



2019

Natural Resources Assessment and Co-Occurrence Mapping

Town of Barrington, New Hampshire

Acknowledgments



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Town of
BARRINGTON
New Hampshire

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Introduction



With an active Conservation Commission tasked with identifying and promoting awareness of the town's natural resources and encouraging wise decisions for their protection, it is no coincidence that Barrington has a long and successful history of land protection activities. In particular, the town has completed several large conservation projects including Stonehouse Pond, Stonehouse Forest, and the Samuel A. Tamposi Water Supply Reserve (SATWaSR). These efforts are helping to reach a regional goal of 75% of conservation focus areas, identified in the "Land Conservation Plan for NH's Coastal Watershed", conserved by 2025, as referenced in PREP's 2018 State of Our Estuaries report.

In 2001, the Barrington Natural Heritage Committee (NHC), a volunteer committee created by the Board of Selectmen and reporting to the Conservation Commission, developed Barrington's first natural resources inventory (NRI) that was designed to help guide the community in protecting environmentally valuable parcels of land throughout town. Eight years later, the Town applied for and received a grant from what was then called the New Hampshire Estuaries Project – now known as the Piscataqua Region Estuaries Partnership – to update the 2001 plan. Nearly a decade later, the Town once again found themselves in need of an update.



Co-Occurrence Map of Barrington NH, 2009 [SRPC]

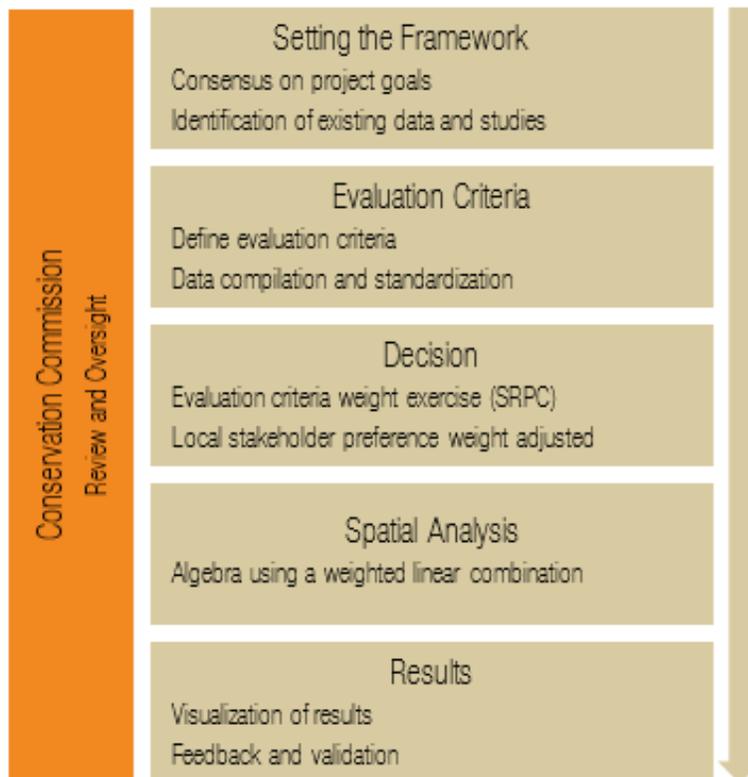
In 2018, the Barrington Conservation Commission approached the Strafford Regional Planning Commission (SRPC) with a request to update the Town's 2009 NRI, as many of the maps and datasets used had become outdated. To meet the goals of the community, while recognizing limited capacity and fiscal constraints, SRPC suggested a modified approach to a traditional NRI. This approach would rely on a detailed spatial analysis using Geographic Information System (GIS) that would identify key geographic areas where multiple natural resource features and priority conservation areas are co-located.

SRPC, in partnership with the Barrington Conservation Commission, applied for and received a small planning grant from the Lamprey River Advisory Committee to undertake the GIS-based natural resource assessment and spatial analysis. The Barrington Conservation Commission supplemented this grant with additional funding from the Town's Conservation Fund.

Information, GIS and a Participatory Process

The foundation of this Natural Resources Assessment (NRA) is a map-based GIS inventory of the town's existing natural resources and conservation priorities' initiatives. Eight primary natural resource-based criteria maps were developed to display the spatial distribution of soils, water resource conservation focus areas, wetlands, wildlife, landscape connectivity, conservation focus areas, other surface and groundwater resources, and climate change resilient and connected. The main goal was to create a weighted co-occurrence map that helps identifying the presence of multiple key natural resources-based criteria important for conservation. Our approach was built off the previous 2009 NRI and included a set of strategies that relied on the participation of members of the conservation commission. They actively provided input throughout different stages in the process by 1) reviewing the criteria and establishing weights based on their local values; 2) reviewing the preliminary results and making any adjustments to the analysis; and, 3) developing strategic conservation recommendations for the town to consider of the next several years.

The spatial analysis process included a weighted linear combination algebra map with all the criteria selected. The analysis was performed using ArcGIS ESRI (2018). A brief description of each the evaluation criteria and the final co-occurrence map is included in this document. A more detailed description of the data



Introduction cont.



and methodology for the co-occurrence map is included in Appendix A. These results were also included in a large 36x36" version of the map as part of this NRA and is available with the Barrington Conservation Commission and on the town's website.

Natural Resource	Criteria Weight Rankings Used		
	2019 Co-occurrence Map	Barrington Points	Max Value
		2019	
Soils	Ag Soils - Local Importance	10	25
	Ag Soils - Statewide Importance	15	
	Ag Soils - Prime	20	
	Active Farms (extracted from Land Use 2015)	25	
Water Resource Conservation Focus Areas	Buffers for Water Quality	15	45
	Flood Storage and Risk Mitigation	15	
	Public Water Supply Protection	15	
	Flood Storage and Risk Mitigation; Public Water Supply	30	
Wetlands (Riparian Habitat)	Wetlands	10	20
	Prime Wetlands	20	
Wildlife (by Tier)	WAP Supporting Landscape	15	25
	WAP Highest Rank in Region	20	
	WAP Highest Rank in State	25	
Connectivity	Unfragmented Land > 500 - <= 1000 acres	15	50
	Unfragmented Land > 1000 acres	25	
	Land within 1/4 mile of existing conservation land	10	
	Coastal wildlife corridors (connect the coast)	25	
Conservation Focus Areas TNC 2006	LCP Supporting Lands	10	20
	LCP Core Focus Areas	20	
Other Surface and Groundwater Resources	Land within 300' of lakes and ponds and 4th order streams	20	55
	Land within 300' of 1st, 2nd, 3rd order streams		
	Stratified Drift Aquifers	20	
Climate Change Resilient and Connected	Resilient Area with Confirmed Diversity	40	40
	Resilient Area Only	30	

Strategic Conservation Recommendations

The co-occurrence map in this document provides an overview of the priority conservation areas based on local values. In addition to the co-occurrence conservation areas, general strategies for outreach, management, and regulatory action are included. This map is a valuable resource to help designing and implementing strategic conservation actions and to support efforts that might help individual projects or initiatives.

Intended Use

The NRA and co-occurrence map are intended to provide information about specific habitats and resources-at both the site and town scale-that can support land use decisions and conservation priorities. This NRA provides a benchmark for observing short- and long-term changes, and it should be updated as conditions change and when new information is available. This baseline assessment may be refined through field investigations and ground truthing and further developed into a comprehensive natural resources master plan chapter. It is intended to serve as an informational tool that may inform future changes in zoning, land use regulations, and policies. Finally, it is an educational resource for town staff, boards, students, residents, and other interested individuals.



Barrington Conservation Commission (SRPC Photo)

Goals and Objectives



The goal of this project was to identify and prioritize key areas for conservation and protection that provide habitat for wildlife, preserving rare or sensitive species and ecosystems, and ensures the sustainability of the ecological services that support a high quality of life in Barrington, NH. We aimed on to develop a user-friendly report that captures Barrington's this goal through existing natural resources and a co-occurrence map. The co-occurrence map would be used to guide the future preservation of environmentally valuable land and guide improvement or development of recreational amenities on existing easements. The map would include: the most updated conservation, natural resources, and other thematic layers; natural corridors favored by wildlife that serve as ideal greenways; and areas where conservation values overlap to guide resource protection efforts.

The objectives of this project were to:

- Create a snapshot of Barrington's natural resources for use as a baseline in tracking land use trends and for a comprehensive natural resources master plan chapter
- Synthesize information and provide visual resources for decisions-makers to support planning and policy decisions
- Promote collaboration among the different stakeholders on mapping local interests, concerns, risks, and opportunities using participatory techniques, expert knowledge, and the best available information
- Develop a tool as an educational resource to raise public awareness about the natural resources and the most valuable conservation areas in Barrington

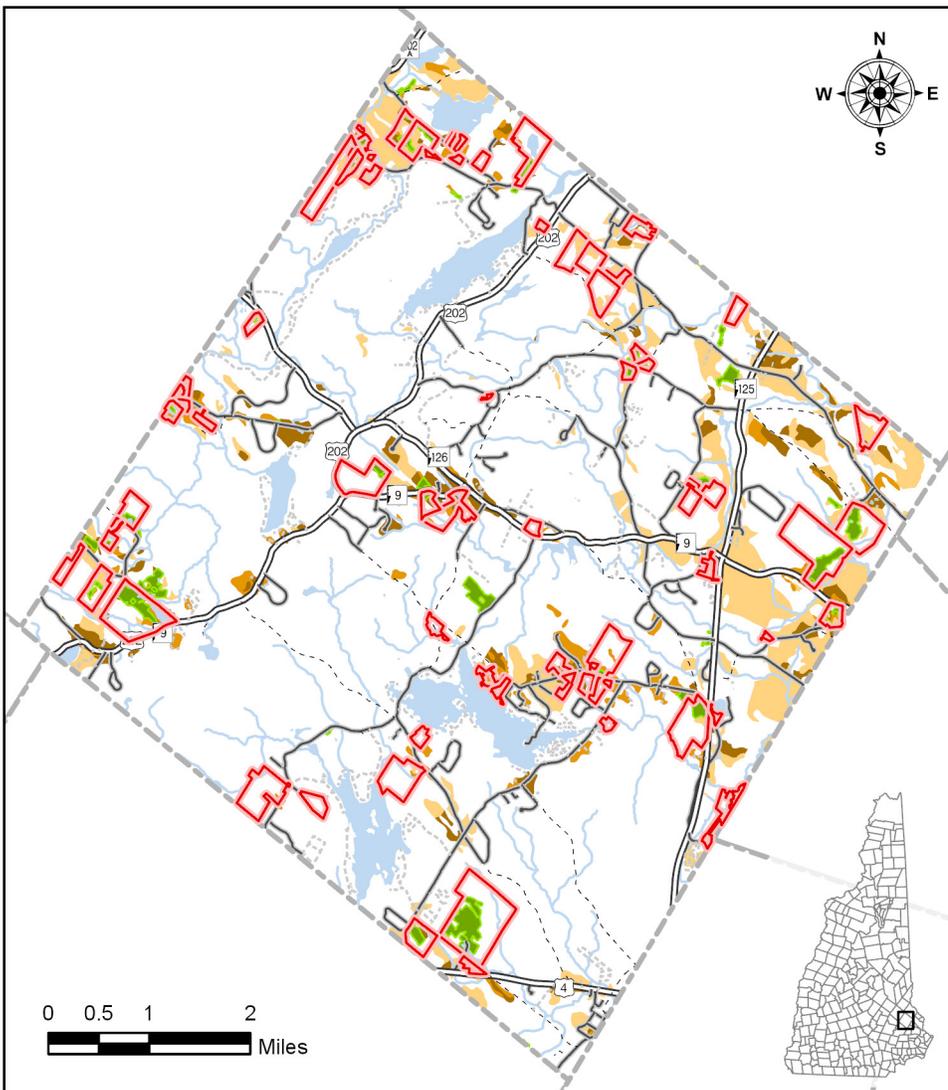
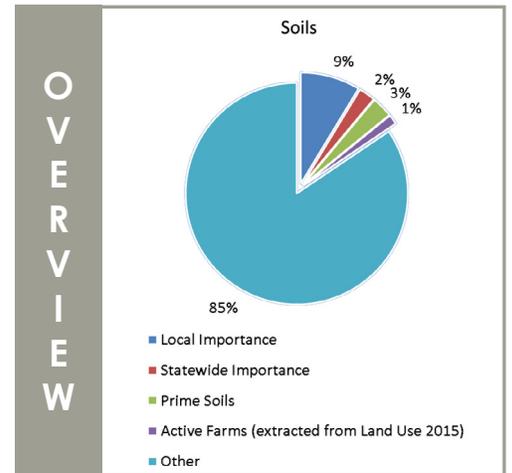
Map 1: Soils



The Natural Resource Conservation Service (NRCS) Strafford County Soil Survey (1973) and regional land use data (2015) were used to identify agricultural uses in Barrington – see pie chart to the right for statistical information.

Due to its geological makeup, the town does not have many large areas identified with agricultural soils. At the time this report was prepared, Brasen Hill Farm off Warren Road was the only significant active farm known within Barrington; however, according to data collected from the tax assessor office, the town has 69 parcels with land in current use that is designated as farmland. Those properties total 528.8 acres which is approximately 1% of Barrington's total acreage.

Given the limited amount of agricultural soils, the evaluation criteria scores for prime soils, statewide importance, and local importance did not change from 2009; however, the Conservation Commission decided to add existing active farms into the analysis with the highest maximum value score.



Soils

Farmland Soils

- All areas are prime farmland
- Farmland of statewide importance
- Farmland of local importance

Agricultural Lands (Land Use)

- Agricultural Lands (Land Use)
- Parcels with current use (Ag)

Political

- Municipalities NH
- Impervious Surface

Water Resources

- Lake Pond
- Streams and Rivers

Transportation

- State
- Local
- Private
- Not Maintained
- Recreation

Data sources: Base features are from GRANIT database (<http://www.granit.unh.edu/>). Land use (2015) Earth Systems Research Center, University of New Hampshire. Soils U.S. Department of Agriculture, Natural Resources Conservation Service. Data were derived from various sources and were updated at different timeframes, with varying levels of accuracy.

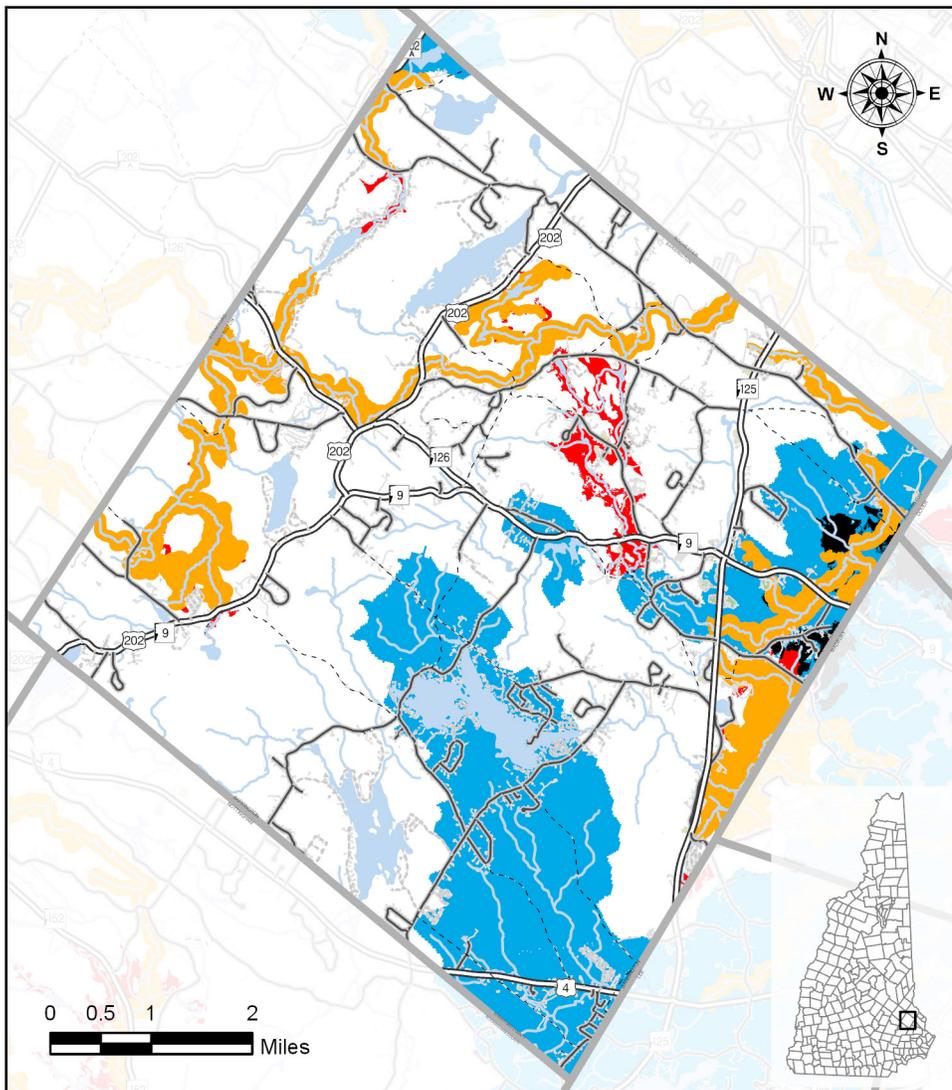
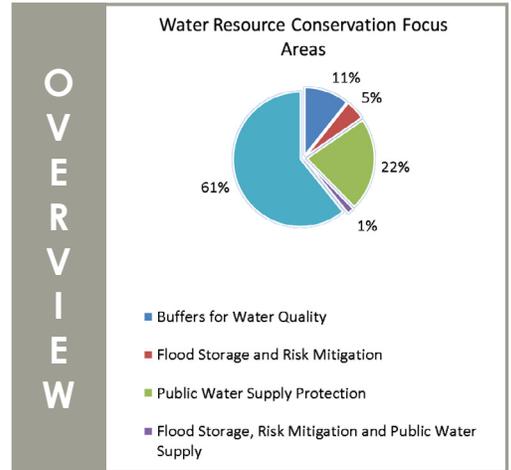
Map 2: Water Resource Conservation Focus Areas



The Land Conservation Priorities for the Protection of Coastal Water Resource (2016) was used to identify land areas that provide benefits for water quality, flood risk reduction, and public water supply protection in Barrington – see pie chart to the right for statistical information.

Public water supply areas were identified as the predominate focus area; however, much of the area south of Swains Lake is already protected as part of the SATWaSR conservation easement, leaving a few additional areas adjacent to Route 9, east of Route 125, and north of Swains Lake. There are water quality protection opportunities along the Isinglass River; Berrys River; Nippo, Spruce, Hall, and Stonehouse Brooks; and tributaries flowing to the Bellamy Reservoir. Flood risk reduction areas are located along portions of Mallego Brook and the tributary draining from Scruton Pond to the Isinglass River.

This dataset was not available during the development of the previous 2009 NRI and was not used to create the prior co-occurrence map. The Conservation Commission was tasked with associating new criteria scores for each of the layers. The Commission decided to give equal weight for water quality, flood risk reduction, and public water supply, and placed the highest value on areas where flood risk reduction overlapped with public water supply.



Water Resources Conservation Focus Areas

Water Resource Overlays

- Riparian Buffer Areas
 - Public Water Supply
 - Flood Storage and Risk Mitigation
 - Flood Storage and Public Water Supply
- | | |
|-----------------------|------------------------|
| Political | Water Resources |
| — Municipalities NH | — Lake Pond |
| — Impervious Surface | — Streams and Rivers |
| Transportation | |
| — State | |
| — Local | |
| — Private | |
| — Not Maintained | |
| — Recreation | |

Data sources: From Land Conservation Priorities for the Protection of Coastal Water Resources (TNC 2016). Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

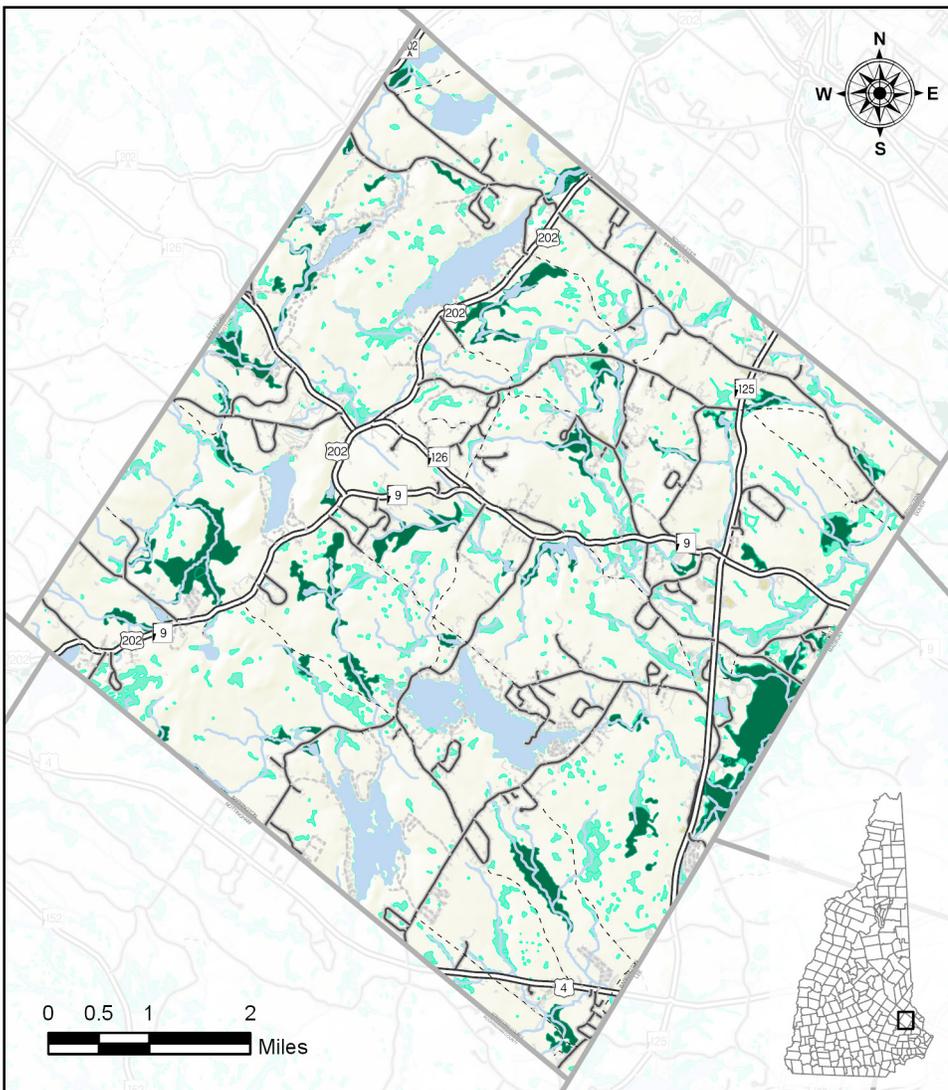
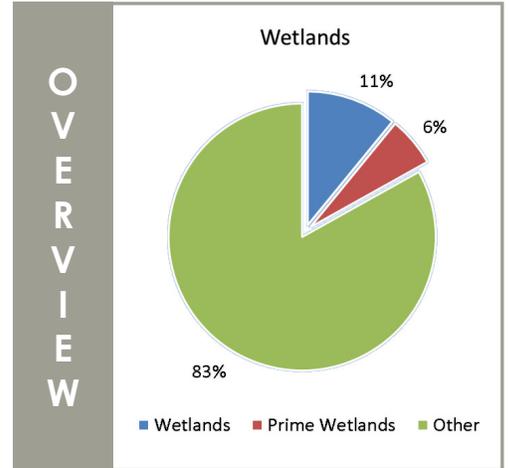
Map 3: Wetlands



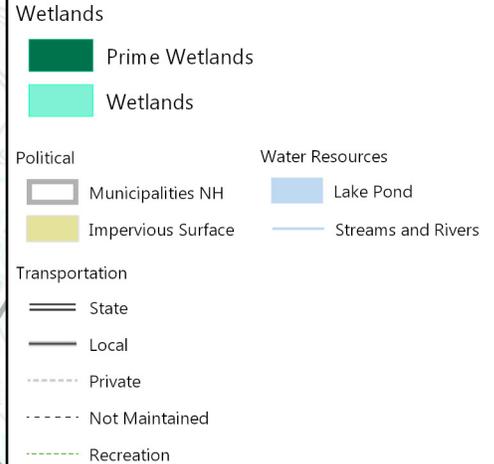
National wetland inventory (NWI) digital data contains records of wetlands location and classification as defined by the U.S. Fish & Wildlife Service, as well as locally defined prime wetlands were used to identify wetlands in Barrington – see pie chart to the right for statistical information.

There is a diversity of wetland types scattered throughout Barrington, including freshwater emergent, forested/shrub and pond types, and riverine (associated with rivers and streams) and lacustrine (associated with lakes and ponds) types. According to the most recent NWI, the town has roughly 3,400 acres of wetlands, excluding open waters. This is roughly 300 acres less than what was calculated in the 2009 NRI. This net loss could be attributed to land use conversion associated with development, more accurate data, beaver activity, or any combination of the three. A more in-depth analysis is needed to determine what the leading cause is.

While the source of data didn't change, an updated NWI layer was used for this analysis; the prime wetlands layer did not change. The Conservation Commission decided to not change the evaluation criteria scores for wetlands or prime wetlands from 2009, with the maximum value for prime wetlands.



Wetlands (Riparian Habitat)



Data sources: From Water Quality Planning Section at NH Dept. of Environmental Services, Watershed Management Bureau. Prime Wetlands were designated by municipalities. Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

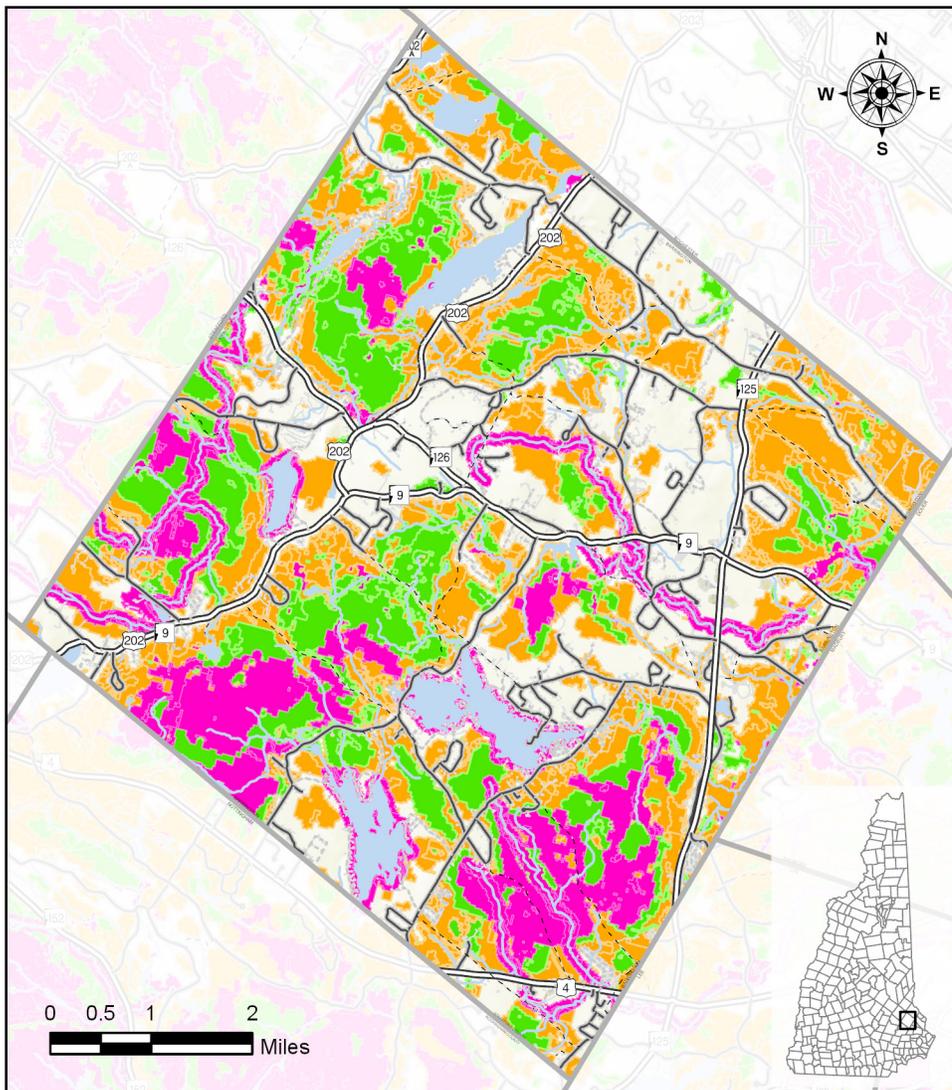
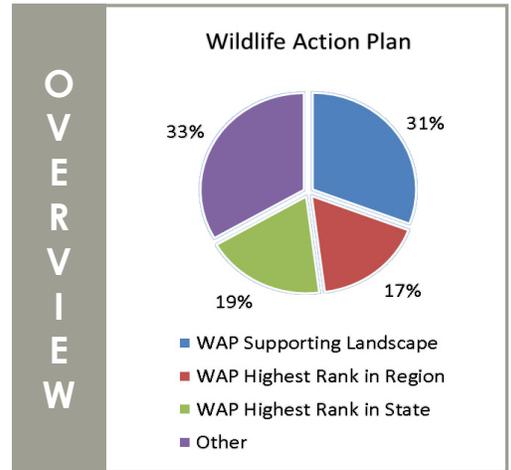
Map 4: Wildlife



Data on species locations, landscape setting, and human influences that affect the ability of habitats to be used by wildlife, referenced in the NH Wildlife Action Plan (2015), was used to identify where wildlife habitat is in the best relative condition in Barrington – see pie chart to the right for statistical information.

The two largest areas identified as the highest ranked habitat in New Hampshire are protected by the SATWaSR, Stonehouse Forest, and Stonehouse Pond conservation easements. Additional opportunities include areas west of Nippo Pond and along portions of Mallego Brook. Areas identified as highest ranked habitat in a biological region include west of Nippo Pond and between Long Pond and Ayers Pond are future opportunities for land protection efforts that would likely provide wildlife benefits.

The source of data didn't change from what was used during the development of the 2009 NRI. The Conservation Commission decided to not change the evaluation criteria scores for highest ranked habitat in the state, highest ranked habitat in a biological region, or supporting landscapes; the highest ranked habitat in the state received the maximum value.



Data sources: From Wildlife Action Plan. Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

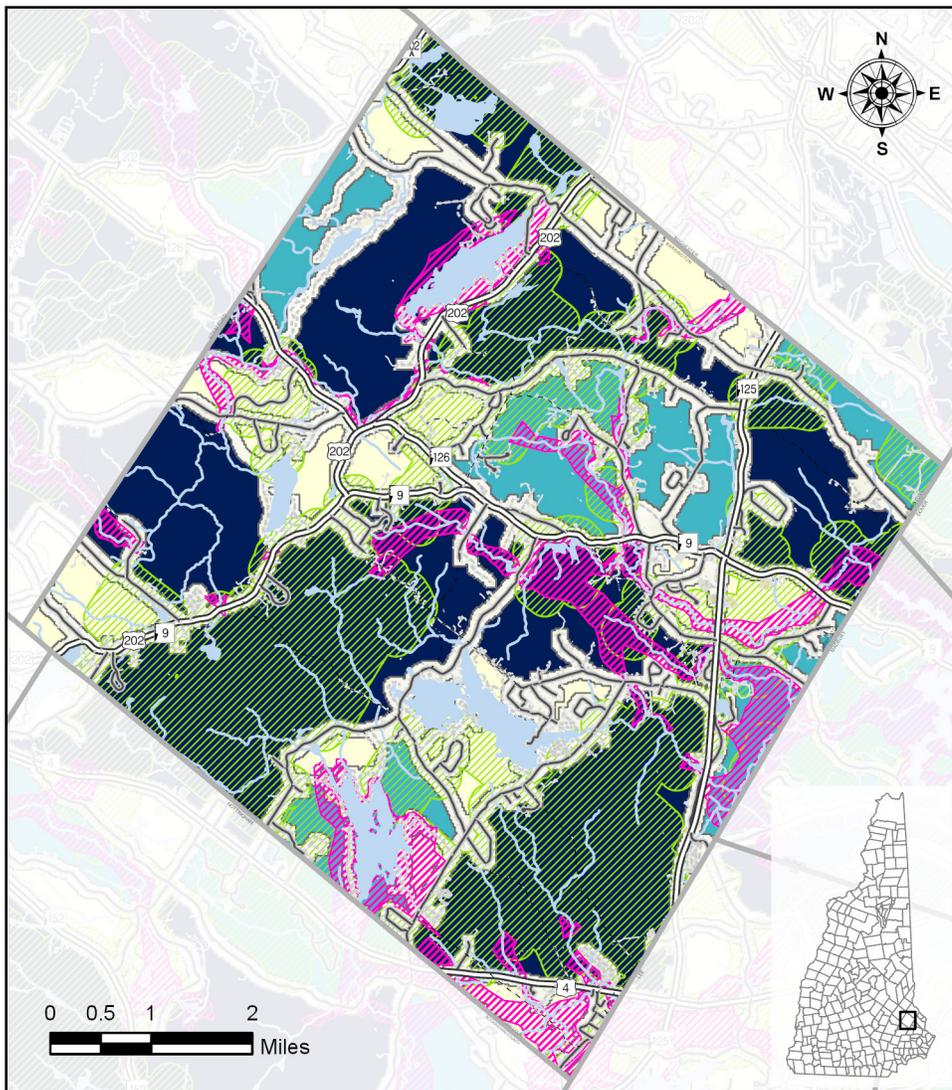
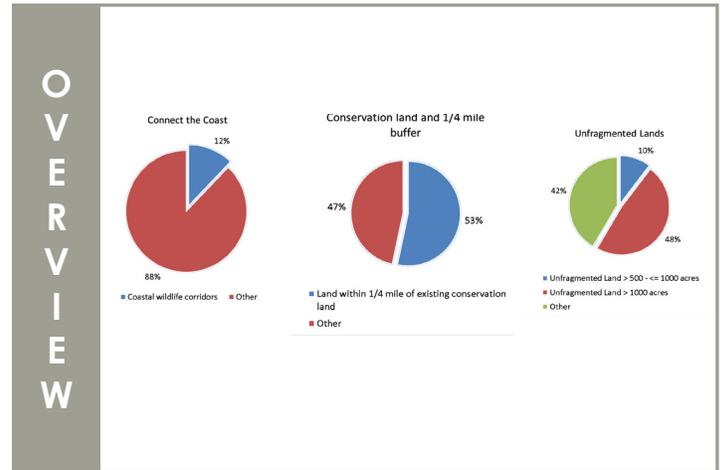
Map 5: Connectivity



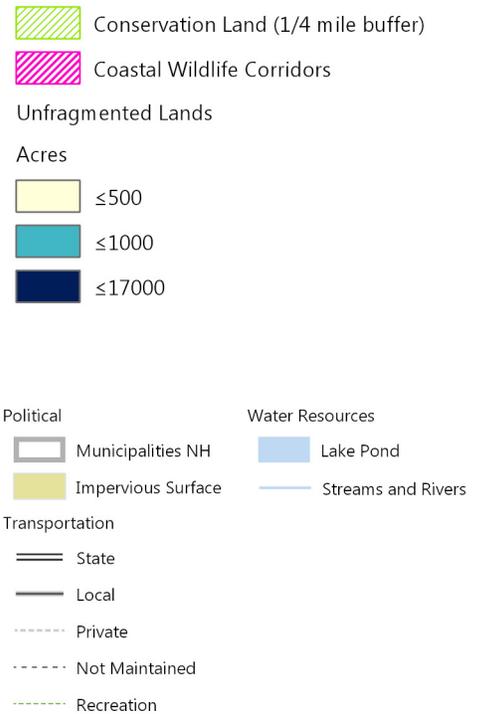
Large unfragmented open space blocks referenced in the NH Wildlife Action Plan (2005), land within a quarter mile of existing conservation land, and coastal wildlife corridors referenced in the Connect the Coast project was used to identify wildlife connectivity opportunities in Barrington – see pie chart(s) to the right for statistical information.

The largest block of unfragmented lands for future protection include areas west of Nippo Pond, between Long Pond and Ayers Pond, and east of Route 125 near the headwaters of Calef Brook. Coastal wildlife corridors to consider for protection include areas from Mendums Pond southeast of Route 4 along the headwaters of the Oyster River; small tributary systems flowing east through the Goodwin Easement towards the Bellamy Reservoir; Mallego Brook; portions of the Isinglass River; and Ayers Pond.

The unfragmented open space blocks data has not been updated since the development of the 2009 NRI; however, the Conservation Commission decided to adjust its evaluation criteria scoring by placing a higher value on larger blocks. The Commission lowered the score for lands within a quarter mile of existing conservation land. The coastal wildlife corridors dataset was a new layer and received a high score.



Connectivity



Data sources: From Connect The Coast, TNC. Unfragmented Lands from Conservation Focus, TNC. Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

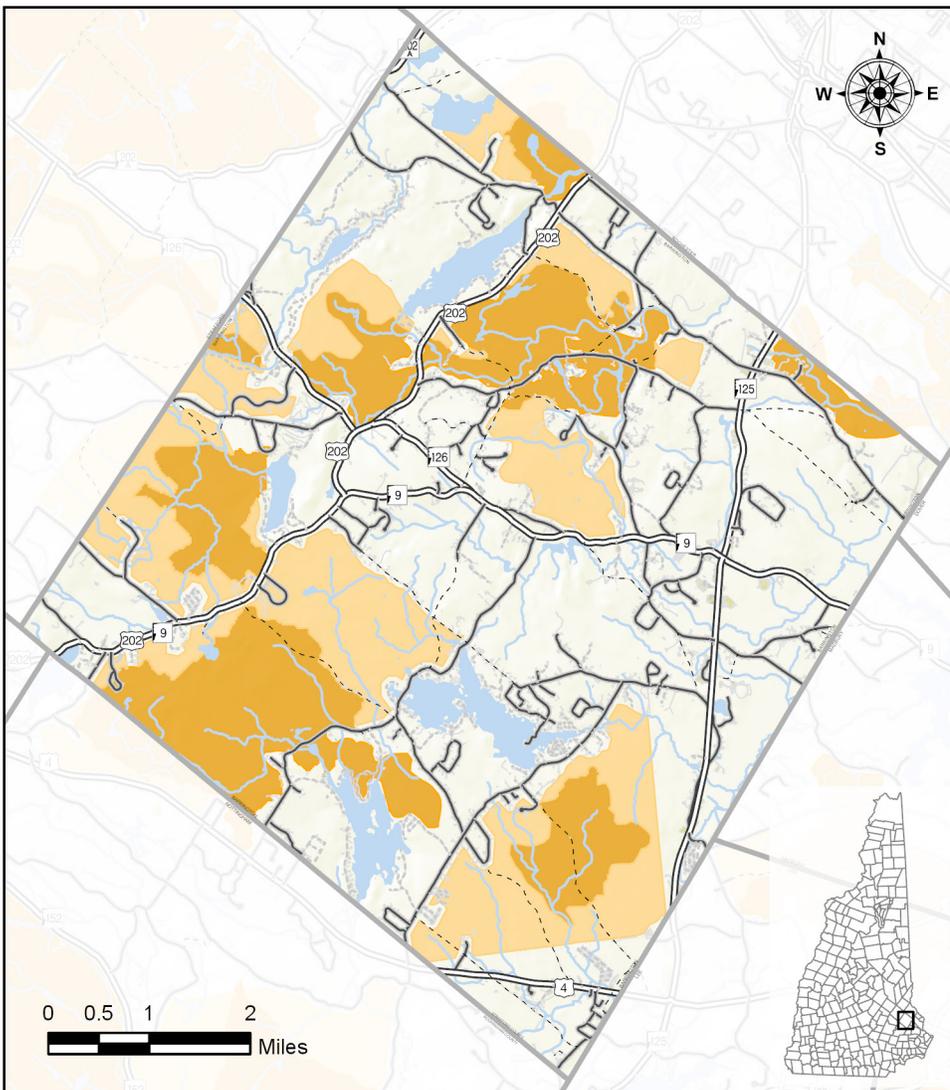
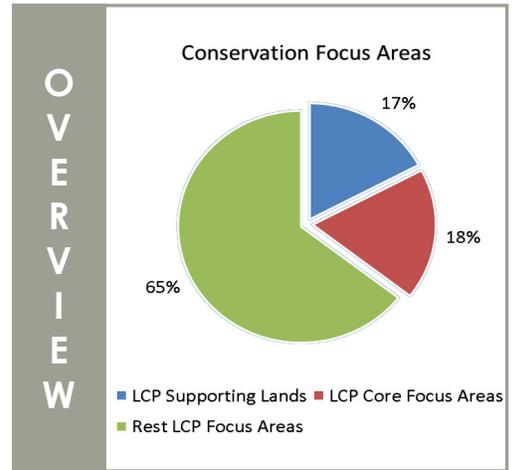
Map 6: Conservation Focus Areas



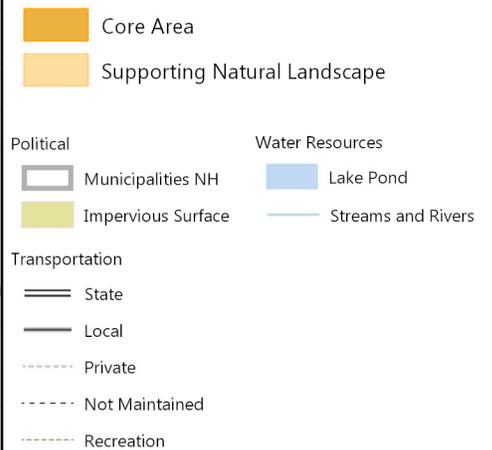
Core areas and supporting natural landscapes referenced in the Land Conservation Plan for New Hampshire's Coastal Watersheds (2006), was used to identify areas important for conserving native plants, animals, and natural communities in Barrington – see pie chart(s) to the right for statistical information.

As with some of the previous maps, three of the largest core areas are protected by the SATWaSR, Stonehouse Forest, Stonehouse Pond, and the Calef conservation easements. The two largest core areas that remain for land protection efforts include areas west of Nippo Lake and just south of Ayers Pond. Additional smaller areas between Preston Pond and Little Long Pond; Scruton Pond and the tributary flowing to the Isinglass River; and along the Isinglass River north of Tolend Road. There are also supporting landscapes that surround many of these identified areas.

The source of data didn't change from what was used during the development of the 2009 NRI and is nearly thirteen years old. As a result of the outdated information, the Conservation Commission decided to lower their evaluation criteria scores for both core focus areas and supporting landscapes, with the maximum value remaining for the core focus areas.



Conservation Focus Areas (TNC 2006)



Data sources: From Conservation Focus Areas TNC (2006). Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

Map 7: Other Surface and Groundwater Resources

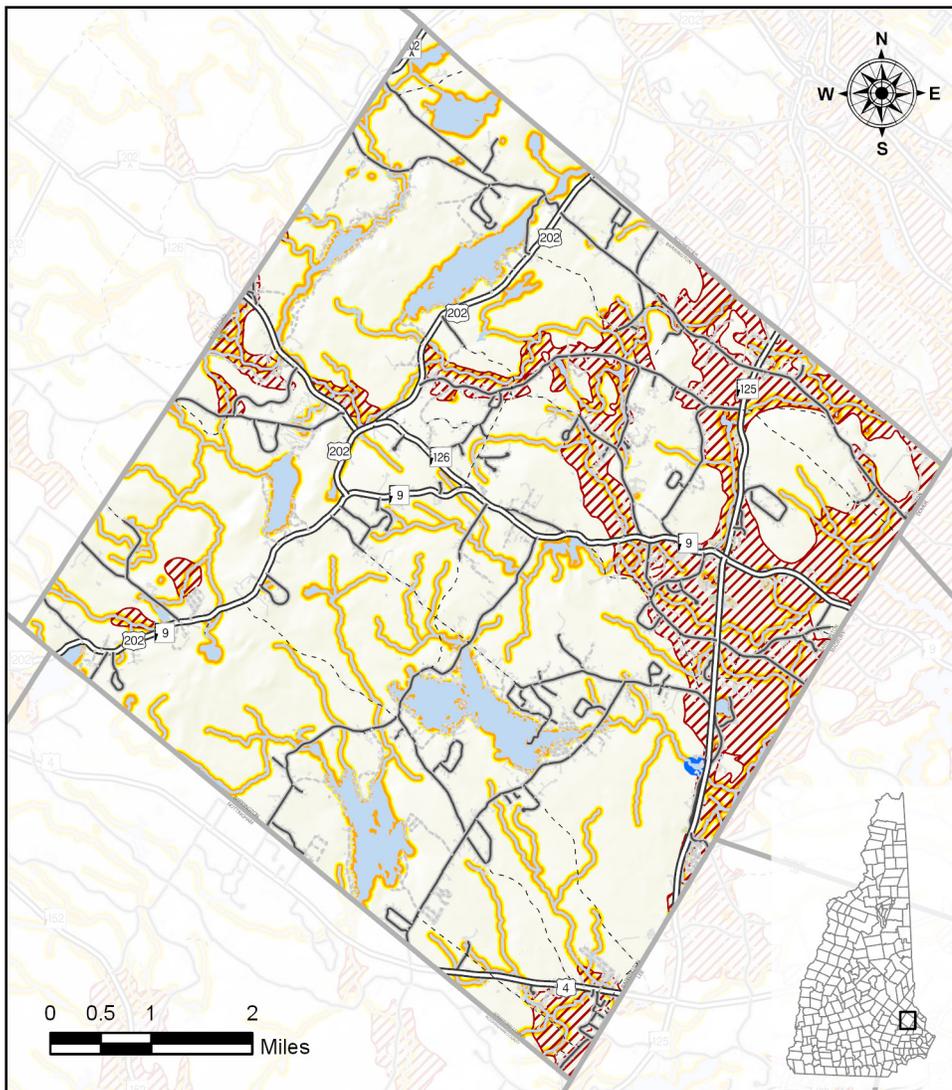
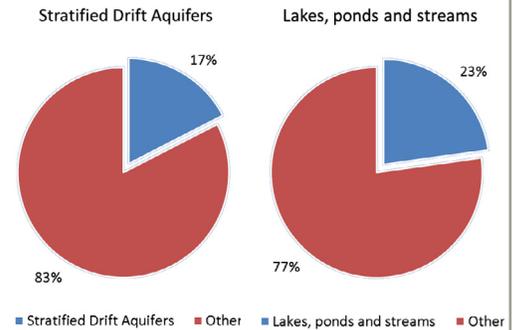


Land within 300' of lakes and ponds and 4th order streams, land within 300' of 1st, 2nd, 3rd order streams, the Pierce Road dam impoundment, and all stratified drift aquifers were used to identify areas with surface and groundwater resources in Barrington – see pie chart(s) to the right for statistical information.

In conjunction with the state protected Isinglass River, there are a significant amount of headwater and small feeder streams throughout the town. These areas contain important natural resources and provide important habitat for a variety of wildlife species. The Pierce Road dam impoundment has been locally recognized as a potential area for a future public drinking water supply. Stratified drift aquifers along the Isinglass River and Mallego Brook, as well as east of Route 125 are opportunity areas for protection.

The stratified drift aquifer data didn't change from what was used during the development of the 2009 NRI. As a result, the Conservation Commission decided to not change the evaluation criteria score for aquifers. The 2009 NRI only considered lakes, ponds, and 4th order streams; this analysis included 1st, 2nd, and 3rd order streams. All surface waters kept the same evaluation criteria score. The Pierce Road impoundment stayed the same as it was in 2009.

OVERVIEW



Other Surface and Groundwater Resources



Data sources: From US Geological Survey. Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

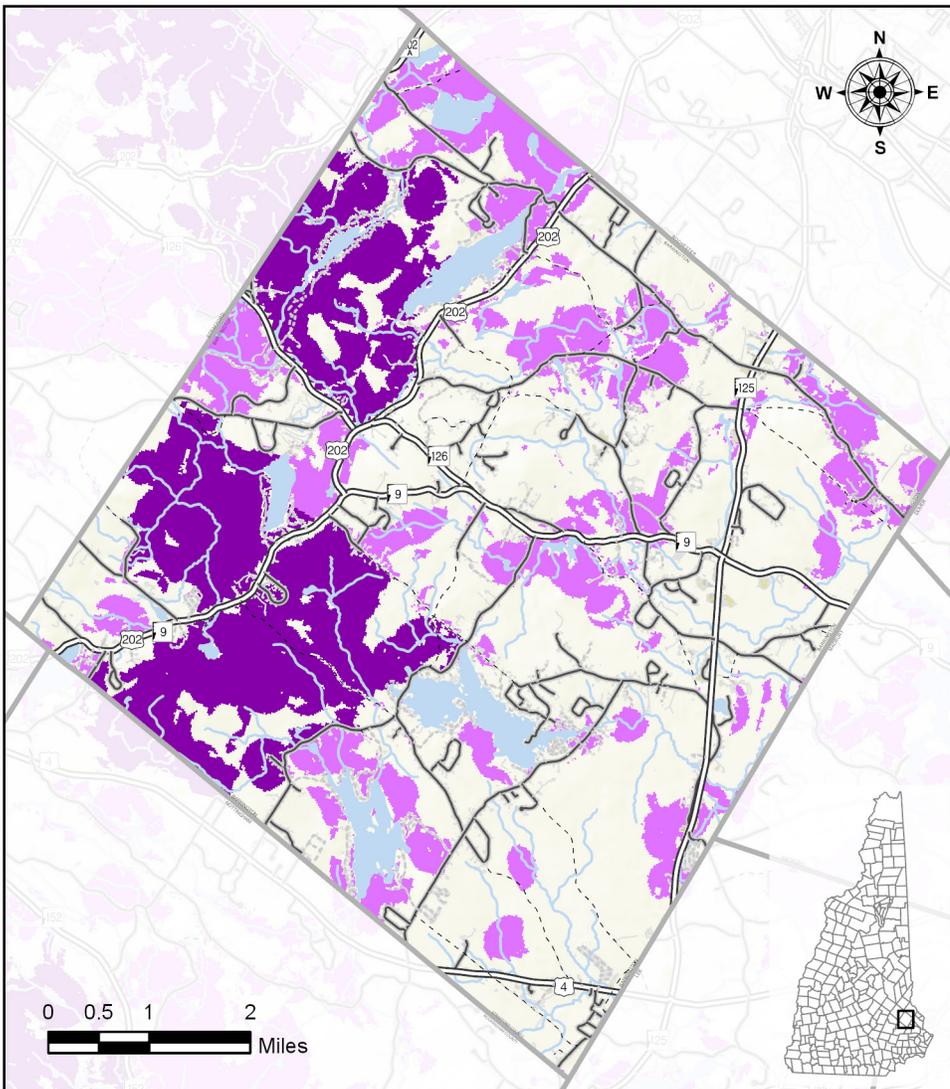
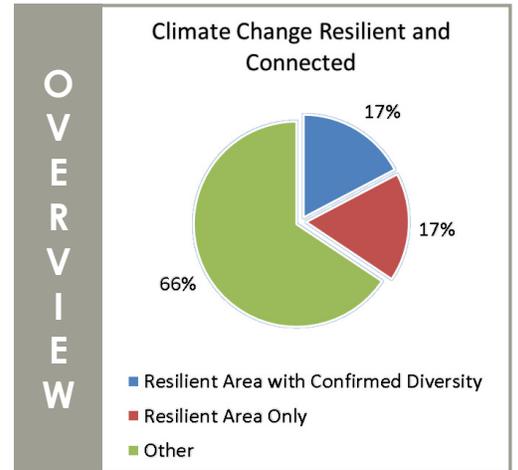
Map 8: Climate Change Resilient and Connected



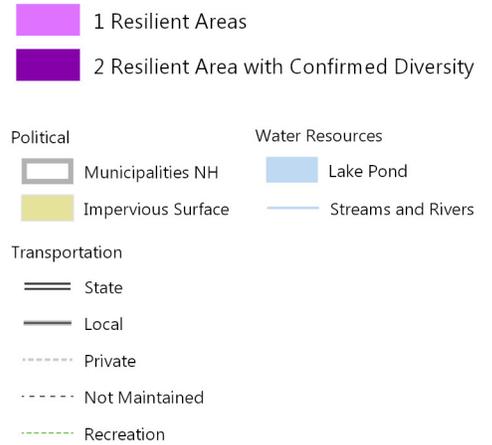
Climate-resilient sites, confirmed biodiversity locations, and species movement areas, referenced in the Resilient and Connected Landscapes for Terrestrial Conservation (2016), was used to identify areas best able to support plants and animals in a changing climate in Barrington – see pie chart(s) to the right for statistical information.

Two future conservation locations identified as resilient areas with confirmed diversity include areas west of Nippo Pond, and between Long Pond and Ayers Pond. Other resilient areas are scattered throughout town.

This dataset was not available during the development of the previous 2009 NRI and was not used to create the prior co-occurrence map. The Conservation Commission was tasked with associating new criteria scores for resilient areas and resilient areas with confirmed diversity. The Commission decided to give the maximum value for resilient areas with confirmed diversity, with a slightly lower score for resilient areas.



Climate Change Resilient and Connected

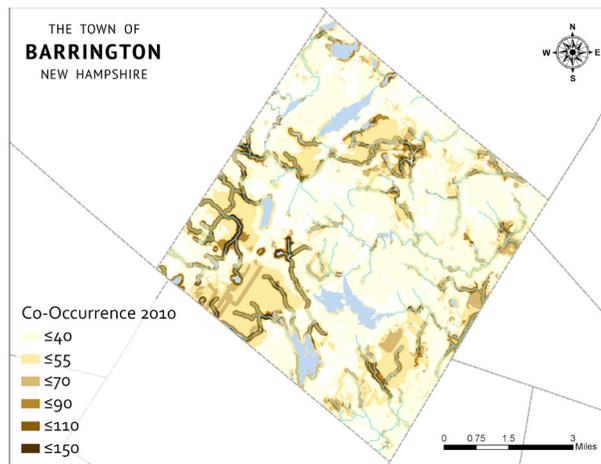


Data sources: From New Hampshire Department of Environmental Services Drinking Water & Groundwater Bureau. Base features are from GRANIT database (<http://www.granit.unh.edu/>). Digital data in NH represent the efforts of the contributing agencies to record information from the cited source materials.

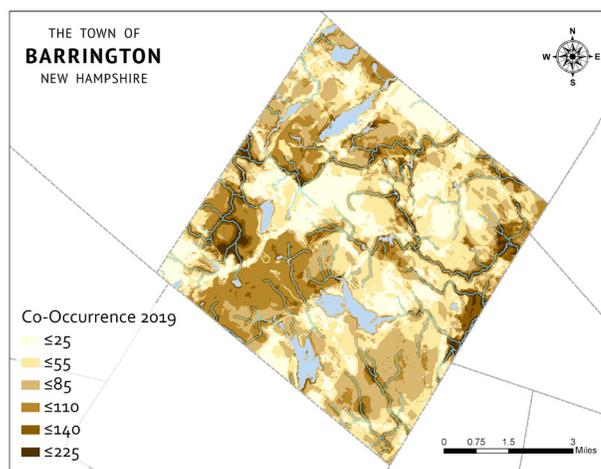
Co-occurrence Mapping Results



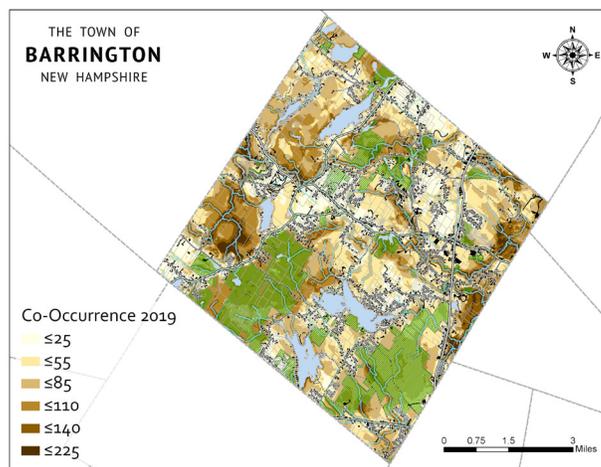
The co-occurrence map for 2010 was created for the use of the Barrington Conservation Commission, to act as an aid in prioritizing land to be actively targeted for conservation and/or protected from intensive development. This exercise included the participation of the conservation commission through a process of defining the criteria and assigning weight to each one of them. The data availability was limited however, it was possible to identify those areas with high priority on conservation (darker shade).



In 2019, this process was repeated however, we were able to include more criteria given the availability of data. Also, some of these criteria utilized layers of information that were a result of an optimization analysis with focus on identifying conservation and protection priorities. Our results highlighted several areas within the town of Barrington that coincided with the previous exercise done in 2010 but the detail provided in the 2019, improves the identification of what characteristics and criteria impacted the analysis.



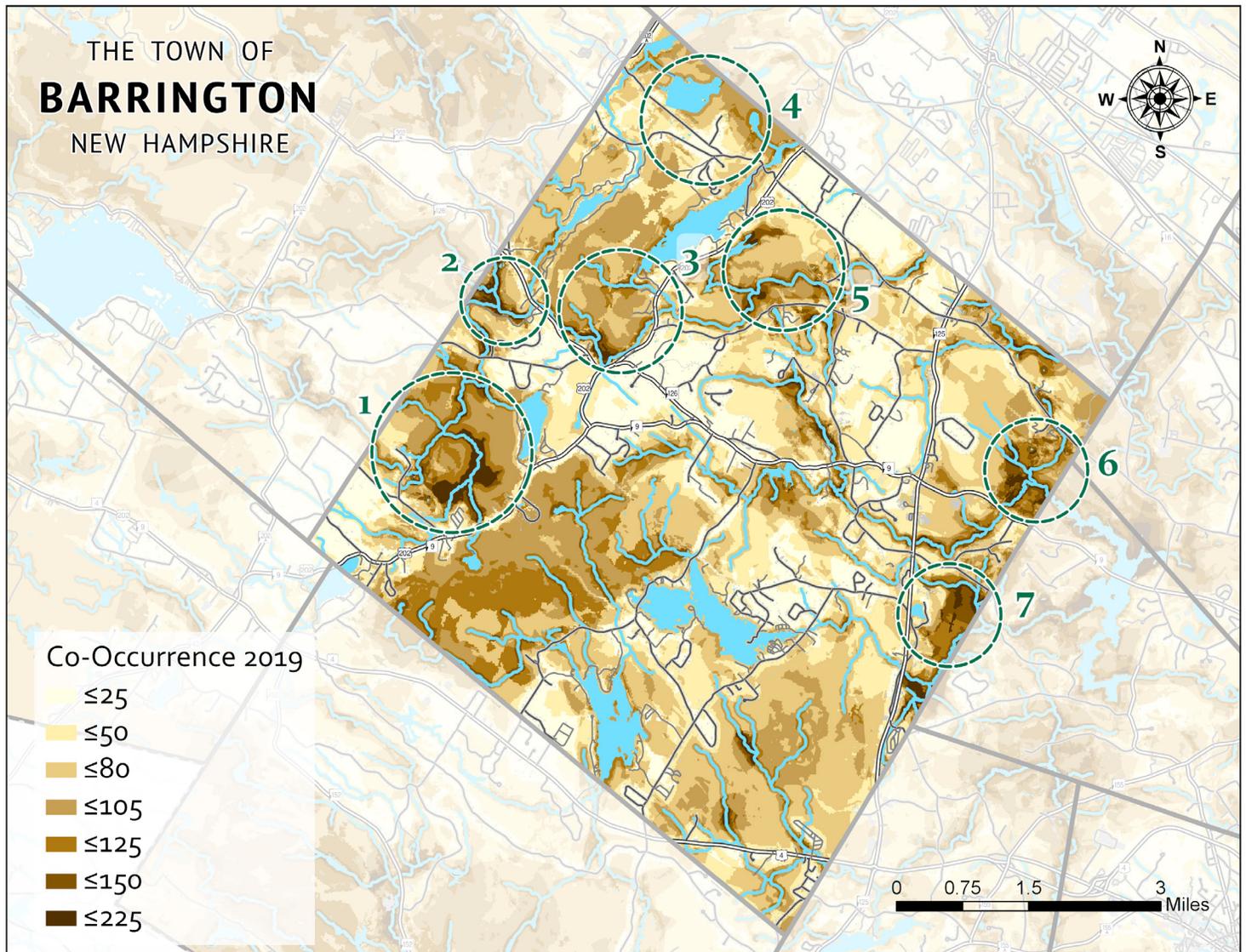
Permanent conservation lands and impervious surfaces were superimposed over the co-occurrence map in order to identify what areas are already protected but also, what other opportunities or regulation tools might help on protecting the areas with high co-occurrence value.



Opportunities and Recommendations



The high value is characterized by the presence and overlap of most or all criteria used for the analysis.



1. West of Nippo Lake

This area is mostly undeveloped and undisturbed where the Lake Nippo and other streams such as the Stonehouse Brook and the Spruce Brook dictated the high conservation value and connectivity. This area has a highest co-occurrence map of 190 points. The mean area of the parcels surrounding the highest value are ~50 acres, which provides an opportunity to strategically plan for its conservation.

2. Confluence of Nippo Brook and Isinglass River

A portion of this area located on the east-south side is the Olson conservation area, which is considered a permanent conservation land close to the public. The surroundings of the Isinglass River are highlighted with co-occurrence values between 140 – 190. The mean area of the parcels located in this area are 8 acres however, prime wetlands are present in a large portion of the area providing an opportunity for protection.

3. South of Ayers and Long Ponds

This area's co-occurrence values range from 65 – 175; however, most of the land is undeveloped with high potential for connecting landscapes,



habitat and providing a great opportunity for conservation. The center of the that area is contained in ~25 acres' parcels. Also, this area is characterized by its high connectivity given the lack of fragmentation due to roads or another impervious surface.

4. Area around Round Pond

This area's co-occurrence values range mostly between 10 – 120 points however, the potential for this area is to connect different permanent conservation lands located around Round Pond, Preston Pond and Little Long Pond. Farmlands of local, prime and statewide importance surround Road pond which represents an opportunity for conservation. The City of Rochester may be interested in conserving additional land in this area to protect the City's drinking water supplies. They City has already conducted several environmental studies in this area, which they may be willing to share with the Barrington Conservation Commission upon request.

5. Scruton Pond and along the Isinglass River west of the Calef easement

This area constitutes a connectivity system that surrounds the Isinglass River and potentially connects with the area #3. The highest co-occurrence value in this area is 185 points. It is also part of a system of several permanent conservation lands that are protected with no or undefined public access. Its high value comes mostly from its water resources, connectivity, the presence of prime wetlands and conservation focus areas.

6. Confluence of Mallego Brook and Wentworth Brook

The highest co-occurrence value in this area is 185 points. The Calef, Mallego and Wentworth Brooks are all present, making this an area with high connectivity potential. The area is mostly comprised by farmland soils with presence of prime wetlands. Developed land is mostly comprise by residential development and farms. The presence of stratified drift aquifer makes this location, along with #7, as a strong candidate to protect groundwater recharge and preserve future groundwater drinking water supplies.

7. Tributaries flowing into the Bellamy River

This area, east of the Swains Lake, is where the Bellamy River starts and contains co-occurrence values as high as 185 points. The north-west part of this high co-occurrence values area is already protected by permanent conservation lands. Some of these conservation lands are close to the public but others are public and use for recreation activities. The Pierce Road Pond Impoundment, one of the local sites with a high conservation value for its water resource, is located there. Commercial and industrial development is present in the area but at the same time, prime wetlands and the aquifer comprise a large portion of it, which represents an opportunity for protecting the land.

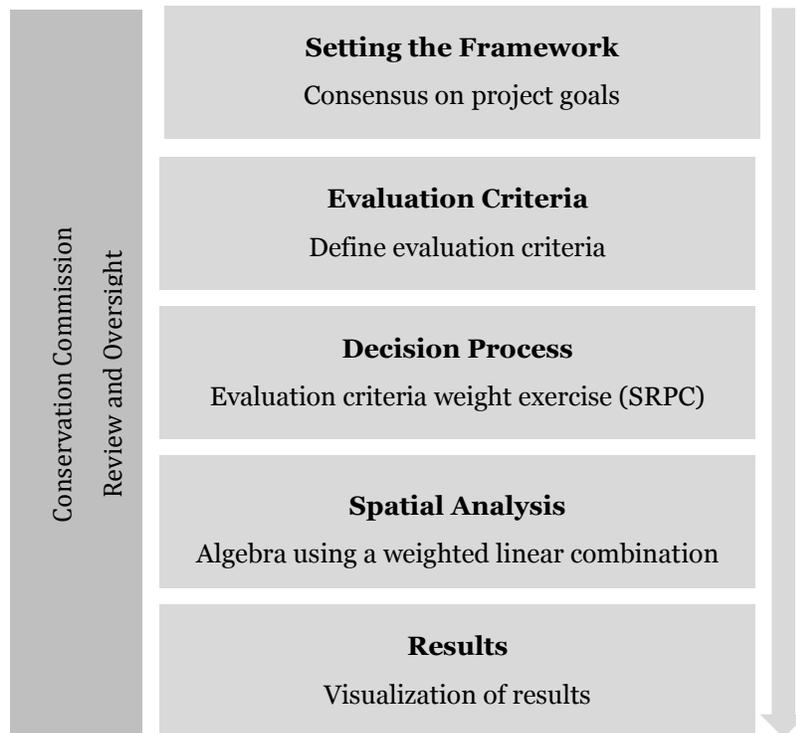


Appendix A. Methodology, Criteria dataset descriptions and metadata.

This appendix describes briefly the methodology and the datasets used as input into the Co-occurrence map as well as the criteria included. Note that criteria (e.g., soils, water resources conservation focus areas, wetlands, etc.), do not aim to provide a full technical assessment, but rather understand what considerations and factors play a role in our analysis. For each criteria dataset, we include the reference and/or data link, units (when applies), spatial resolution, year of data, and a brief description. Unless otherwise noted, spatial representations are based on data reported in the reference provided. The spatial analysis is described as a process of data compilation and tools used to develop a co-occurrence map (aka conservation hotspots). Results are not described in this section even though they are listed as part of the process. A description of results and final remarks are included in the main document to which this appendix is attached.

1 Methodology

The methodology used to accomplish the goal of identifying and prioritizing key areas for conservation and protection that provide habitat for wildlife, preserving rare or sensitive species and ecosystems, and ensures the sustainability of the ecological services that support a high quality of life in Barrington, NH., was generally as follows:



Many of these project tasks happened simultaneously and were modified as needed throughout the process.

In addition to producing a co-occurrence map, a major goal of the project was to increase cooperation between representatives of the conservation commission with the intention of exchanging ideas for conservation and planning.

1.1 Setting the Framework

The framework for this project was developed to bring consensus in terms of conservation goals for the Town of Barrington and to identify those datasets that would provide with the necessary information to accomplish our goal.

The data integration and standardization were accomplished by identifying spatial layers of information related to the natural resources, conservation and climate change (Figure 1A).

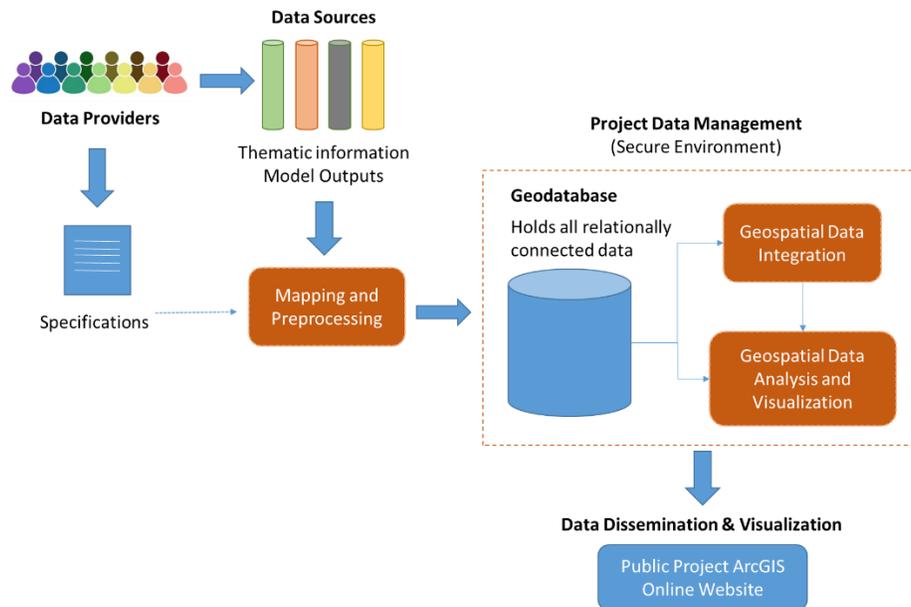


Figure 1A. Data Integration and Standardization Process

We made that information available through ArcGIS Online and the conservation commission reviewed the different layers available for the town. The members of the committee determined that they wanted to use Satellite images to really understand the geographical distribution of the information.

1.2 Evaluation Criteria

For the evaluation criteria we selected nine different groups of natural resources or analysis where the main goal was to protect those or to understand its conservation value (Table 1A). To start with a base line, we used the criteria used for the co-occurrence map (2010) – also see: http://www.barringtonconcom.org/Maps_%26_Links.html.

The list of criteria was then increased with additional criteria based on new datasets available such as: 1) Land Conservation Priorities for the Protection of Coastal Water Resources: A Supplement to The Land Conservation Plan for New Hampshire's Coastal Watersheds (Steckler, et al., 2016); or 2) Resilient Sites for Terrestrial Conservation in Eastern North America (Anderson et al., 2016).

1.3 Defining Decision Process

Each one of the Natural Resources criteria selected included different layers or attributes described in Table A1. A weighted system was replicated by using the points assigned in the 2010 co-occurrence map. We then assigned values to the criteria following a similar process as the 2010 weighted system. Finally, the criteria and weight were evaluated together with the conservation commission to determine a final value to each of the criteria.

Natural Resource	2010 Co-occurrence Map	Criteria	2019 Co-occurrence Map	Barrington	SRPC	Barrington	Sub-totals	Max Value
				Points 2010	Points 2019	Points 2019		
Soils	Ag Soils - Local Importance	Ag Soils - Local Importance		10	10	10		
	Ag Soils - Statewide Importance	Ag Soils - Statewide Importance		15	15	15		
	Ag Soils - Prime	Ag Soils - Prime		20	20	20		
		Active Farms (extracted from Land Use 2015)		-	25	25	70	25
Water Resource Conservation Focus Areas		Buffers for Water Quality		-	10	15		
		Flood Storage and Risk Mitigation		-	15	15		
		Public Water Supply Protection		-	20	15	75	
		Flood Storage and Risk Mitigation; Public Water Supply				30		45
Wetlands (Riparian Habitat)	Wetlands	Wetlands		10	10	10		
	Prime Wetlands	Prime Wetlands		20	20	20	30	20
Wildlife (by Tier)	WAP Supporting Lands	WAP Supporting Landscape		15	15	15		
	WAP Highest Rank in Region	WAP Highest Rank in Region		20	20	20		
	WAP Highest Rank in State	WAP Highest Rank in State		25	25	25	60	25
Connectivity	Unfragmented Land > 500 - <= 1000 acres	Unfragmented Land > 500 - <= 1000 acres		10	10	15		
	Unfragmented Land > 1000 acres	Unfragmented Land > 1000 acres		20	20	25		
	Land within 500' of existing conservation land	Land within 1/4 mile of existing conservation land		15	15	10		
		Coastal wildlife corridors (connect the coast)		-	25	25	75	50
Conservation Focus Areas TNC 2006	LCP Supporting Lands	LCP Supporting Lands		15	15	10		
	LCP Core Focus Areas	LCP Core Focus Areas		25	25	20	30	20
Other Surface and Groundwater Resources	Land within 300' of Surface Water	Land within 300' of lakes and ponds and 4th order streams		20	20	20		
	Round Pond inlet - 100' buffer	Land within 300' of 1st, 2nd, 3rd order streams		-		0		
	Pierce Rd Dam impoundment			20	0	0		
	Stratified Drift Aquifers	Stratified Drift Aquifers		15	15	15		
Climate Change Resilient and Connected				20	20	20	55	55
		Resilient Area with Confirmed Diversity		-	20	40		
		Resilient Area Only		-				
				Total Points	295	380	465	

This process included meetings and coordination with the conservation commission.

1.4 Spatial Analysis

The spatial analysis was performed using map algebra and weighted linear combination. This analytical method was used to deal with multi-attribute decision making (MADM) and with more than one attribute. Every attribute that was considered was called a criterion. Each criterion was assigned a weight based on the importance given by the conservation commission members. This multi-criteria evaluation method allows flexibility and tradeoffs amongst all parameters used.

A model composed with several sub-models (inputs) were developed in ArcGIS ESRI (2018). Model Builder was used to develop the model and to run the analysis (see Figure 2A as an example of how sub-models feed the model).

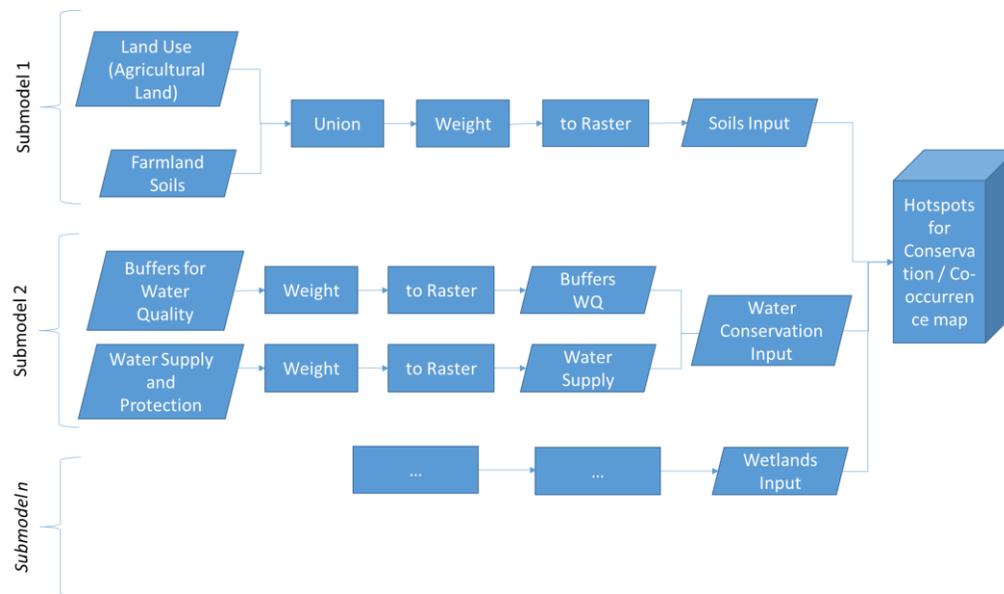


Figure 2A. Spatial Analysis process.

Given that a co-occurrence model was previously generated in 2010 for the town of Barrington, the current model was based on a customize and updated model using updated datasets. The intention was to compare results from 2010 with the updated and enhanced model.

1.5 Results

The final co-occurrence values for the GIS evaluation are displayed in a range of shading to represent values of co-occurrence. The dark brown represents the largest values of co-occurrence gradating to lighter colors, which represent low cooccurrence (Figure 3A).

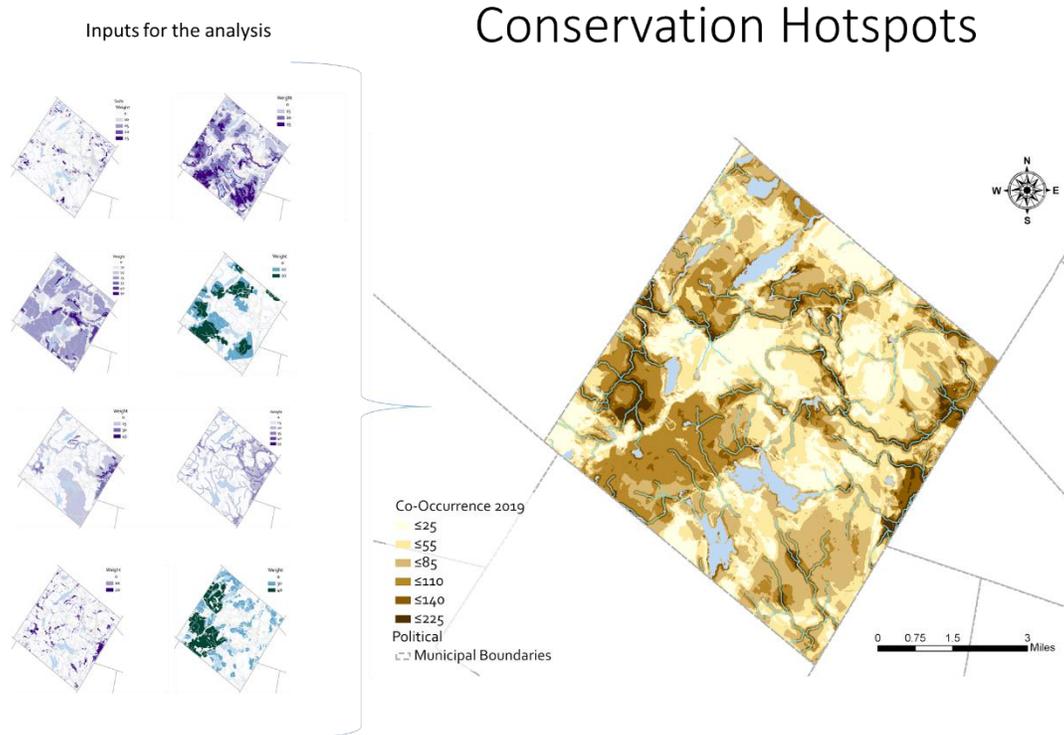
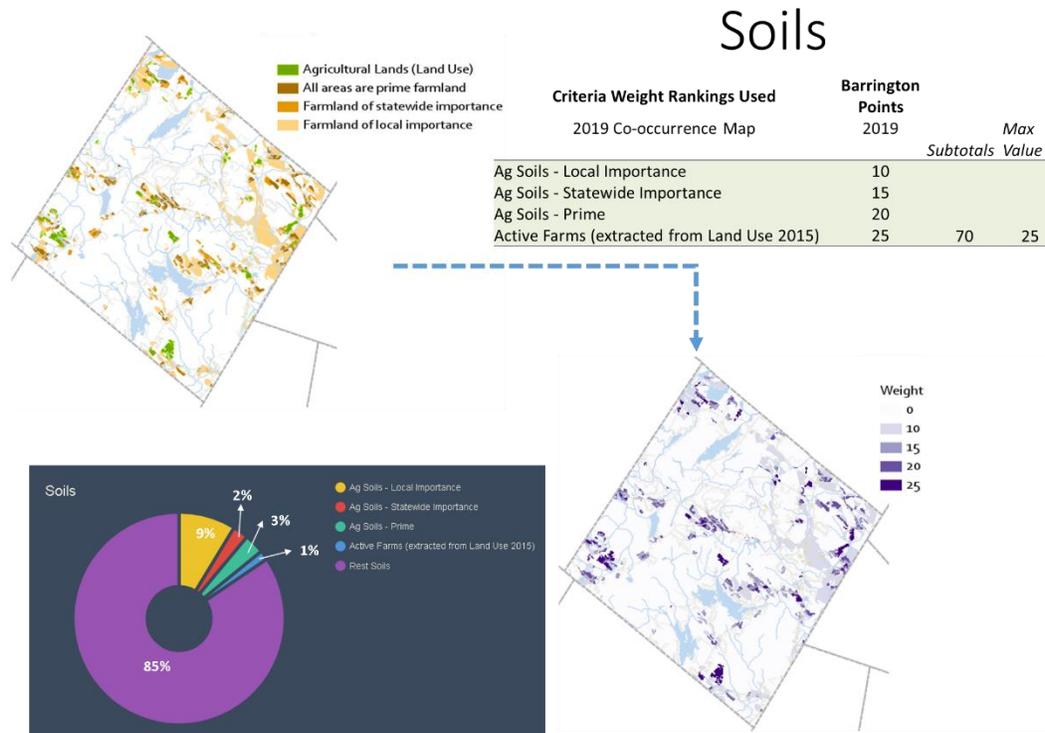


Figure 3A. Co-occurrence map

Two co-occurrence maps were generated for this project. The co-occurrence using the weighted criteria and the co-occurrence without the weighted criteria. These maps allowed to view the distribution high value resources such as wetlands, streams, habitat and groundwater resources. With this map, we aim to support further the town of Barrington to identify key conservation areas.

2 Datasets and Spatial Weighted Distribution

2.1 Soils – Farm Land



2.1.1 Soils - Agricultural Lands

2.1.1.1 Reference:

Soil Survey Geographic (SSURGO) database for New Hampshire, U.S. Department of Agriculture, Natural Resources Conservation Service. 2009.

2.1.1.2 Data link:

<http://www.granit.unh.edu/data/metadata?file=soils/nh/soils.html>

2.1.1.3 Description:

SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey.

The dataset was downloaded on 2/09/2019 from the NRCS GeoSpatial Data Gateway (<https://gdg.sc.egov.usda.gov/GDGOrder.aspx>) and processed by GRANIT staff at the UNH Earth Systems Research Center to:

- 1) Project to NH State Plane feet, NAD83
- 2) Clip to the NH state boundary
- 3) Attach key soil attributes from the collection of related tables distributed by NRCS (see SSURGO_Metadata_-_Table_Column_Descriptions.pdf for descriptions)
- 4) Add and populate the "acres" field

The remainder of this metadata record is as provided with the downloaded source data, with the exception of the addition of several theme keywords and updating the Spatial Reference Information to reflect the processing described above.

2.1.2 Active Farms - Land Use (2015)

2.1.2.1 *Reference:*

Earth Systems Research Center, University of New Hampshire. Publication_Date: 20170712

2.1.2.2 *Data link:*

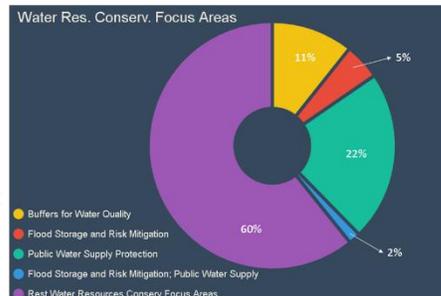
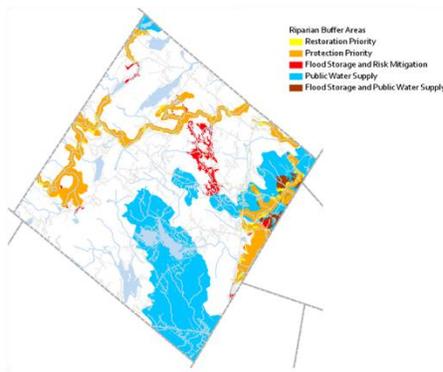
<http://www.granit.unh.edu/resourcelibrary/GRANITresources/standards/landusestandards.html>

2.1.2.3 *Description:*

This data set contains detailed land use data (polygons) for 45 communities in southeastern New Hampshire. The primary source used to map the land use was high resolution (1-foot), true color aerial photography, collected in the spring of 2015. Data development was completed by Rockingham Planning Commission (27 communities) and Strafford Regional Planning Commission (18 communities), with GRANIT providing technical support, metadata development, and standardizing/merging of the datasets into a regional product.

2.2 Water Resources Conservation

Water Conservation Focus Areas



Criteria Weight Rankings Used	Barrington		Max Value
	2019 Co-occurrence Map	2019 Points	
Buffers for Water Quality	15		
Flood Storage and Risk Mitigation	15		
Public Water Supply Protection	15		
Flood Storage and Risk Mitigation; Public Water Supply	30	75	45
		<i>Subtotals</i>	

2.2.1 Water Resources Conservation Areas

2.2.1.1 *Reference:*

Steckler, P., Glode, J., and Flanagan, S. 2016. Land Conservation Priorities for the Protection of Coastal Water Resources: A Supplement to The Land Conservation Plan for New Hampshire's Coastal Watersheds. The Nature Conservancy. Prepared for the New Hampshire Department of Environmental Services Coastal Program, Concord, NH.

2.2.1.2 *Data link:*

https://extension.unh.edu/resources/files/Resource006517_Rep9334.pdf

2.2.1.3 *Description:*

The coastal watershed, which extends from the densely settled seacoast, west toward Manchester and north towards the Lakes Region, has experienced rapid development over the last few decades. As a result, water resources in New Hampshire's coastal watersheds are threatened by degradation and in some places they are already considered impaired based on standards set by the Clean Water Act. The

link between development and declining water quality is provided by a range of pathways including:

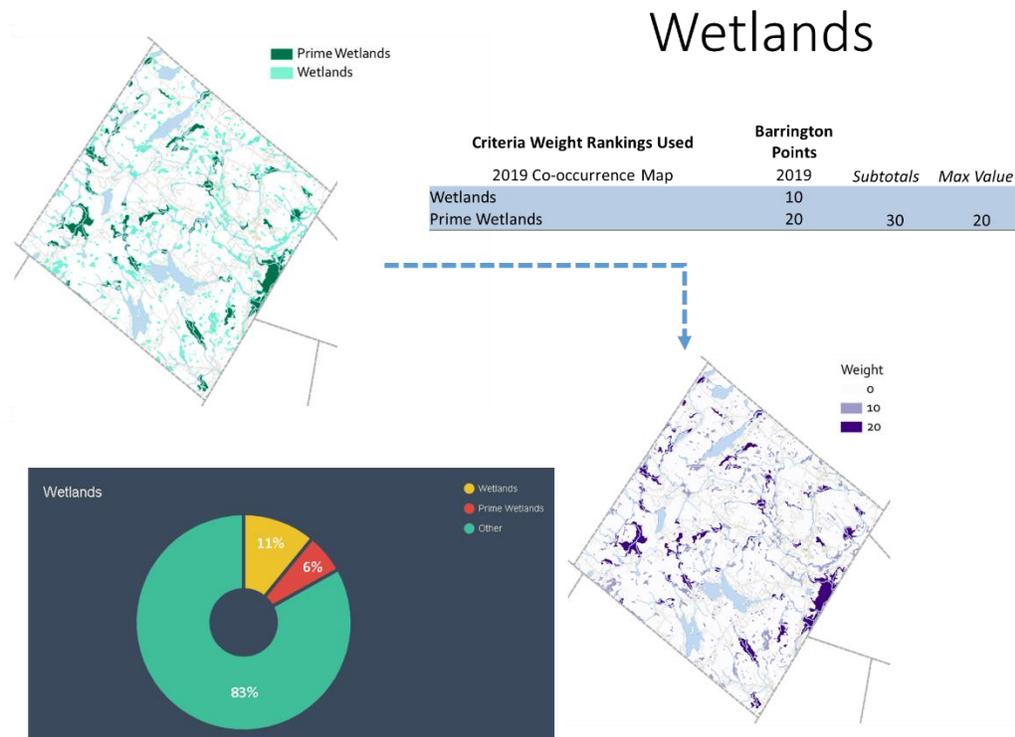
1. The loss of lands under natural cover that provide important ecosystem services such as water purification, flood water retention, and groundwater recharge
2. An increase in pollutant loads to surface waters, stormwater runoff, and flood risk to downstream areas
3. An increase in valuable public and private infrastructure that is both reliant upon and often degrades key ecosystem services such as clean water.

When combined with the continuing effects of climate change, the effects of development on water quality are amplified. For example, more frequent high-intensity storms are likely to contribute to additional pollutant laden stormwater runoff, more flooding, and greater flood damages. Similarly, more frequent and intense droughts will put additional stress on public water supplies. Built and natural infrastructure will also become increasingly at risk as rising sea levels inundate low-lying coastal areas.

As additional population growth and development across the coastal watershed continues, these threats and pressures on water resources will be exacerbated even further. Given the magnitude of these challenges, it is critical to capitalize upon existing natural infrastructure to maintain and improve current water quality and reduce risks to communities in the coastal watershed. Addressing land conversion by protecting critical lands is one important strategy to meet this need.

The purpose of this project was to identify land conservation opportunity areas that provide the greatest benefits to coastal water resources. Opportunity areas are targeted specifically to address threats associated with existing and future development.

2.3 Wetlands



2.3.1 Wetlands

2.3.1.1 *Reference:*

NH Dept. of Environmental Services. New Hampshire Base Wetland Assessment Unit IDs - 2010. Created using the NWI layer created by the U.S. Fish and Wildlife Service

2.3.1.2 *Data link:*

http://www.granit.unh.edu/data/metadata?file=nhwetlandsbase/nh/nhwetlandsbase_Lite.html

2.3.1.3 *Description:*

Wetland complexes were constructed from the National Wetlands Inventory (NWI) base layer completed by US F&WS in the mid-1980's. This derived coverage was created by constructing wetland complexes from the individual NWI wetland polygons in accordance with the 2010 "Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire" (NH Method). Complexes bisected by large roads and rivers were split into separate wetland complexes. Once the complexes were created, an Assessment Unit ID (AUID) was assigned to each fresh water and estuarine wetland complex according to the primary hydrologic unit boundary at the subwatershed (12-digit) level that it resided in.

2.3.2 Prime Wetlands

2.3.2.1 Reference:

Conservation Commissions.

2.3.2.2 Data link:

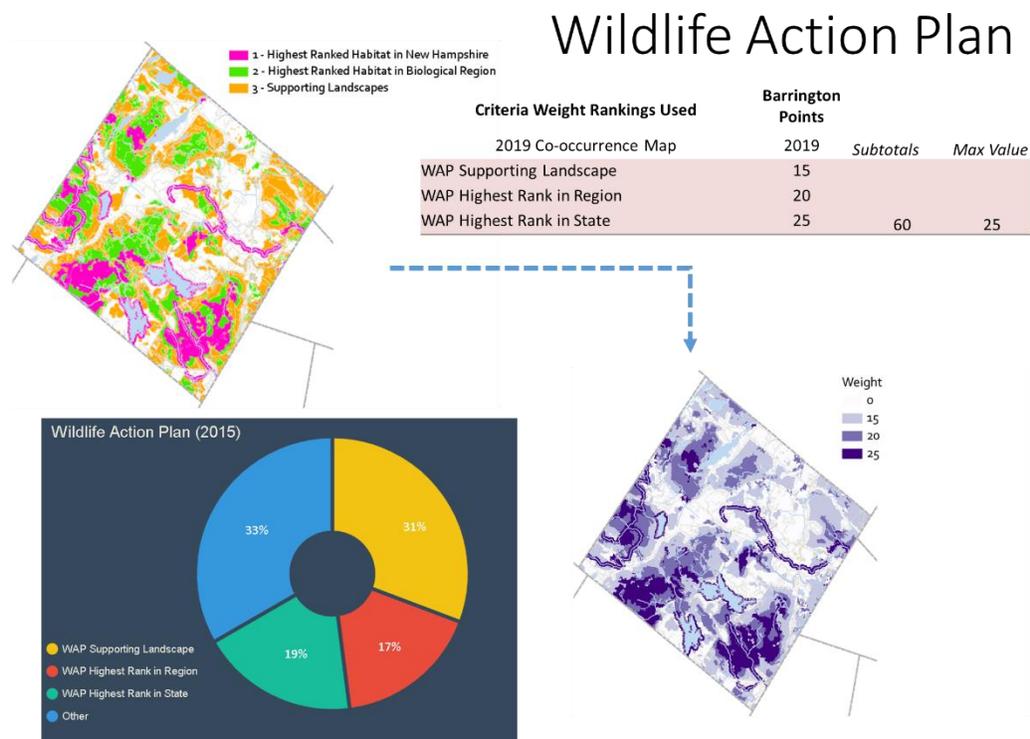
N/A

2.3.2.3 Description:

Individual municipalities can designate wetlands as "prime-wetlands" under RSA 482-A:15 and administrative rules Env-Wt 700. This designation may only apply to high-quality wetlands (large size, unspoiled character, ability to sustain populations of rare/threatened species). Four communities - Barrington, Northwood, Newmarket, and Rochester - in the SRPC region have designated prime wetlands.

Data process: Wetlands were merged but giving priority to primary wetlands when the weight was assigned. The layer was rasterized to be incorporated in the model.

2.4 Wildlife Action Plan



2.4.1 New Hampshire Wildlife Action Plan

2.4.1.1 Reference:

New Hampshire Fish and Game Department, Wildlife Division Publication_Date: 20151001

2.4.1.2 Data link:

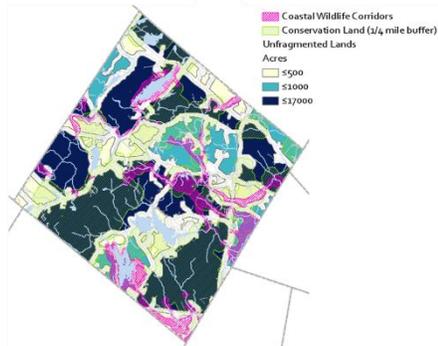
http://www.granit.unh.edu/data/metadata?file=wap2015_habitat/nh/wap2015_habitat.html
<https://www.wildlife.state.nh.us/wildlife/wap.html>

2.4.1.3 Description:

The 2015 revision of the Wildlife Action Plan incorporates new data, methodologies and extensive public input to identify species in greatest need of conservation, habitats that are at the greatest risk, as well as land uses and activities that present the greatest threats to wildlife and habitat. It outlines more than 100 actions that can be taken by diverse stakeholders to protect and manage wildlife and habitat in New Hampshire.

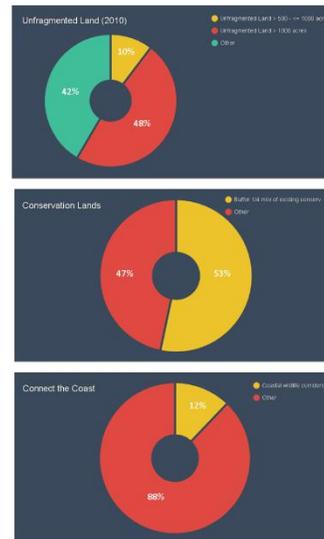
Data process: This layer was included as such in the analysis. Weights were, and the layer was rasterized to be incorporated in the model.

2.5 Connectivity

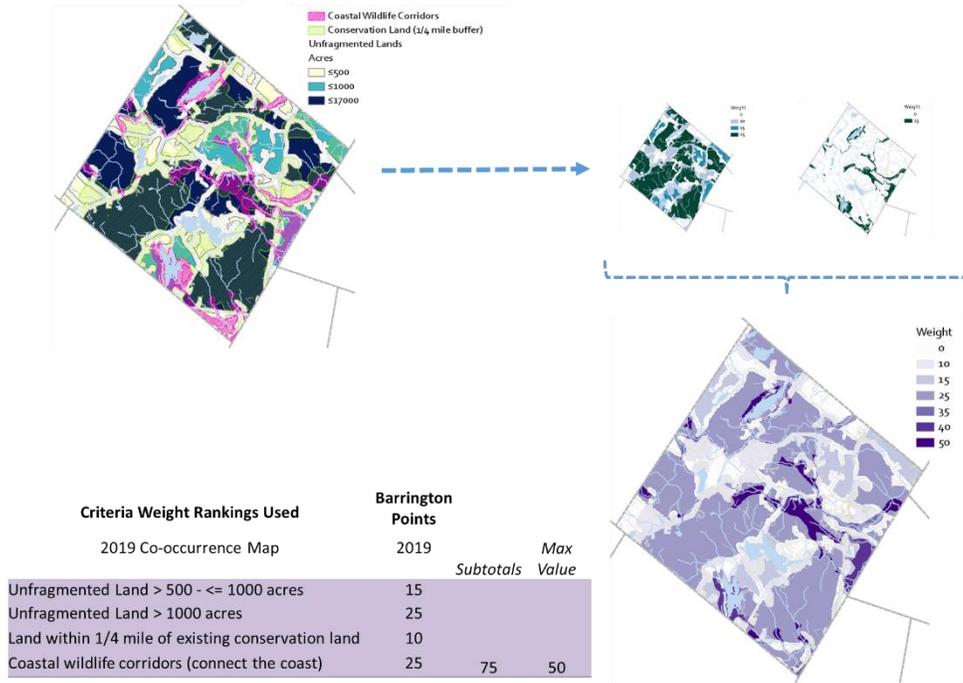


Criteria Weight Rankings Used	Barrington Points		
	2019	Subtotals	Max Value
Unfragmented Land > 500 - <= 1000 acres	15		
Unfragmented Land > 1000 acres	25		
Land within 1/4 mile of existing conservation land	10		
Coastal wildlife corridors (connect the coast)	25	75	50

Connectivity



Connectivity



2.5.1 Unfragmented Lands

2.5.1.1 Reference:

New Hampshire Fish and Game Department

2.5.1.2 Data Link:

N/A

2.5.1.3 Description:

The coverage contains contiguous areas of natural land cover.

Unfragmented blocks are based on the 2001 NH Land Cover Assessment Data grid provided by NH GRANIT at Complex Systems Research Center, UNH; reselected for values of 200 or greater (excludes 110=Residential/Commercial/Industrial and 140=Transportation). Next, the NHDOT Smartmap roads data (Legislative classes I-V), and NHDOT private roads were buffered. Only private roads that intersect or are extensions of a NHDOT class I-V road were included (some private roads are extensions of class VI roads/trails and thus are not indicators of development and were not considered fragmenting features). Three hundred feet (from edge of roadway) is thought to be a large enough buffer to encapsulate effects of development. It was based on the distance previously used by other organizations in NH for unfragmented land analysis, and from limited random spot checks using the USGS digital orthophotos. Road buffers were generated as raster data by first converting the road arc coverages to grids using a cell size of 93.5ft, setting the extent to match the 2001NH Land Cover Assessment data; then expanding the roads grid by 3 cells and the private roads grid by 2 cells. Certain waterbodies were also considered. Rivers delineated as polygons in the 1:24,000-scale USGS DLG data were not included as fragmenting features, nor surface water less than 1/4 mile wide, nor lakes or ponds totally enveloped by

natural landcover. Most organisms will be able to circumvent the lake/pond as long as they are not hindered by roads and development.

2.5.2 Permanent conservation lands – buffer ¼ mile

2.5.2.1 *Reference:*

The Conservation/Public Lands data layer is updated periodically. Data gaps may occur if 1) a parcel has been protected since our last data update, or 2) a parcel was inadvertently overlooked during previous mapping phases. If you identify such gaps, please review the materials below and contact the GRANIT Conservation/Public Lands Data Manager.

2.5.2.2 *Data Link:*

<http://www.granit.unh.edu/resourcelibrary/GRANITresources/standards/conslandstandards.html>

2.5.2.3 *Description:*

The NH GRANIT Conservation/Public Lands data layer contains a digital record of parcels of land of two or more acres that are mostly undeveloped and are protected from future development. Smaller parcels that adjoin previously mapped parcels or represent unique features, such as a bog or state-owned boat ramp, may also be included in the data layer.

Several "levels of protection" are recognized, as follows:

- 1) Permanent conservation land. Land permanently protected from development through legally enforceable conservation easement, deed restriction, or outright ownership by an organization whose mission emphasizes protecting land in perpetuity. More than 50% of the area will remain undeveloped.
- 2) Unofficial conservation land. Not permanently protected through any legal mechanisms. Owned by a public institution, public agency, or other organization whose mission may not be focused on conservation, but whose clear intent is to keep land for conservation, recreation or educational purposes and in mostly natural land cover.
- 3) Unprotected water supply land. Not permanently protected through any legal mechanisms. Owned or controlled by suppliers of public drinking water, including unprotected supplies owned by municipalities, subdivisions of municipalities, and private water systems serving 500 people or more.
- 4) Developed public land. No known institutional or legal mandates to prevent conversion of natural land cover to human uses. Includes public land having, or expected to have, developed infrastructure on more than 50% of its area (e.g. beaches, picnic areas, ball fields, boat ramps, municipal wellfields).
- 9) Unknown.

Note that some properties included in the data layer are privately owned and not open for public access.

2.5.3 Connected Coast

2.5.3.1 *Reference:*

The Nature Conservancy – work in progress.

2.5.3.2 *Data Link:*

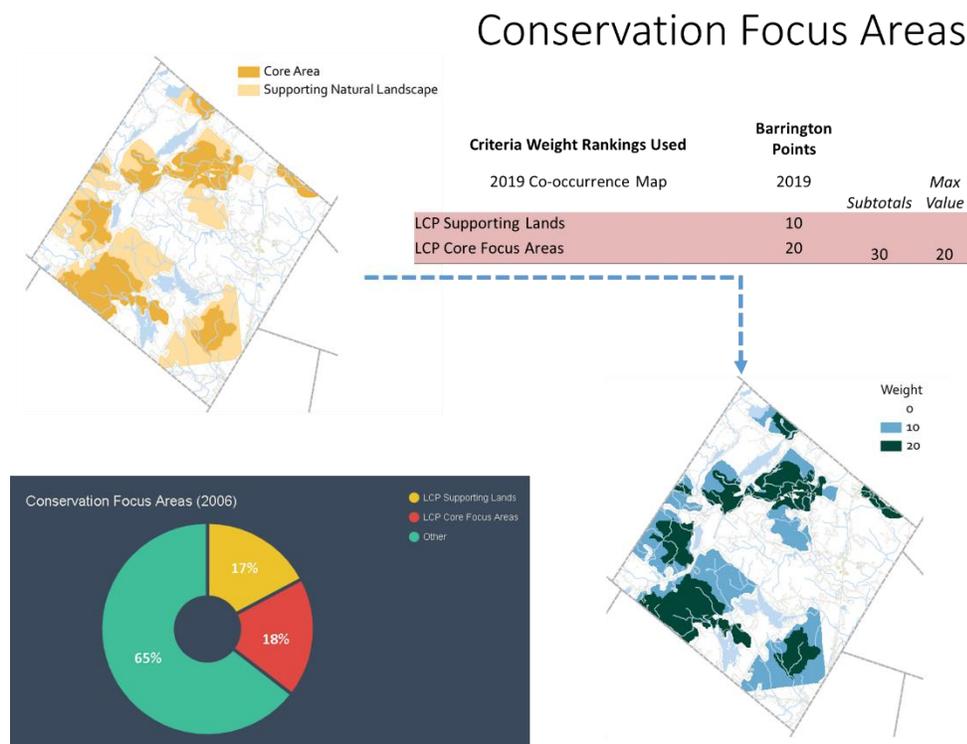
N/A

2.5.3.3 *Description:*

Connect The Coast is a project that identifies wildlife corridors within and beyond New Hampshire's coastal watershed—from the north shore of Massachusetts to southwestern Maine. The coastal corridors or wildlife corridors are areas identified as wildlife crossings zones at roadways, which are critically important in creating and addressing a network of connected and protected lands between core habitats. This corridors provide a pathway to mitigating the effects of roads on wildlife movement. These areas are one of the outputs of the "Connect the Coast: Linking wildlife across New Hampshire's seacoast and beyond" project (Steckler, TNC).

Data process: This layer was included as such in the analysis. Weight classification was assigned, and the layer was rasterized to be incorporated in the model.

2.6 Conservation Focus Areas



2.6.1 Conservation Focus Areas

2.6.1.1 *Reference:*

Zankel, M., C. Copeland, P. Ingraham, J. Robinson, C. Sinnott, D. Sundquist, T. Walker, and J. Alford. 2006. The Land Conservation Plan for New Hampshire's Coastal Watersheds. The Nature Conservancy, Society for the Protection of New Hampshire Forests, Rockingham Planning Commission, and Strafford Region Planning Commission. Prepared for the New Hampshire Coastal Program and the New Hampshire Estuaries Project, Concord, NH.

2.6.1.2 *Data link:*

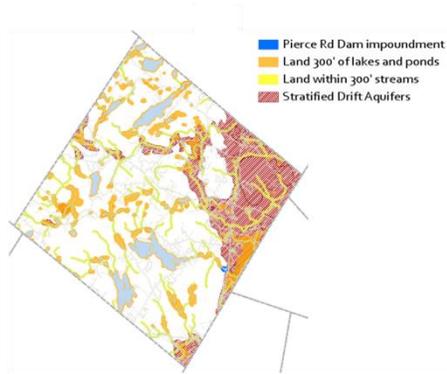
https://www.epa.gov/sites/production/files/2015-09/documents/piscataqua_land_conservation_plan.pdf

2.6.1.3 *Description:*

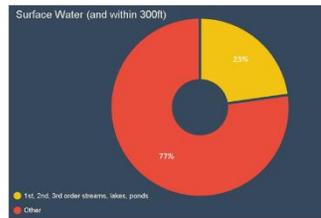
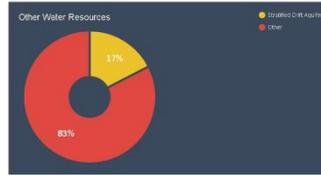
A Conservation Focus Area is an area that is of exceptional significance for the protection of living resources and water quality in the coastal watersheds. In general, focus areas occur in places where multiple important natural resource features co-occur to an extent that is significant from a whole-watershed perspective. Occasionally, focus areas emerged that contained only one or two important features, because the features were considered truly irreplaceable (e.g., habitat for a globally rare species or an intact coastal saltmarsh). Each Conservation Focus Area is comprised of a Core Area. Some Conservation Focus Areas also include Supporting Natural Landscape.

Data process: This layer was included as such in the analysis. Weight classification was assigned, and the layer was rasterized to be incorporated in the model.

2.7 Water Resources

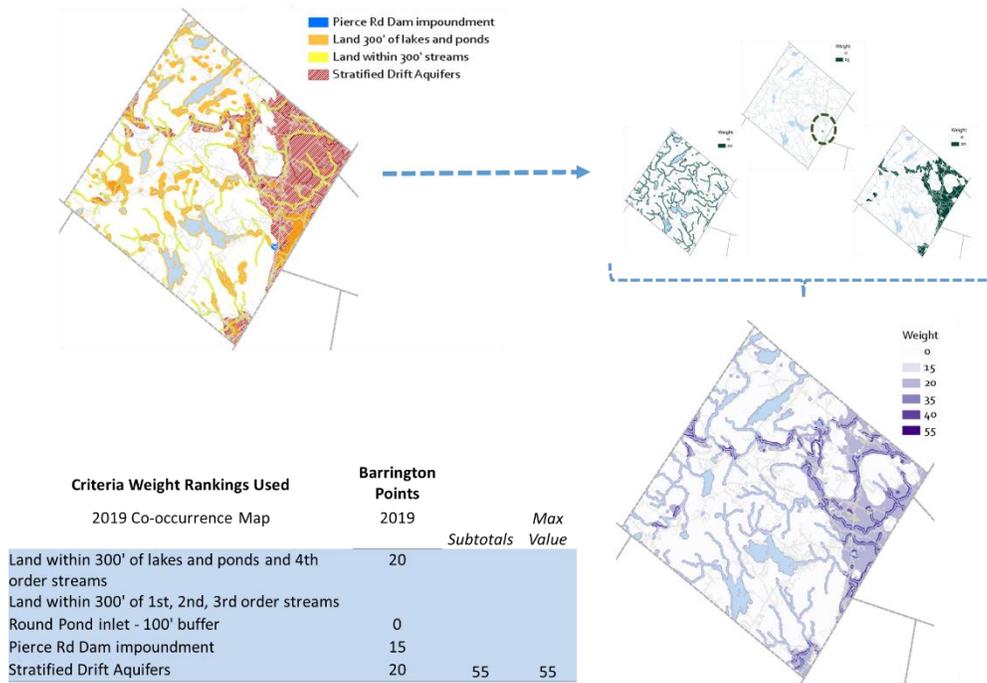


Other Water Sources



Criteria Weight Rankings Used 2019 Co-occurrence Map	Barrington Points		
	2019	Subtotals	Max Value
Land within 300' of lakes and ponds and 4th order streams	20		
Land within 300' of 1st, 2nd, 3rd order streams			
Round Pond inlet - 100' buffer	0		
Pierce Rd Dam impoundment	15		
Stratified Drift Aquifers	20	55	55

Other Water Sources



2.7.1 Streams: New Hampshire Hydrography Dataset

2.7.1.1 *Reference:*

Complex Systems Research Center, University of New Hampshire

2.7.1.2 *Data link:*

<http://www.granit.unh.edu/data/metadata?file=nhhd/nh/nhhd.html>

2.7.1.3 *Description:*

The New Hampshire Hydrography Dataset (NHHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the state's surface water drainage system. The NHHD, developed at 1:24,000 scale, is an extract from the high-resolution National Hydrography Dataset (NHD) housed at the US Geological Survey. The NHHD contains reach codes for networked features, flow direction, names, and centerline representations for areal water bodies. Reaches are also defined on waterbodies and the approximate shorelines of the the Atlantic Ocean. The NHHD also incorporates the National Spatial Data Infrastructure framework criteria established by the Federal Geographic Data Committee.

2.7.2 Water Bodies: New Hampshire Hydrography Dataset

2.7.2.1 *Reference:*

Complex Systems Research Center, University of New Hampshire

2.7.2.2 *Data link:*

<http://www.granit.unh.edu/data/metadata?file=nhhd/nh/nhhd.html>

2.7.2.3 *Description:*

The New Hampshire Hydrography Dataset (NHHD) is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the state's surface water drainage system. The NHHD, developed at 1:24,000 scale, is an extract from the high-resolution National Hydrography Dataset (NHD) housed at the US Geological Survey. The NHHD contains reach codes for networked features, flow direction, names, and centerline representations for areal water bodies. Reaches are also defined on waterbodies and the approximate shorelines of the the Atlantic Ocean. The NHHD also incorporates the National Spatial Data Infrastructure framework criteria established by the Federal Geographic Data Committee.

2.7.3 National Inventory of Dams (NID): Pierce Rd Dam impoundment

2.7.3.1 *Reference:*

National Inventory of Dams (NID)

2.7.3.2 *Data link:*

<https://nid-test.sec.usace.army.mil/ords/f?p=105:22:9244053073211::NO::>

2.7.3.3 *Description:*

January 2019 – The 2018 National Inventory of Dams (NID) is now available! All charts, queries and maps reflect the most current NID database. The NID was populated using the 116th Congressional District information. State and federal dam regulators provided their data from May to November 2018 for inclusion in the 2018 database. Please be aware that inspection and EAP dates reflect 2018 data, so any inspections or updates since then will not be reflected in the current NID. USACE manages the NID but does not own most of the dams in the NID. Operation, maintenance, and repair of these dams is the responsibility of each dam owner. Please contact the respective state or federal regulatory authority for the most up-to-date information.

January 2019 – Major changes to the 2018 NID allow users to download or export certain NID data and to view the hazard potential classification. State or federal agencies may restrict access to information on dams within their jurisdiction, in some cases. For information not published in the NID, USACE recommends consulting the agency exercising responsibility over the dam. Also, it is important to note the hazard potential classification, as published in the NID, does not reflect the condition of a dam. That information can be found in the condition assessment, which is available to approved government users.

2.7.4 Stratified-Drift Aquifers in New Hampshire

2.7.4.1 *Reference:*

US Geological Survey

2.7.4.2 Data link:

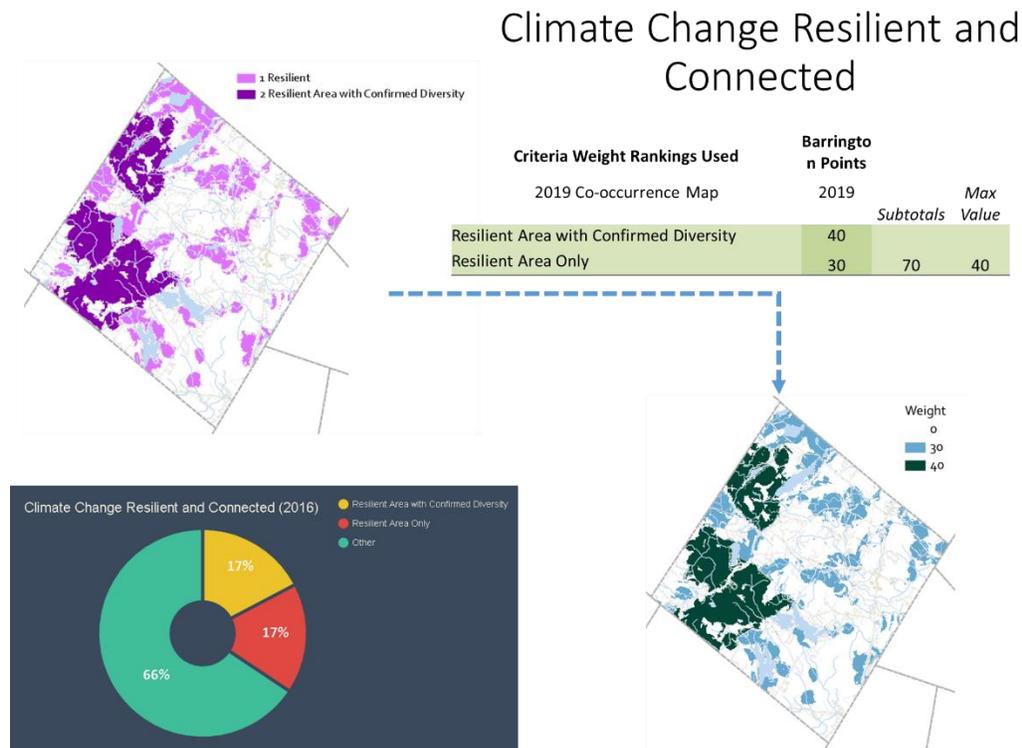
<https://nid-test.sec.usace.army.mil/ords/f?p=105:22:9244053073211::NO::>

2.7.4.3 Description:

N/A.

Data Process: A buffer of 75 feet was performed in streams (1st, 2nd, 3rd, and 4rd order. For lakes and ponds, we included a buffer of 75 feet. We selected the Pierce Rd Dam impoundment as an important site for conservation. The stratified aquifer was integrated with the other layers and all data was integrated in one single layer using union and weights were assigned. The layer was rasterized and used as an input for the model.

2.8 Climate Change Resilient and Connected



2.8.1 Resilient Areas with and without diversity

2.8.1.1 Reference:

Anderson, M.G., Barnett, A., Clark, M., Prince, J., Olivero Sheldon, A. and Vickery B. 2016. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA.

2.8.1.2 *Data link:*

<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/resilience/Pages/default.aspx>

2.8.1.3 *Description:*

Our method to identifying Resilient and Connected Landscapes sites had several steps: First, we started with the map of resilient sites (see resilient sites website for more information, maps, and data. Next, we mapped areas that were critical flow zones and narrow climate corridors. Next, we mapped areas resilient areas that had confirmed rare species, exemplary natural communities, and representative geophysical settings. Finally, we combined these datasets to prioritize a subset of resilient sites using criteria based on flow and diversity, and then to identify critical between-site linkages that both connected essential features and corresponded to areas of concentrated flow. The results of this assessment may inform a variety of conservation strategies aimed at influencing decisions or maximizing the natural benefits and services provided by nature while simultaneously sustaining its diversity and resilience. If you have questioned the full report is at "Resilient and Connected Landscapes for Terrestrial Conservation".

Data Process: We assigned the values to the data and was integrated into the model. This data was already a raster layer.

3 References:

Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, J. Prince. 2016. Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science.

Steckler, P., Glode, J., and Flanagan, S. 2016. Land Conservation Priorities for the Protection of Coastal Water Resources: A Supplement to The Land Conservation Plan for New Hampshire's Coastal Watersheds. The Nature Conservancy. Prepared for the New Hampshire Department of Environmental Services Coastal Program, Concord, NH.