
CT-1	Corp. Technology Park 1	109.6	59.3	50.2
H	Healthcare	7.6	0.0	7.5
I	Industrial	337.2	193.1	144.0
M	Mobile Home Park	18.6	0.1	18.5
MS	Mobile Home Subdivision	0.7	0.0	0.7
NP	Neighborhood Professional	59.2	8.0	51.2
PP	Professional Technology Park	65.5	22.0	43.4
R-1	Single Family	2004.7	804.5	1200.2
R-2	Single Family	577.0	148.3	428.7
R-3	Single Family	5.2	0.0	5.2
R-4	Multi-Family	43.5	18.2	25.2
R-5	Multi-Family/Elderly	6.0	1.3	4.7
R-6	Retirement Planned Community	21.0	16.4	4.6
RU	Rural	954.6	406.7	547.9
WC	Waterfront Commercial	2.7	0.0	2.7
Total Available		4482.2	1763.6	2718.6

The constraints analysis does not address parcel boundaries. While a particular site may be called both available and suitable for development, in practical terms development might not be possible there because of setback requirements, access requirements, and other site-specific considerations. To attempt to address these issues, the available/suitable lands were compared to parcel boundaries to identify parcels with significant portions of available and suitable land.

These parcels were then classed as either having or not having road frontage. Map 14 highlights these parcels and tabulates their size and developable portion.

Analysis of Resource Risk

Methodology

The fourth phase of this project was the analysis of future development risk to the resource-rich focus areas. The development risk areas – lands available and suitable for future development – were overlaid with the conservation focus areas identified through the final co-occurrence analysis. The overall available/suitable status of the focus areas was calculated to determine which areas as a whole were most vulnerable. Areas with significant overlap were considered resource risk areas and priority areas for conservation activity.

Resource Risk

The comparison of conservation focus areas with development risk areas highlights those regions that may be the highest priority for future conservation efforts. Figure 3, below, shows the percent of the Exeter portion of each focus area that is available and suitable for future development. The Fort Rock and Upper Exeter River focus areas have the highest overall percentages of available/suitable land – about 25% each. The Exeter portions of the Piscassic, Dudley Brook and Dearborn Brook focus areas, conversely, are almost entirely unavailable/ unsuitable for development. This does not, however, mean that those focus areas are fully protected. For example, the Dearborn Brook focus area, as shown in Figure 1, is largely unprotected across the town border in Stratham. The acres of available/suitable land for each focus area are summarized below in Table 7.

Figure 3. Natural Resource Focus Areas: Development Potential

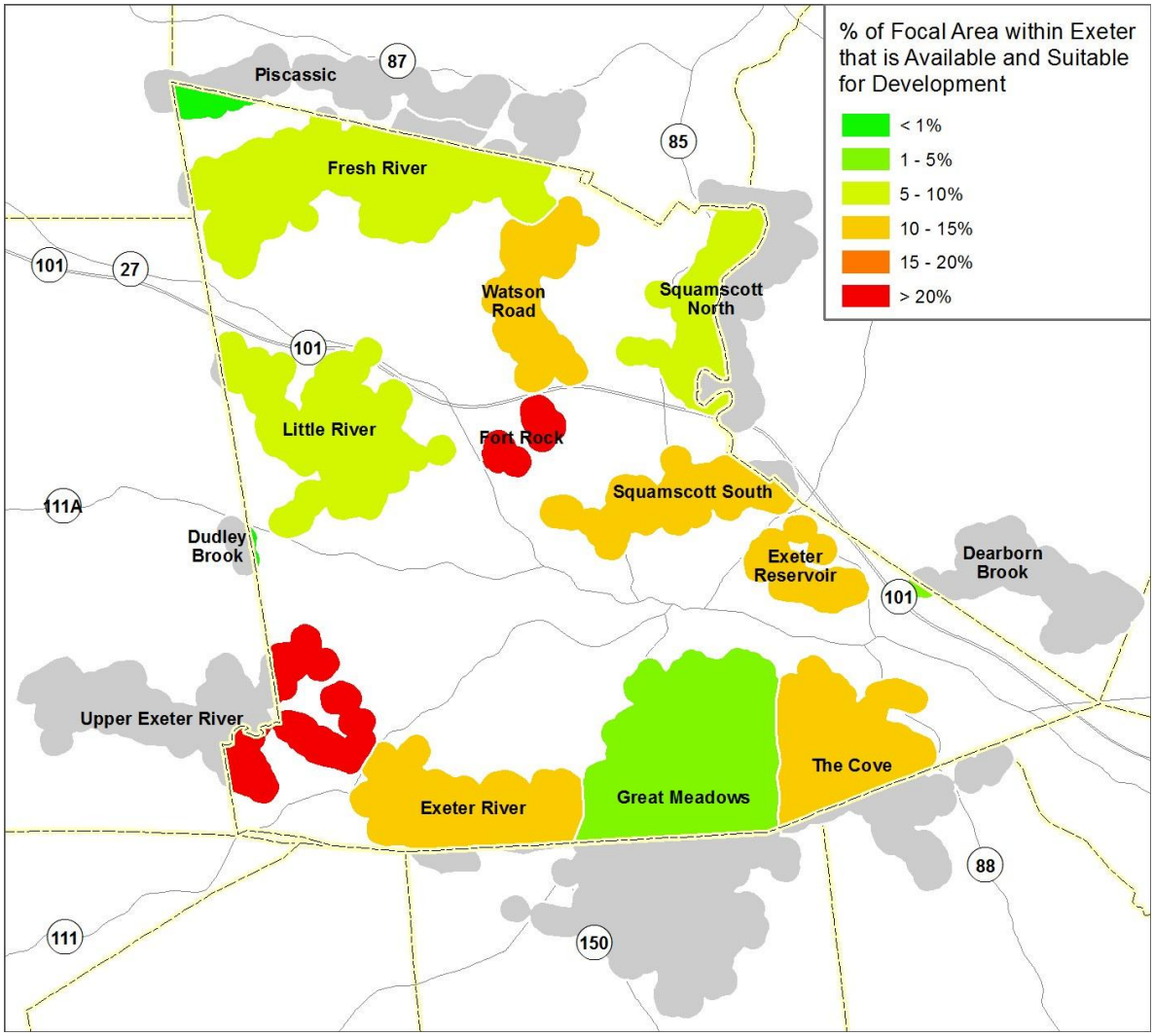


Table 7. Focus Areas that are Available and Suitable for Development

Name	Acres in Exeter both Available & Suitable for Dev.	% of Exeter Portion both Available & Suitable for Dev.
Fresh River	98.5	9.9%
Upper Exeter River	93.3	24.4%
Exeter River	82.4	14.5%
Little River	77.7	9.8%
Squamscott South	60.1	14.1%
The Cove	58.6	10.4%
Watson Road	57.9	14.6%
Fort Rock	31.3	25.8%
Squamscott North	27.2	7.2%
Exeter Reservoir	26.8	11.2%
Great Meadows	21.8	2.2%
Dearborn Brook	0.16	1.4%
Dudley Brook	0.04	0.5%
Piscassic	0.00	0%

Map 14 illustrates the overlap of the resource-rich focus areas with parcels with high percentages of available/suitable land – that is, likely development areas. The development risk areas are well distributed across Exeter, and many coincide with focus areas. Significant development risk parcels occur in the Little River, Fort Rock, Fresh River, Watson Road, Upper Exeter River, and Exeter River focus areas. The development constraints and parcel-based analysis was not conducted outside of Exeter, but it is worth noting again that particularly in the case of the Dearborn Brook focus area, the portion outside of Exeter is largely unprotected.

Conclusions and recommendations

Exeter has taken great strides in attempting to identify and conserve natural resources within the community. To date, more than 33% of Exeter's land base has been conserved to at least a minimal level. Conservation efforts have successfully addressed key resource features including groundwater, stream and river corridors, wildlife habitat, unfragmented blocks of open space and, to a certain extent, farmland. In addition, a number of regulatory controls are in place to help mitigate development impacts on these resources.

However, threats from future development and from the requirements of the existing infrastructure are ongoing. Exeter's population is now approaching 15,000, a 36% increase since 1980. Its population density is approximately 750 people per square mile, the sixth highest in Rockingham County. Given the limited amount of undeveloped property left in the community

one would anticipate that in the next twenty years, Exeter will approach build-out. As this occurs the competition for remaining open space will intensify and opportunities to utilize all public or privately owned land in the community will be explored. Planning and additional strategic land conservation work at this critical stage can direct these pressures toward redevelopment of the existing built-out areas of the community, help reduce further sprawl, and move new development toward the least valuable natural resource areas.

Economic considerations will pressure these decisions. A perception remains that continued growth reduces property taxes. However, studies such as the 1997 Cost of Community Services (as well as similar studies throughout New England), demonstrate that virtually all types of development are net drains to taxpayers when all costs are factored in over time. The added service costs for developed areas (education, police, fire, water, and waste disposal) continue on forever. Open space investments, on the other hand, carry either a one-time cost or relatively short-term bond.

Regulatory Controls

Exeter has an impressive set of regulatory controls that either directly or indirectly address natural resources. These include zoning ordinances for protection of wetlands, aquifers, shore lands and floodplains. There are also growth management and open space ordinances. Given the pressures that the community will face in the future and impending requirements dealing with stormwater drainage and wastewater treatment, the regulatory framework should be reviewed now to address difficult questions: Are the regulations working? What can be done to enhance them from a natural resource perspective? Are the regulations causing collateral damage to unintended audiences? Should some regulations be eliminated? The post-development water quality, riparian zones, wetlands, and wildlife habitat of properties that have been developed using the current framework of regulatory controls should be assessed to see if those controls are in fact achieving their goals.

Exeter has added pressure to address stormwater drainage because it is one of the MS4 (municipal separate storm sewer system) communities. As such it is required to address storm water runoff and water quality standards set by the NH Department of Environmental Services and the Environmental Protection Agency. Truly effective Low Impact Development (LID) requirements require better site design up-front to meet modern design requirements. It may make sense for these LID requirements to be standalone regulations rather than having them incorporated into the stormwater regulation framework.

Recommendations: Regulatory

- External Review – Evaluate all natural resource-related regulations to determine their effectiveness. Include assessment of properties after development.
- Low Impact Development – Integrate mandatory LID techniques and standards into the permitting process.
- Stormwater – Update stormwater, erosion and sediment control regulations.

- MS4 – Establish redevelopment strategies in the high density MS4 sections of the community that will address water quality issues.
- Water Conservation (old construction) – Establish an incentive-based program for installing low water use fixtures and having older structures evaluated by professional plumbers for leaks.
- Water Conservation (new construction) – Require on-site water sources for lawn irrigation in new development.
- Conservation Subdivision – review and update conservation subdivision regulations to reflect data from this natural resources inventory and enact mandatory conservation subdivision regulations.

Non-Regulatory Controls

Exeter has done an exemplary job conserving key open space parcels. The Conservation Lands map indicates that the town now has a total of 4,283 acres of conserved land, encompassing more than 33% of the land base. It was an early leader in passing a conservation bond, which was used to purchase development rights on a number of outstanding properties and to acquire key properties, such as the Raynes Farm. Additional land conservation work has been accomplished by land trusts and the Great Bay Resource Protection Partnership. It is clear from the impressive percentages of core composite areas in conservation (Table 5) that strategic land and conservation easement acquisitions have encompassed some of the most important natural resource features of the community.

Map 14, "High Resource and Development Risk," highlights some of the opportunities for future conservation efforts, and also shows that there are not that many more parcels to consider. There are about a dozen highly developable parcels next to conservation lands in focus areas. These should be the first priorities for future conservation.

However, there are several more parcels that are not highlighted as highly developable because they are in one or more of the protective overlay areas for aquifers, floodplains, shoreland or wetlands. These properties are still at risk, as the protective ordinances do not fully restrict future development. These ordinances are also open to change, and may become less restrictive in the future. Therefore, areas on Map 13 that are yellow, lavender, blue or peach should not be considered protected from future development. Any significant parcels – perhaps larger than 40 acres – within the final focus areas should be considered key conservation opportunities.

Another important consideration is the level of protection that conservation lands are actually afforded – that is, are Exeter's conservation lands truly "conserved"? The lands that are commonly considered conservation lands, and that have been used as such throughout this project's analysis, actually represent many different categories of ownership and restriction. Conservation Land includes town-owned lands under the supervision of the Conservation Commission, such as the Oaklands Town Forest, and state-owned properties such as the Piscassic Wildlife Management Area. It also includes privately-owned properties with

conservation easements held by the town, land trusts, or other qualifying organizations. Also included are properties owned by other institutions, such as the Phillips Exeter Academy, and a mix of devoted open space areas associated with certain developments such as the Exeter Farms Open Space.

One would assume that all of these properties are permanently protected in such a way that they cannot ever be developed. In fact, a significant portion of the total acreage listed as conservation lands in Exeter carry some risk of future development. Approximately 1,674 acres of the total are town-owned properties. Few of these parcels are conserved beyond the designation as Town Forest or Town Conservation Lands. The Phillips Exeter Academy (PEA) lands may be especially vulnerable. PEA lands encompass nearly 700 acres in Exeter, none of which are permanently conserved.

Many towns in New Hampshire have begun to understand the need for making decisions on which town-owned parcels should be permanently conserved and are working with private land trusts to place permanent restrictions on these properties with conservation easements. Exeter should inventory all of its town-owned properties and think about taking this action. This is a relatively inexpensive way to ensure that these properties are not vulnerable to future development pressure.

Two focus areas – Great Meadow and the Cove – are particularly valuable across multiple resource areas: wildlife, surface water, drinking water, and forests. The mix of outstanding natural resource features in the combined Cove and Great Meadow areas is unusually high from a statewide perspective. In other words, it is highly unusual to run into such a rich natural resource area in New Hampshire. While it may appear that the Great Meadows and the Cove focus areas are very well conserved, it is important to realize that there are significant gaps in their protection. A very significant portion of the Great Meadows area is PEA land, which as noted above is *not* permanent conservation land. At least one of the town's holdings in the Cove area, the Katz land, has no secondary protection (such as a conservation easement) to prevent its future development. (The abutting town-owned parcels, Smith and Page, have deed restrictions which may provide additional protection.) Finally, other large privately-owned parcels nearby may appear to be protected by ordinances such as the Aquifer Protection Overlay, but as discussed above, this does not necessarily restrict development.

Exeter is already utilizing PEA lands for some of its drinking water needs, and there may be more potential in the Cove. The length of undeveloped Exeter River corridor and Great Brook are exceptional, particularly this close to such a highly urbanized area. The PEA lands also include extensive actively managed farms in Kensington which abut a considerable acreage of conserved land in that community. Achieving permanent protection for this area should be a priority for the town. While Exeter cannot be expected to shoulder the financial burden of conserving this area alone, by partnering with private conservation organizations such as the Southeast Land

Trust of NH or the Society for the Protection of NH Forests, the town may be able to leverage more resources and maximize the area's eventual protection.

Recommendations: Non-Regulatory

- Conservation Funding – Consider a second conservation bond and establish a meaningful annual funding stream for the Conservation Fund through a mix of appropriations, Current Use change tax and/or other means. Highly developable parcels within the final focus areas should be the first priority for new conservation activity.
- Land Trust Partnership – Establish a contractual relationship with a land trust to conserve strategic focus area properties as identified in this natural resources inventory.
- Permanently Conserve Town Lands – Place conservation easements on town-owned properties, including all Town Forest parcels.
- Protect Drinking Water – Expand land conservation efforts to conserve properties that provide or have the potential for providing additional public drinking water. Work with neighboring towns as needed; for example, work with Stratham to achieve greater protection of the Dearborn Brook Focus Area.

Appendix A. GIS Data Sources and Methodology

Co-occurrence Mapping Model

As described throughout this report, the co-occurrence mapping was conducted as a series of resource-specific sub-composites that were then added together to yield a final, full composite. The steps to create each sub-composite, the final composite, and associated focus areas are described below:

Surface Water Sub-Composite and Focus Areas:

1. All input data layers were clipped to a two-mile buffer around the town of Exeter. Seven data layers were created for the analysis.
    a. A total wetlands layer was created by merging together wetlands from the National Wetlands Inventory, wetlands identified by the National Hydrography Dataset (NHD) (FTYPE = 466), and Very Poorly Drained soils from the NRCS SSURGO soils database. The boundaries between the merged wetlands were dissolved.
    b. Prime Wetlands (mapped by West Environmental in 2005; digitized by Cartographic Associates) were buffered by 150' and 300'.
    c. Streams (NHDflowline, FCODE = 460), NHDwaterbodies (FTYPE <> 466), and NHDarea were buffered by 150' and 300'.
    d. The 150' buffers of NHDflowline, NHDwaterbodies, and NHDarea were merged together and their boundaries dissolved.
    e. The 300' buffers of NHDflowline, NHDwaterbodies, and NHDarea were merged together and their boundaries dissolved.
    f. FEMA Digital Flood Insurance Rate Map (DFIRM) polygons where FLOODZONE = A, AE, or AO were selected, exported, and their boundaries dissolved.
    g. GRANIT's Stream Buffer Characterization 150' buffer data were selected where AltCateg = I (Intact) or MI (Mostly Intact), exported, and their boundaries dissolved.
2. All of the above data layers—wetlands, prime wetlands 150', prime wetlands 300', NHD 150', NHD 300', Floodplains, and Characterized Stream Buffers – were converted to rasters using the Polygon to Raster tool, cell assignment type = maximum area, cell size = 30.
3. Null values were converted to 0 with the raster calculator.
4. Resulting rasters were added together with the raster calculator. The result was the Surface Water Sub-Composite.
5. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.
6. The symbology of the resulting smoothed data set was set to "Classified" using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the "Classify" button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
7. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.

8. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field “Value” and simplifying polygons.
9. Small polygons and islands (<5 acres) were eliminated by selecting (“grid_code” = 0 AND “Acres” < 5) OR (“grid_code” = 1 AND “Acres” >= 5) and exporting to a new layer, then dissolving the boundaries within that layer. The result was the Surface Water Focus Areas.

Drinking Water Sub-Composite and Focus Areas:

1. All input data layers were clipped to a two-mile buffer around the town of Exeter. Input data layers were:
    a. Stratified Drift aquifers mapped by the USGS (as well as aquifers where MAT = OE, BE, & SB, as per emails with Rich Moore, USGS) in the Lamprey (Aqula) and Lower Merrimack (Aqulm) study areas, merged together and boundaries dissolved.
    b. Wellhead Protection Areas from NHDES
    c. Source Water Protection Areas
2. All of the above data layers—Aquifers, SWPA, WHPA—were converted to rasters using the Polygon to Raster tool, cell assignment type = maximum area, cell size = 30.
3. Null values were converted to 0 with the raster calculator.
4. Resulting rasters were added together with the raster calculator. The result was the Drinking Water Sub-Composite.
5. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.
6. The symbology of the resulting smoothed data set was set to “Classified” using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the “Classify” button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
7. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.
8. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field “Value” and simplifying polygons.
9. Small polygons and islands (<5 acres) were eliminated by selecting (“grid_code” = 0 AND “Acres” < 5) OR (“grid_code” = 1 AND “Acres” >= 5) and exporting to a new layer, then dissolving the boundaries within that layer. The result was the Drinking Water Focus Areas.

Wildlife Sub-Composite and Focus Areas:

1. All input data layers were clipped to a two-mile buffer around the town of Exeter.
    a. A layer representing steep, south facing slopes was created by calculating aspect for an extract of the NH DEM. Extracted by mask to just steep slope areas (>15%). Reclassified areas where the aspect was 112.5 – 247.5 = 1, all other values = 0. The resulting raster was converted to a polygon dataset, not simplifying polygons.
    b. A habitat composite was created by merging together steep slopes, National Wetlands Inventory wetlands, NHD wetlands, prime wetlands, very poorly drained soils,

grasslands (digitized for this project from 2010 aerial photographs) and the following layers from the 2010 NH Fish & Game Wildlife Action Plan: floodplain forests, peat, marsh, salt marsh.

   c. NH Fish & Game Wildlife Action Plan (WAP) 2010 tiers were selected where gridcode = 1 or 2 (highest quality habitat in state and highest quality habitat in biological region).
   d. Data points were received from the NH Natural Heritage Bureau (NHB) indicating the presence of threatened, rare, or endangered species or exemplary communities. Locations were shifted randomly by NHB prior to data delivery. According to NHB mapping policy, elements whose precise locations are known by NHB were buffered by a half mile, and those whose precise locations are not known due to unclear records were buffered by ¾ mile. Boundaries between buffer circles were dissolved.

2. All of the above data layers—habitat composite, WAP highest quality habitat, and NHB buffered occurrences—were converted to rasters using the Polygon to Raster tool, cell assignment type = maximum area, cell size = 30.
3. Null values were converted to 0 with the raster calculator.
4. Resulting rasters were added together with the raster calculator. The result was the Wildlife Sub-Composite.
5. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.
6. The symbology of the resulting smoothed data set was set to "Classified" using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the "Classify" button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
7. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.
8. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field "Value" and simplifying polygons.
9. Small polygons and islands (<5 acres) were eliminated by selecting ("grid_code" = 0 AND "Acres" < 5) OR ("grid_code" = 1 AND "Acres" >= 5) and exporting to a new layer, then dissolving the boundaries within that layer. The result was the Wildlife Focus Areas.

Agriculture Water Sub-Composite and Focus Areas:

1. All input data layers were clipped to a two-mile buffer around the town of Exeter. Input data layers were created:
   a. NRCS Soils were dissolved on the field FarmlndCls, and a new field called "Value" was calculated. Where FarmlndClas = All areas are prime farmland, Value = 3; Where FarmlndClas = Farmland of statewide importance, Value = 2; and Where FarmlndClas = Farmland of local importance, Value = 1
   b. 2010 aerial photographs were interpreted to identify areas in active or recent agricultural use.

2. Each of the above data layers—farmland soils and active agricultural land—were converted to rasters using the Polygon to Raster tool, cell assignment type = maximum area, cell size = 30. The value field in the farmland soils layer became the Value field in the new raster.
3. Null values were converted to 0 with the raster calculator.
4. Resulting rasters were added together with the raster calculator. The result was the Agriculture Sub-Composite.
5. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.
6. The symbology of the resulting smoothed data set was set to "Classified" using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the "Classify" button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
7. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.
8. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field "Value" and simplifying polygons.
9. Small polygons and islands (<5 acres) were eliminated by selecting ("grid_code" = 0 AND "Acres" < 5) OR ("grid_code" = 1 AND "Acres" >= 5) and exporting to a new layer, then dissolving the boundaries within that layer. The result was the Agriculture Focus Areas.

Forest Sub-Composite and Focus Areas:

1. All input data layers were clipped to a two-mile buffer around the town of Exeter.
    a. Unfragmented blocks were created by buffering roads (except Class VI roads) by 500 feet and unioning the results with the two-mile buffer around the town. Acreage of all blocks was calculated, and a new field "BlockValue" was populated based on the acreage range. Blocks < 200 acres received a value of 0, blocks 200 – 400 acres received value = 1, blocks 400 – 1,000 acres received value = 2, and blocks > 1,000 acres received value = 3.
    b. The targeted Important Forest Soils (IForSoiGrp = IA, IB, IIA) were clipped to any forest blocks larger than 200 acres (value > 0) and their boundaries were dissolved.
    c. Conducted a spatial join of the clipped Important Forest Soils to the Unfragmented Blocks. The total area of important forest soils that fall within each large block was calculated. A new field "SoilValue" was populated so that any large block that had >100 acres of important soils received a value of 1.
    d. A new field, "TotalValue" was created and calculated equal to the sum of "BlockValue" and "SoilValue".
2. In order to apply a methodology consistent with the other sub-composites, the forest blocks were converted to raster, with the raster value equal to the "TotalValue" field, cell assignment type = maximum area, cell size = 30. The result was the Forest Sub-Composite.
3. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.

4. The symbology of the resulting smoothed data set was set to “Classified” using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the “Classify” button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
5. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.
6. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field “Value” and simplifying polygons. The result was the Forest Focus Areas.

Final Composite and Focus Areas:

1. The five raster format resource-specific sub-composites (each re-classified to values of 0 and 1 based on the 1 standard deviation above the mean criterion described above) were added together using the raster calculator. The result was the final composite.
2. The Focal Statistics tool was used to smooth the data, using a rectangular neighborhood of 5 cells by 5 cells, calculating the mean of the cells in the neighborhood.
3. The symbology of the resulting smoothed data set was set to “Classified” using 2 classes. The break point for the two classes was determined by viewing the histogram of values (by clicking the “Classify” button on the Symbology tab of the Properties window). The break point was set at one standard deviation above the mean value.
4. The Reclassify tool was used to calculate the value for all cells below the break point to 0, and all cells above the break point to 1.
5. The Raster to Polygon tool was used to convert the reclassified raster to polygons, using the field “Value” and simplifying polygons.
6. Small polygons and islands (<5 acres) were eliminated by selecting (“grid_code” = 0 AND “Acres” < 5) OR (“grid_code” = 1 AND “Acres” >= 5) and exporting to a new layer, then dissolving the boundaries within that layer.
7. Buffered the resulting polygons (where “grid_code” = 1) by 500 feet. All resulting polygons that were >= 50 acres and all or partially within Exeter became the Final Focus Areas.
8. The largest Focus Areas were cut at logical places (typically roads or watershed divides). Areas not within or intersecting the Exeter town boundary were eliminated. The remaining areas were named for ease of discussion.

Development Analysis

The development analysis was essentially a constraints analysis, in which lands not available for development, land not suitable for development, and land with limited suitability for development were compared to the total town area to identify areas most likely to be developed in the future. The steps to conduct this analysis are described below.

Land Not Available for Development:

1. Conservation lands are not available for development. Lands identified as “conservation land” for this analysis included tax parcels tagged as conservation by Cartographic Associates, as well

as GRANIT's conservation lands layer, clipped to the boundaries of Exeter. These two data sets were merged together and their boundaries dissolved to create a comprehensive data set.

2. Already developed land is also not available for development. For this analysis, developed land was represented by Rockingham Planning Commission's 2005 land use/land cover data set where built = 1, merged with GRANIT's impervious surfaces dataset where grid >= 5.
3. Conservation land and developed land were merged, dissolved, and clipped to Exeter to create Land Not Available for Development.

Land Not Suitable for Development:

1. Wetlands and buffers around wetlands were defined based on the town's 2011 Zoning Ordinance and 2010 Site Plan and Subdivision Regulations. Prime wetlands were buffered 100 feet; very poorly drained soils were buffered 50 feet; poorly drained soils were buffered 40 feet; and intermittent streams were buffered 25 feet. These buffers were merged and dissolved.
2. Shoreland protection areas were identified by creating 300 foot buffers around the Exeter River, Fresh River, Squamscott, Water Works Pond, and major tributaries: Little River, Dudley Brook, Bloody Brook, Norris Brook, Wheelwright Creek, Parkman Brook, Rocky Hill Brook, Dearborn Brook, the stream flowing north from Great Meadows, the stream flowing west from the Cove, and the wetlands between Hampton and Hampton Falls Roads. It also included 150 foot buffers around all other perennial streams and around any tidal wetlands adjacent to the Squamscott River. These buffers were merged and dissolved.
3. NHDarea and NHDwaterbodies (not including NHD wetlands, FCODE = 466) were merged to represent bodies of open water.
4. The wetland buffers, shoreland protection areas, and open water were merged, dissolved, and clipped to Exeter to create Land Not Suitable for Development.

Land with Limited Suitability for Development:

1. Aquifer recharge zones and 100-year flood hazard zones are considered land with limited suitability for development. The Aquifer Protection Overlay District from Cartographic Associates' ZONEAQUI layer and the FEMA DFIRM where FLOODZONE = A, AE, or AO represented these areas.

Constraints Analysis:

1. Land Not Available for Development was unioned with the town boundary.
2. Land Not Suitable for Development was unioned with the town boundary.
3. The two resulting datasets were unioned together to create a dataset that tagged every portion of town as either available, suitable, both, or neither.
4. The available/suitable dataset was also unioned with other datasets, such as the zoning dataset from Cartographic Associates and the parcel polygons from Cartographic Associates, to evaluate the availability and suitability for development of different zones and parcels.

Appendix B.

List of Maps

Map 1. Water Resources

Map 2. Wildlife

Map 3. Agricultural Resources

Map 4. Forest Resources

Map 5. Conservation Lands

Map 6. Surface Water Sub-Composite

Map 7. Drinking Water Sub-Composite

Map 8. Wildlife Sub-Composite

Map 9. Wildlife Corridors

Map 10. Agriculture Sub-Composite

Map 11. Forest Sub-Composite

Map 12. Composite: All Resource Areas

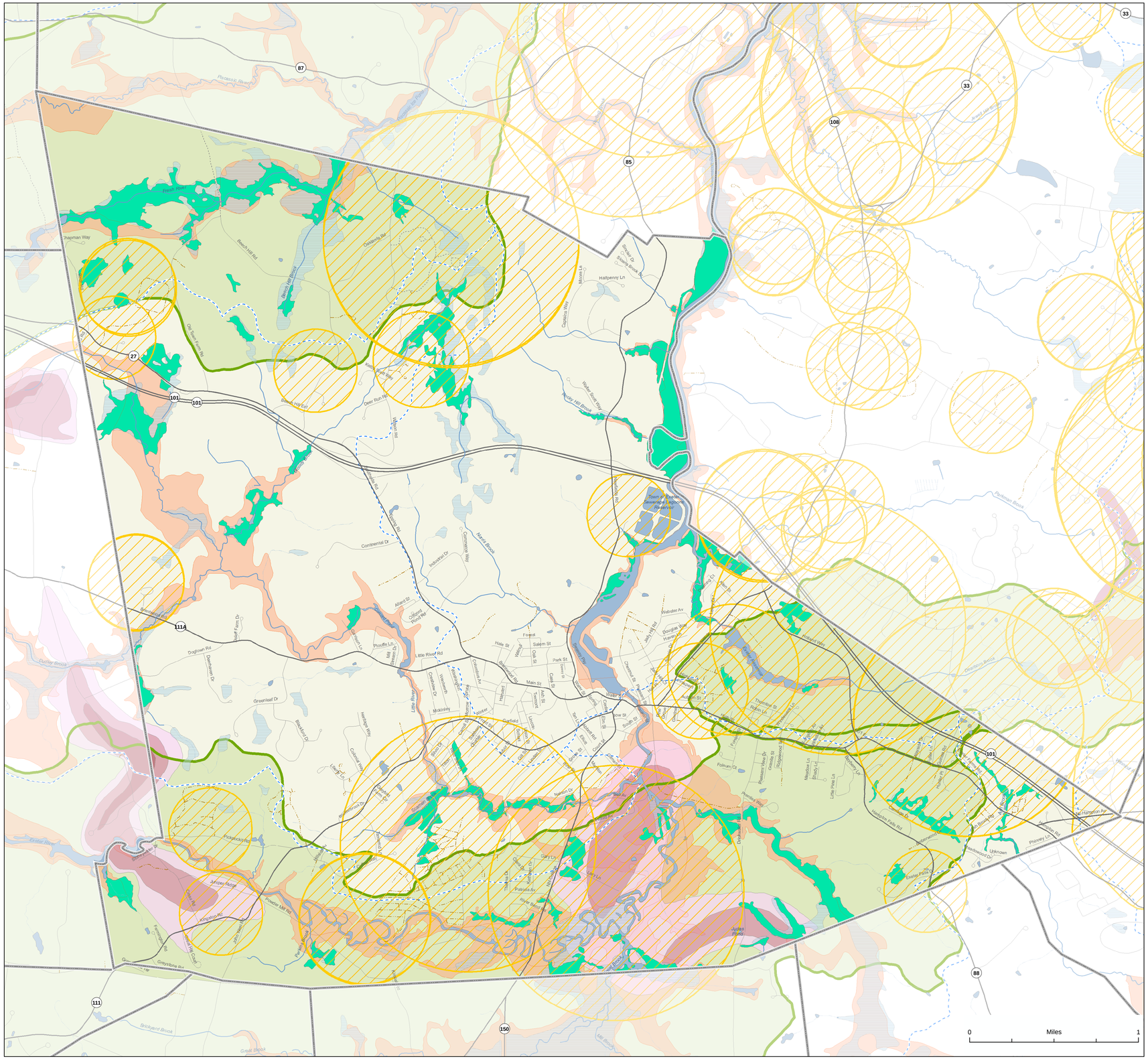
Map 13. Development Potential

Map 14. High Resource and Development Risk

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE BASE MAPS

MAP 1. WATER RESOURCES



- Prime Wetland
- Other Wetland (NHD)
- Waterbody (NHD)
- Perennial Stream
- Intermittent Stream
- Watershed Boundary
- Floodplain

Aquifer Transmissivity

- > 500 ft2/day
- > 1000 ft2/day
- > 2000 ft2/day
- > 3000 ft2/day
- Wellhead Protection Area
- Drinking Water Protection Area

- Town Boundary
- Local Road
- Not Maintained
- Private Road

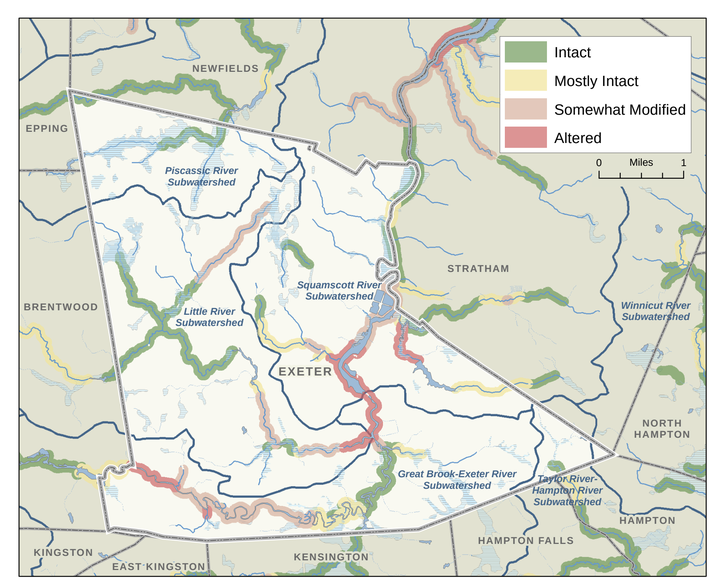
Data Sources:

Prime wetlands are wetlands that have been designated by the town because of their significant function and value; their boundaries were provided by the Town of Exeter and Cartographic Associates. **Floodplains** indicate the flood insurance rate zone that corresponds to areas of 100-year flooding (Zones A and AE), based on the Digital Flood Insurance Rate Maps (DFIRMs) mapped by FEMA and distributed by NH GRANIT. **Transmissivity of stratified drift aquifers** was mapped at 1:24,000 by the USGS and NHDES and distributed by NH GRANIT. **Wellhead Protection Areas** represent a protective radius around community and non-community, non-transient drinking water supplies, mapped by NHDES. **Drinking Water Source Protection Areas** are watershed delineations for surface water intakes for community and non-community, non-transient drinking water supplies, mapped by NHDES. The following datasets were mapped at 1:24,000 and distributed by NH GRANIT: **surface water** (waterbodies, streams and non-prime wetlands) from the NH National Hydrography Dataset, mapped by the USGS, US EPA and NHDES; **roads** mapped by NHDOT; **political boundaries** mapped by USGS; and **watershed boundaries** mapped by NRCS and NHDES.

Stream Buffer Characterization was conducted by the Complex Systems Research Center at UNH. Second order and higher streams were characterized based on the degree to which each stream's buffer was impacted by human activity such as development, roads, and agriculture. 300-foot buffers are displayed here.

Neatline Associates
Deerfield, NH
www.nhgis.com

1A. STREAM BUFFER CHARACTERIZATION



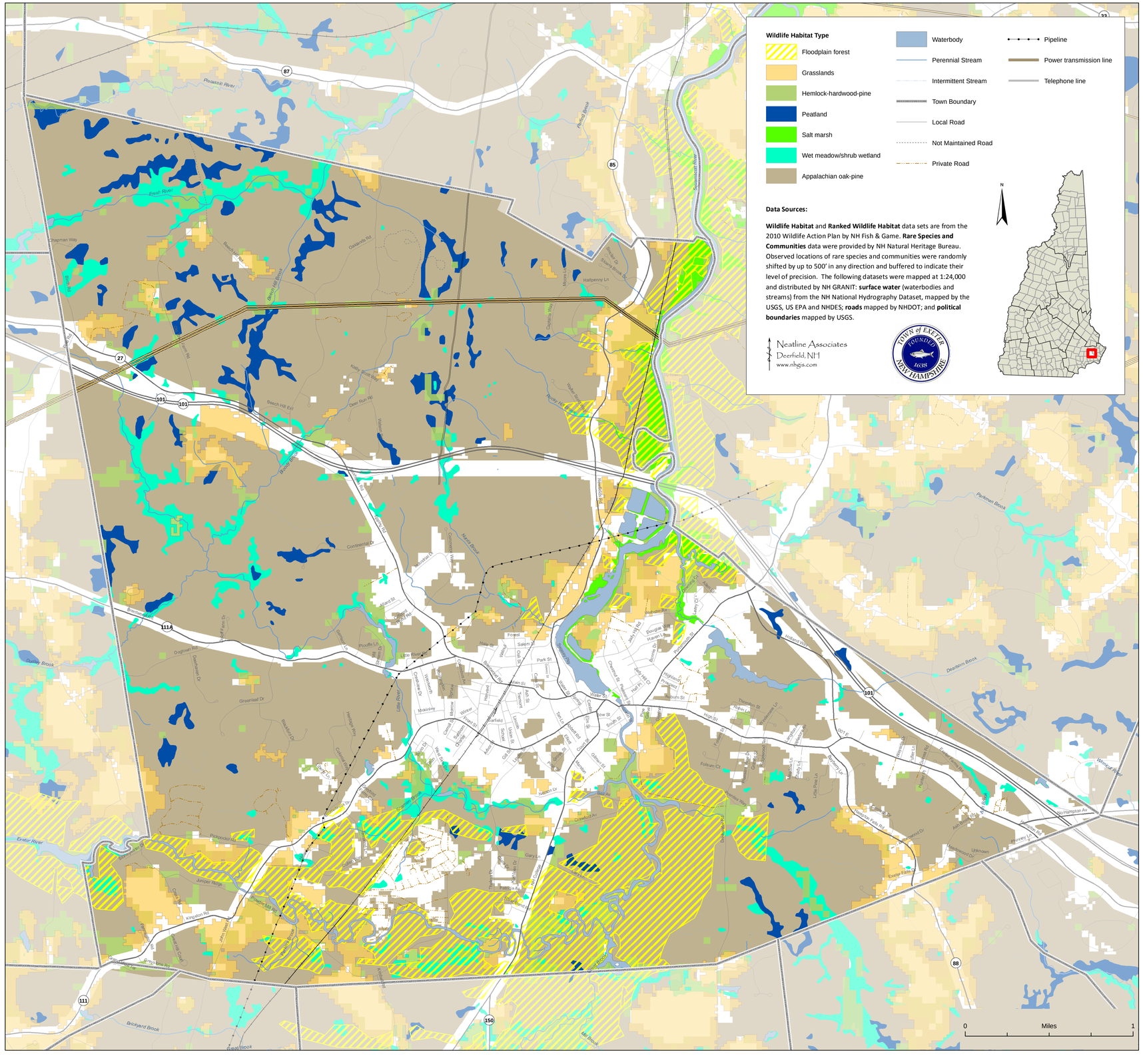
EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE BASE MAPS

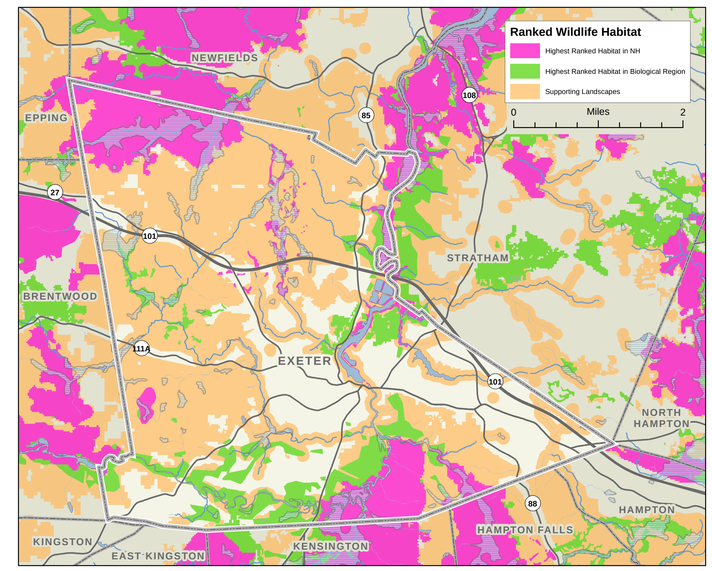
MAP 2. WILDLIFE HABITAT

Maps 2 and 2A present data from NH Fish & Game's 2010 Wildlife Action Plan (WAP). The WAP provides profiles of species and habitats across the state, maps that depict these different habitats, and an analysis of the condition of wildlife habitat throughout the state. To rank the condition of habitats, NH F&G evaluated biological factors, such as rare plant and animal species and overall biodiversity; landscape factors, such as size of distribution of habitat patches; and human impact factors, such as density of roads, dams, and pollution sources. Map 2A displays the highest ranked habitats in the state, highest ranked habitats in the ecological region (for Exeter, the Gulf of Maine Coastal Plain Lowland), and supporting landscapes. The top 15% (by area) of each forest habitat and top 10% of all other habitats are considered highest ranked.

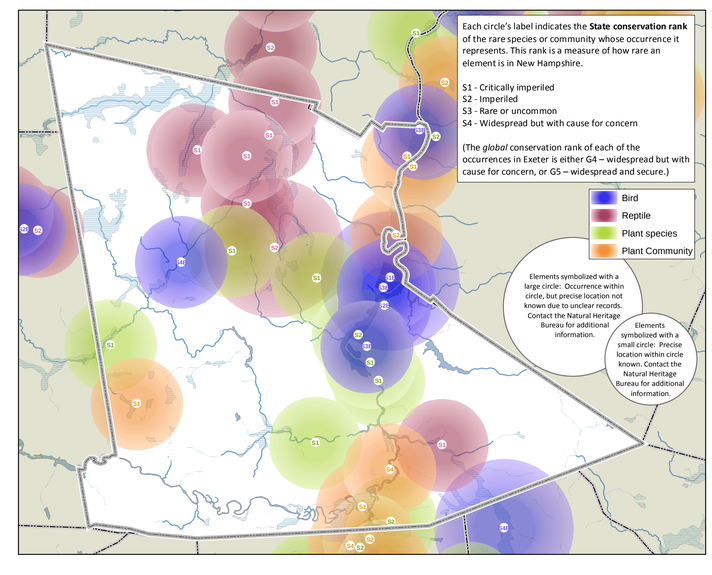
Map 2B illustrates the general locations of rare plants, wildlife, and natural communities (natural communities are different types of wetlands, forests, etc.). Precise locations are not shown due to the data's sensitive nature. The NH Natural Heritage Bureau's database contains more detailed information including locations, population sizes, and habitat descriptions. Please contact the Natural Heritage Bureau at (603) 271-2214 for more information. Wildlife occurrences are compiled and displayed in cooperation with the NH Fish & Game Department's Nongame Program, which can be reached at (603) 271-2462.



2A. RANKED WILDLIFE HABITAT



2B. NH NATURAL HERITAGE BUREAU DATA: RARE SPECIES AND COMMUNITIES



EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE BASE MAPS

MAP 3. AGRICULTURAL RESOURCES

Important Agricultural Soils

- All areas are prime farmland
- Farmland of statewide importance
- Farmland of local importance
- Active Agricultural Areas
- Conservation Land
- Waterbody (NHD)
- Wetland

- Perennial Stream
- Intermittent Stream
- Town Boundary
- Local Road
- Not Maintained Road
- Private Road

Important Agricultural Soils were mapped by the NRCS as part of the Rockingham County Soil Survey. Several classes of farmland soils are identified in the soil database: prime farmland, farmland of statewide importance, and farmland of local importance.

Prime farmland is the highest quality designation, and is typified by:

- Soils that have an appropriate moisture regime and sufficient available water capacity to produce the commonly grown cultivated crops adapted to New Hampshire in 7 or more years out of 10.
- Soils that are have an appropriate 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.
- 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 refers to soils that while not meeting the criteria for *prime* farmland, have still been determined by a state committee to be of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. These soils:

- 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 refers to soils that are neither prime nor of statewide importance, but still have still been determined by the County Conservation District Board to have significance for production of food, feed, fiber, and forage. In Rockingham County, these soils may be:

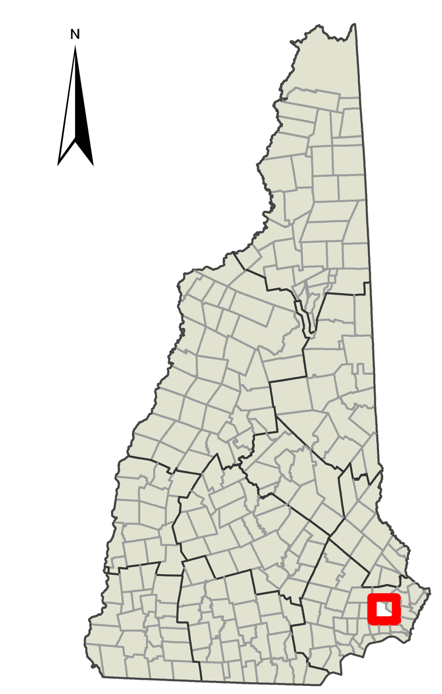
- Poorly drained, with artificial drainage established and are being farmed
- Specific soil map units as determined by the Conservation District Board.

Please note that the NRCS county-wide soil survey was mapped at 1:24,000, but are displayed on this 24"x36"printed map at 1:18,000. The smallest soil area that can be shown on the survey is 3 to 5 acres in size. These maps are intended for general land use planning purposes only and are accurate for this purpose. They do not display sufficient precision to be used for site-specific applications.

Farmland Soil Class	Acres (within Exeter)	Percent of Town	Acres in Conservation	% in Conservation	Acres Already Developed	% Already Developed
All areas are prime farmland	1,313.2	10.2%	388.5	29.6%	669.7	51.0%
Farmland of local importance	4,546.6	35.5%	1,668.0	36.7%	1,420.7	31.2%
Farmland of statewide importance	900.4	7.0%	188.0	20.9%	376.2	41.8%
Total Important Farmland	6,760.3	52.8%	2,244.5	33.2%	2,466.7	36.5%

Data Sources:

Important Agricultural Soils are from the Soils SSURGO database, mapped at 1:24,000 by the NRCS. **Active Agricultural Areas** were digitized from interpretation of 2010 aerial photography. **Conservation Lands** provided by the Town of Exeter and Cartographics Associates. The following datasets were mapped at 1:24,000 and distributed by NH GRANIT: **surface water** (waterbodies and streams) from the NH National Hydrography Dataset, mapped by the USGS, US EPA and NHDES; **roads** mapped by NHDOT; and **political boundaries** mapped by USGS. **Wetlands** include both NH NHD wetlands and prime wetlands provided by the Town of Exeter and Cartographics Associates.



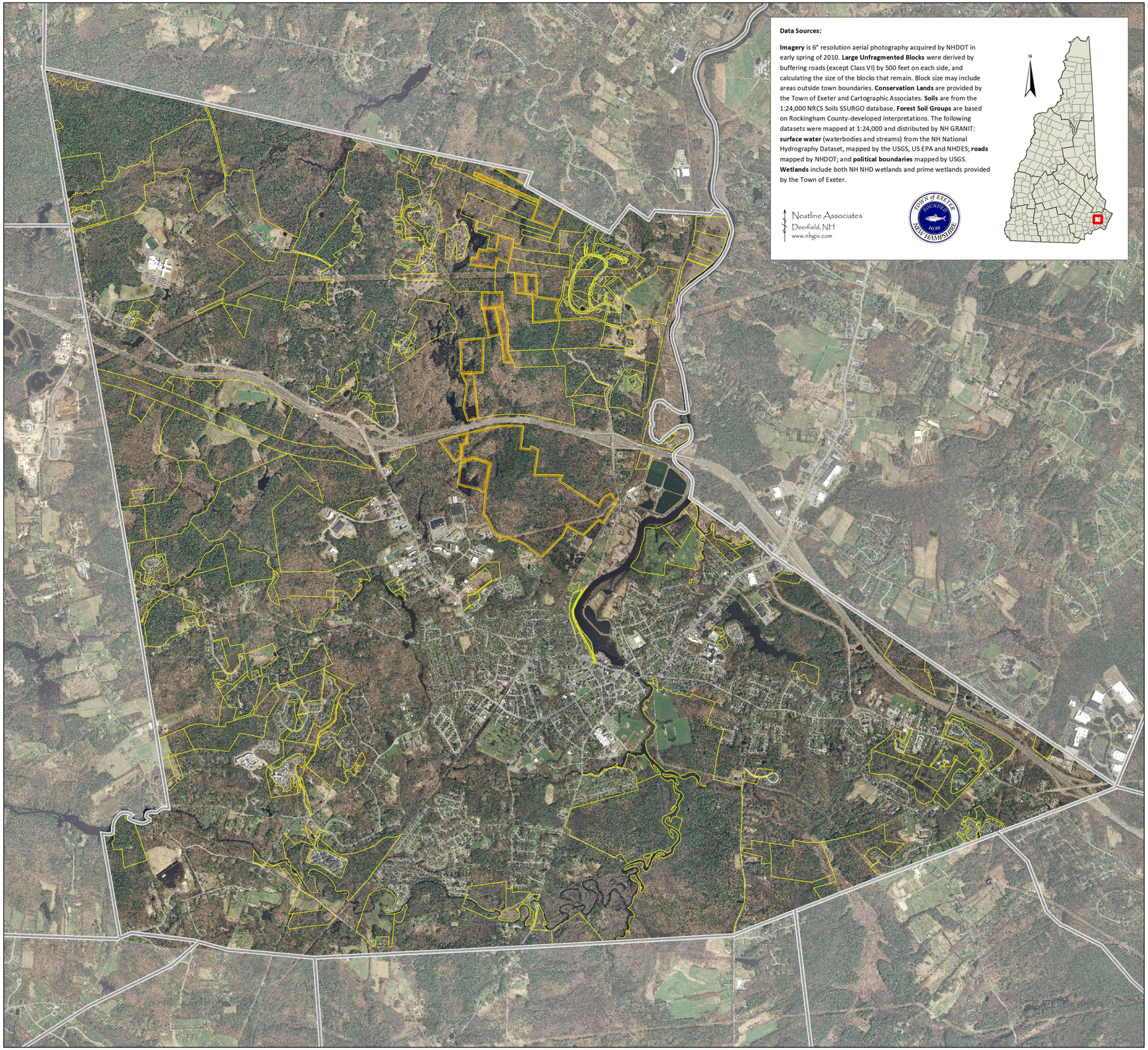
Neatline Associates
Deerfield, NH
www.nhgis.com

TOWN of EXETER FOUNDED 1638 NEW HAMPSHIRE

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE BASE MAPS

MAP 4. FOREST RESOURCES

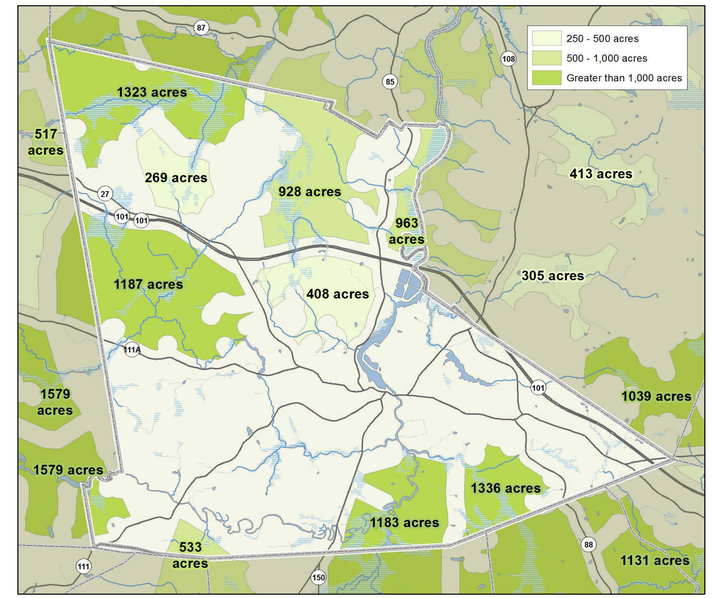


Town Forest

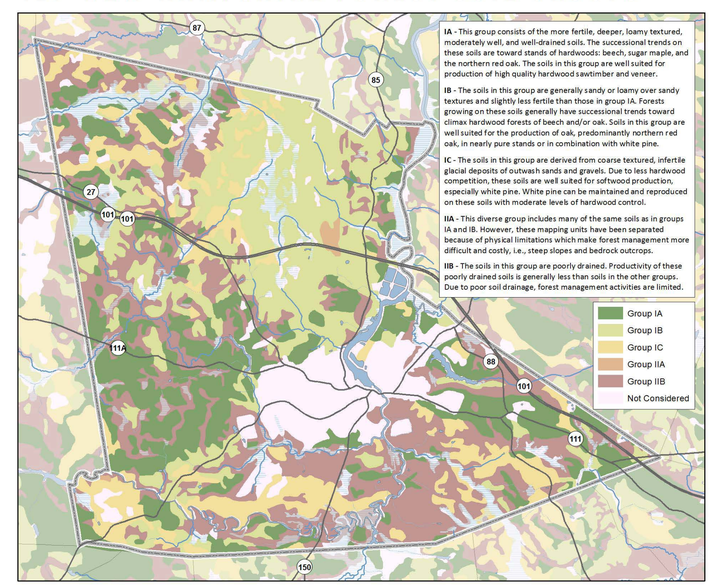
Conservation Land

Town Boundary

4A. LARGE UNFRAGMENTED BLOCKS (>250 ac.)



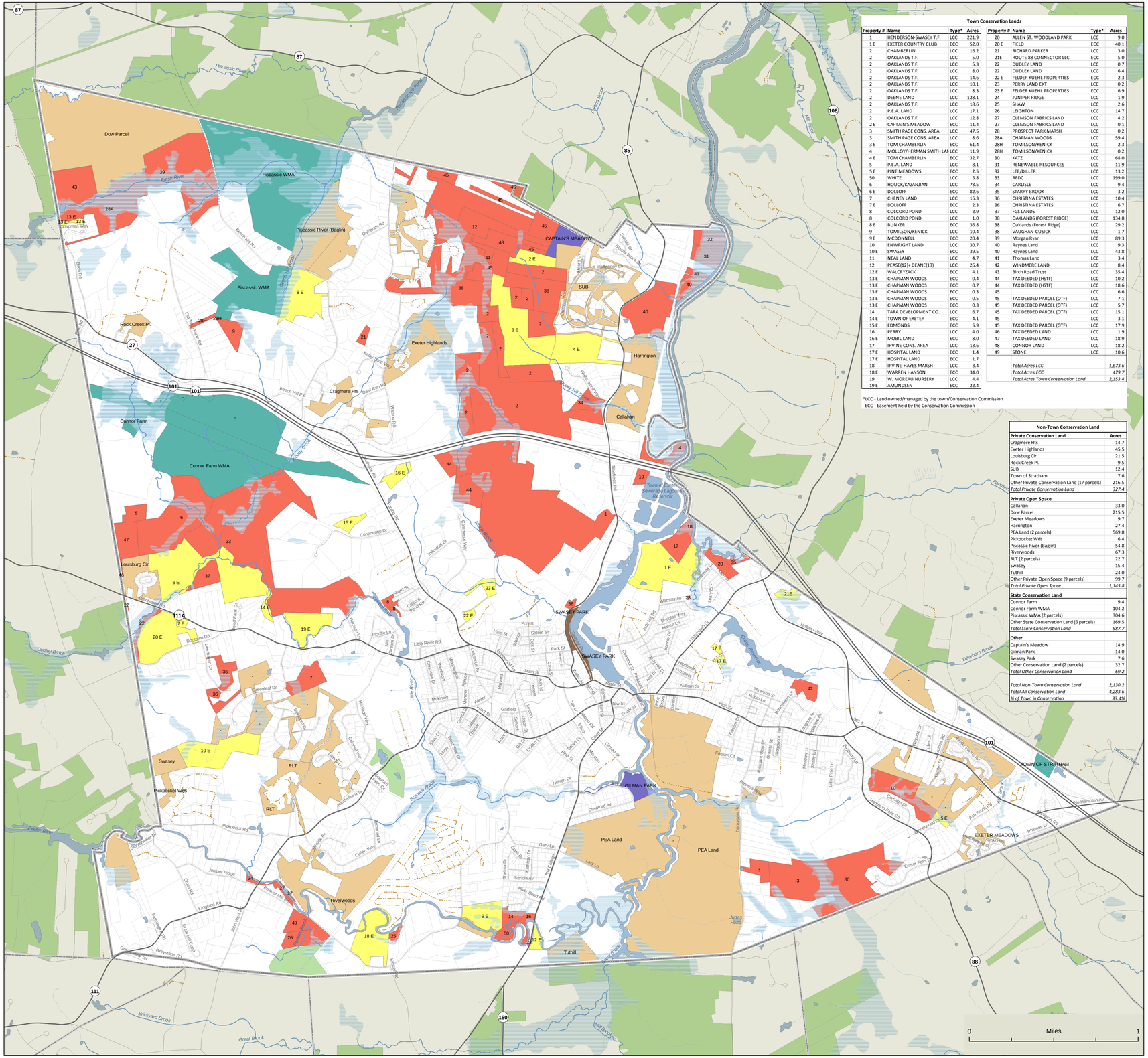
4B. NEW HAMPSHIRE FOREST SOIL GROUPS



EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE BASE MAPS

MAP 5. CONSERVATION LANDS



Town Conservation Lands

Property #	Name	Type*	Acres
1	HENDERSON-SWASEY T.F.	LCC	221.9
1 E	EXETER COUNTRY CLUB	ECC	52.0
2	CHAMBERLIN	LCC	16.2
2	OAKLANDS T.F.	LCC	5.0
2	OAKLANDS T.F.	LCC	5.3
2	OAKLANDS T.F.	LCC	8.0
2	OAKLANDS T.F.	LCC	14.6
2	OAKLANDS T.F.	LCC	10.1
2	OAKLANDS T.F.	LCC	8.3
2	DEENE LAND	LCC	128.1
2	OAKLANDS T.F.	LCC	18.6
2	P.E.A. LAND	LCC	17.1
2	OAKLANDS T.F.	LCC	12.8
2 E	CAPTAIN'S MEADOW	ECC	11.4
3	SMITH PAGE CONS. AREA	LCC	47.5
3	SMITH PAGE CONS. AREA	LCC	8.6
3 E	TOM CHAMBERLIN	ECC	61.4
4	MOLLOY/HERMAN SMITH LAN	LCC	11.9
4 E	TOM CHAMBERLIN	ECC	32.7
5	P.E.A. LAND	LCC	8.1
5 E	PINE MEADOWS	ECC	2.5
50	WHITE	LCC	5.8
6	HOUCK/KAZANJIAN	LCC	73.5
6 E	DOLLOFF	ECC	82.6
7	CHENEY LAND	LCC	16.3
7 E	DOLLOFF	ECC	2.3
8	COLCORD POND	LCC	2.9
8	COLCORD POND	LCC	1.0
8 E	BUNKER	ECC	36.8
9	TOMILSON/KENICK	LCC	10.4
9 E	MCDONNELL	ECC	20.4
10	ENWRIGHT LAND	LCC	30.7
10 E	SWASEY	ECC	39.5
11	NEAL LAND	LCC	4.7
12	PEASE(12)+ DEANE(13)	LCC	26.4
12 E	WALCRYZACK	ECC	4.1
13 E	CHAPMAN WOODS	ECC	0.4
13 E	CHAPMAN WOODS	ECC	0.7
13 E	CHAPMAN WOODS	ECC	0.3
13 E	CHAPMAN WOODS	ECC	0.5
13 E	CHAPMAN WOODS	ECC	0.3
14	TARA DEVELOPMENT CO.	LCC	6.7
14 E	TOWN OF EXETER	ECC	4.1
15 E	EDMONDS	ECC	5.9
16	PERRY	LCC	4.0
16 E	MOBIL LAND	ECC	8.0
17	IRVINE CONS. AREA	LCC	13.6
17 E	HOSPITAL LAND	ECC	1.4
17 E	HOSPITAL LAND	ECC	1.7
18	IRVINE-HAYES MARSH	LCC	3.4
18 E	WARREN HANSON	ECC	34.0
19	W. MOREAU NURSERY	LCC	4.4
19 E	AMUNDSEN	ECC	22.4
20	ALLEN ST. WOODLAND PARK	LCC	9.0
20 E	FIELD	ECC	40.1
21	RICHARD PARKER	LCC	3.0
21E	ROUTE 88 CONNECTOR LLC	ECC	5.0
22	DUDLEY LAND	LCC	0.7
22	DUDLEY LAND	LCC	6.4
22 E	FELDER KUEHL PROPERTIES	ECC	2.3
23	PERRY LAND EXT	LCC	0.2
23 E	FELDER KUEHL PROPERTIES	ECC	6.9
24	JUNIPER RIDGE	LCC	1.9
25	SHAW	LCC	2.6
26	LEIGHTON	LCC	14.7
27	CLEMSON FABRICS LAND	LCC	4.2
27	CLEMSON FABRICS LAND	LCC	0.1
28	PROSPECT PARK MARSH	LCC	0.2
28A	CHAPMAN WOODS	LCC	59.4
28H	TOMILSON/KENICK	LCC	2.3
28H	TOMILSON/KENICK	LCC	0.2
30	KATZ	LCC	68.0
31	RENEWABLE RESOURCES	LCC	11.9
32	LEE/DILLER	LCC	13.2
33	REDC	LCC	199.0
34	CARLISLE	LCC	9.4
35	STARRY BROOK	LCC	3.2
36	CHRISTINA ESTATES	LCC	10.4
36	CHRISTINA ESTATES	LCC	6.7
37	FGS LANDS	LCC	12.0
38	OAKLANDS (FOREST RIDGE)	LCC	134.8
38	Oaklands (Forest Ridge)	LCC	29.2
38	VAUGHAN-CUSICK	LCC	1.7
39	Morgan Ryan	LCC	89.3
40	Raynes Land	LCC	9.3
40	Raynes Land	LCC	43.8
41	Thomas Land	LCC	3.4
42	WINDMERE LAND	LCC	8.4
43	Birch Road Trust	LCC	35.4
44	TAX DEEDED (HSTF)	LCC	10.2
44	TAX DEEDED (HSTF)	LCC	18.6
45		LCC	6.6
45	TAX DEEDED PARCEL (OTF)	LCC	7.1
45	TAX DEEDED PARCEL (OTF)	LCC	5.7
45	TAX DEEDED PARCEL (OTF)	LCC	15.1
45		LCC	3.1
45	TAX DEEDED PARCEL (OTF)	LCC	17.9
46	TAX DEEDED LAND	LCC	1.9
47	TAX DEEDED LAND	LCC	18.9
48	CONNOR LAND	LCC	18.2
49	STONE	LCC	10.6
	Total Acres LCC		*1,673.6*
	Total Acres ECC		*479.7*
	Total Acres Town Conservation Land		*2,153.4*

*LCC - Land owned/managed by the town/Conservation Commission
ECC - Easement held by the Conservation Commission

Non-Town Conservation Land

Private Conservation Land	Acres
Cragmere Hts	14.7
Exeter Highlands	45.5
Louisburg Cir.	21.5
Rock Creek Pt.	9.5
SUB	12.4
Town of Stratham	7.6
Other Private Conservation Land (17 parcels)	216.5
Total Private Conservation Land	*327.4*
Private Open Space	
Callahan	33.0
Dow Parcel	215.5
Exeter Meadows	9.7
Harrington	27.4
PEA Land (2 parcels)	569.8
Pickpocket Wds	6.4
Piscassic River (Baglin)	54.8
Riverwoods	67.3
RLT (2 parcels)	22.7
Swasey	15.4
Tuthill	24.0
Other Private Open Space (9 parcels)	99.7
Total Private Open Space	*1,145.8*
State Conservation Land	
Connor Farm	9.4
Connor Farm WMA	104.2
Piscassic WMA (2 parcels)	304.6
Other State Conservation Land (6 parcels)	169.5
Total State Conservation Land	*587.7*
Other	
Captain's Meadow	14.9
Gilman Park	14.0
Swasey Park	7.6
Other Conservation Land (2 parcels)	32.7
Total Other Conservation Land	*69.2*
Total Non-Town Conservation Land	*2,130.2*
Total All Conservation Land	*4,283.6*
% of Town in Conservation	*33.4%*

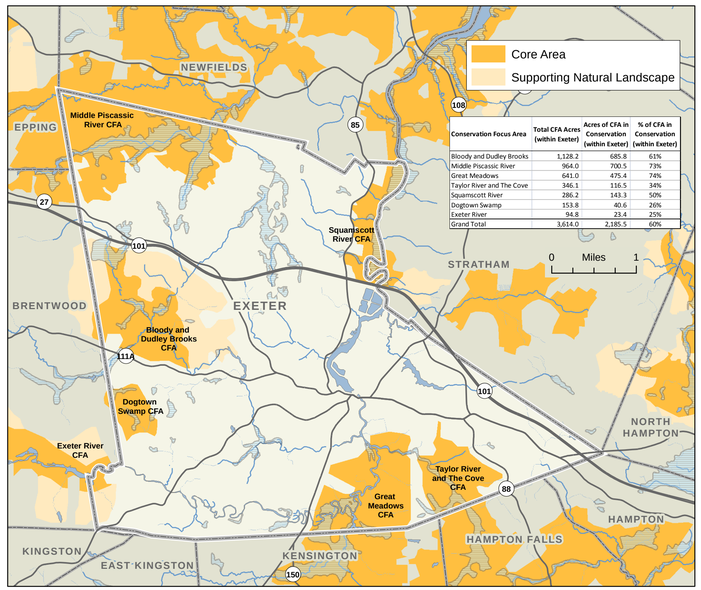
- Land owned or managed by the Town/Cons. Com.
- Easement held by Conservation Commission
- Private Open Space/Conservation Area or Unknown
- Trustees of Gilman Park
- Trustees of Swasey Park
- State Conservation Land
- Other Conservation Land (GRANIT)
- Tax Parcel Boundary
- Town Boundary
- Waterbody (NHD)
- Wetland
- Perennial Stream
- Intermittent Stream
- Local Road
- Not Maintained Road
- Private Road

Data Sources:

Conservation Lands are provided by the Town of Exeter and Cartographic Associates. **Other Conservation Lands** are conservation areas in other towns from the GRANIT conservation lands database. Some conservation lands not shown in the Town of Exeter data are also displayed. **Conservation Focus Areas (Core Areas and Supporting Landscapes)** were identified by The Nature Conservancy's 2006 Land Conservation Plan for NH's Coastal Watersheds. **Tax Parcel Boundaries** are provided by the Town of Exeter and Cartographic Associates. The following datasets were mapped at 1:24,000 and distributed by NH GRANIT: **surface water** (waterbodies and streams) from the NH National Hydrography Dataset, mapped by the USGS, US EPA and NHDES; **roads** mapped by NHDOT; and **political boundaries** mapped by USGS. **Wetlands** include both NH NHD wetlands and prime wetlands provided by the Town of Exeter.

Neatline Associates
Deerfield, NH
www.nhgis.com

5a. CONSERVATION FOCUS AREAS from THE LAND CONSERVATION PLAN for NH's COASTAL WATERSHEDS



Conservation Focus Area	Total CFA Acres (within Exeter)	Acres of CFA in Conservation (within Exeter)	% of CFA in Conservation (within Exeter)
Bloody and Dudley Brooks	1,128.2	685.8	61%
Middle Piscassic River	964.0	700.5	73%
Great Meadows	641.0	475.4	74%
Taylor River and The Cove	346.1	116.5	34%
Squamscott River	286.2	143.3	50%
Dogtown Swamp	153.8	40.6	26%
Exeter River	94.8	23.4	25%
Grand Total	3,614.0	2,185.5	60%

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 6. SURFACE WATER SUB-COMPOSITE

Surface Water Composite and Focus Areas

The surface water resources sub-composite is an overlay of:

- All wetlands, including the National Wetlands Inventory, the National Hydrography Dataset, and the USGS Soils Survey's very poorly drained soils.
- 150-foot buffers around prime wetlands
- 300-foot buffers around prime wetlands
- 150-foot buffers around all streams, rivers, lakes, and ponds
- 300-foot buffers around all streams, rivers, lakes, and ponds
- FEMA 100-year floodplain
- GRANIT's 150-foot Stream Buffer Characterization where the buffer is considered "Intact" or "Mostly Intact"

Each of these resource inputs received one point in the co-occurrence overlay. In order to avoid double-counting the wetland resources that were mapped by multiple sources, the different datasets were merged together and any area that was considered wetland by any of these sources received just one point. The two different buffer distances, however, do overlap. For example, for a given feature such as a pond, the 150-foot buffer area includes the pond itself and the area within 150 feet of that pond. The 300-foot buffer area includes the pond and the area within 300 feet of the pond. Each of the buffer areas received one point, so that when these two buffers were overlain (added together), the pond and the area within 150 feet of it received a total two points, and the area from 150 feet to 300 feet of the pond received a total of one point.

To create the composite, each of the above input layers was added together. The resulting surface water composite has values ranging from 0 – 7, where higher values represent areas with higher resource importance. In order to further generalize or smooth the composite, each cell was given a new value: the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The resulting surface water focus areas cover about 5,500 acres, or 45% of the town.

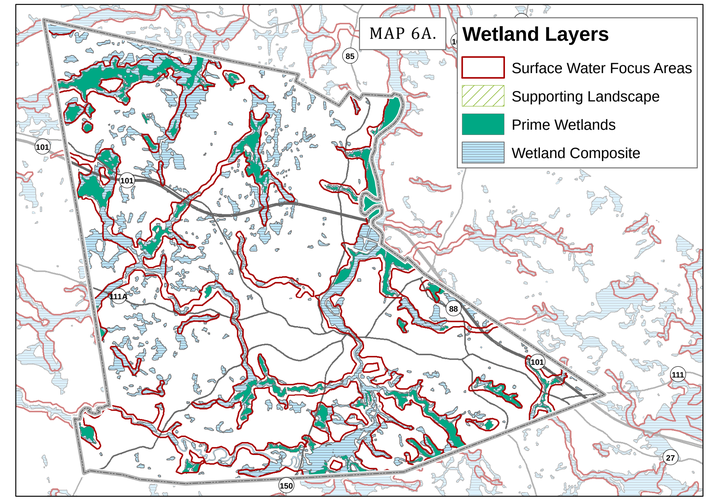
Co-occurrence of Surface Water Resources

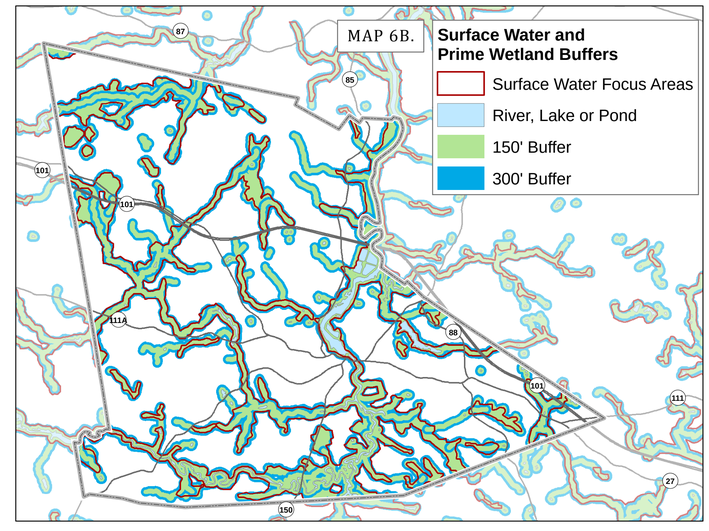
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7

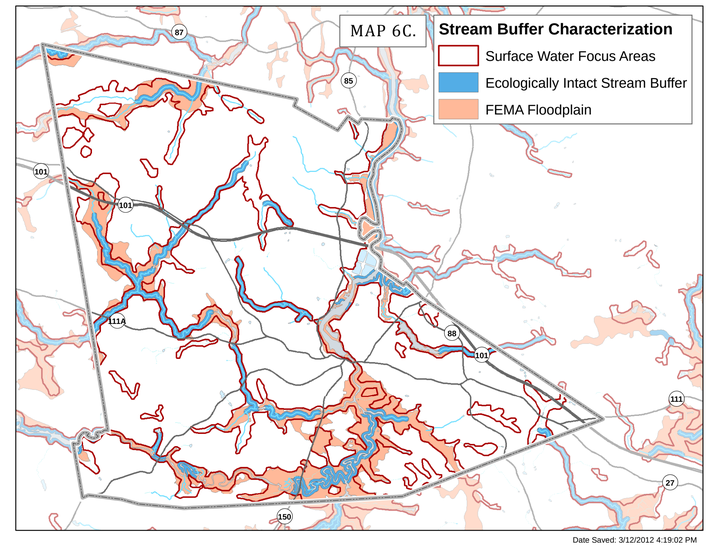
Surface Water Focus Areas

Neatline Associates
Deerfield, NH
www.nhgis.com

0 Miles 1





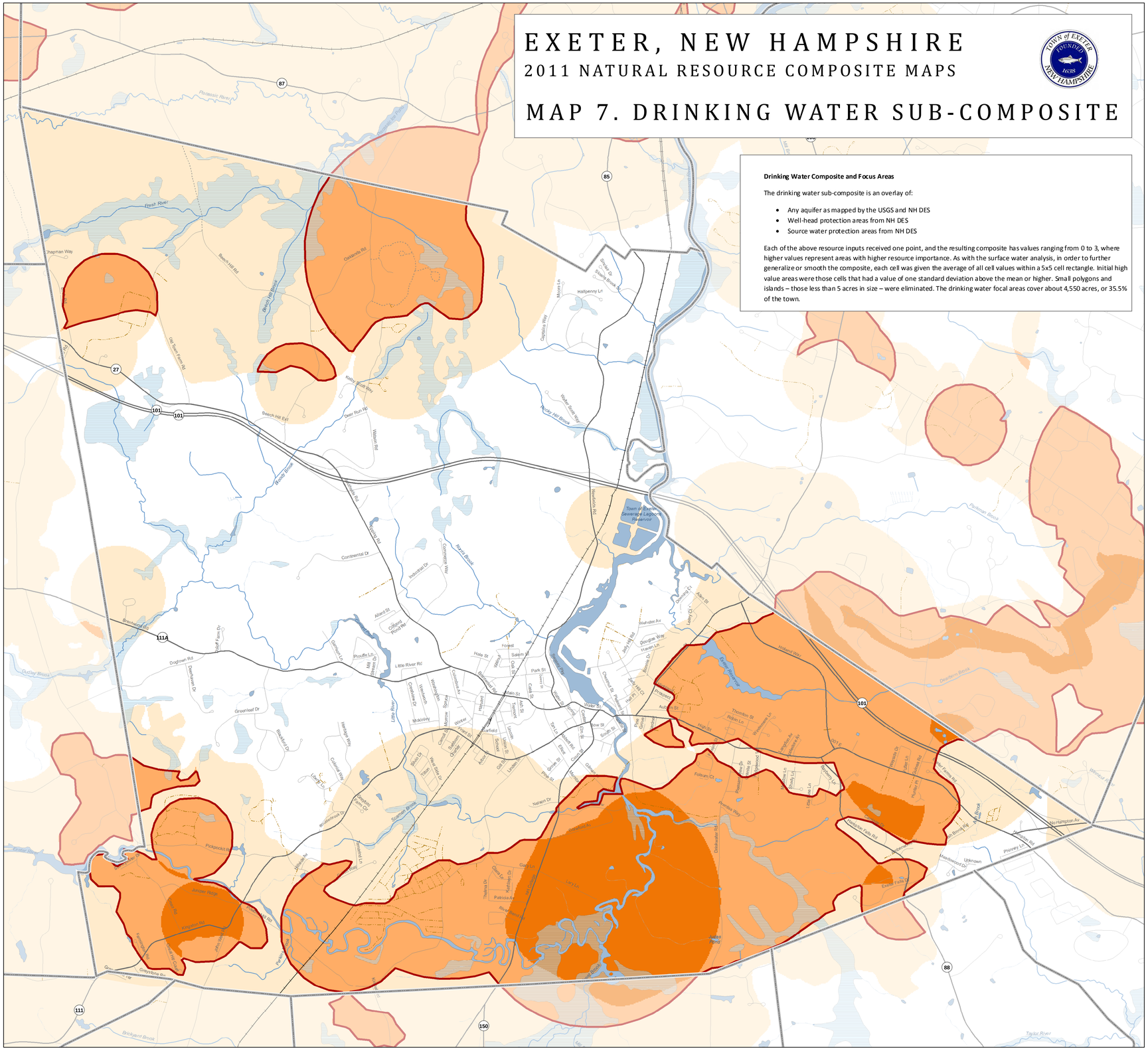


Date Saved: 3/12/2012 4:19:02 PM

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 7. DRINKING WATER SUB-COMPOSITE



Drinking Water Composite and Focus Areas

The drinking water sub-composite is an overlay of:

- Any aquifer as mapped by the USGS and NH DES
- Well-head protection areas from NH DES
- Source water protection areas from NH DES

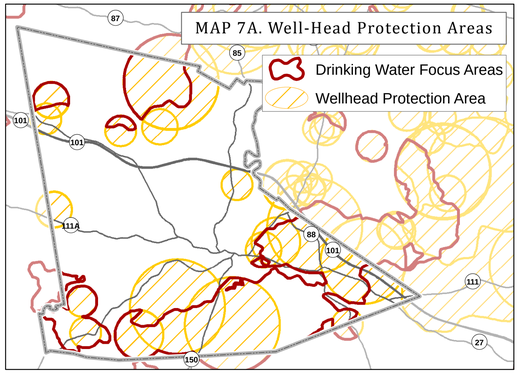
Each of the above resource inputs received one point, and the resulting composite has values ranging from 0 to 3, where higher values represent areas with higher resource importance. As with the surface water analysis, in order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The drinking water focal areas cover about 4,550 acres, or 35.5% of the town.

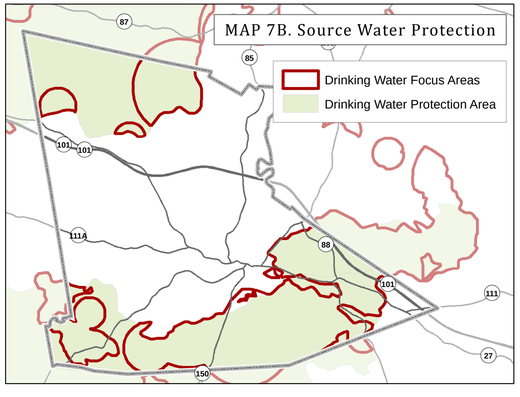
Co-occurrence of Drinking Water Resources

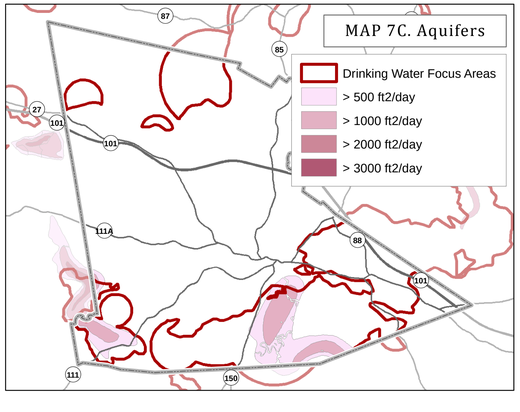
- 0
- 1
- 2
- 3
- Drinking Water Focus Areas

Neatline Associates
Deerfield, NH
www.nhgis.com

0 Miles 1







EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 8. WILDLIFE SUB-COMPOSITE

This map illustrates the co-occurrence of several wildlife-related natural resource areas: potentially important wildlife habitat; areas ranked as highest in state or highest in region by the NH Fish & Game Wildlife Action Plan; and areas with documented occurrences of rare or exemplary species or habitats by the Natural Heritage Bureau.

First, a composite was created of areas with potentially important wildlife habitat. This habitat composite (Map 6a) comprised wetlands from the National Wetlands Inventory; very poorly drained soils; National Hydrography Dataset wetlands, water bodies, and river areas; prime wetlands; steep south-facing slopes; grasslands and agricultural lands digitized from aerial photography; and floodplain forests, peatlands, marshlands, and salt marsh as modeled by the Wildlife Action Plan. Because many of the layers that contributed to the habitat composite were ultimately representing the same resource type (e.g., wetland), they were not themselves overlain as a co-occurrence; instead, they were simply merged together to create a single composite "important habitat" layer. Any area that contained any number of the contributing layers received 1 point.

The second contributor to the co-occurrence model is highly ranked areas from the Wildlife Action Plan (Map 6b). Areas that are highest ranked habitat in the state received 2 points, and areas that are highest ranked habitat in the biological region received 1 point.

The final contributor to the co-occurrence model is data from the NH Natural Heritage Bureau, showing documented occurrences of rare species or rare/exemplary communities (Map 6c). Each point, representing a known occurrence, has been shifted a small random distance and buffered by up to ¾ of a mile, depending on the precision of the data point. Any circle representing one or more occurrences received 1 point.

The three contributing layers: the habitat composite, wildlife action plan tiers, and Natural Heritage Bureau data—were then added together to yield the Wildlife Sub-Composite co-occurrence map. The resulting data were smoothed and areas with the highest scores were identified as Wildlife Focus Areas.

Wildlife Focus Areas

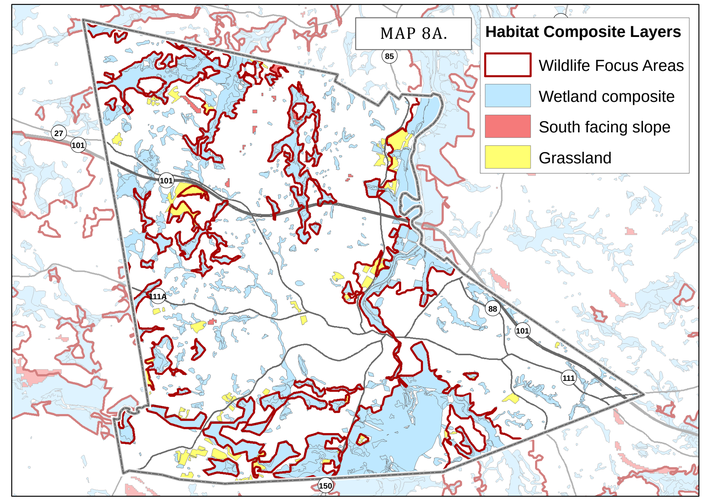
Co-occurrence of Wildlife Resources

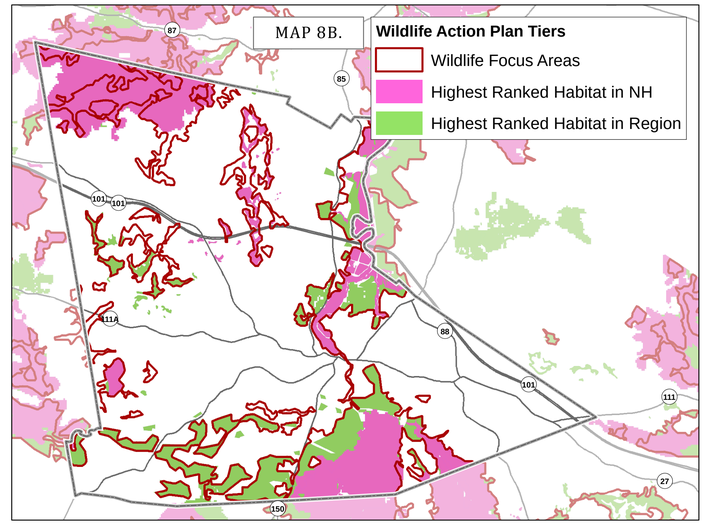
- 0
- 1
- 2
- 3

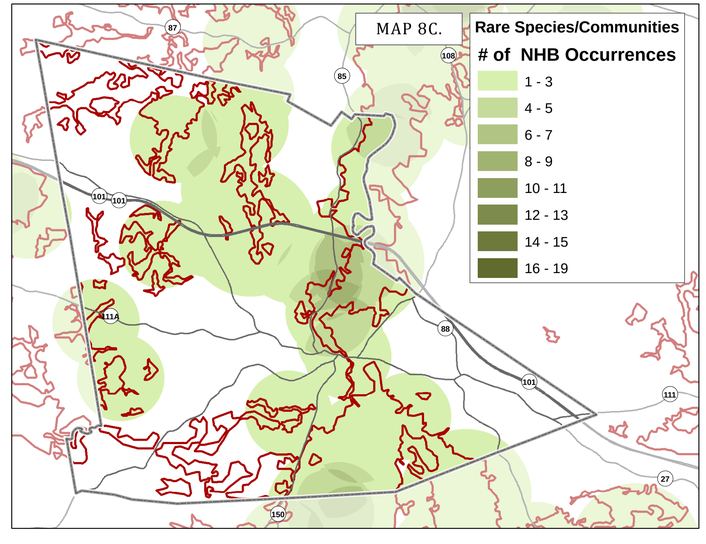
Neatline Associates
Deerfield, NH
www.nhgis.com

N

0 Miles 1



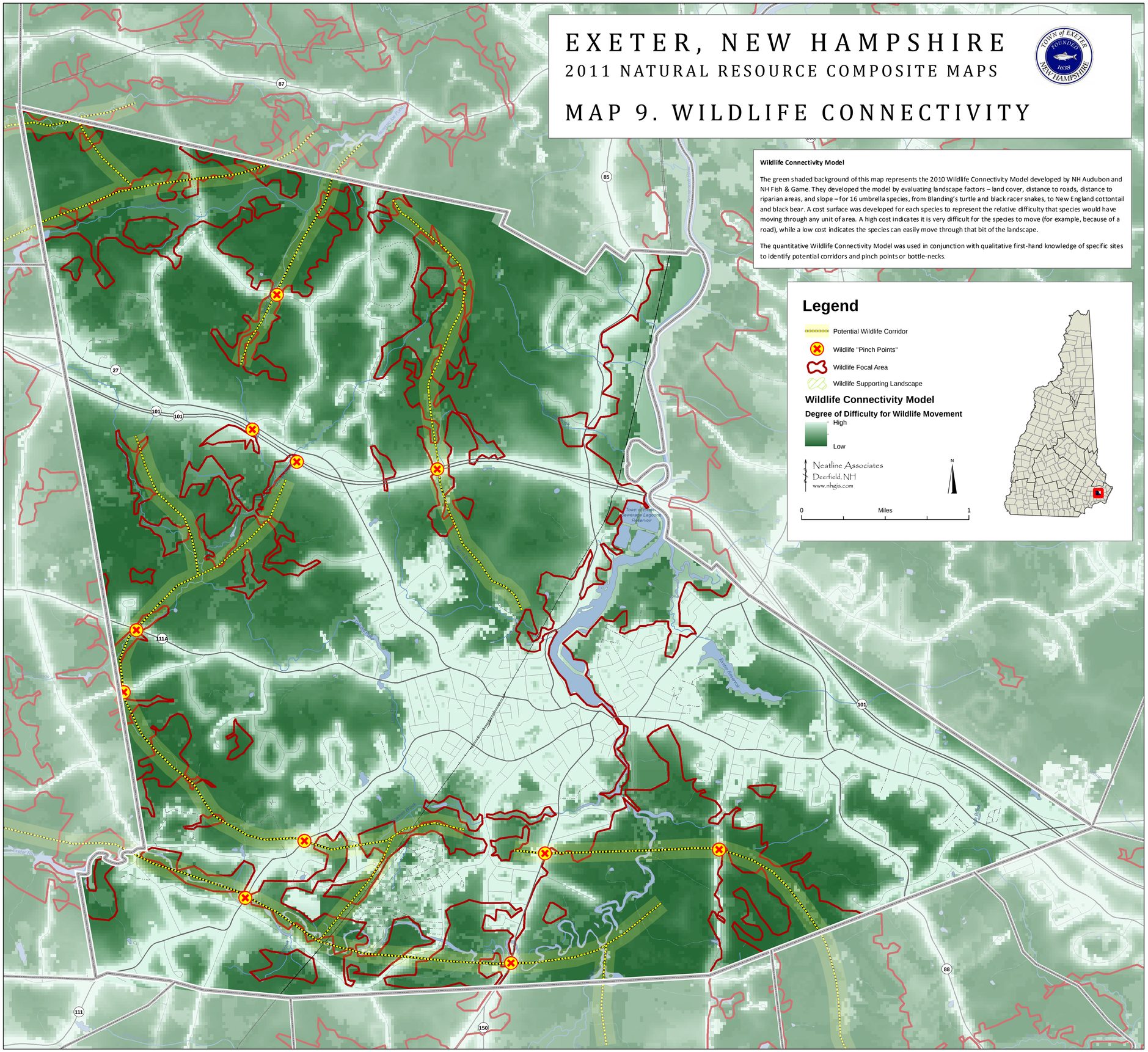




EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 9. WILDLIFE CONNECTIVITY



Wildlife Connectivity Model

The green shaded background of this map represents the 2010 Wildlife Connectivity Model developed by NH Audubon and NH Fish & Game. They developed the model by evaluating landscape factors – land cover, distance to roads, distance to riparian areas, and slope – for 16 umbrella species, from Blanding's turtle and black racer snakes, to New England cottontail and black bear. A cost surface was developed for each species to represent the relative difficulty that species would have moving through any unit of area. A high cost indicates it is very difficult for the species to move (for example, because of a road), while a low cost indicates the species can easily move through that bit of the landscape.

The quantitative Wildlife Connectivity Model was used in conjunction with qualitative first-hand knowledge of specific sites to identify potential corridors and pinch points or bottle-necks.

Legend

- Potential Wildlife Corridor
- Wildlife "Pinch Points"
- Wildlife Focal Area
- Wildlife Supporting Landscape

Wildlife Connectivity Model

Degree of Difficulty for Wildlife Movement

High

Low

Neatline Associates
Deerfield, NH
www.nhgis.com

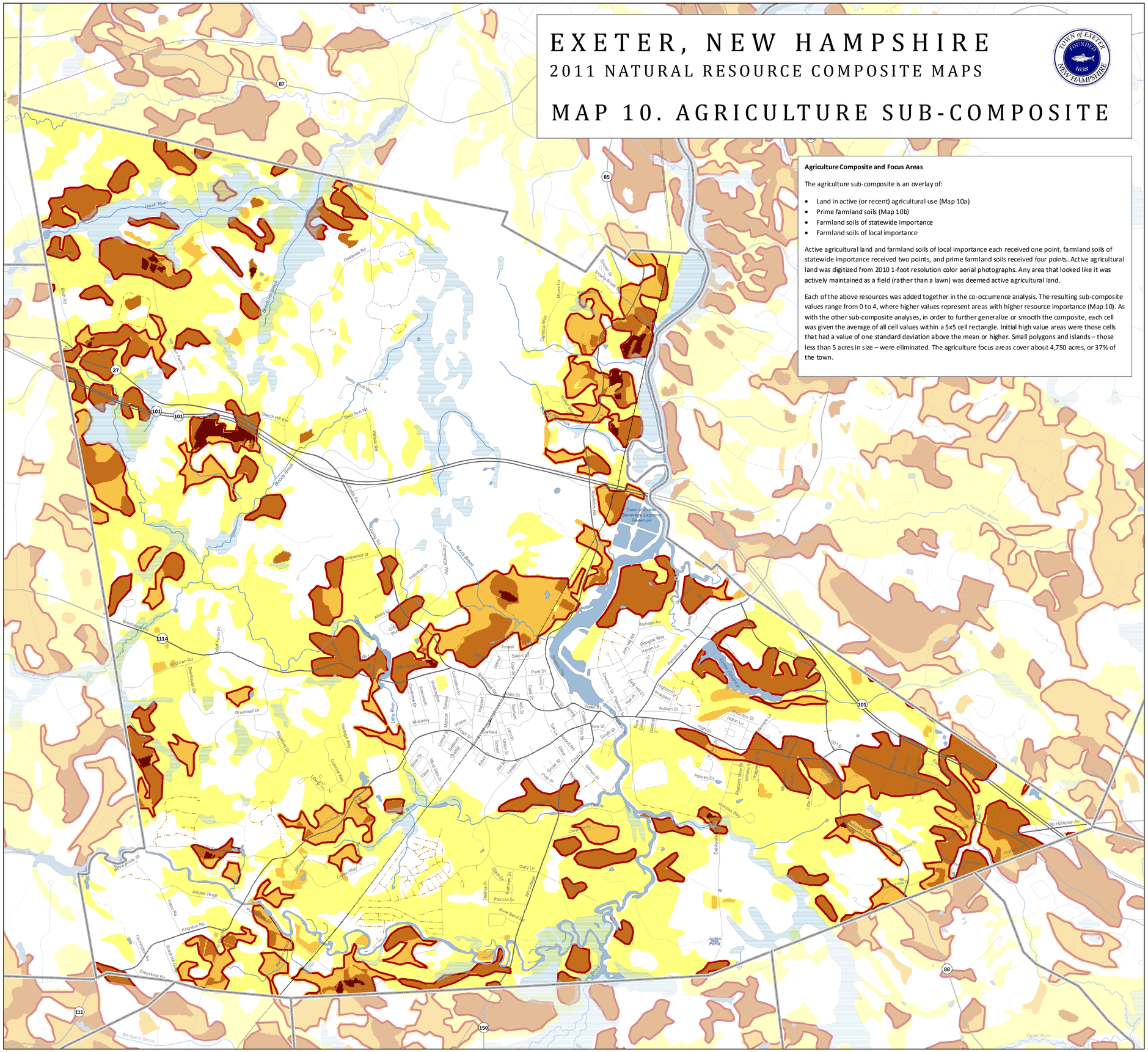
N

0 Miles 1

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 10. AGRICULTURE SUB-COMPOSITE



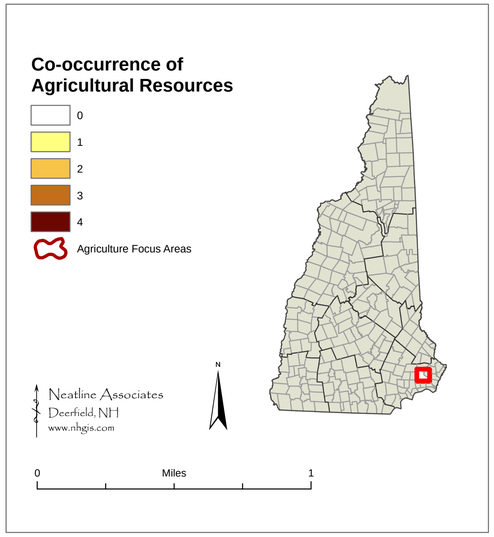
Agriculture Composite and Focus Areas

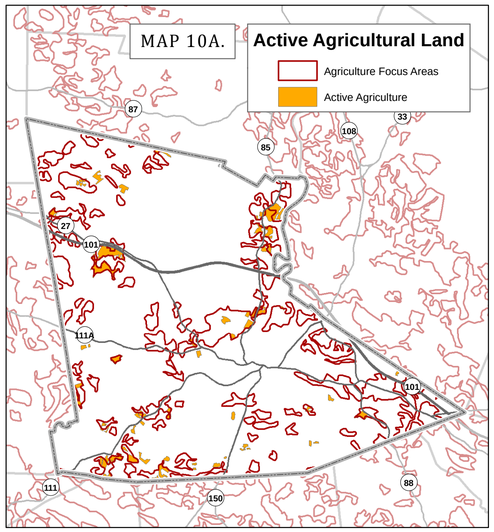
The agriculture sub-composite is an overlay of:

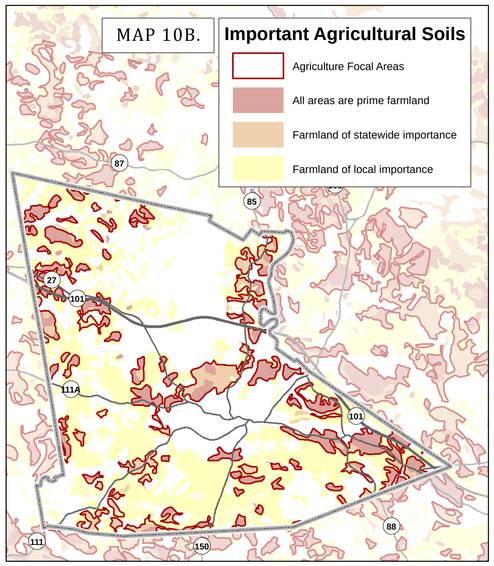
- Land in active (or recent) agricultural use (Map 10a)
- Prime farmland soils (Map 10b)
- Farmland soils of statewide importance
- Farmland soils of local importance

Active agricultural land and farmland soils of local importance each received one point, farmland soils of statewide importance received two points, and prime farmland soils received four points. Active agricultural land was digitized from 2010 1-foot resolution color aerial photographs. Any area that looked like it was actively maintained as a field (rather than a lawn) was deemed active agricultural land.

Each of the above resources was added together in the co-occurrence analysis. The resulting sub-composite values range from 0 to 4, where higher values represent areas with higher resource importance (Map 10). As with the other sub-composite analyses, in order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. Small polygons and islands – those less than 5 acres in size – were eliminated. The agriculture focus areas cover about 4,750 acres, or 37% of the town.



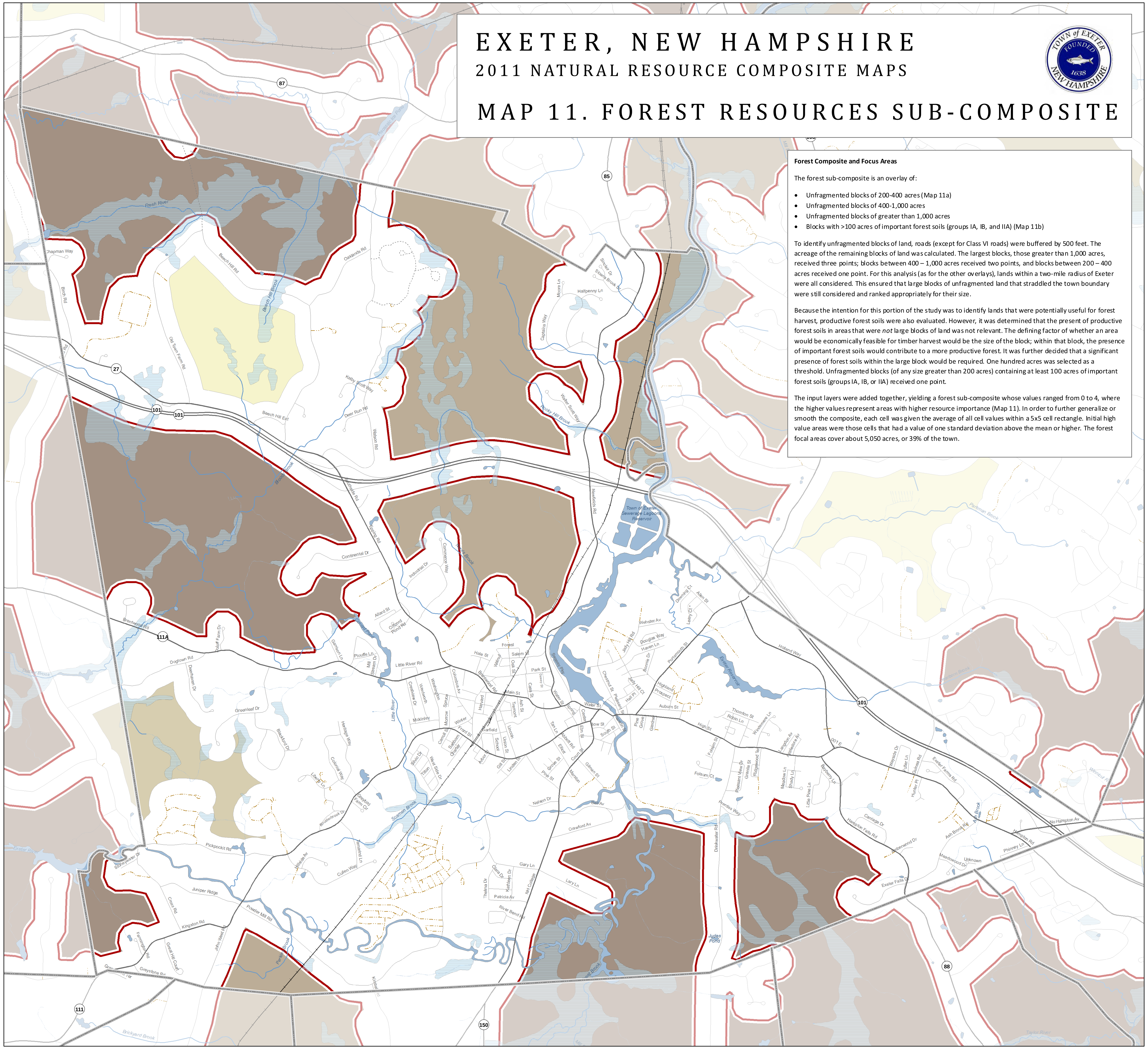




EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 11. FOREST RESOURCES SUB-COMPOSITE



Forest Composite and Focus Areas

The forest sub-composite is an overlay of:

- Unfragmented blocks of 200-400 acres (Map 11a)
- Unfragmented blocks of 400-1,000 acres
- Unfragmented blocks of greater than 1,000 acres
- Blocks with >100 acres of important forest soils (groups IA, IB, and IIA) (Map 11b)

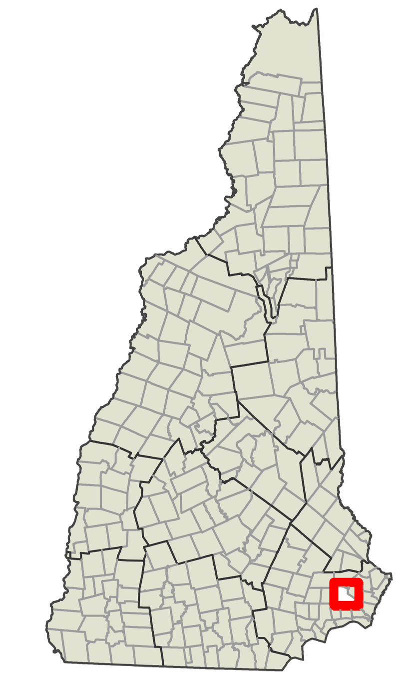
To identify unfragmented blocks of land, roads (except for Class VI roads) were buffered by 500 feet. The acreage of the remaining blocks of land was calculated. The largest blocks, those greater than 1,000 acres, received three points; blocks between 400 – 1,000 acres received two points, and blocks between 200 – 400 acres received one point. For this analysis (as for the other overlays), lands within a two-mile radius of Exeter were all considered. This ensured that large blocks of unfragmented land that straddled the town boundary were still considered and ranked appropriately for their size.

Because the intention for this portion of the study was to identify lands that were potentially useful for forest harvest, productive forest soils were also evaluated. However, it was determined that the present of productive forest soils in areas that were *not* large blocks of land was not relevant. The defining factor of whether an area would be economically feasible for timber harvest would be the size of the block; within that block, the presence of important forest soils would contribute to a more productive forest. It was further decided that a significant presence of forest soils within the large block would be required. One hundred acres was selected as a threshold. Unfragmented blocks (of any size greater than 200 acres) containing at least 100 acres of important forest soils (groups IA, IB, or IIA) received one point.

The input layers were added together, yielding a forest sub-composite whose values ranged from 0 to 4, where the higher values represent areas with higher resource importance (Map 11). In order to further generalize or smooth the composite, each cell was given the average of all cell values within a 5x5 cell rectangle. Initial high value areas were those cells that had a value of one standard deviation above the mean or higher. The forest focal areas cover about 5,050 acres, or 39% of the town.

Co-occurrence of Forest Resources

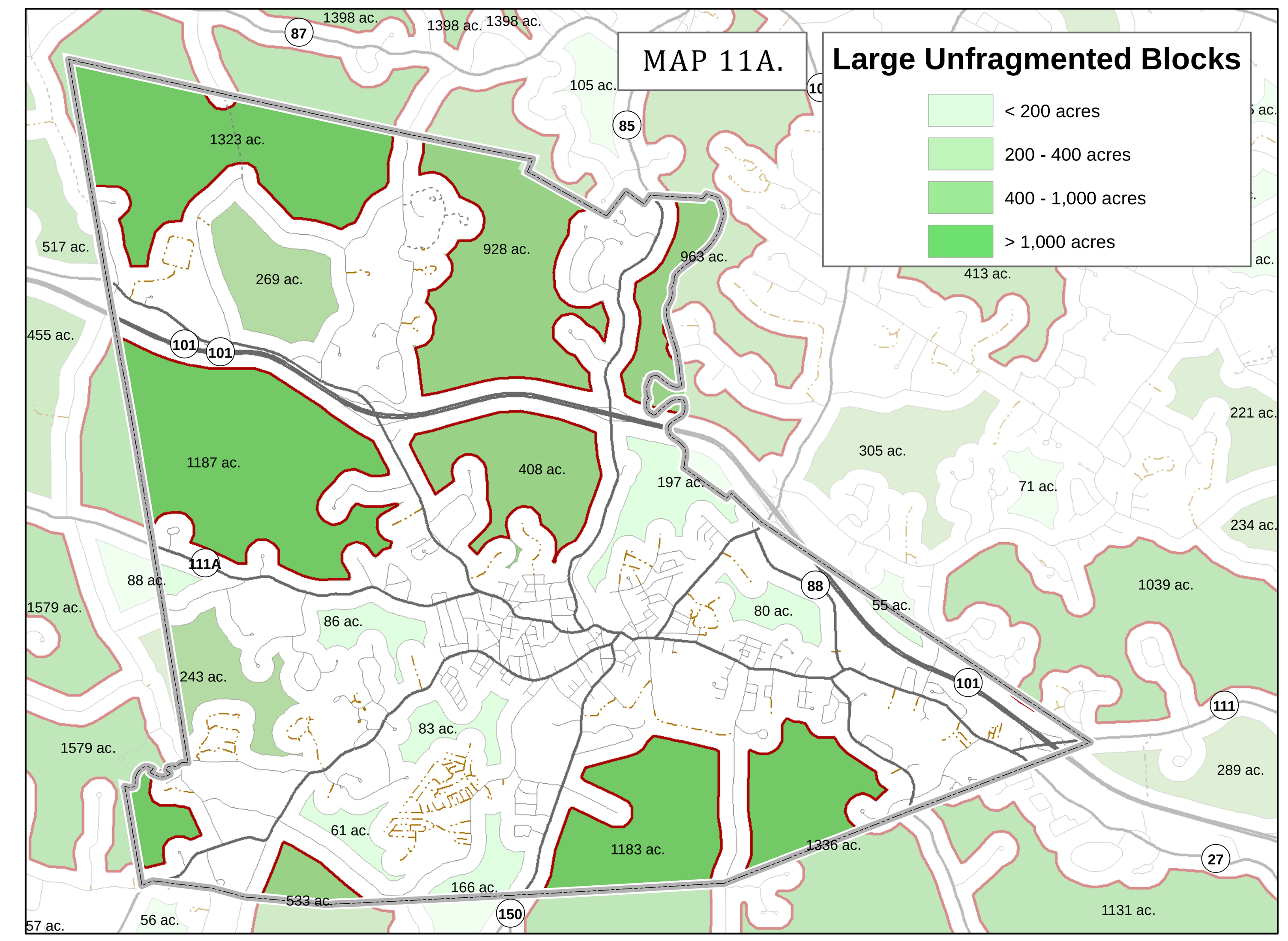
- 1
- 2
- 3
- 4
- Forest Focal Area
- Forest Supporting Landscape

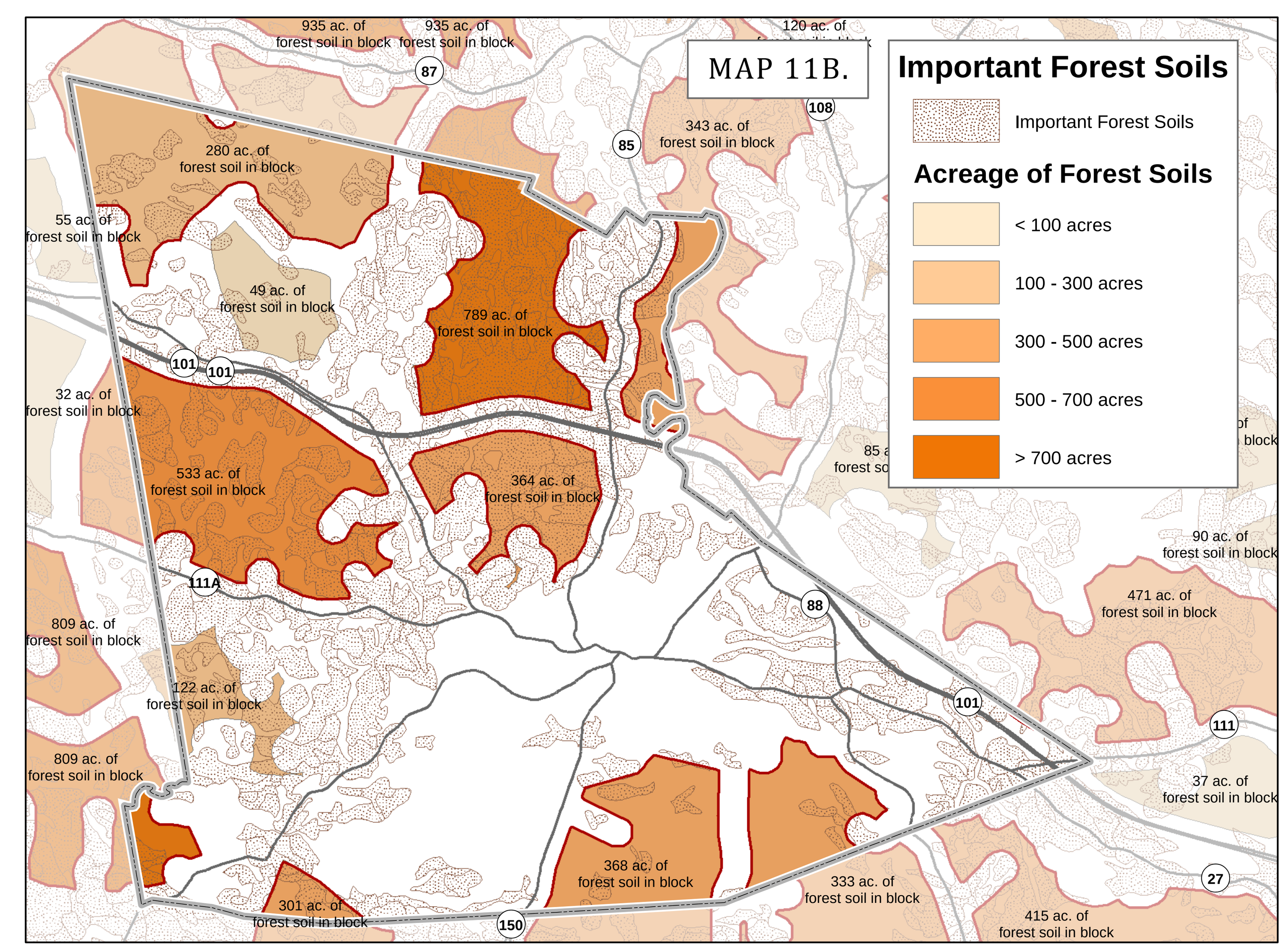


Neatline Associates
Deerfield, NH
www.nhgis.com

N

0 Miles 1



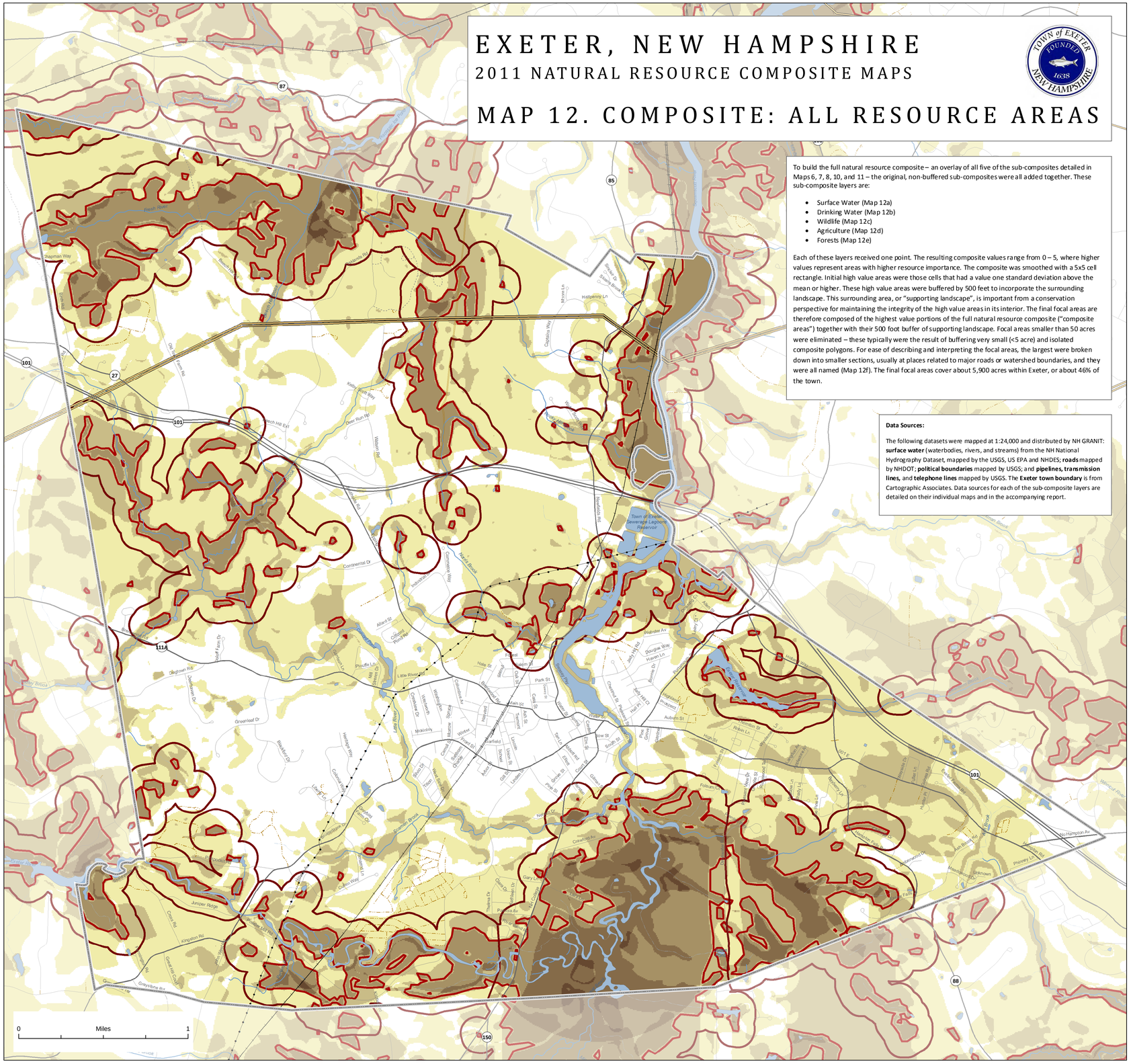


Date Saved: 3/13/2012 1:26:09 AM

EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 12. COMPOSITE: ALL RESOURCE AREAS



To build the full natural resource composite – an overlay of all five of the sub-composites detailed in Maps 6, 7, 8, 10, and 11 – the original, non-buffered sub-composites were all added together. These sub-composite layers are:

- Surface Water (Map 12a)
- Drinking Water (Map 12b)
- Wildlife (Map 12c)
- Agriculture (Map 12d)
- Forests (Map 12e)

Each of these layers received one point. The resulting composite values range from 0 – 5, where higher values represent areas with higher resource importance. The composite was smoothed with a 5x5 cell rectangle. Initial high value areas were those cells that had a value one standard deviation above the mean or higher. These high value areas were buffered by 500 feet to incorporate the surrounding landscape. This surrounding area, or "supporting landscape", is important from a conservation perspective for maintaining the integrity of the high value areas in its interior. The final focal areas are therefore composed of the highest value portions of the full natural resource composite ("composite areas") together with their 500 foot buffer of supporting landscape. Focal areas smaller than 50 acres were eliminated – these typically were the result of buffering very small (<5 acre) and isolated composite polygons. For ease of describing and interpreting the focal areas, the largest were broken down into smaller sections, usually at places related to major roads or watershed boundaries, and they were all named (Map 12f). The final focal areas cover about 5,900 acres within Exeter, or about 46% of the town.

Data Sources:

The following datasets were mapped at 1:24,000 and distributed by NH GRANIT: **surface water** (waterbodies, rivers, and streams) from the NH National Hydrography Dataset, mapped by the USGS, US EPA and NHDES; **roads** mapped by NHDOT; **political boundaries** mapped by USGS; and **pipelines, transmission lines,** and **telephone lines** mapped by USGS. The **Exeter town boundary** is from Cartographic Associates. Data sources for each of the sub-composite layers are detailed on their individual maps and in the accompanying report.

Co-occurrence of All Resource Areas

- 0
- 1
- 2
- 3
- 4
- 5

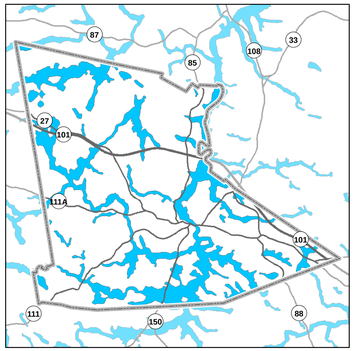
- Core Composite Areas
- Final Focus Areas

- Town Boundary
- Interstate Highway
- Major Route
- Local Road
- Not Maintained
- Private Road
- Railroad
- Pipeline
- Power transmission line
- Telephone line
- Waterbody (NHD)
- Perennial Stream
- Intermittent Stream

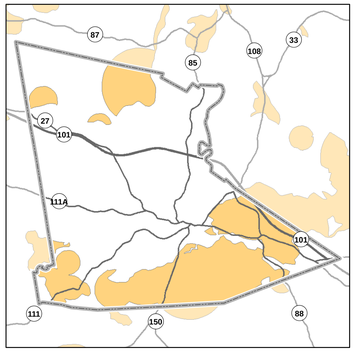
Neatline Associates
Deerfield, NH
www.nhgis.com

N

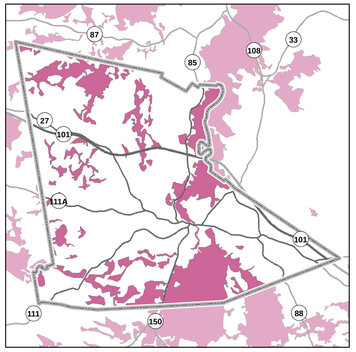
MAP 12A. SURFACE WATER FOCUS AREAS



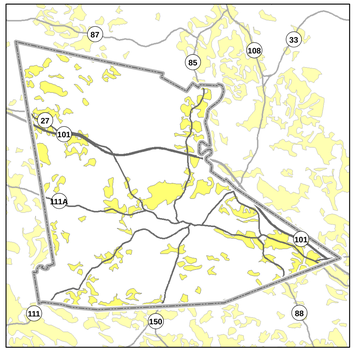
MAP 12B. DRINKING WATER FOCUS AREAS



MAP 12C. WILDLIFE FOCUS AREAS

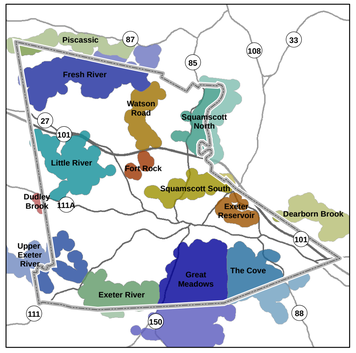


MAP 12D. AGRICULTURE FOCUS AREAS



MAP 12E. FOREST FOCUS AREAS

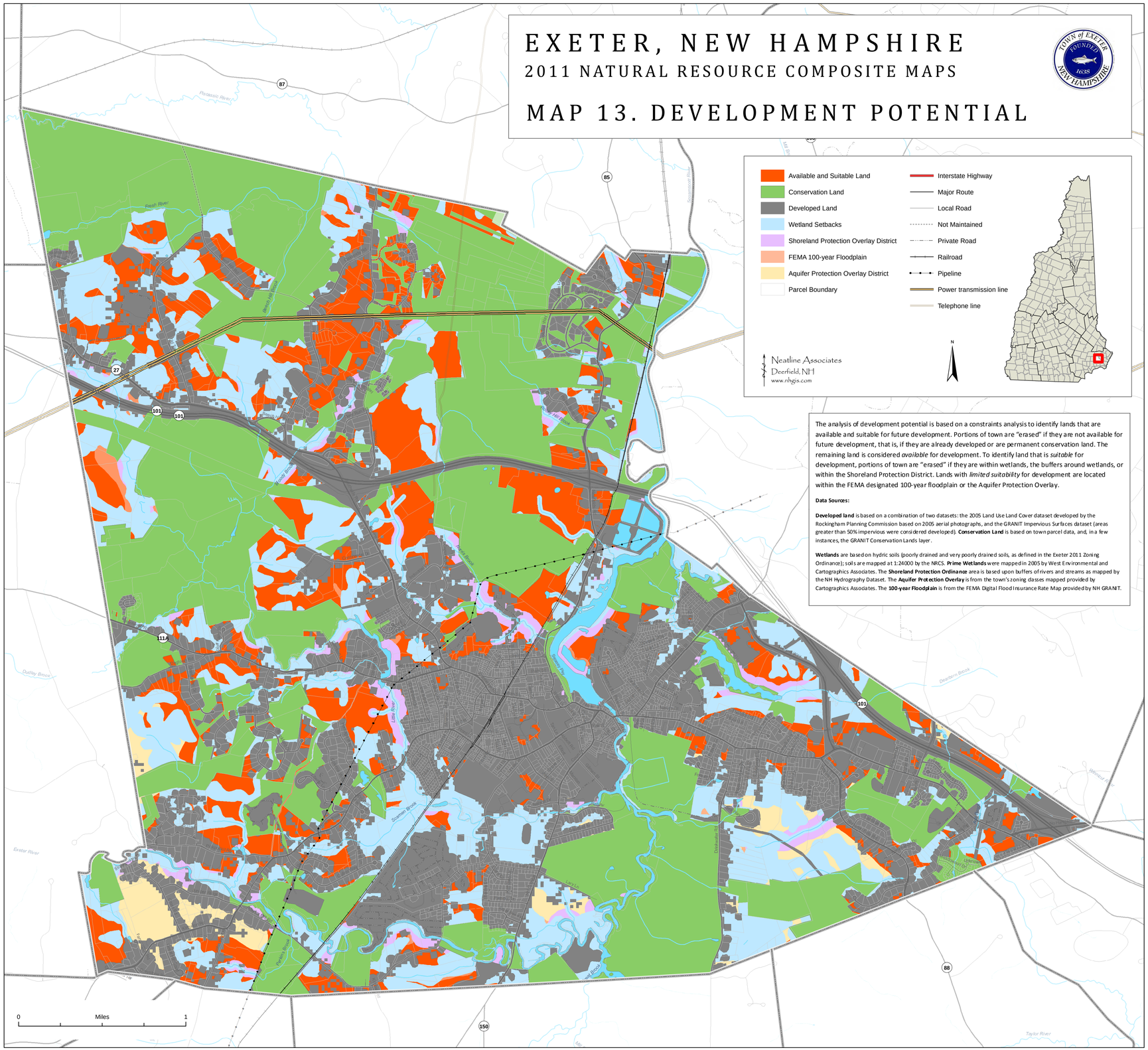
MAP 12F. FINAL FOCUS AREAS



EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 13. DEVELOPMENT POTENTIAL



The analysis of development potential is based on a constraints analysis to identify lands that are available and suitable for future development. Portions of town are "erased" if they are not available for future development, that is, if they are already developed or are permanent conservation land. The remaining land is considered *available* for development. To identify land that is *suitable* for development, portions of town are "erased" if they are within wetlands, the buffers around wetlands, or within the Shoreland Protection District. Lands with *limited suitability* for development are located within the FEMA designated 100-year floodplain or the Aquifer Protection Overlay.

Data Sources:

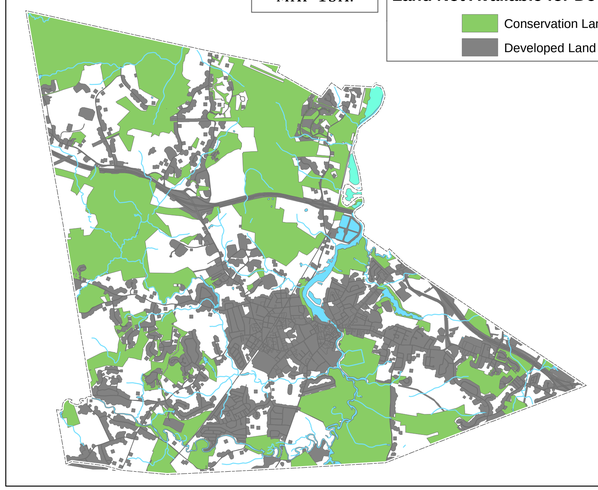
Developed land is based on a combination of two datasets: the 2005 Land Use Land Cover dataset developed by the Rockingham Planning Commission based on 2005 aerial photographs, and the GRANIT Impervious Surfaces dataset (areas greater than 50% impervious were considered developed). **Conservation Land** is based on town parcel data, and, in a few instances, the GRANIT Conservation Lands layer.

Wetlands are based on hydric soils (poorly drained and very poorly drained soils, as defined in the Exeter 2011 Zoning Ordinance); soils are mapped at 1:24000 by the NRCS. **Prime Wetlands** were mapped in 2005 by West Environmental and Cartographics Associates. The **Shoreland Protection Ordinance** area is based upon buffers of rivers and streams as mapped by the NH Hydrography Dataset. The **Aquifer Protection Overlay** is from the town's zoning classes mapped provided by Cartographics Associates. The **100-year Floodplain** is from the FEMA Digital Flood Insurance Rate Map provided by NH GRANIT.

MAP 13A.

Land Not Available for Development

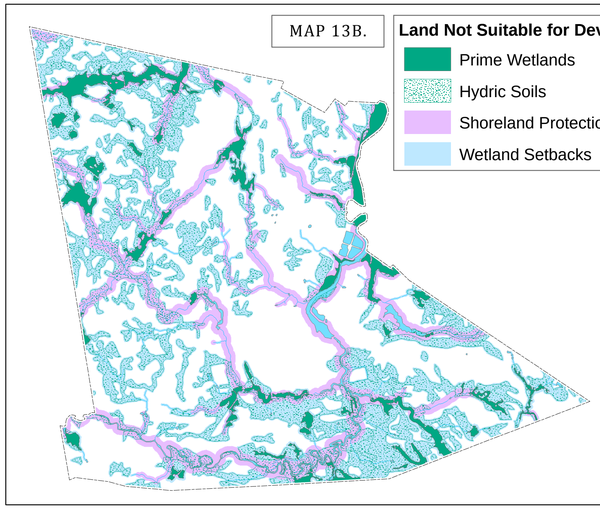
- Conservation Land
- Developed Land



MAP 13B.

Land Not Suitable for Development

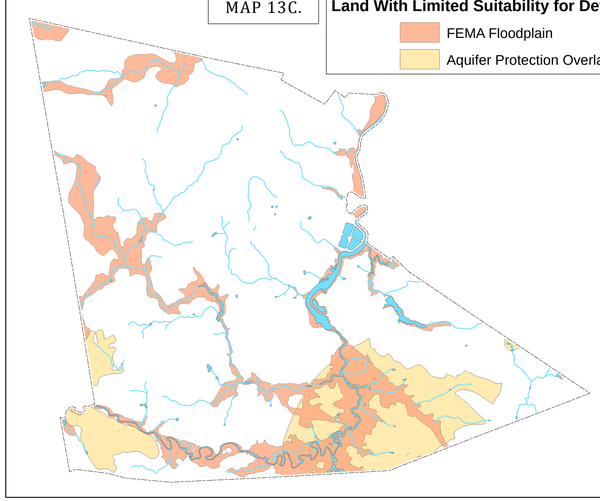
- Prime Wetlands
- Hydric Soils
- Shoreland Protection Overlay
- Wetland Setbacks



MAP 13C.

Land With Limited Suitability for Development

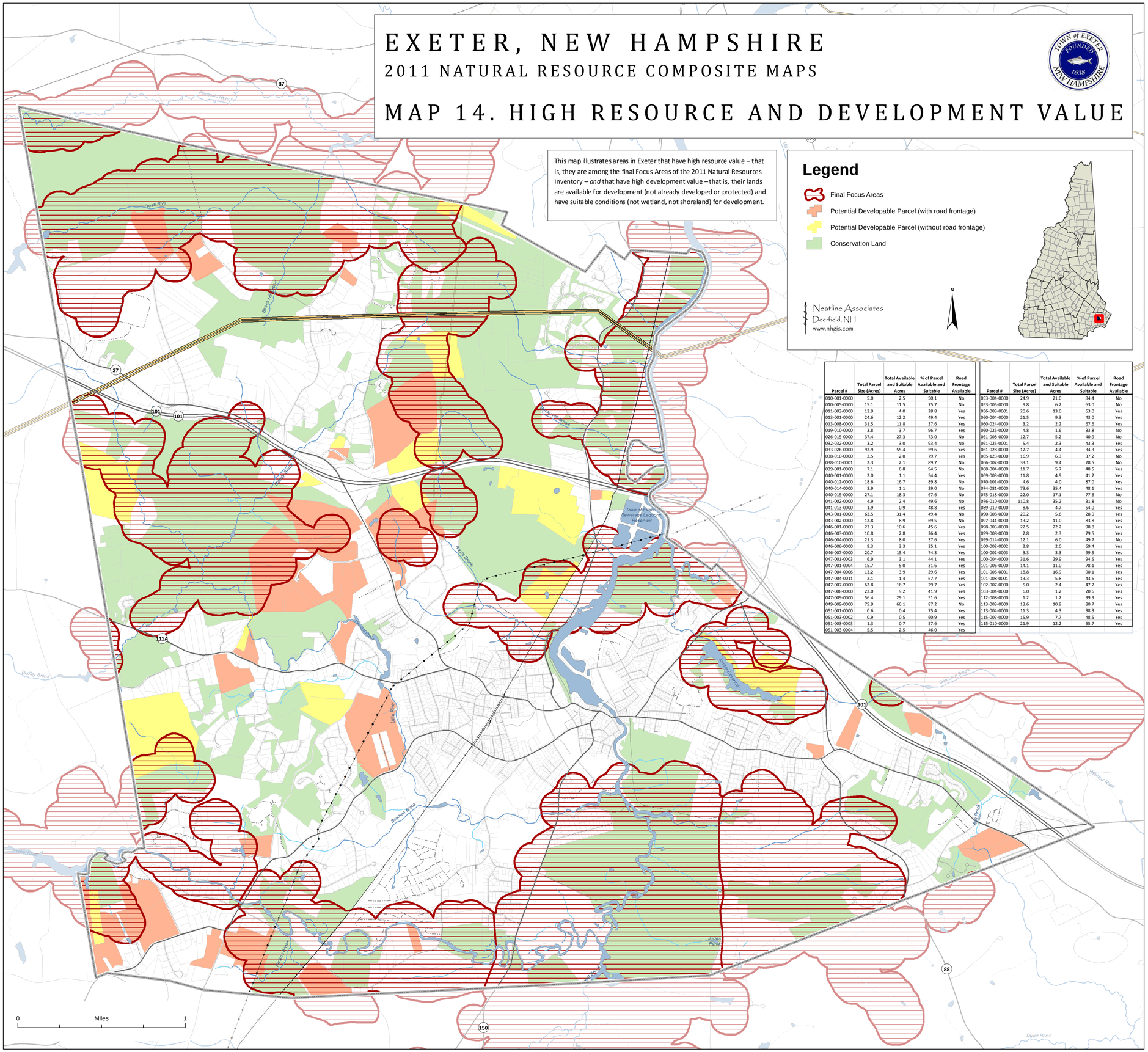
- FEMA Floodplain
- Aquifer Protection Overlay



EXETER, NEW HAMPSHIRE

2011 NATURAL RESOURCE COMPOSITE MAPS

MAP 14. HIGH RESOURCE AND DEVELOPMENT VALUE



This map illustrates areas in Exeter that have high resource value – that is, they are among the final Focus Areas of the 2011 Natural Resources Inventory – *and* that have high development value – that is, their lands are available for development (not already developed or protected) and have suitable conditions (not wetland, not shoreland) for development.

Parcel #	Total Parcel Size (Acres)	Total Available and Suitable Acres	% of Parcel Available and Suitable	Road Frontage Available
010-001-0000	5.0	2.5	50.1	No
010-005-0000	15.1	11.5	75.7	No
011-003-0000	13.9	4.0	28.8	Yes
013-001-0000	24.6	12.2	49.4	Yes
013-008-0000	31.5	11.8	37.6	Yes
019-010-0000	3.8	3.7	96.7	Yes
026-015-0000	37.4	27.3	73.0	No
032-032-0000	3.2	3.0	93.4	No
033-026-0000	92.9	55.4	59.6	Yes
038-010-0000	2.5	2.0	79.7	Yes
038-010-0001	2.3	2.1	89.7	No
039-001-0000	7.1	6.8	94.5	No
040-001-0000	2.0	1.1	54.4	Yes
040-012-0000	18.6	16.7	89.8	No
040-014-0000	3.9	1.1	29.0	No
040-015-0000	27.1	18.3	67.6	No
041-002-0000	4.9	2.4	49.6	No
041-013-0000	1.9	0.9	48.8	Yes
043-001-0000	63.5	31.4	49.4	No
043-002-0000	12.8	8.9	69.5	No
046-001-0000	23.3	10.6	45.6	Yes
046-003-0000	10.8	2.8	26.4	Yes
046-004-0000	21.3	8.0	37.6	Yes
046-006-0000	9.3	3.3	35.1	Yes
046-007-0000	20.7	15.4	74.3	Yes
047-001-0003	6.9	3.1	44.1	Yes
047-001-0004	15.7	5.0	31.6	Yes
047-004-0006	13.2	3.9	29.6	Yes
047-004-0011	2.1	1.4	67.7	Yes
047-007-0000	62.8	18.7	29.7	Yes
047-008-0000	22.0	9.2	41.9	Yes
047-009-0000	56.4	29.1	51.6	Yes
049-009-0000	75.9	66.1	87.2	No
051-001-0000	0.6	0.4	75.4	Yes
051-003-0002	0.9	0.5	60.9	Yes
051-003-0003	1.3	0.7	57.6	Yes
051-003-0004	5.5	2.5	46.0	Yes

Parcel #	Total Parcel Size (Acres)	Total Available and Suitable Acres	% of Parcel Available and Suitable	Road Frontage Available
053-004-0000	24.9	21.0	84.4	No
053-005-0000	9.8	6.2	63.0	No
056-003-0001	20.6	13.0	63.0	Yes
060-004-0000	21.5	9.3	43.0	Yes
060-024-0000	3.2	2.2	67.6	Yes
060-025-0000	4.8	1.6	33.8	No
061-008-0000	12.7	5.2	40.9	No
061-025-0001	5.4	2.3	43.3	Yes
061-028-0000	12.7	4.4	34.3	Yes
065-123-0000	16.9	6.3	37.2	No
066-002-0000	33.1	9.4	28.5	No
068-004-0000	11.7	5.7	48.5	Yes
069-003-0000	11.8	4.9	41.2	Yes
070-101-0000	4.6	4.0	87.0	Yes
074-081-0000	73.6	35.4	48.1	Yes
075-018-0000	22.0	17.1	77.6	No
076-010-0000	110.8	35.2	31.8	No
089-019-0000	8.6	4.7	54.0	Yes
090-008-0000	20.2	5.6	28.0	Yes
097-041-0000	13.2	11.0	83.8	Yes
098-003-0000	22.5	22.2	98.8	Yes
099-008-0000	2.8	2.3	79.5	Yes
099-014-0000	12.1	6.0	49.7	No
100-002-0002	2.8	2.0	69.4	Yes
100-002-0003	3.3	3.3	99.5	Yes
100-004-0000	31.6	29.9	94.5	Yes
101-006-0000	14.1	11.0	78.1	Yes
101-006-0001	18.8	16.9	90.1	Yes
101-008-0001	13.3	5.8	43.6	Yes
102-007-0000	5.0	2.4	47.7	Yes
103-004-0000	6.0	1.2	20.6	Yes
112-008-0000	1.2	1.2	99.9	Yes
113-003-0000	13.6	10.9	80.7	Yes
113-004-0000	11.3	4.3	38.3	Yes
115-007-0000	15.9	7.7	48.5	Yes
115-010-0000	21.9	12.2	55.7	Yes